

Trade costs, trade facilitation, and agrifood exports in Central Asia

Alfinura Sharafeyeva

Thesis submitted to the University of Adelaide in fulfilment of the requirements for
the degree of Doctor of Philosophy

The Centre for Global Food and Resources

The Faculty of the Professions

The University of Adelaide

April 2021

Table of contents

Table of contents	ii
List of figures	v
List of tables	vii
List of acronyms	ix
Dedication	xii
Declaration	xiii
Publications and presentations from this thesis	xiv
Acknowledgements	xv
Abstract	xvii
Chapter 1 Introduction	1
1.1 THESIS RATIONALE	1
1.2 BACKGROUND	4
1.3 TRADE COSTS AND TRADE FACILITATION IN CENTRAL ASIA	5
1.4 PROBLEM STATEMENT	9
1.5 RESEARCH OBJECTIVES AND QUESTIONS	11
1.6 METHODS AND RESEARCH APPROACH	12
1.7 THESIS STRUCTURE	12
Chapter 2 Conceptual framework: Trade costs and trade facilitation	17
2.1 INTERNATIONAL TRADE COSTS	17
2.2 TRADE FACILITATION	23
2.3 THEORETICAL FRAMEWORK	26
2.4 SUMMARY	29
Chapter 3 Impact of trade facilitation on trade flows: A critical insight of quantitative studies	30
ABSTRACT	30
INTRODUCTION	32
TRADE FACILITATION AND TRADE COSTS: DEFINITIONS AND INDICATORS	32
A SYSTEMATIC REVIEW	35
CONCLUSION	59
Chapter 4 Central Asia: Physical setting, economic and political developments	61
4.1 PHYSICAL CONTEXT	61
4.2 POLITICAL CONTEXT	66
4.3 SECTOR ANALYSIS	68
4.4 TRADE	79
4.5 TRADE COSTS AND TRADE FACILITATION IN CENTRAL ASIA	96
4.6 CONCLUSION	116
Chapter 5 What does ‘doing business’ really measure? Evidence from trade times	119
ABSTRACT	119
INTRODUCTION	121
STRUCTURAL GRAVITY MODEL	122
CONCLUSION	127

Chapter 6 Feeding your workhorse with quality data: Analysis of trade costs in Central Asia	128
ABSTRACT	128
INTRODUCTION	130
THE WORLD BANK'S TRADING ACROSS BORDERS INDICATORS	133
METHODS, DATA, AND ESTIMATION STRATEGY	138
RESULTS AND DISCUSSION	142
CONCLUSION	148
Chapter 7 CPMM as a direct measure of trade costs	149
7.1 BACKGROUND	149
7.2 CAREC TRADE FACILITATION INDICATORS	151
7.3 THE DATASET	154
7.4 TRADE COSTS AND POLITICAL CONTEXT	155
7.5 CPMM TFIS VS TAB INDICATORS	160
7.6 GRAVITY MODEL ANALYSIS OF TRADE COSTS AND TRADE FLOWS USING CPMM TFIS	166
7.7 GRAVITY MODEL RESULTS	172
7.8 CONCLUSION	178
Chapter 7 Conclusions and policy recommendations	180
8.1 SUMMARY OF THE THESIS	180
8.2 THE OUTCOMES	181
8.3 POLICY IMPLICATIONS	188
8.4 LIMITATIONS	190
8.5 FUTURE RESEARCH	191
References	193
Appendices	205
APPENDIX A DEFINITIONS OF TRADE FACILITATION	206
Appendix B Selected studies on the effect of trade facilitation on trade flows	208
APPENDIX C DIARY OF BUILDING THE SEARCH TERM COMBINATION	210
APPENDIX D SAMPLE OF EXCLUDED LITERATURE	214
APPENDIX E DEFINITIONS OF THE TRADE FACILITATION GROUPS	215
APPENDIX F AREA, 100 THOUSAND SQUARE KILOMETRES, AND DISTANCE TO WORLD CAPITALS FROM CENTRAL ASIAN COUNTRIES, KILOMETRES.	216
APPENDIX G GDP: GROWTH, CONSTANT AND PER CAPITA	217
APPENDIX H THEORETICAL REVEALED COMPARATIVE ADVANTAGE	218
APPENDIX I CENTRAL ASIAN EXPORTS BY GOODS AND SERVICES, 2018, US DOLLARS, AND COMPARISON WITH 2010 (% CHANGE)	219
APPENDIX J IMPORT TARIFF RATES IN CENTRAL ASIA	221
APPENDIX K VALUE CHAIN LINKAGES	223
APPENDIX L DATA AND SOURCES USED FOR THE ANALYSIS	225
APPENDIX M BASELINE RESULTS FOR PERISHABLE AND NON-PERISHABLE PRODUCTS AT HS 4-DIGITS LEVEL ESTIMATED WITH PPML EXPORTER-YEAR, IMPORTER-YEAR FIXED EFFECTS, 2005-2014	226
APPENDIX N DESCRIPTIVE STATISTICS FOR GRAVITY MODEL ANALYSIS, 2005-2014 FULL DATASET	227
APPENDIX O DESCRIPTIVE STATISTICS FOR GRAVITY MODEL ANALYSIS, 2015-2017 FULL DATASET	229
APPENDIX P CORRELATION BETWEEN INDEPENDENT VARIABLES FOR GRAVITY MODEL ANALYSIS, 2015-2017 FULL DATASET	231
APPENDIX Q SIX CAREC CORRIDORS	232
APPENDIX R CAREC FOUR TFIS BASED ON ADB (2014)	235
APPENDIX S SUMMARY STATISTICS OF THE CPPM COMMODITY GROUPS FOR 2011-2017	236
APPENDIX T DEFINITIONS OF THE CPMM VARIABLES	237
APPENDIX U SAMPLE SIZE (NUMBER OF RESPONDENTS) AT EACH OUTBOUND ROAD BCP BASED ON THE ANNUAL CPMM REPORTS, 2013-2017	239

APPENDIX V MAJOR REGIONAL AND GEOPOLITICAL EVENTS OCCURRED IN CENTRAL ASIA BETWEEN 2010 AND 2018.....	242
APPENDIX W SHAPIRO-WILK W TEST FOR THE NORMALITY DISTRIBUTION OF THE CPMM AND TAB INDICATORS.....	244
APPENDIX X CONSTRUCTED CPMM MATRICES FOR CENTRAL ASIAN COUNTRIES.....	245
APPENDIX Y EORA MACRO AND MICRO SECTORS AND MATCHING CPMM COMMODITY GROUPS.....	249
APPENDIX Z STRUCTURAL GRAVITY MODEL RESULTS FOR CPMM TRADE COST INDICATORS WITH EORA MICRO SECTORS EXPORTS FOR CAREC COUNTRIES	250

List of figures

Chapter 2

Figure 2.1	Trade costs - key broad areas of barriers to trade internationally.	18
Figure 2.2	Composition of trade costs in industrialised countries.	19
Figure 2.3	Effects of tariffs under partial equilibrium for a small economy case.	27
Figure 2.4	Effects of trade costs under partial equilibrium for a small economy case.	28

Chapter 3 (paper)

Figure 1	Overview of the literature selection process (PRISMA with details).	39
Figure 2	Total number of articles per year and TFA negotiation timeline.	41
Figure 3	Journals where articles on trade facilitation with quantitative methods were published.	43
Figure 4	Articles featuring a broad or narrow definition of trade facilitation term.	44
Figure 5	Number of articles per region	45
Figure 6	Type of trade cost indicator.	53
Figure 7	Gravity model estimation techniques over the years.	56
Figure 8	Trade flow (dependent variable).	57

Chapter 4

Figure 4.1	Map of the Central Asian region	61
Figure 4.2	Average distance to world capitals from Central Asia, kilometres.	64
Figure 4.3	Map of the Köppen climate classification in Central Asia.	65
Figure 4.4	Annual GDP growth in Central Asian countries (%).	68
Figure 4.5	Top 10 global exporters of wheat in 2018, volume (million tonnes) and value (\$billion).	74
Figure 4.6	Goods exports from Kazakhstan in 2010-2018, percentage and US dollars (million) for Agriculture	81
Figure 4.7	Goods exports from Kyrgyzstan in 2010-2018, percentage and US dollars (million) for Agriculture	82
Figure 4.8	Goods exports from Tajikistan in 2010-2018, percentage and US dollars (million) for Agriculture	82
Figure 4.9	Goods exports from Turkmenistan in 2010-2018, percentage and US dollars (million) for Agriculture	83
Figure 4.10	Goods exports from Uzbekistan in 2010-2018, percentage and US dollars (million) for Agriculture	83
Figure 4.11	Main destinations of agricultural exports from Central Asia, 2010-2018, percentage share.	85
Figure 4.12	Main destinations of agricultural exports from Kazakhstan, 2010-2018, percentage share.	85
Figure 4.13	Main destinations of agricultural exports from Kyrgyzstan, 2010-2018, percentage share.	86
Figure 4.14	Main destinations of agricultural exports from Turkmenistan, 2010-2018, percentage share.	86
Figure 4.15	Main destinations of agricultural exports from Tajikistan, 2010-2018, percentage share.	87

Figure 4.16	Main destinations of agricultural exports from Uzbekistan, 2010-2018, percentage share.	87
Figure 4.17	Product structure of Central Asian agricultural exports, 2018.	88
Figure 4.18	Applied tariff rate, weighted mean for all products (%) in Central Asia, 2010-2017	91
Figure 4.19	Trading Across Borders rank, 2018.	97
Figure 4.20	Map of the six CAREC corridors. <i>Source: ADB (2014a)</i>	103
Figure 4.21	Map of Central Asian transport improvements under BRI.	106
Figure 4.22	Central Asia (all five countries). Value added in gross exports by origin, 2015 (%).....	111
Figure 4.23	Kazakhstan. Value added in gross exports by origin, 2015 (%).....	112
Figure 4.24	Kyrgyzstan. Value added in gross exports by origin, 2015 (%).....	113
Figure 4.25	Tajikistan. Value added in gross exports by origin, 2015 (%).....	114
Figure 4.26	Turkmenistan. Value added in gross exports by origin, 2015 (%).....	115
Figure 4.27	Uzbekistan. Value added in gross exports by origin, 2015 (%).....	116

Chapter 6 (paper)

Figure 1	Cost (left) and time (right) to export in DB2015 vs DB2016 for Central Asian countries.....	136
----------	---	-----

Chapter 7

Figure 7.1	UNESCAP time/cost/distance chart.	152
Figure 7.2	Number of the outbound BCPs (mean across all years).	155
Figure 7.3	Average time-to-export spent at BCPs, hours.	156
Figure 7.4	Average cost-to-export, US dollars spent at BCPs (official payments only).	157
Figure 7.5	Kyrgyzstan: Time-to-export, hours at BCP (top); Cost-to-export, US dollars at BCP (bottom).	159
Figure 7.6	Histogram of means distribution for CPMM and TAB indicators.....	165

List of tables

Chapter 1

Table 1.1	Summary of key thesis findings	14
-----------	--------------------------------------	----

Chapter 2

Table 2.1	Overview of the key trade cost indicators developed by the international organisations	22
-----------	--	----

Chapter 3 (paper)

Table 1	Focus sector and countries' income group	46
Table 2	Quantitative methods used to estimate impact of trade costs on trade flows	54
Table 3	Key advancements of the gravity model over the years.....	54
Table 4	Gravity model specifications in literature.....	55
Table 5	Direction and significance of impact of trade facilitation indicators on trade flows	58

Chapter 4

Table 4.1	Land resources of Central Asia, 2016	62
Table 4.2	Key indicators of social development	67
Table 4.3	Sectors value added (% of GDP) and employment in each sector (% of total employment), 2019 (or latest available).....	69
Table 4.4	Theoretical Revealed Comparative Advantage 2015 relative to agriculture, and percentage change between 2000 and 2015.....	72
Table 4.5	Key indicators of agricultural sector in Central Asia, 2016	74
Table 4.6	The volumes of budget financing for the agricultural sector in Central Asia, 2016-2018, million monetary units	75
Table 4.7	Theoretical Revealed Comparative Advantage 2018 in agriculture relative to raw cotton, all countries	78
Table 4.8	Total exports, imports and trade balance in goods and services in 2017, percentage and \$billion.....	79
Table 4.9	Top five export goods and services for each Central Asian country in 2018, US dollars (thousands)	80
Table 4.10	Central Asian countries WTO accession year, and the import tariff rates for all products (%) in 2017.....	92
Table 4.11	Bilateral trade agreements between Central Asian and other post-Soviet countries, 2018	93
Table 4.12	Participation in the global or intra-regional agreements.	93
Table 4.13	Selected export promotion activities in Central Asia.....	100
Table 4.14	Export promotion instruments in Central Asian countries	101

Chapter 5 (paper)

Table 1	Baseline gravity model estimation results	125
Table 2	Gravity model estimation results with governance.....	126

Table 1	Comparison of Trading across the border measurement, DB2015 and DB2016	134
Table 2	Ease of Trading across borders ranking, 2013-2014 vs 2015-2016	135
Table 3	Doing Business contributors from Central Asia	137
Table 4	Gravity model results for perishable and non-perishable products at HS 4-digits level estimated with PPML exporter, importer and year fixed effects, 2005-2014	143
Table 5	Gravity model results for perishable and non-perishable products at HS 4-digits level estimated with PPML exporter, importer and year fixed effects, 2015-2017.....	147

Chapter 7

Table 7.1	Number of years with unavailable data for key variables (cost-to-export and time-to-export)	154
Table 7.2	Cost and time-to-export in Central Asia: TAB indicators vs CPMM TFIs.....	163
Table 7.3	Correlation between CPMM and TAB trade cost indicators.....	164
Table 7.4	The sample mean values for CPMM and TAB indicators	164
Table 7.5	T-test for CPMM and TAB cost and time-to-export indicators, full sample.....	166
Table 7.6	T-test for CPMM TFI and TAB cost-to-export and time-to-export indicators, samples split by periods	166
Table 7.7	Number and percentage of the missing observations by variable in CPMM dataset.....	168
Table 7.8	Structural gravity model results obtained with constructed CPMM dataset for Central Asia using Eora (columns 1-6) and UN Comtrade (columns 7 and 8) exports, 2011-2015	173
Table 7.9	Sensitivity test of the CPMM TFIs to the changing fixed-effects specification	174
Table 7.10	Structural gravity model results for CPMM TFIs and TAB Time-to-export indicators with Eora macro sectors exports for CAREC countries	175
Table 7.11	Structural gravity model results for CPMM TFIs and TAB Cost-to-export indicators with Eora macro sectors exports for CAREC countries	176
Table 7.12	Structural gravity model results for CPMM TFIs and selected Eora micro sectors exports for CAREC countries.....	177

List of acronyms

\$	US dollar
ADB	Asian Development Bank
APEC	Asia Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
AUS	Australia
BCP	Border crossing points
BRA	Brazil
BRI	Belt and Road Initiative
BRIC	Brazil, Russia, India, China
CA	Central Asia
CACO	Central Asian Cooperation Organization
CAEC	Central Asian Economic Community
CAREC	Central Asia Regional Economic Cooperation
CCWAEC	China-Central Asia-West Asia Economic Corridor
CEPA	Comprehensive and Enhanced Partnership Agreement with the European Union
CEPII	Centre d'Études Prospectives et d'Informations Internationales
CEZ	Common Economic Zone
CHN	China
CIF	Cost insurance and freight
CIS	The Commonwealth of Independent States
CPMM	Corridor Performance Measurement and Monitoring
CU	Customs Union
DB	Doing Business
DEU	Germany
DVA	Domestic value added
ECE	Economic Commission for Europe
EEU	Eurasian Economic Union
EGY	Egypt
EPA	Export Promotion Agency
ESCAP	Economic and Social Commission for Asia and the
ETI	World Economic Forum's Enabling Trade Index
EU	European Union
FAO UN	Food and Agriculture Organization of the United Nations is a specialized agency of the United Nations
FDI	Foreign direct investment
FE	Fixed effects
FOB	Free on board
FVA	Foreign value added
GDP	Gross domestic product

GSP	Generalised Scheme of Preferences
GVC	Global value chain
HS	Harmonised System
IATA	International Air Transport Association
IBRD	International Bank for Reconstruction and Development
ICT	Information and communications technology
ILO	International Labour Organization
IMAR	Inner Mongolia Autonomous Region
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification of All Economic Activities
ITU	International Telecommunication Union
JPN	Japan
JSC	Joint Stock Company
KAZ	Kazakhstan
KGZ	Kyrgyzstan
KOR	South Korea
LDC	Least-developed countries
LPI	Logistics Performance Index
MRIO	Multi-region input-output
MRT	Multilateral resistance terms
n/a	Not available
NAFTA	North American Free Trade Agreement
NGO	Non-Governmental Organisation
NTM	Non-tariff measures
OECD	Organisation for Economic Co-operation and Development
OECD TFI	OECD Trade Facilitation Indicators
OLS	Ordinary least squares
PPML	Poisson Pseudo-Maximum Likelihood
PRC	People 's Republic of China
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
R&D	Research and development
RCA	Revealed comparative advantage
RKDF	Russian-Kyrgyz Development Fund
RTA	Regional trade agreement
RUS	The Russian Federation
RVC	Regional value chain
SCO	Shanghai Cooperation Organization
SJR	Scimago Journal & Country Rank
SME	Small and medium-sized enterprises
SPECA	Special Programme for the Economies of Central Asia

SPS	Sanitary and phytosanitary
TAB	Trading across Borders
TBT	Technical barriers to trade
TCD	Time-Cost-Distance
TFA	Trade Facilitation Agreement
TFI	Trade facilitation indicators
TIR	Transports Internationaux Routiers (International Road Transport)
TJK	Tajikistan
TKM	Turkmenistan
TRACECA	Transport Corridor Europe–Caucasus–Asia
TRCA	Theoretically revealed comparative advantage
TRS	Time Release Study
TUR	Turkey
UN Comtrade	United Nations Commodity Trade Statistics Database
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
USA	United States of America
UZB	Uzbekistan
WCO	The World Customs Organization
WTO	World Trade Organization
XUAR	Xinjiang Uygur Autonomous Region

Dedication

This work I want to dedicate to the memory of people of my hometown, Zhanatas (Kazakhstan), who could not make it through the hardship of 1990s, the turbulent years of our country's early days of independence, including my classmates Ruslan, Natalia and Alexandr. Their spirits would come in my night dreams along the whole PhD time, reminding, that policies are not an abstract writing, but a tool that impacts (and takes, if not properly applied) lives of people.

Rest in peace, friends.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

I acknowledge that copyright of published works contained within this thesis resides with the copyright holder(s) of those works.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

I acknowledge the support I have received for my research through the provision of a University of Adelaide Beacon of Enlightenment Scholarship.

Alfinura Sharafeyeva

April 2021

Publications and presentations from this thesis

Academic journal articles (peer-reviewed)

Sharafeyeva, A., & Shepherd, B. (2020). What does “doing business” really measure? Evidence from trade times. *Economics Letters*, 109215.

Conference papers (peer-reviewed)

Sharafeyeva, A. (2019). *Impact of trade costs on agrifood exports in Central Asia*. 14th Biennial Australasian Association for Communist and Post-communist Studies (AACaPS) Conference. Griffith University, Gold Coast, January 31-February 1, 2019.

Sharafeyeva, A. (2019). *Trade costs and agrifood exports in Central Asia*. Central Eurasian Studies Society 20th Annual Conference (CESS). George Washington University’s Central Asia Program at the Institute for European, Russian and Eurasian Studies, Washington DC, USA, October 10-13, 2019.

Working paper

Sharafeyeva, A. (2019). *Feeding your workhorse with quality data: Analysis of trade costs in Central Asia*. University of Adelaide Jean Monnet Centre of Excellence in International Trade and Global Affairs. Discussion Paper.

Other conferences and seminars

Sharafeyeva, A. (2018). *Impact of trade costs on agrifood exports in Central Asia*. Interdisciplinary Approaches to Big Issues in Central Asia. The Humanities Research Centre Workshop. ANU College of Arts & Social Sciences, The Australian National University, Canberra, December 17-18, 2018.

Sharafeyeva, A. (2019). *Impact of trade costs on agrifood exports in Central Asia*. 63rd Australasian Agricultural and Resource Economics Society Conference. Melbourne, Australia, February 12-15, 2019.

Sharafeyeva, A. (2019). *Trade facilitation and performance of agricultural exports in post-Soviet countries*. 3rd Adelaide PhD Summer Institute in International Trade. Adelaide, Australia, March 20-21, 2019.

Acknowledgements

My PhD journey was a challenging but still joyful experience, in many ways because of the beautiful people, who was there to support me in achieving my goal – to produce a high-quality piece of research. And this is my praise to these people.

First of all, I want to take a bow to the beacons that were showing me which way to follow, what dangerous reefs to avoid and how to anchor my point of view in the enormous body of academic voices, to my three supervisors.

I am grateful to my principal supervisor - Associate Professor Alec Zuo, who, supported me to structure all the great ideas into achievable within the given time frame PhD topic and research questions, and patiently helped me to understand and interpret econometrical or statistical issues that encountered along the way. I also appreciate Alec's consciousness and always reminding me to keep work-life balance in order to succeed in my research.

I am thankful to Dr David Adamson, my co-supervisor, who was always an open-door for discussions that, when stuck, would help taking me from the point A to the point B in my research. Particularly, I appreciate the way David taught me to critically analyse the policies from various angles. I thank him for many hours spend on editing the early writings of my thesis, showing how to develop an academic argument, and discussing alternative ways on the results interpretation.

I am grateful to Professor Richard Pomfret, my co-supervisor. His expertise in Central Asian economies is the key reason I wanted to do research at the University of Adelaide under his supervision. I am happy I did this decision, as his knowledge helped me to build a strong vision of the issues that encounter the Central Asian countries and some prospective ways to overcome many of the obstacles that holding this region from a steady development. I appreciate that all three supervisors would provide their feedback to my writings as quickly as possible, which is why I am able to submit this work just in time.

I am thankful that early in my PhD I came across with Ben Shepherd, the Principal of Developing Trade Consultants, who, with his extensive academic knowledge and practical experience coupled with passion to international trade matters, would provide a valuable insight to the questions I investigate in my thesis.

I am thankful to Barbara Brougham for her professional and very thoughtful language editing for this thesis manuscript, understanding and providing a help with all the "asap" deadlines.

I want to thank my PhD colleagues, Nikki Dumbrell and Dr Constantine Seidl, for sharing their valuable views on econometric and policy questions. I am grateful to all the PhD colleagues for being such a friendly and supportive team any time, all time.

This work would not be possible without financial support from the University. I am grateful to the University of Adelaide for providing me with the Beacon of Enlightenment scholarship for international students, and the Centre for Global Food and Resources offering an incredible research environment. Special thanks to Julia Avdeeva and Dr

Natasha Caulfield for their flawless administrative support, which made my study a smooth no hustle process.

Thanks to my friend Associate Professor Larissa Statsenko, a graduate from the University of Adelaide University, for putting a hat of my unofficial PhD mentor.

I am grateful to my parents, and parents-in-law, my brothers and siblings-in-law for supporting my endeavours, wherever far way they could take me. I appreciate that my family would notice my love to study and explore from the early ages, and would always encourage to keep studying, working despite the traditional norms and any other social expectations of what a girl supposed to be doing. Not just that, I never even had a doubt that I can and should do everything I am passionate for, because my parents raised me very confident person, and I am forever grateful to my oldest brother for his decision to leave the high school to a marble factory work just to make money for my extra-curriculum education (pianoforte and English language classes), when he was just 16 and I was 7 years old. I appreciate my parents-in-law's saying: "Always give a way to the girl, who is striving to learn".

Dearest Johanna Cole and Chris Norris, thanks for being my Australian family from the first day I landed in this country many years ago. I am grateful our relationship only deepened since then and your kindest advises were always helping me to navigate easily in the totally unfamiliar to me Australian waters.

The hugest amount of love and appreciation goes to my husband Bakhytzhan Azamatov. He is a hero of a time, supporting my career endeavours in every possible way, listening, advising, taking care of all the duties when needed, giving me space for thinking and reflection, making me laugh and organising short getaways to the near and far places of Australian travel destinations. Most of all, thank you Bakhytzhan, for never letting me even doubt myself as a researcher.

My sweetest boys, Tanirlan and Ilan, you are my heart-melting energy boosters. I am impressed and grateful to my 4 years old son Tanirlan for being such a compassionate companion in my journey. Ilan, you arrived just in time and reminded me about the importance of taking a break from study and work and just be with those, who are there for you.

Abstract

With tariffs now at historic lows, WTO members and researchers are tackling another challenge to improve trade flows – reducing the trade costs. The 2017 Trade Facilitation Agreement identified that trade facilitation can provide mechanisms to reduce trade costs. However, the scale and scope of the impact of trade facilitation on trade flows are still debated due to complexity and ambiguity of the trade facilitation term.

The goal of this study is to provide a comprehensive analysis of the effects of trade costs on agrifood exports in Central Asia. The findings are expected to assist policymakers in allocating resources to maximise the gains from trade facilitation. This research provides in-depth analyses of trade facilitation definitions, measurements of trade facilitation indicators and estimation techniques applied in econometric models that are broadly used in trade facilitation studies. Systematic literature review and a gravity model of international trade were employed to address the key questions posed in this thesis.

The systematic literature review, based on critical analysis of 181 papers, supports the view that improvement of international trade depends on a complex relationship between social, environmental, and economic factors. However, ambiguous results for the impact of these factors on trade flows suggest a need for careful analysis of existing data on trade facilitation, estimation techniques and dataset specification.

Analysing Central Asian exports with the commonly used gravity model and the World Bank's *Doing Business* indicators results in nonsensical theory-inconsistent estimates. This is especially true for disaggregated agricultural products, where the logistics of agrifood trade differs from the assumptions used in the Trading Across Borders (TAB) segment of the *Doing Business* dataset. The TAB indicators are not only imprecise but have biases associated with geography, e.g. landlocked countries, and the composition of trade, e.g. share of agricultural products, that reduce the value of using the TAB indicators in cross-country regressions. The problems, exacerbated by the discontinuity of the TAB indicators after changes in assumptions in 2016, suggest that there is a need to find alternative data sources and estimation techniques for the impact of trade costs on perishable and non-perishable products in Central Asia.

The Corridor Performance Monitoring Mechanism (CPMM) trade cost indicators from the Asian Development Bank, an alternative data source based on traders' actual experience as compared to the perception-based TAB indicators, is found to be more appropriate for analysing and measuring the impact of trade costs on exports of Central Asian countries. Improved trade facilitation is particularly beneficial for perishable agricultural products as compared to other commodity groups.

Econometric analysis of trade cost indicators and trade is sensitive to the choice of estimation techniques, such as inclusion of a full-set of fixed effects between the country-pairs. This suggests that researchers need to follow the most recent advances in gravity model theory. From a policy perspective, such sensitivity of the results to the choice of indicators and of econometric method suggests careful consideration be given to trade facilitation budget allocation. The potential gains from trade facilitation are certainly large, but imprecise estimation approaches may give misleading results of the size of gains and of where the policy impact can be greatest.

Trade costs, trade facilitation, and agrifood exports in Central Asia

Introduction

Chapter 1 outlines the motivation behind the questions addressed in this thesis, provides a background to the research topic, and introduces the objectives and research questions. The chapter highlights that high trade costs can be a major obstacle to international trade and significantly disrupt trade flows – and that trade facilitation is needed to minimise trade costs. However, the research on trade facilitation is still relatively new and a number of gaps and inconsistencies exist within the literature regarding trade cost/facilitation definitions, measurement and geographical coverage. The aim of this thesis is to address these gaps and add more clarity to the research on trade facilitation. The structure of this chapter is as follows. Firstly, the chapter outlines the rationale behind this research, followed by the study background and literature review – after which the problem statement and research objectives are introduced. The chapter concludes with the research design and methodology and provides a roadmap of the thesis structure.

1.1 Thesis rationale

The most salient feature of international trade is that the exchange of capital, goods, and services occurs across national borders, and that movement from one country to another inevitably faces barriers. These barriers range from tariffs to other foreign policy settings and compliance requirements, to language, and the potential for corruption or simple incompetence and inexperience at all levels of trade movement into and out of local jurisdictions. To benefit from international trade, countries are therefore keen to reduce their trade costs. Efforts to reduce trade costs are termed trade facilitation that aims to move goods and services across international borders more efficiently.

After ten years of negotiations the Trade Facilitation Agreement (TFA) came into force on 22 February 2017 when two-thirds of the 164 WTO members had ratified the Agreement (WTO, 2017). Adhering to the provisions of the TFA will expedite the movement of goods both in and out of member countries, and promote cooperation between customs and other authorities, improving transparency, customs compliance and participation in global supply chains (WTO,

2017). The World Trade Organisation (WTO) has calculated that developing countries could increase exports by US\$1.9 trillion if they fully implemented the TFA (WTO, 2015). This thesis argues that despite the evident benefit from trade facilitation, its estimated effects on trade volume may be biased due to its ambiguous definitions, inconsistent data measurements and limitations in the estimation techniques. Thus, the budget allocations based on such estimates could be inefficiently distributed.

A range of trade facilitation definitions that vary from narrow border-related impediments to trade to broad behind-the-border obstacles are explored and summarised by means of systematic literature review. Measuring trade facilitation remains challenging as it depends on construction and estimation of underlying trade cost indicators. The most commonly used trade cost indicators are the World Bank's Trading Across Border (TAB) indicators. However, indicators such as the TAB may be subject to limitations related to the underlying assumptions of their data collection approach and respondents who provide this data. The thorough analysis of the TAB indicators presented in this thesis suggests that this data source needs to be treated with caution. For example, landlocked Central Asian countries had the highest trade costs before 2015 but very different rankings in the following years. The TAB indicators for Central Asian countries in 2015 suggested implausibly large changes, for example, in Kyrgyzstan the time taken to export fell from 63 days in 2014 to two days in 2015 and in Tajikistan the cost to export fell from \$9,050 to \$643.

This thesis analyses the tools and techniques used to estimate the impact of trade costs. The gravity model is the most commonly used tool to estimate the impact of trade costs on trade flows. Despite the prominent features of this model, critical analysis of quantitative studies revealed that more than half of the articles reviewed did not apply theory-consistent estimation techniques, casting doubt on the quality of their findings. Applying the work-horse gravity model and using TAB indicators for Central Asian countries produced implausible results, suggesting that high trade costs had either a positive effect on trade or no impact.

Trade costs are particularly critical for agrifood products, as compared to other less perishable commodities. Implementing the TFA, the cost of trading agricultural goods could be reduced

by more than 18 percent given the time-sensitivity of this products (WTO, 2015). Empirical evidence in this thesis, obtained from structural gravity model estimated by the Poisson Pseudo Maximum Likelihood (PPML) and using an alternative database on trade costs developed within the Central Asia Regional Economic Cooperation (CAREC) confirms the negative impact of high trade costs on agrifood exports from the landlocked Central Asian countries. Additionally, the trade costs indicators developed by CAREC are confirmed to be better suitable for analysing and measuring their impact on exports of Central Asian countries as compared to the TAB indicators. The findings of the thesis support the idea that Central Asian countries have the real potential to become a land-linked region, despite being landlocked geographically, as well as play an important role as the food suppliers to the global markets.

1.2 Background

According to the World Bank's global tariffs profile, tariffs have gradually declined in the last decades (World Bank, 2020d). Thus, this study focuses on trade costs, defined as all costs, excluding export and import tariffs, that are incurred when supplying goods and services to an international market. Potential trade costs include logistics costs, border-clearing costs, transaction costs, and other costs associated with the fulfilment of non-tariff measures, for example, technical barriers to trade (TBTs), and sanitary and phytosanitary (SPS) measures.

The measurement of trade costs worldwide is an important aspect of managing trade for the benefit of everyone involved. However, measurement of trade costs is controversial in what to measure, how or at what point. Nevertheless, all measurement shows that *ad valorem* trade costs are higher than *ad valorem* tariffs for both developing and developed countries (WTO 2015). Consequently, trade facilitation – providing extensive policy options and processes that enable local producers and exporters to take advantage of trade – has become increasingly important to maximise potential gains from international trade.

Trade facilitation is particularly important for the agrifood trade, where *ad valorem* trade costs can be greater when compared to other commodities (Arvis, Duval, Shepherd, Utoktham, & Raj, 2016), mainly due to the time-sensitivity of non-processed agrifood products (Chen & Novy, 2011). Time affects income earned from perishable commodities in two correlated ways: reduced quantity, and price. Djankov, Freund, and Pham (2010) calculated that a 10% increase in export time reduces the export volume of time-sensitive agricultural products by approximately 3.5%.

The issue of time delays in the transport of agriproducts is so great that some countries may decide not to export time-sensitive agricultural goods at all due to accumulated time lost along the transit route (Freund & Rocha, 2010). Implementation of the TFA may result in the streamlining of agriproduct trade, allowing more countries to benefit from their agricultural goods of comparative advantage. Improved trade facilitation can support countries in achieving

Sustainable Development Goal 2 to end hunger and improve food security (Tripoli & Schmidhuber, 2018).

1.3 Trade costs and trade facilitation in Central Asia

This section provides a brief overview of the literature that explores the impacts of trade costs on Central Asian trade. This section details specific issues for Central Asia associated with being landlocked; the high costs to export agrifood produce from this region; potential benefits from trade facilitation; as well as the lack of the reliable data sources to analyse to what extent trade costs impact exports in Central Asia. It concludes with the gaps and limitations in the literature specific to Central Asian trade and trade facilitation.

1.3.1 Impact of landlockedness and remoteness to major markets on trade in Central Asia

Earlier work that attempted to quantitatively estimate the impact of trade costs in Central Asia mainly focused on the geographic disadvantages of the region. Landlockedness and remoteness from global markets were identified as key impediments to international trade in Central Asia. Raballand (2003) suggests that the high transport cost burden for Central Asian countries is due to their longer distances from seaports; for example, it is 2.5 times more costly per kilometre to send a container from the USA to Kyrgyzstan (no seaport), than from the USA to Turkey (a seaport country). The combination of bulk low-value commodities and the prohibitive costs of airfreight mean that Central Asian countries are dependent on a combination of land and sea transport, such as ship, rail and road (Raballand, Kunth, & Auty, 2005).

Mazhikeyev, Edwards, and Rizov (2015) estimated the impact of landlockedness, as well as remoteness, for five Central Asian countries and 37 trading partners. They found that a 10% increase in distance leads to a 16-22% decline in trade values. Trade value is reduced by 13-

35% when one trading partner (exporter or importer) is landlocked or by 10-51% if both are landlocked.

However, according to Debie and Steck (2001), historically the central position of a country could be an advantage when economies were strong; whereas, after some period of economic decline, landlockedness could be a disadvantage. Central Asia was at the crossroads of the trade between the East and West from the 3rd century until the 16th century, whereas at the beginning of the 17th century, caravan trade passing through this region declined (Debie & Steck, 2001). Moreover, an economically strong neighborhood also plays an important part in landlocked countries' development.

Recent studies have debated whether high trade costs resulting from poor hard and soft infrastructure have been a major impediment to trade as much as the geographic specifics of Central Asia (Pomfret, 2017). Lücke and Rothert (2006) claim that long distances and some 'idiosyncratic' factors result in high transport costs between Western Europe and Central Asia. The 'idiosyncratic' factors are the replacement cost of containers in the price of shipments to Central Asia, as it was assumed that the containers could not be recovered.

Additionally, Central Asian logistics infrastructure is inefficient and expensive for small exporters (Lücke & Rothert, 2006). Small producers generally are not involved in the bulk goods supply chain, but may wish to export a higher value, smaller quantity product. As transporters prefer to move full containers rather than containers with empty space, producers of small quantities lose time and money waiting for other products to be added to theirs in order that a full container can be transported (Lücke & Rothert, 2006).

Even when the physical infrastructure is improved, trade costs remain high due to inadequate soft infrastructure in Central Asia, including, but not limited to, lengthy border delays due to customs inefficiencies (Pomfret, 2018). Arvis, Raballand, and Marteau (2010) reported that cost-to-cross the border is a major impediment to trade in Central Asia. Among the costs are bribery, red tape, poor border infrastructure and unnecessary delays. Border delays can be due to a mismatch between the carriers' schedules and working hours in administrative offices, as

well as slow handling and replication of tasks between two border countries (Arvis, Raballand, & Marteau, 2010).

1.3.2 Impact of trade costs on agrifood trade in Central Asia

There is evidence suggesting that agricultural exports are heavily penalised by high trade costs, as well as uncertainty in the trading environment in Central Asia (World Bank, 2020f). Arvis et al. (2016) calculated that in Europe and Central Asia the trade costs estimate in *ad valorem* equivalent were 107% and 179% in manufacturing and agriculture, respectively, in 2010. Raballand et al. (2005) estimated that transport costs are below 10% of the FOB price of exports for metals from Central Asia to Western Europe, and for cotton exports from Kyrgyzstan to the Russian Federation. Whereas, for more perishable agricultural products, such as tobacco and apple juice concentrate, transport costs from Central Asia are at excessive levels, even for exports to the Russian Federation (around 16% for tobacco), thus limiting exports despite the abundant local supply (Raballand et al., 2005). This, as suggested by Lücke and Rothert (2006), would lead to re-orientation of agricultural exports to intra-regional trade, which, according to the statistics for recent years, has proven to be true. Chapter 4 of this thesis demonstrates that agrifood exports to the Russian Federation were almost entirely substituted by exports among Central Asian countries as a result of the high costs to trade. However, even within the region, the agrifood export capacity cannot be met due to the uncertainty and regular time delays at border crossing points (Kim & Mariano, 2020).

Pomfret (2018) argues for strategies to enable an enhanced trade environment in Central Asia. Improving infrastructure is one strategy. Just joining the WTO and following TFA guidelines is another. The guidelines emphasise streamlining border checks and controls, and promote interstate communication, as well as the liberalisation of commerce to give the producer greater control. This approach has had benefits in Kyrgyzstan, one of the most open economies in Central Asia. Kyrgyzstan has brought new skills and inputs from overseas in order to expand their kidney bean production, their producers having learned about prospective export markets from foreign partners. The beans production area in Talas oblast increased from 5,000 hectares in 1999 to 45,000 hectares in 2012, as local households involved in bean production became

competitive enough to sell their produce to Turkey, Bulgaria and Russia (Tilekeyev, Mogilevskii, Abdrazakova, & Dzhumaeva, 2018).

1.3.3 Challenges and opportunities to estimating trade facilitation in Central Asia

No peer-reviewed papers were identified that would apply a common gravity model and the World Bank's Trading across Borders (TAB) indicators approach to estimate impact of trade cost and trade facilitation on trade in Central Asian countries. This study deals with this gap by shedding light on the TAB's unsuitability for measuring facilitation outcomes in Central Asia and the limiting factors for such an analysis. Nevertheless, some studies attempted to quantify the trade cost and trade facilitation impacts in Central Asia, using alternative approaches.

Grigoriou (2007) estimated the impact of domestic infrastructure and landlockedness on bilateral trade flows in Central Asia. Their infrastructure index was based on Limao and Venables (2001) and constructed using the variables from the World Development Indicators for 2005: kilometres of roads, of paved roads, of railways, and number of telephone sets/lines per capita. It was concluded that an improvement of the infrastructure index in the transit-country to the level of the best 25th percentile among other landlocked countries would increase exports from Central Asia by 52% (Grigoriou, 2007).

The impact of the trade costs on exports in Central Asia has also been calculated using the gravity model. Kim and Mariano (2020) in ADB working paper series used new data on bilateral time and cost measures for trade facilitation in the Central Asia Regional Economic Cooperation (CAREC) Program and International Monetary Fund (IMF) quarterly trade flows. Their findings suggest that reducing time at the importer's border by 10% increases intraregional trade value among CAREC countries by 1.41%.

Moreover, they found that time spent at the importer's border influenced trade flows more than time spent at the exporter's border. According to Kim and Mariano's (2020) simulation results, however, less time at the border would only assist economic growth in Central Asia if there were also improvements behind the border, such as changes to policy settings and cross border communication. It should be noted that, due to internal trade data limitations, the authors did not apply the recent advanced gravity model that accounts for multilateral trade resistance.

Thus, they may have overestimated the impact of trade costs, as debated in Chapter 7 (section 7.7).

Venables, Bird, and Lebrand (2020) developed a computable spatial equilibrium model to analyse the potential impacts of the Belt and Road Initiative (BRI), which is expected to facilitate trade in Central Asia, on this region's economy. Their findings suggest that the region's aggregate real income benefits from the BRI range from 2% to 3% of regional income. Moreover, it was estimated that reduction of the time spent at the border results in greater average time saving than investments in physical infrastructure, with 39% reduction in travel times, as compared to a 15%, respectively. Both Venables, Bird, and Lebrand (2020) and Kim and Mariano (2020) then highlight the importance of reducing border related time-costs to facilitate trade in Central Asia.

Nevertheless, despite the growing literature on trade facilitation, there is still limited research for Central Asia, with only a few studies that quantitatively estimate the impact of trade costs and trade facilitation on trade in this region. A lack of appropriate trade cost indicators and other necessary data, for example, domestic trade flows, that are required for a robust econometric model analysis could be among the reasons for limited research in this field. Studies on the impact of trade facilitation at the sectoral level, the agricultural sector in particular, are even scarcer for Central Asia in the literature.

1.4 Problem statement

Trade facilitation for international trade is clearly highly desirable among trading nations, as evidenced by the development of the TFA. However, although trading nations want to make trade easier and cheaper, the actual impact of trade facilitation measures is difficult to determine, and there is ongoing debate related to how trade facilitation is to be defined and measured. Agriculture, for example, has been identified as one of the most penalised sectors by high trade costs, but there is still limited evidence to advise what factors, and to what extent,

need to be facilitated in order to boost agricultural trade, with what possible outcome, or what measures to use in quantifying an outcome.

The nature of the debate on trade facilitation implies that positive results obtained by various institutions such as the WTO (2015) may be misleadingly over- or under-estimated, depending on the tools and parameters used for measuring costs and benefits. For example, Anderson and Wincoop (2004) found that average trade costs in high-income countries can reach 170% *ad valorem* tariff, while the WTO (2015) reported trade costs equivalent to a 219% or 134% *ad valorem* tariff for developing and developed countries, respectively. Both estimates are far higher than the *ad valorem* trade costs for the USA (4-8%) and New Zealand (7-11%) reported by Hummels (2007). As a result, there is a potential for false economic guidance for policymakers on trade facilitation related reforms and investments. It should be noted, though, that despite these studies estimate the trade costs, they in fact measure very different things. Anderson and Wincoop (2004) defines trade costs as all the costs along supply chain from the farm gate to the final consumer, whereas Hummels (2007) measures the difference between the CIF and FOB prices, which is a much narrower measure of transport and border costs. Thus, it is important to be careful about definition and about comparing findings from different authors.

The applied measurement of trade facilitation issue is twofold: quality of the underlying trade cost indicators used for the analysis, as well as estimation techniques applied for the calculation of the trade facilitation impact. For example, the World Bank's Trading Across Borders (TAB) indicators have been criticised, due to limitations related to the underlying assumptions of the surveys, which 'hardly makes them representative of the universe of companies as a whole' (p.31 Martincus, 2016). The workhorse gravity model, without applying all the advanced techniques, might have misleading results. However, the application of the advanced techniques requires a rigorous data that is often not available to a researcher, in particular for the analysis of developing countries.

Another concern with the trade facilitation literature is that most studies focus on developed states, even though developing countries have been identified as the major beneficiaries of the

TFA. Analysis of trade facilitation has predominantly focused on the largest economies in the world, such as China, the European Union (EU) and the United States (US), or regional blocs, such as the countries of the Asia Pacific Economic Cooperation (APEC) or Association of Southeast Asian Nations (ASEAN). There are few studies focusing on low- or middle-income countries or on geographically challenged regions, for example landlocked countries.

Therefore, this research focused on trade costs and their ramifications, as well as their measurement, in Central Asia, a growing area of the integrated Eurasian economy and a group of countries still open to reform from their past highly regulated economies as a result of the Communist regime.

1.5 Research objectives and questions

The aim of this study is to provide a comprehensive analysis of the effects of trade costs and trade facilitation on agrifood trade flows in Central Asia. The analysis could guide policymakers during their deliberations over ways to facilitate trade and maximise the gains of their agriproduct. Moreover, this research aims to complement the existing literature by providing in-depth analysis of trade facilitation definitions, measurements of trade cost indicators and commonly used estimation techniques and econometric models in trade facilitation studies.

Specifically, the following research questions were addressed:

- 1 How trade costs and trade facilitation are defined, and what are their impact on trade?
- 2 What trade facilitating factors and trade cost indicators are commonly studied by researchers, and how do they differ across world regions and industry sectors?
- 3 What economic sector has a comparative advantage to export in Central Asia?
- 4 To what extent is Central Asia integrated into global and regional value chains?
- 5 To what extent is the impact of trade costs, expressed in money and time terms, greater for perishable than non-perishable goods?

- 6 How do changed measurements of the same trade cost indicator, as well as changed estimation techniques, affect gravity model estimates?
- 7 Do trade cost indicators based on real experience provide a better estimate than those based on perceptions for Central Asian countries?

These questions are addressed within the thesis.

1.6 Methods and research approach

The nature of the research questions required alternative methods to be utilised. To address research questions 1-2 a systematic literature review and critical analysis of 181 articles on trade facilitation, guided by the checklist of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is used.

The theoretically revealed comparative advantage (TRCA) model as in Costinot, Donaldson, and Komunjer (2012) is applied to identify the sectors of comparative advantage in Central Asia (question 3). To answer question 4, Central Asia's participation in global and regional value chains is estimated as per the exposition of the Leontief inverse approach to the trade-in-value added decomposition, as in Aslam, Novta, and Rodrigues-Bastos (2017).

To explore questions 5-7 the workhorse gravity model was employed to investigate the reliability of the common trade cost indicators, as well as impact of trade costs on agrifood exports in Central Asia. The two primary sources of trade cost indicators employed for this research are the widely used, but recently heavily criticised, Trading Across Borders indicators provided by the World Bank, and the novel CPMM trade facilitation indicators developed for Central Asian countries by the Asian Development Bank (ADB).

1.7 Thesis structure

This thesis is organised into eight chapters and combines published and unpublished work. Figure 1.1 provides the thesis structure and connection between the chapters and Figure 1.1

An overview of the thesis structure.

Table 1.1 presents the summary for each chapter.

Following this introduction, Chapter 2 sets up a conceptual framework for trade costs and trade facilitation, as well as highlights the limitations in the trade facilitation literature. Chapter 3 provides a critical analysis of the existing trade facilitation literature based on the systematic literature review approach.

Chapter 4 has three principal roles. First, it introduces the study area, five Central Asian countries, and provides an overview of each country's physical and climatic conditions, and socio-economic and political context, international trade policies, trade costs and trade facilitation programs in the region. Second, it analyses the sectors with comparative advantage to export, as well as the participation of Central Asian countries in global and regional value chains. Third, it summarises the key developments and challenges that Central Asian countries need to tackle in order to promote their exports.

Chapters 5 to 7 are analytical chapters that address the key research questions of this thesis. Qualitative assessment of the datasets as well as structural gravity model analysis for goods exports globally, and in Central Asia at aggregates, micro and macro sectors level are used to address these questions.

Chapter 8 summarises the thesis' findings, discusses limitations of the thesis, explores the policy implications from the findings, and makes recommendations for future research. The Appendices provide detailed and supportive information for various chapters.

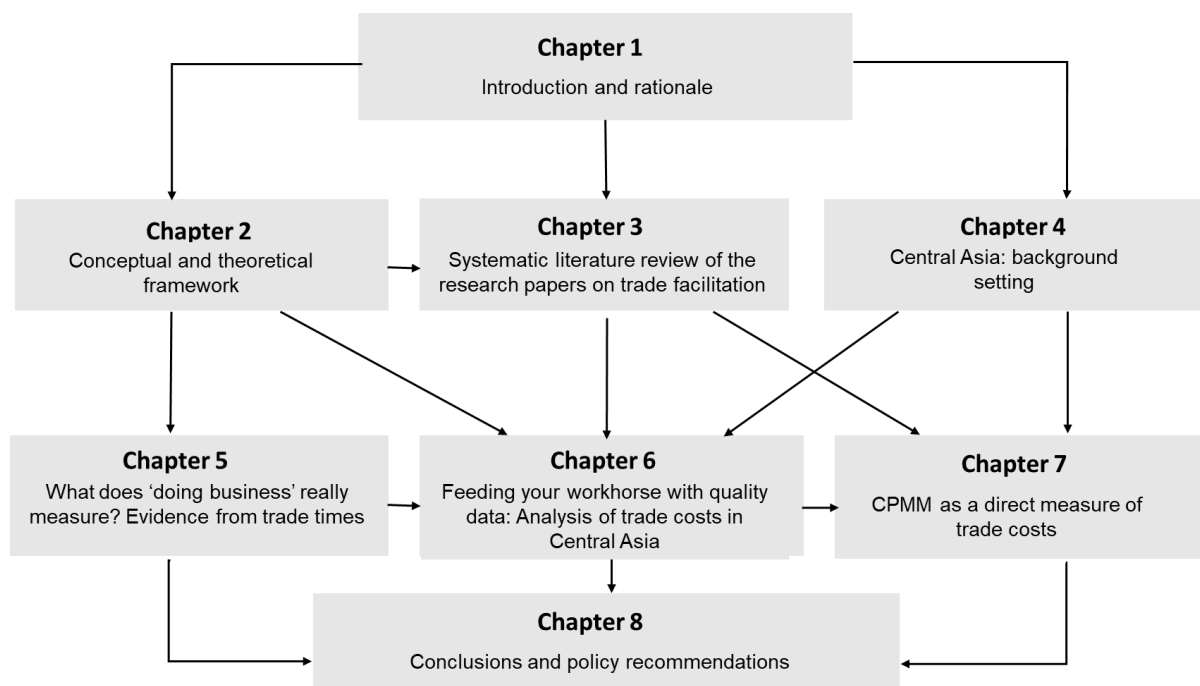


Figure 1.1 An overview of the thesis structure.

Table 1.1 Summary of key thesis findings

Chapter	Findings	Method
Two Conceptual framework: Trade costs and trade facilitation	<ul style="list-style-type: none"> Theoretically, all trade costs can be represented as an equivalent to the imposed import tariff. Unlike the tariff, trade costs do not generate government revenue. The beneficiaries are the 'intermediary' agents along the trade costs value chain. The measurement of the trade facilitation remains debated. A range of different trade cost/facilitation indicators has been developed across the studies and global institutions. The quality of some indicators is questioned in the literature and can be misleading. 	Literature review

Chapter	Findings	Method
<p>Three</p> <p>Impact of trade facilitation on trade flows: a critical insight of quantitative studies.</p>	<ul style="list-style-type: none"> • The findings of this systematic review support the view that improvement of international trade depends on a complex relationship between social, environmental, and economic factors. • The most studied factors that impact trade are border and transport efficiency, business and regulatory environment as well as factors related to human capital. • Overall ambiguous results for these and other indicators suggest a need for careful analysis of the existing data on trade facilitation, as well as estimation techniques and dataset specification. • To date, peer-reviewed studies predominantly focused on developed countries. • Gravity model is the main approach to quantitatively estimate the impact of trade facilitation on trade flows. • More than half of the reviewed studies fail to address the best gravity model techniques that allow to execute a theory-consistent econometric analysis. • Thus, the findings based on those studies as well as policy recommendations based on them might be of concern. 	<p>Systematic literature review</p>
<p>Four</p> <p>Central Asia: Physical setting, economic and political developments.</p>	<p>Despite the perception that Central Asian countries disadvantageously positioned to participate in the international trade, the literature review suggest that countries' poor policies and weak institutions play a major obstacle to trade as compared to the geography.</p>	<p>Literature review</p>
	<p>The calculation of the sector of comparative advantage suggests an unfulfilled exports potential, in particular in agricultural trade.</p>	<p>Theoretically revealed comparative advantage model</p>
	<p>Analysis of countries participation in regional and global value chains suggest a rudimentary development of inter-regional value chain linkages, and slightly more active involvement in global value chains.</p>	<p>Value chain linkages estimates following exposition of the Leontief inverse approach to the trade in value added decomposition as in Aslam, Novta, and Rodrigues-Bastos (2017).</p>
<p>Five</p> <p>What does 'doing business' really measure? Evidence from trade times.</p>	<p>The value added of the paper is in highlighting a measurement problem in the TAB data: they capture aspects of a country's governance structure in addition to the strict mechanics of crossing borders. A methodology revision in 2015 only partly responds to this problem. These findings have major implications for governments that use TAB to track performance over time.</p>	<p>Structural gravity model tested on global goods and services trade using split dataset for TAB pre- and post-2015</p>

Chapter	Findings	Method
<p>Six</p> <p>Feeding your workhorse with quality data: analysis of trade costs in Central Asia.</p>	<ul style="list-style-type: none"> The methodology changes in the World Bank's Trading across border indicators (TAB) over the years results in significant fluctuations of the indicators values. Commonly used gravity model and pre-2016 TAB indicators result in nonsensical theory inconsistent estimates for disaggregated agricultural products and Central Asian exports, where the logistics of agrifood commodities may differ from the assumed practices in TAB dataset. The discontinuity of the TAB indicators suggests that there is a need to find alternative data sources and estimation techniques to estimate the impact of trade costs on perishable and non-perishable products in Central Asia. 	<p>Qualitative analysis of the TAB indicators.</p> <p>Structural gravity model for exports of perishable and non-perishable agricultural commodities and TAB time and cost to export indicators.</p>
<p>Seven</p> <p>CPMM as a direct measure of trade costs.</p>	<ul style="list-style-type: none"> CPMM indicators are confirmed to be better suitable for analysing and measuring their impact on exports of Central Asian countries as compared to the TAB indicators. More detailed nature of CPMM indicators allows to qualitatively evaluate which border crossing points create the major obstacles to trade in Central Asia, which, in turn, allows policy-makers to focus on strengthening the facilitation efforts on the most vulnerable routes and border crossing points, instead of randomly spending budget investments. The continual time-series nature of the CPMM indicators makes it possible to quantitatively estimate the impact of time and cost to export in Central Asia. It was confirmed that improved trade facilitation is particularly beneficial for the perishable agricultural products as compared to other commodity groups. The trade cost indicators are very sensitive to the changing estimation techniques, such as full-set of fixed effects between the country-pairs, which warns the researchers to follow the most recent advances in gravity model. 	<p>Qualitative assessment of the CPMM trade costs dataset.</p> <p>Structural gravity model analysis for goods exports in Central Asia at aggregates, micro and macro sectors level. Partial and full-set fixed effects estimation techniques as opposed to only standard gravity controls in a PPML analysis are tested.</p>

Conceptual framework: Trade costs and trade facilitation

This chapter provides a background on the terms trade cost and trade facilitation. The aim of the chapter is to review the literature in order to understand the theoretical concepts, measurement, and definitions behind these two terms. The key findings of the literature review suggest that theoretically, all trade costs can be represented as an equivalent to the imposed import tariff. However, unlike the tariff, trade costs do not generate government revenue. A range of different trade cost/facilitation indicators have been developed across academic research and global institutions, however the measurement of trade facilitation remains a source of debate. Moreover, the quality of some indicators are questioned within the literature and can often be misleading. The chapter concludes that there is a need for a systematic approach to best define trade costs/trade facilitation within the literature, which is performed in the following Chapter 3.

The structure of this chapter is as follows. The chapter, first, reviews the literature on trade cost specifications, indicators and definitions, as well as providing an overview of trade facilitation literature. It finishes by describing the theoretical framework for trade costs and trade facilitation.

2.1 International trade costs

Some researchers define trade costs narrowly as border related costs only, others – broadly, by including all the behind-the-border related costs incurred while selling goods internationally. The broad approach to define trade costs is a challenging task for the researchers due to difficulty of determining which behind-the-border costs are relevant. Moreover, there are different dimensions of trade costs: financial – cost expressed in actual money terms; time – long and delayed trading procedures that affect the exports and imports; and uncertainty – increased costs (or reduced volume and value of traded goods) due to unpredictable trading environment, such as road bottlenecks, closed customs without initial notice, and other.

2.1.1 Trade cost definitions

Trade costs can be defined as ‘...all costs incurred in getting a product to the’...markets, ‘other than the production costs of the good itself’ (Duval, 2007, p. 16). This broad definition of all costs from factory door or farm gate to consumer was used by Anderson and Wincoop (2004) who measured trade costs as all of the following combined:

- transportation (freight and time) costs;
- tariff and non-tariff policy barriers;
- information costs;
- contract enforcement costs;
- legal and regulatory costs; and
- local (wholesale and retail) distribution costs.

Trade costs can be the direct or indirect costs incurred to move goods and services along the entire supply chain, from the producer’s door in the exporting country to the consumer in the importing country. They can be divided into three classes based on the nature of the barriers (Figure 2.1).

- *pre-border*: costs incurred bringing goods to the border within a country
- *border*: costs incurred to cross the border
- *post-border*: costs experienced once the border is crossed.

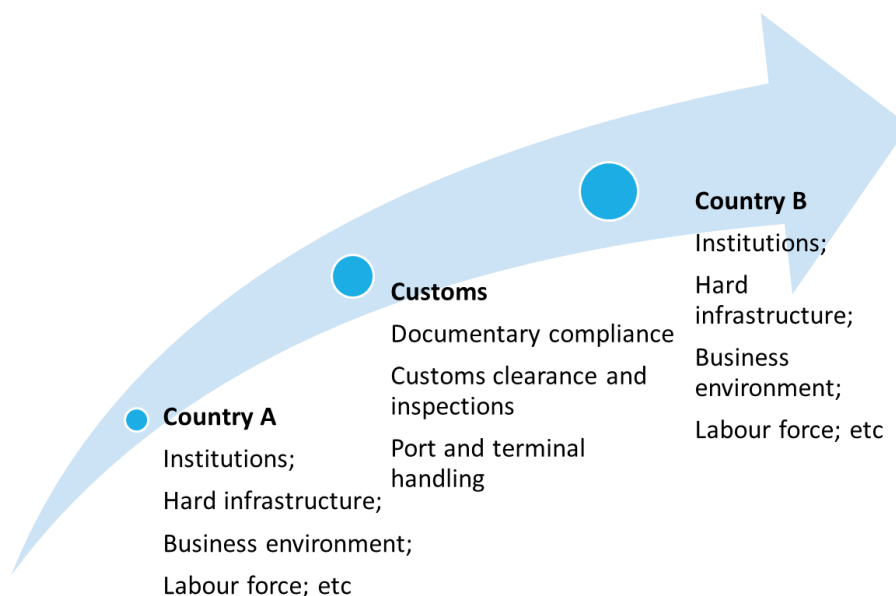


Figure 2.1 Trade costs - key broad areas of barriers to trade internationally.

Based on the estimates by Anderson and Wincoop (2004), Portugal-Perez and Wilson (2009) the composition of trade costs in industrialised countries is graphically represented in Figure 2.2. More than 40% of costs to trade internationally are encountered at border crossing points.

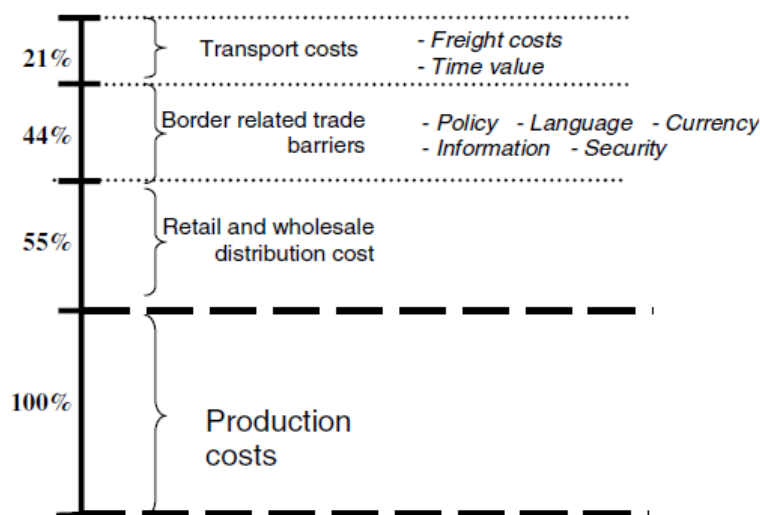


Figure 2.2 Composition of trade costs in industrialised countries.
Source: Portugal-Perez and Wilson (2009, p. 383)

Alternatively, trade costs can be defined as the difference between the costs of domestic and international trade, other than those costs related to traditional trade policy instruments, for example, import tariffs (Sourdin & Pomfret, 2012). Domestic transport costs from the producer to the port and costs from the port of entry to final consumer that have parallels to costs incurred in domestic sales are excluded. Some authors adopting the narrow definition express trade costs as the difference between CIF and FOB¹ prices, as initially proposed by Harrigan (1993) and popularised by Hummels (2007) and (Sourdin & Pomfret, 2012). An advantage of this approach of defining trade costs is that it uses the money-cost and can help to analyse the trade costs in relation to policy changes. Exogenous factors, such as a country’s landlockedness, cannot be captured by either approach and may mislead the policy implications on trade costs.

¹ *Investopedia* (2020a): CIF–cost insurance and freight (named port of destination): Seller must pay the costs and freight includes insurance to bring the goods to the port of destination. However, risk is transferred to the buyer once the goods are loaded on the ship. FOB–free on board (named port of shipment): The seller must themselves load the goods on board of the ship nominated by the buyer, cost and risk being divided at ship’s rail. The seller must clear the goods for export. Maritime transport only but NOT for multimodal sea transport in containers. The major difference between CIF and FOB is the transportation costs and insurance during it.

Alternatively, trade costs can be measured by the time (hours, days, time differences, or time delays) incurred for trading goods internationally. For example, agricultural goods, in particular perishable goods (e.g. fruits, dairy products), are vulnerable to time-related trade costs. The time to get goods to market can be increased by *ad hoc* administrative obstacles, uncertain road and rail conditions, and other unexpected challenges that prevent smooth movement of goods (Christ & Ferrantino, 2011).

Focusing on customs delays in Uruguay, Volpe Martincus et al. (2015) have noted that customs delays in that country negatively impact exports, especially food, because their value declines as they perish. Chen and Novy (2011) have pointed out that inland transit time (the time to transport a good from the main city to the port) has the strongest impact on countries' decisions not to export time-sensitive agricultural goods rather than document time, customs time or port time (terminal handling times).

Uncertainty is another dimension of trade cost in international trade. Risk and uncertainty in the realities of engaging in trade lead to additional trade costs, including 'scheduling costs, information costs, suboptimal inventory levels, supply chain redundancy, and reduced orders' (Christ & Ferrantino, 2011, p. 1751). Ansón, Arvis, Boffa, Helble, and Shepherd (2020) have found that uncertainty may have a larger impact on trade than lengthy time-to-trade.

2.1.2 Trade cost indicators

Often, trade costs can be presented as the indices of ease-to-trade internationally and cover various impediments to trade. The measurement of trade costs depends solely on the construction and estimation of trade cost indicators. Up to this point, a range of trade cost indicators has been developed across trade studies.

The number and scope of the indicators per study are usually restricted to the data availability, as well as the specific objectives of the researcher's analysis. For example, Wilson, Mann, and Otsuki (2003) and (2005) focused on four aggregated indicators of trade cost for Asia-Pacific Economic Cooperation (APEC) countries: port infrastructure; customs environment; regulatory environment; and e-business infrastructure. Alternatively, Moïsé, Orliac, and Minor (2011) developed and tested 12 trade facilitation indicators aligned to the WTO draft agreement

on trade facilitation², while Portugal-Perez and Wilson (2012) constructed four new aggregate trade cost indicators from a wide range of primary variables. Two of the four indicators are related to the ‘hard’ dimension of trade facilitation - physical infrastructure and information and communications technology (ICT). The ‘soft’ dimension indicators are border and transport efficiency and the business and regulatory environment.

Most of these trade cost variables are predominantly based on indicators developed by global institutions, for example, the World Bank’s Trading across Borders (TAB) and Logistics Performance Index (LPI); the World Economic Forum’s Enabling Trade Index (ETI); and the Organisation for Economic Co-operation and Development’s (OECD) Trade Facilitation Indicators (OECD TFI) (Table 2.1).

However, these indicators are subject to the various assumptions and limitations, which are important to consider in order to address their shortcomings in empirical research. For example, the World Bank's TAB indicators are easy to use in a regression, but data validity may be an issue because reported data only refer to businesses in the economy’s largest city; and the reporting relies on consultancy firms in the capital rather than traders' actual experience in crossing borders.

Behar (2010) noted the low correlations between the two main data sources for the trade facilitation estimates: trade cost indicators based on the firm-level responses in the Enterprise Surveys and the perception-based TAB indicators. Some earlier practices attempted to create composite trade cost variables based on these indicators, for example, in such seminal works as Portugal-Perez and Wilson (2012), who developed four aggregated trade cost indicators using various sub-indices from different sources. However, the literature review shows that most recent analyses tend to avoid aggregating the indicators due to the complexity of the process and interpretation of the results afterwards. Instead, researchers tend to directly test publicly available indicators, such as those mentioned above: LPI, TAB or ETI (Ansón et al., 2020).

² WTO Draft Consolidated Negotiating Text on trade facilitation (DCNT)

Table 2.1 Overview of the key trade cost indicators developed by the international organisations

	Logistics Performance Index (LPI)	Trading across Borders (TAB) indicators	Enabling Trade Index (ETI)
Organisation	World Bank	World Bank	World Economic Forum
Overview	An interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance	Time and cost (excluding tariffs) associated with three sets of procedures—documentary compliance, border compliance and domestic transport—within the overall process of exporting or importing a shipment of goods	Assesses the extent to which economies have in place institutions, policies, infrastructures and services facilitating the free flow of goods over borders and to their destination. The ETI was developed within the context of the World Economic Forum's Enabling Trade program
Frequency/Years	Biannually: 2007-2018	Annually: 2005-2019	Biannually: 2008-2016
Number of countries covered	160	190	136
Data collection methods	A worldwide survey of operators on the ground (global freight forwarders and express carriers), providing feedback on the logistics 'friendliness' of the countries in which they operate and those with which they trade. Feedback from operators is supplemented with quantitative data on the performance of key components of the logistics chain in the country of work.	The data on trading across borders are gathered through a questionnaire administered to local freight forwarders, customs brokers, port authorities and traders.	A composite indicator, consists of an aggregation of individual indicators measuring various trade-enabling factors based on different sources such as on the World Economic Forum's Executive Opinion Survey, International Trade Centre, World Bank, the United Nations Conference on Trade and Development (UNCTAD), IATA, ITU, Global Express Association
Structure	Six indicators: 1. The efficiency of customs and border management clearance. 2. The quality of trade- and transport-related infrastructure. 3. The ease of arranging competitively priced international shipments. 4. The competence and quality of logistics services. 5. The ability to track and trace consignments. 6. The frequency with which shipments reach consignees within the scheduled or expected delivery time.	Time-to-trade (hours) Cost-to-trade (US dollars)	These factors are organized into seven pillars, which are, in turn, organized, into four larger, umbrella groupings, called subindexes: Market access. Border administration. Infrastructure. Operating environment
Limitations	Although the LPI and its components now offer the most comprehensive and comparable data on country logistics and trade facilitation environments, they have a limited domain of validity because of the limited experience of survey respondents and, for landlocked countries and small island states, the dependence of their logistics on the logistics of other countries.	Perception-based Refers to the economy's biggest cities only. May be subject to limitations related to the underlying assumptions of the surveys, which 'hardly makes them representative of the universe of companies as a whole' (p.31 Martincus, 2016).	The aggregated ETI is based on various sources, including LPI and TAB. The criticism around the TAB indicator might also raise the questions regarding the reliability of the ETI data.

2.2 Trade facilitation

Trade facilitation is a policy objective and a process to reduce trade costs. As a country's trade costs increase, their ability to trade according to comparative advantage decreases. As trade liberalisation has resulted in economic gains from tariff reductions between nations worldwide, the cost of the actual movement of goods across borders has become increasingly important (Martinez-Zarzoso & Márquez-Ramos, 2008). Pomfret and Sourdin (2010) state that trade facilitation is a reduction in trade costs, which include transport costs and the costs of clearing borders, but there is a grey area concerning which behind-the border costs should be included in a measurement of trade costs.

2.2.1 Definitions of trade facilitation

The 'broad' definition of trade costs has contributed to a wide range of definitions of trade facilitation across the literature (Appendix A: List of selected definitions). A broad definition includes issues 'behind-the-border', from ICT and transport infrastructure development to country's doing business environment. Narrower definitions focus only on the reduction of the administrative burden at the border.

Leading institutions involved in the implementation of the TFA tend to define trade facilitation narrowly, focusing only on reduction of costs incurred at border crossings. The WTO definition states:

Trade facilitation is elimination of paperwork, modernisation of trade procedures and harmonisation of customs requirements, towards reduction of the costs and time needed to trade goods across the border. (WTO 2017, online)

The OECD defines trade facilitation as the:

Set of measures that streamline and simplify the technical and legal procedures for products entering or leaving a country to be traded internationally. As such, trade facilitation covers the full spectrum of border procedures, from the electronic exchange of data about a shipment, to the simplification and harmonisation of trade documents,

to the possibility to appeal administrative decisions by border agencies. (OECD 2020, online)

According to the United Nations Conference on Trade and Development (UNCTAD), trade facilitation aims to create a transparent and predictable environment to trade across the borders based on ‘simple, standardised customs procedures and practices, documentation requirements, cargo and transit operations, and trade and transport arrangements’ (WTO, 2015).

A number of academic articles, however, suggest that a broad approach to trade facilitation definitions is required to determine where the greatest benefits can be achieved. Duval (2007) suggests that to achieve greater gains from trade, facilitation that encourages improvements in custom procedures, transportation infrastructure, and reforms in banking and insurance (services and infrastructure) are also required. Portugal-Perez and Wilson (2012) build up trade facilitation definition around a ‘hard’ dimension - related to physical infrastructure, such as roads, ports, etc. and a ‘soft’ dimension - institutional aspects that are intangible.

Anderson and Marcouiller (2002) argue that trading countries’ institutional quality significantly affects bilateral trade, with better institutions leading to improved trade. Specifically, they state that international trade dramatically deteriorates when there is corruption and imperfect contract enforcement. Latin American countries’ total trade in goods could improve by 30% if they raise their institutional quality to the same levels as those found in the European Union (Anderson and Marcouiller, 2002). Schuler (2003) and Levchenko (2007) suggest that differences in institutional quality decrease a country’s comparative advantage, although the impact of institutions varies for different commodity groups in a country. Greater transparency in a country’s legal system and the protection of property rights, for example, has greatly facilitated agrifood exporters and importers in BRIC³ countries (Bojnec, Fertő, & Fogarasi, 2014).

These different aspects of trade facilitation naturally influence the measures for assessing the impact of trade facilitation on trade flows, which again leads to widely varied results, from highly positive and statistically significant to non-significant or highly negative, depending on the measure. For example, Freund and Rocha (2010) found a strong positive or non-significant impact on trade in Africa from improved port efficiency. On the other hand, the estimates by

³ Brazil, Russia, India, China

Jordaan (2014) for an analogical indicator in a similar geographical setup revealed a nonsensical negative impact on trade flows.

Maur and Wilson (2010), who made a comprehensive survey of existing studies on trade costs and trade facilitation, concluded that a number of definitions of trade facilitation tend to focus on common concepts of the simplification, harmonisation and transparency of procedures associated with international trade. Moreover, trade facilitation definitions vary depending on the specific policy objectives required by countries, often covering regulatory issues that had been neglected or ignored so far, therefore drawing attention to the need of empirical studies of these policies (Maur & Wilson, 2010).

Appendix B summarises the diversity of positive estimates from the various trade facilitating factors across the studies, suggesting that the impact of trade facilitation is not one-dimensional and that there is no clear direction as to where and how much to allocate the budget to boost trade. While all new private and public investment in both the quantity and quality of hard and soft capital can provide opportunities for developing a comparative advantage in trade, there is no guarantee that welfare gains will materialise if resources are poorly allocated and institutional rigour is not established and maintained (Francois & Manchin, 2006).

2.2.2 Attempting facilitation

Thus, trade facilitation, that is, the extensive domestic policy options for enabling local producers and exporters to take advantage of trade, is becoming increasingly important to maximise the gains from global trade integration.

Simulations using the gravity model suggest that the full implementation of the 2017 Trade Facilitation Agreement (TFA) would cut trade costs of TFA signatories by an average of 14.3%, as well as increase exports by US\$ 1.9 trillion for developing countries (WTO, 2015) through the adoption of improved domestic legal frameworks and the application of the TFA guidelines on trade facilitation.

Based on notifications of commitments, 65% of TFA provisions had been implemented by 2019, with a 100% implementation rate for developed members and 64% for developing members. The least developed countries in the agreement have reached a 31% implementation rate (WTO,

2020b). However, the actual benefits and trade cost reduction due to implementation and complying with the TFA rules are still to be estimated by the WTO and its members.

2.3 Theoretical framework

In 1817, David Ricardo introduced the theory of comparative advantage to explain trade between two countries. Ricardo's work now lies at the centre of all trade models to explain that trade emerges between countries according to their ability to produce goods at different prices based on technology (Krugman et al., 2015). In the 20th century, Heckscher-Ohlin (1934, 1949) argued that comparative advantage also includes other economic aspects, including natural endowment in factors of production, such as the size of the resource base, capital and labour (Krugman et al., 2015). Consequently, if two or more countries engage in trade, their welfare can increase by taking advantage of different prices derived from a comparative advantage.

Krugman et al. (2015) challenge the simple starting point of comparative advantage by arguing that nations trade for two reasons. First, because they have a comparative advantage in producing a particular good at a lower relative opportunity cost; and second, because they can achieve economies of scale in production. In other words, comparative advantage is not static, but rather changeable. Investments (private and public) in technology, labour and capital alter a country's comparative advantage.

In the real world, investment is not restricted to just production, but also influences underlying institutions and infrastructure that support trade. Sourdin & Pomfret (2012) state that to take advantage of the world's export markets, countries seek to minimise trade costs at all levels, since costs can be represented as import tariffs on world trade (Figure 2.3).

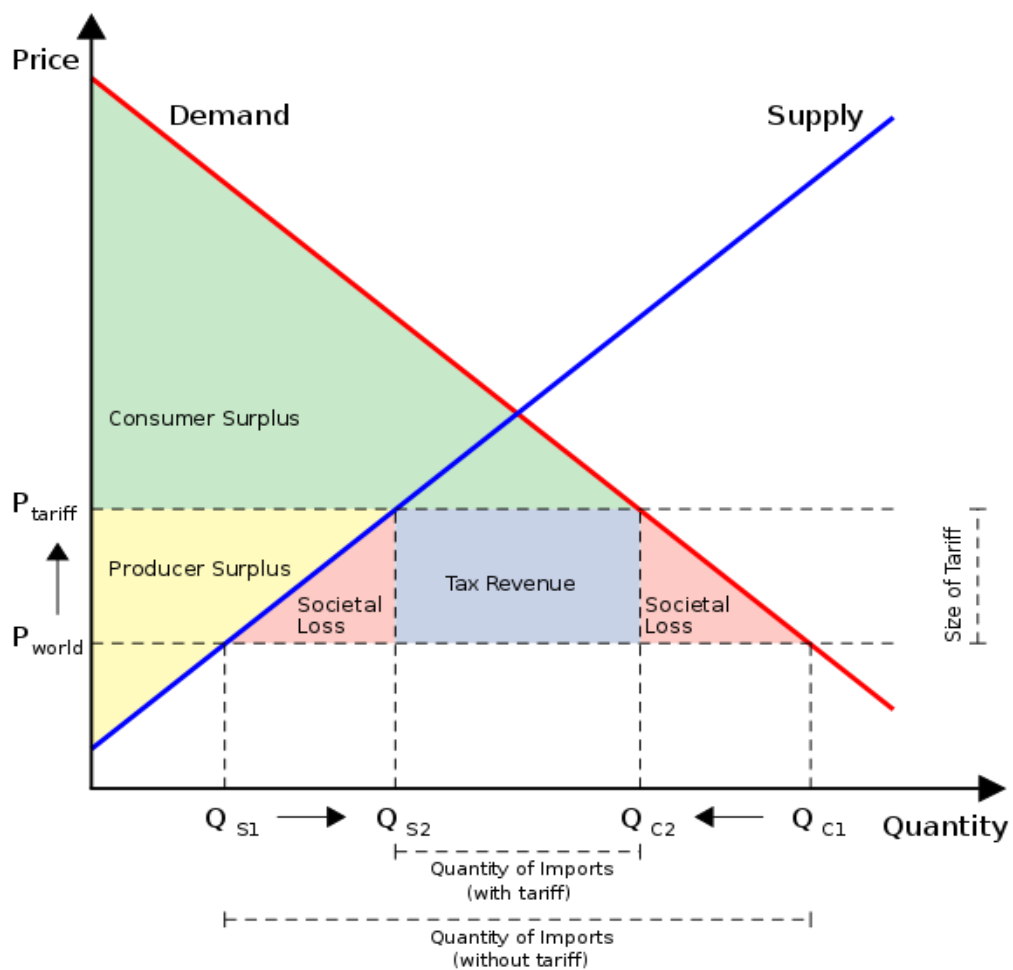


Figure 2.3 Effects of tariffs under partial equilibrium for a small economy case. *Source:* adapted from Krugman et al., 2015

When a tariff or other price-increasing policy is introduced, it is expected to raise the prices and reduce the volume of imports. An import tariff increases the price from P_{world} to P_{tariff} and this higher price stimulates domestic production of the good so that the quantity supplied increases from Q_{S1} to Q_{S2} . This also shifts the total local quantity consumed Q_{C1} left to Q_{C2} . The overall impact is reduced imports, increased domestic production, and higher consumer prices, so that consumers are worse off. However, the imposition of import duty provides revenues to the government. The revenue receipts of the government can be determined by the purple rectangle.

Similarly, all trade costs can be represented as an equivalent to the imposed import tariff (Figure 2.4). However, unlike the tariff, trade costs do not generate government revenue. The beneficiaries are the ‘intermediary’ agents along the trade costs value chain. Therefore, trade facilitation or reduction of trade costs, could benefit consumers and hurt import-competing

producers, while decreasing the costs of ‘intermediary agents’, without any loss of government revenue.

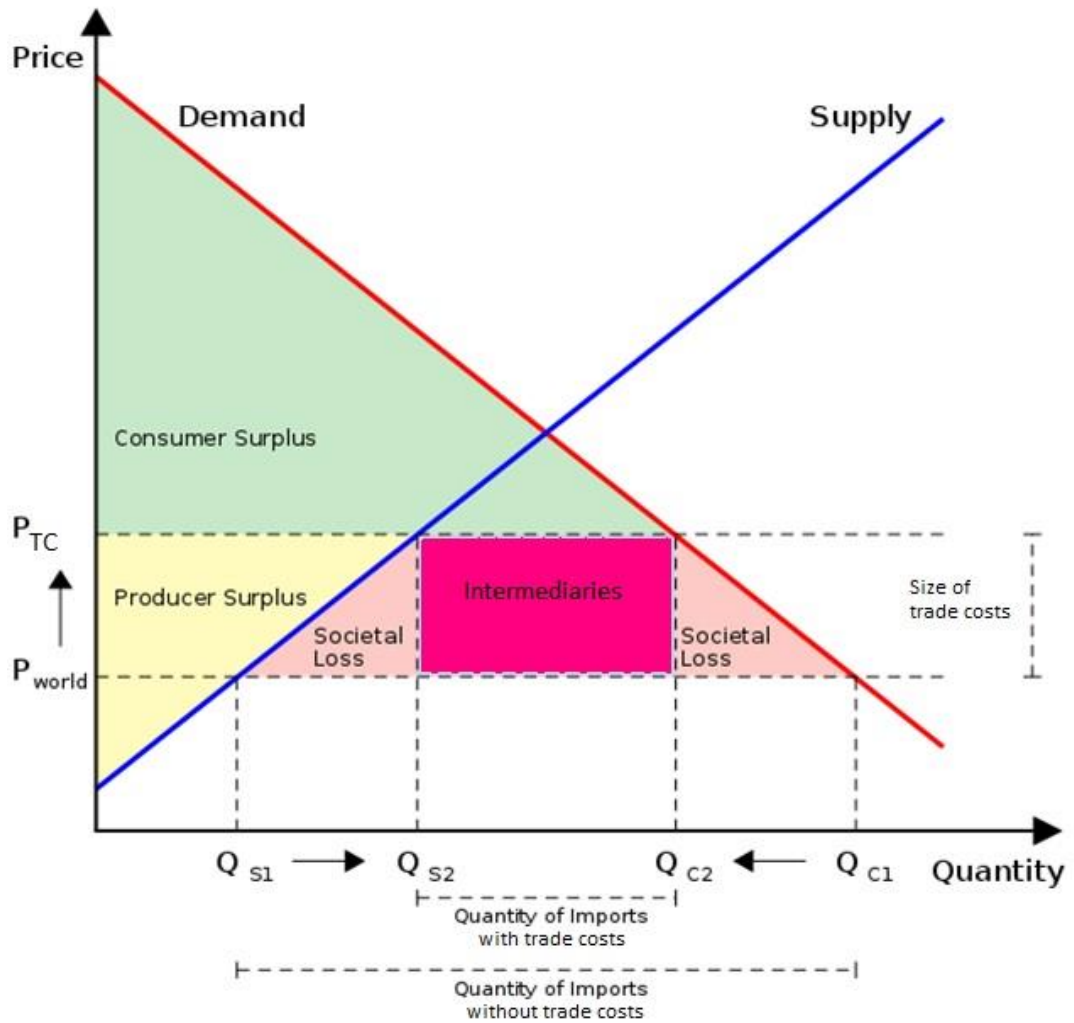


Figure 2.4 Effects of trade costs under partial equilibrium for a small economy case.

Unlike the reduction of tariffs, trade facilitation may require some expenditure in order to implement trade facilitation measures (Nguyen, Nguyen, & Hoang, 2016). Though, in some situations, such as eliminating paperwork at the border, may even reduce government expenditure on printing and monitoring forms. Thus, in the long run, an enhanced trade environment could eventually cut government spending and allow more productive use of state budgets.

2.4 Summary

With tariffs now at historic lows, WTO members and researchers are tackling the next challenge to improve trade flows, trade costs. The 2017 signing of the Trade Facilitation Agreement is a demonstration of the understanding that trade facilitation can provide mechanisms to reduce trade costs. Overall, however, the literature review suggests that cost-to-trade remains high globally. There is no unique measurement of trade costs and their impact on trade for various reasons. The concepts of trade cost and trade facilitation are poorly defined, as it is generally determined by the author/country who are examining a set of reforms (Maur & Wilson, 2010).

Subjective definition prevents clarity within the economic literature. The measurement of trade facilitation, its scale and scope, as well as quality, depends on the construction and estimation of trade cost indicators that are diverse, as can be observed in the literature. Additionally, trade facilitation at sectoral level is insufficiently addressed in the existing literature. The evidence shows that trade costs and time delays are the main obstacles to trade in perishable products, and thus it warrants more specific investigation and development of trade facilitation indicators.

To provide more clarity about the gaps and limitations of the understanding of trade costs and trade facilitation, the next chapter of this thesis provides a thorough analysis of the global literature that quantitatively estimates the impact of trade costs and trade facilitation on international trade, providing the first systematic review on this topic.

Impact of trade facilitation on trade flows: A critical insight of quantitative studies

This chapter presents an unpublished manuscript, yet to be submitted to a journal for review. It is formatted in submittable manuscript form, *with headings, tables and figures incorporated into the text, but without chapter designations.* There is naturally some repetition with other chapters of this thesis.

Alfinura Sharafeyeva^{1*} and David Adamson¹

¹Centre for Global Food and Resources, The University of Adelaide; Adelaide SA 5000, Australia; *Email: alfinura.sharafeyeva@gmail.com

Abstract

Academic and policy interest in exploring the economic benefits from trade facilitation on international trade flows has been increasing since early 2000s as a response to the launch of the WTO Doha round negotiations. This article presents a systematic review of 181 articles and fills an important gap in understanding of the potential key factors that facilitate international trade. The results highlight that the most studied trade facilitating factors in the literature were indicators related to: business and regulatory environments border and transport efficiency; and human capital. However, the findings from these studies suggest that there is evidence within the literature that trade facilitation can both decrease and improve international trade. This confusion in the literature then fails to provide the clarity needed to assist policy makers' allocation of resources. The study provides a series of recommendations on directions of further research including reduction of post-border trade costs; the experience of developing countries; and improvement of quality of the trade facilitation indicators for comprehensive understanding on the benefits and costs from trade facilitation.

Keywords: international trade; trade costs; trade facilitation

Statement of Authorship

Title of Paper	Impact of trade facilitation on trade flows: A critical insight of quantitative studies
Publication Status	<input type="checkbox"/> Published <input type="checkbox"/> Accepted for Publication <input type="checkbox"/> Submitted for Publication <input checked="" type="checkbox"/> Unpublished and Unsubmitted work written in manuscript style
Publication Details	NA

Principal Author

Name of Principal Author (Candidate)	Alfinura Sharafeyeva		
Contribution to the Paper	Designed and executed the systematic literature review. Prepared data for analysis, interpreted results and wrote the manuscript.		
Overall percentage (%)	80%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	6.02.2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- i. the candidate's stated contribution to the publication is accurate (as detailed above);
- ii. permission is granted for the candidate to include the publication in the thesis; and
- iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	David Adamson		
Contribution to the Paper	Assisted in the design of the analysis Contributed to writing & editing the manuscript		
Signature		Date	08/02/2021

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Please cut and paste additional co-author panels here as required.

Introduction

Trade facilitation is a policy objective and a process to reduce trade costs. Efforts designed to reduce the cost and time to export and import goods are the key metrics in trade facilitation. These metrics include reducing the paperwork, streamlining procedures, and harmonising customs requirements. The reduction of trade costs became a core discussion of many organisations and World Trade Organization (WTO) members when they signed the Trade Facilitation Agreement (TFA) in 2017. It is estimated that the full implementation of the TFA will reduce global trade costs by an average of 14.3%, with African countries and least-developed countries (LDCs) forecast to receive the biggest average reduction in trade costs (WTO, 2015).

Trade facilitation and trade costs: Definitions and indicators

There will always be trade costs when goods have to move between or within countries, and there is always a desire to keep them as low as possible in order to facilitate movement along a supply chain. These costs can stem from national regulations, and impediments along the supply chain and rationally national governments can address these costs to facilitate the movement of goods by the removal of regulations and the construction of hard and soft infrastructure if their provision is in the nation's interest.

Trade facilitation

According to the OECD (2018b), trade facilitation covers the full range of border procedures, from the 'electronic exchange of data about a shipment, to the simplification and harmonisation of trade documents, to the ability to appeal administrative decisions by border agencies.

Trade facilitation, by lowering trade costs, contributes to overall increase of economic welfare, with developing and emerging economies receiving the greater benefits (OECD, 2018b). Elimination of avoidable trade costs is important for firms to capitalize on new market openings (González, Munro, Gourdon, Mazzini, & Andrenelli, 2019). In addition, trade facilitation is crucial for time-sensitive commodities such as perishable agricultural products and high-tech manufacturing components (OECD, 2018b). Finally, trade facilitation not only contributes to economic development, but it also eliminates incentives for corruption at the border, hence promoting a good governance.

However, due to the complex nature of trade costs, a debate continues on the:

- scale and scope of trade facilitation;
- appropriate methodologies;
- data sources and their collection; and
- true benefits and costs of TFA adoption

These complications create ambiguity in the literature. Numbers of trade facilitation definitions (i.e. broad and narrow) have emerged, preventing the direct comparison of results from alternative articles.

Leading institutions involved in the implementation of the TFA follow a narrow definition, focusing only on costs incurred at border crossings. The WTO definition states:

Trade facilitation is elimination of paperwork, modernisation of trade procedures and harmonisation of customs requirements, towards reduction of the costs and time needed to trade goods across the border. (WTO, 2017, online)

According to the United Nations Conference on Trade and Development (UNCTAD), 'trade facilitation seeks to establish a transparent and predictable environment for *cross-border trade transactions* based on simple, standardised customs procedures and practices, documentation requirements, cargo and transit operations, and trade and transport arrangements' (WTO, 2015).

On the other hand, a number of academic articles suggest that a broad trade facilitation approach is required to determine where the greatest benefits can be achieved from trade cost reduction. Anderson and Wincoop (2004) identified trade costs as:

- transportation (freight and time) costs;
- tariff and non-tariff policy barriers;
- information costs;
- contract enforcement costs;
- legal and regulatory costs; and
- local (wholesale and retail) distribution costs.

Duval (2007) suggests that to achieve greater gains from trade, facilitation that encourages improvements in customs procedures, transportation infrastructure, and reforms in banking and insurance (services and infrastructure) are required. Portugal-Perez and Wilson (2012) propose that trade facilitation measures can be undertaken along two dimensions: a 'hard' dimension related to tangible infrastructure, such as telecommunications, roads, ports, and highways; and a 'soft' dimension related to transparency, customs management, the business environment, and other institutional aspects that are intangible.

Alternatively, trade costs can be defined as the difference between the costs of domestic and international trade, other than those costs related to traditional trade policy

instruments, for example, import tariffs (Sourdin & Pomfret, 2012). This can be expressed as the difference between CIF and FOB prices as initially proposed by Harrigan (1993) and popularised by Hummels (2007). Nevertheless, there is a grey area regarding which behind-the-border costs should be included in a measurement of trade facilitation (Pomfret & Sourdin, 2010).

Trade cost indicators

Different understandings of what costs need to be reduced while facilitating trade have resulted in a number of trade cost indicators being developed by individual researchers, as well as by global institutions. Among the challenges in the development of such indicators is data collection. Trade cost indicators must be measured and harmonised across a large number of stakeholders involved in the trade procedures within and across countries. Attempts to harmonise indicators may result in the use of data sources that do not capture all aspects of trade facilitation, creating misleading and unreliable indicators, unsuitable for an econometric analysis.

For example, Doing Business' Trading across Borders (TAB) indicators are commonly used by researchers due to their convenience for a global analysis of the impact of trade costs on trade flows. Composite indicators, such as the TAB, may be subject to limitations related to the underlying assumptions of the data surveys, which 'hardly makes them representative of the universe of companies as a whole' (Volpe Martincus, 2016, p.31). Behar (2010), for example, found low correlations between trade facilitation measures from firm-level responses in the World Bank's Enterprise Surveys and the analogous, but perception-based, TAB indicators. In addition, the TAB mixes aspects of a country's institutional environment with information on trade, and the indicators might not be relevant to the analysis of landlocked countries (Sharafeyeva, 2019), and need to be treated with caution. The TAB indicators' perception-based method of measurement, which means that data is collected from the experts in the big cities rather from the drivers on the ground, is also among the reasons for issues with TAB indicators.

Finally, different interpretations of trade facilitation and the heterogeneity of trade cost indicators affect the estimates of the trade facilitation impacts on trade flow. The use of the indicators yields broadly varied results, from highly positive and statistically significant to non-significant or highly negative. For example, Freund and Rocha (2010) found a strong positive or non-significant impact for improved port efficiency on trade in Africa; whereas the estimates for an analogical indicator in a similar geographical setup by Jordaan (2014) produced a nonsensical negative impact on trade flows. Understanding the reasons behind such conflicting results was a central goal of the current research.

A systematic review

This paper offers the first systematic review of the effect of the use of heterogeneous indicators when measuring trade facilitation. The systematic literature review had four objectives:

- analyse the scope and the scale of trade facilitation studies, including definitions, geographical regions and economic sectors that have been studied;
- identify and analyse the data and the main methodologies and techniques used to estimate the impact of trade costs and facilitation on trade flows;
- analyse the direction and statistical significance of the estimated impact of trade facilitation on trade flows; and
- identify gaps and current consensuses in the literature.

The review was based on articles from peer reviewed journals that were published from January 1977 to December 2019. It explores the benefits and costs of trade facilitation, and provides insight into the methods and datasets available for such an analysis.

Materials and method

The term 'systematic review' can be defined as:

A means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest. (Kitchenham, 2004, p.1)

The difference of the systematic literature review approach from the traditional narrative reviews is in a detailed methodology that can be reproduced (Staples & Niazi, 2007).

A systematic literature review may contain a meta-analysis of numerical data from the included studies (Hanratty, 2018). However, in instance of this research, the questions posed were better answered with qualitative data, as the data used in the studies under review were too disparate to combine and compare. The trade cost variables are extremely heterogenous across the studies, and the calculation of trade flow is very idiosyncratic in terms of aggregation and measurement. The data from the published articles cannot be combined and compared using any shared assumptions and meaningfully quantified.

PRISMA. This systematic review was guided by the checklist of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Initially developed in the health sciences, such an approach is being used to investigate the research questions in social sciences as well (Maki, Cohen, & Vandenberg, 2018).

Five stage investigation. There were five stages in this systematic review:

- 1 Identification
- 2 Screening
- 3 Eligibility assessment
- 4 Data extraction
- 5 Summary and synthesis.

Qualitative data analysis software, *DistillerSr*, was used to classify articles at stages 2, 3 and 4. The number of excluded and included references at each stage is presented in Figure 3.1.

Stage 1 Identification

Peer-reviewed academic journal articles were investigated, from which relevant data was extracted and validated.

To identify relevant abstracts for the review, literature written in English was selected using the following keywords and sources. There were no time period restrictions.

- *Web of Science* (trade facilitation_and trade flows; trade facilitation_and trade flows_and international trade; trade facilitation; trade costs_and trade flows_not import tariffs_not export tariffs);
- *Scopus* (trade facilitation_and trade flows_and international trade; trade facilitation_and trade flows; trade facilitation; trade costs_and trade flows_not import tariffs_not export tariffs);
- *Emerald Insight* (trade facilitation; trade costs_and trade flows_not import tariffs_not export tariffs)
- *Business Source Complete (EBSCOhost)* (trade facilitation; trade costs_and trade flows_not import tariffs_not export tariffs).

A construction diary of this combination is shown in Appendix C. The keywords were sought for in the title, abstract and keywords of each publication. This step resulted in 2016 publications that formed the 'raw database'.

Stage 2 Screening

As a second step, the raw database was processed against rapid screening of the title and abstract using the following criteria:

- International trade is the main focus of this article.
- 'Trade facilitation' or 'trade costs' is one of the main research questions.
- The article had been peer reviewed.

Consequently, 956 articles were removed as their focus was not international trade. 82 articles failed to analyse trade costs or trade facilitation related questions. 66 articles did not adhere to other selection criteria (for example, working papers, book chapters).

Stage 3 Eligibility assessment

The rapid screening was followed by more detailed, full-text assessment, analysing the eligibility of the remaining 611 articles against the following criteria:

- impact of trade facilitation on trade flows (both goods and services)
- quantitative methods applied
- full article can be retrieved.

At this stage, 354 articles were excluded as not meeting the first selection criteria: impact of trade costs and/or facilitation on trade flows. The remaining articles demonstrated highly quantitative nature of the research, with only 67 articles removed as non-quantitative. Finally, eight articles were excluded because the full text could not be retrieved from the online sources.

Stage 4 Data extraction

In total, 181 articles were then processed for data extraction. From the selected studies, the following information was collected:

- definitions of the trade facilitation and trade costs terms
- focus country and region, as well as sector analysed in the study
- trade flow, or dependent variable of the study
- data source of the trade facilitation indicators
- methodology and estimation techniques

- dataset specifications and regression outcome.

The results section of this review reports the outcome of the data extraction in detail. Appendix D provides a sample of the excluded literature.

Stage 5 Summary and synthesis

To provide quantitative and qualitative information on the scope of the classified literature, a summary of findings is presented in the Results section. Based on the findings, a comprehensive report on the state of the knowledge in this realm, and gaps and limitations are reported in the Discussion section.

Limitations of this systematic review

To manage a large number of the research articles some methodological constraints had to be considered. Firstly, the analysis was limited to the online available articles in peer reviewed journals. Books, working papers or other types of research reports were excluded from the analysis. Therefore, some important findings may have been omitted from the review. Nevertheless, some conclusions from important working papers, such as Heid, Larch, and Yotov (2017) that were not counted towards the data extraction and results analysis, were reviewed, and used as background material.

Secondly, the articles in languages other than English were excluded. The proportion of such papers in the total amount of yielded papers during the search stage was less than 1%.

Thirdly, the article focuses only on the impact of trade costs and facilitation on trade flows. This resulted in the exclusion of articles that estimated the impact of trade facilitation on other economic aspects, for example, economic growth, flow of foreign income, or development of other social features. It must be recognised therefore that this review may have missed some important findings outlined in those works.

Finally, due to restrictions on the keywords used in the literature search, some articles, for example, those with a particular focus on services in their abstracts, could not be included in the final database. Despite these limitations, it was anticipated that the selected articles represented a good sample of the literature on the relationship between trade facilitation and trade flows (Figure 1).

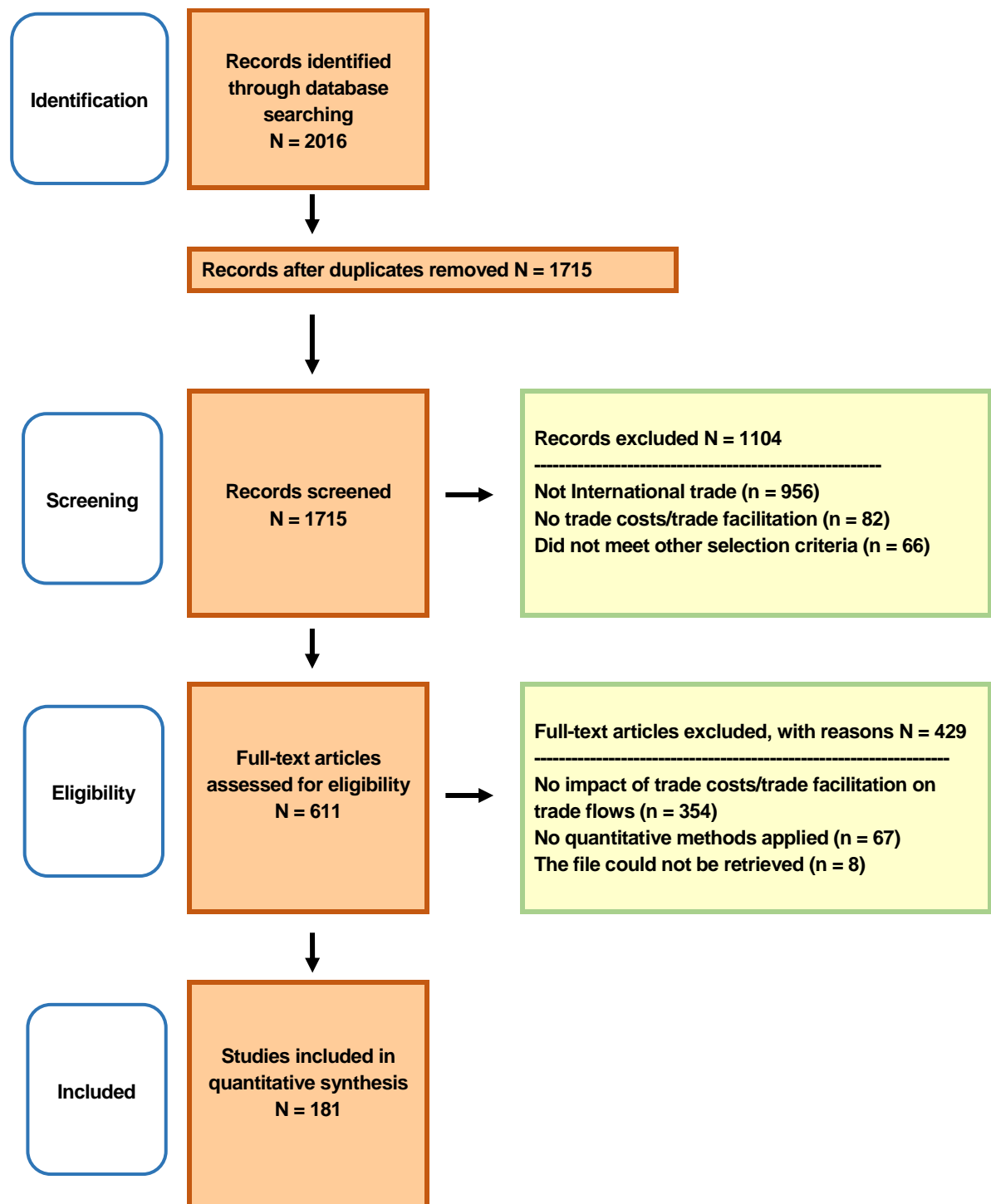


Figure 1 Overview of the literature selection process (PRISMA with details).

Critical research findings within the literature

In total 181 articles, or 9% of the initially yielded number of articles, were reviewed (Figure 1). The findings provide a comprehensive report on the state of the academic knowledge, discuss the limitations in the reviews to date, and identify gaps in the literature.

Summary of classified abstracts

Figure 2 shows that the first attempts to quantify the impact of trade costs, and thus explain the possible impact from trade facilitation, was made by Geraci and Prewo (1977). In their study, Geraci and Prewo estimated the impact of transportation costs as a barrier to trade by calculating them as the Cost, Insurance, and Freight (CIF)–Free on Board (FOB) gap, using a gravity-like model. The CIS–FOB approach was novel. Previously, distance had been used as a proxy for transport costs.

However, as in the 1970s, the academic focus was on exploring the trade gains from reducing high tariff and non-tariff protection levels, and the trade facilitation literature remained idle until the 1990s. Gould (1994) reignited the trade facilitation debate by finding a positive impact on trade flows for migrants' links in trading country-pairs, supporting the idea that migrants reduce transaction costs in international trade.

The number of publications then increased in response to the WTO Doha round in 2001, when the need for joint action on trade facilitation was first discussed at high levels (WTO, 2001). In the dataset, publications peaked in 2014 (n=23), a year after the WTO members adopted the text of the TFA at the Bali Ministerial Conference (WTO, 2017). A second peak appeared in 2019, amid active implementation by the WTO member countries of the 2017 TFA, as well as the growing interest of researchers in the impact of China's trade facilitating Belt and Road initiative (BRI) on global trade. These peaks represent the academic community being increasingly involved in the on-going public debate.

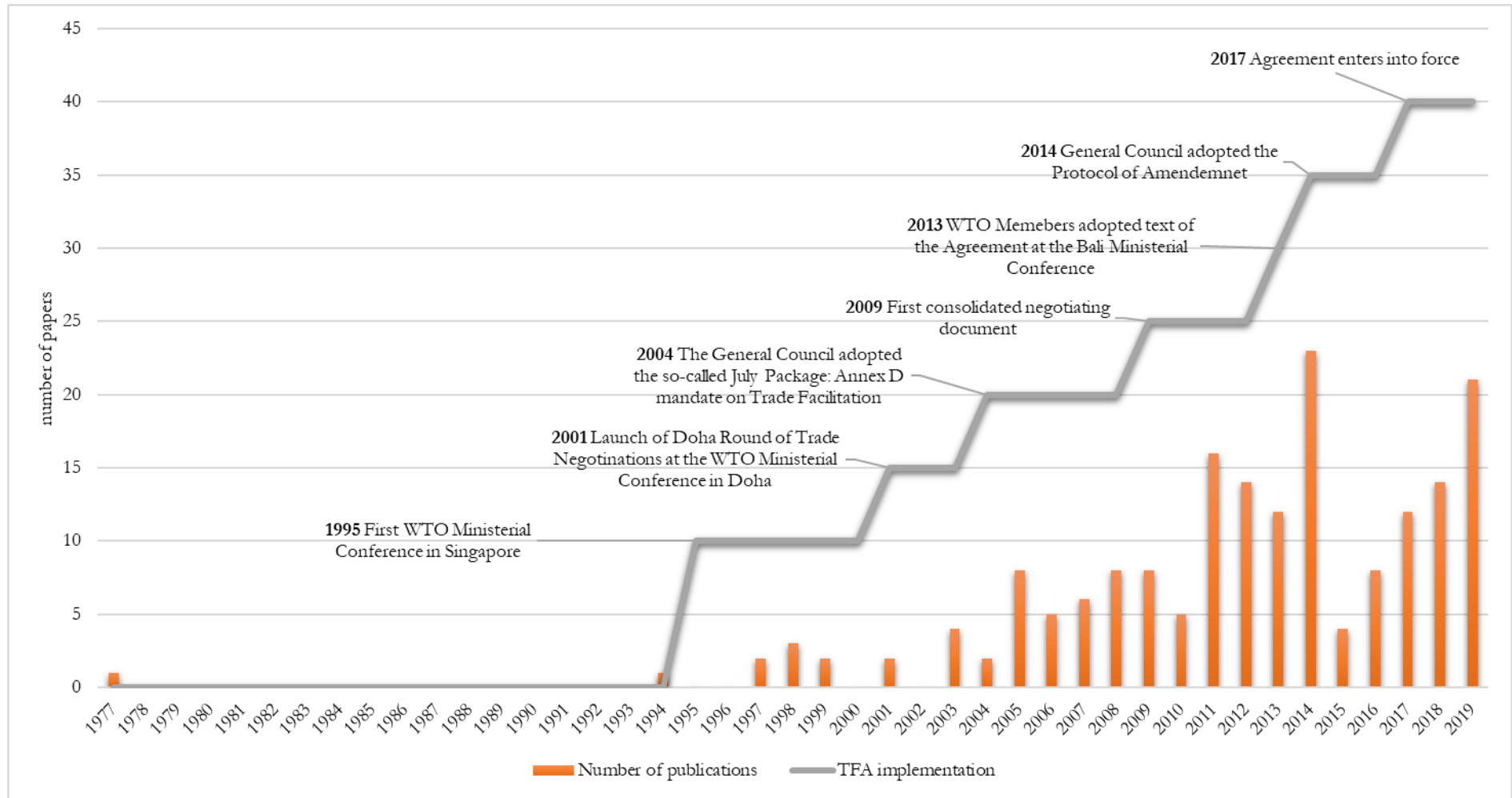


Figure 2 Total number of articles per year and TFA negotiation timeline.

The economic debate on defining, measuring and estimating the impact of trade facilitation was found in over 86 individual journal titles, highlighting the interest in and importance of the topic across sub-disciplines of economics, including economic theory, socio-economic studies, agricultural economics, energy economics, as well as informatics and technologies. As demonstrated on Figure 3, the debate is concentrated in the following journals:

- 10% of all publications were in the *World Economy*, a Q2⁴ (a second quartile) ranked journal published in the United Kingdom.
- 7% of all publications were in the *Journal of international economics*, a Q1 rated journal published in the Netherlands.
- 5% of all publications were in *World Development*, another Q2 ranked journal from the United Kingdom.
- *Journal of International Trade & Economics* published eight articles.
- *Applied Economics* published five.
- *Applied Economics Letters* published five.
- *Review of International Economics* published five.
- *International Trade Journal* published four.
- *Maritime Economics and Logistics* published four.
- The remaining 79 journals published three or fewer articles each.

⁴ Quartile rankings are based on the Scimago Journal & Country Rank (SJR), date and site

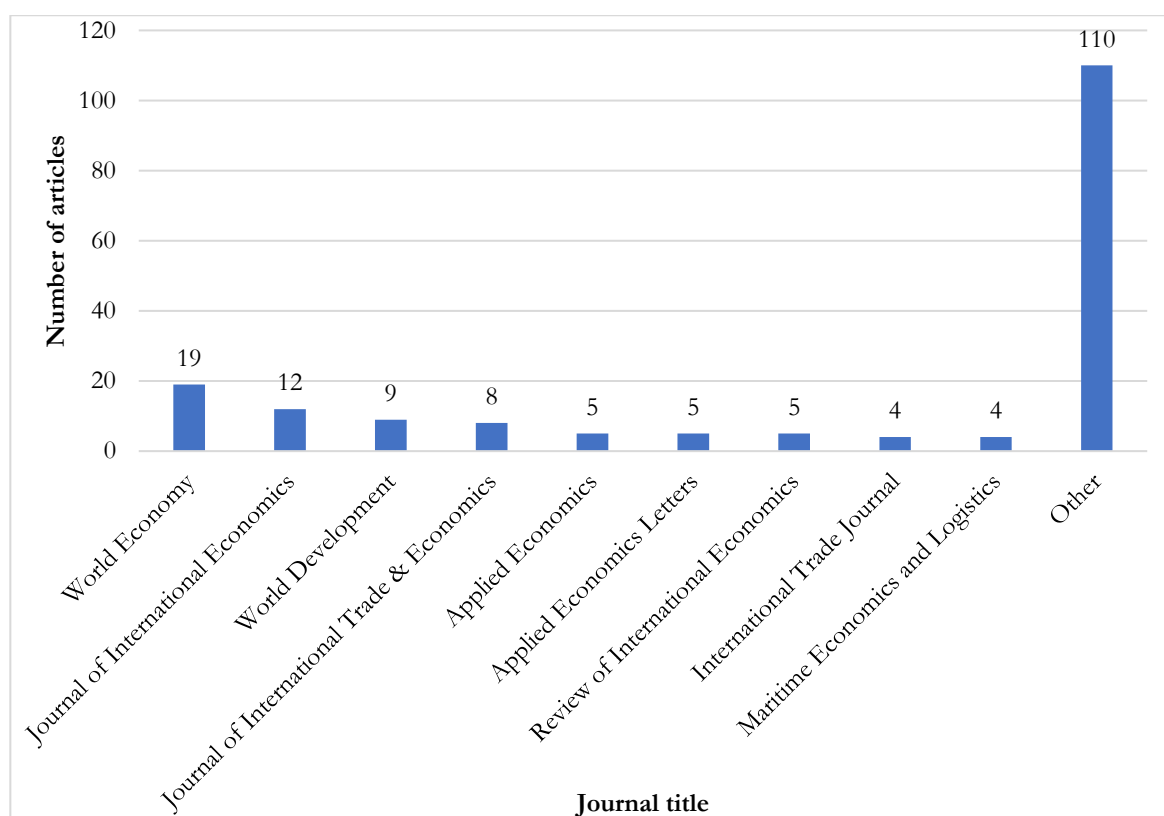


Figure 3 Journals where articles on trade facilitation with quantitative methods were published.

Trade facilitation definition

The concept of trade facilitation was first discussed to highlight issues with road transportation costs as early as 1977. However, the term ‘trade facilitation’ remains poorly defined as it often reflects the interests of the author, the country of interest, and the set of reforms the article explores (Maur & Wilson, 2010).

In terms of the use of ‘broad’ or ‘narrow’ definitions of trade facilitation, it was found in this review that more than 70% of the studies (n=127) followed a broad approach to define trade facilitation (Figure 4). This allowed their authors to expand their discussion beyond border crossing trade costs to explore a wider, ‘behind-the-border’ set of indicators. Issues explored included, but were not limited to:

- quality of institutions [Álvarez, Barbero, Rodríguez-Pose, and Zofío (2018); Hyun (2018)]
- availability and level of development of hard infrastructure [Coşar and Demir (2016); Bojnec and Fertó (2011)]
- environmental issues [De Santis (2012); Van Beers and Van Den Bergh (1997)]
- human capital Kang (2018); Hatzigeorgiou and Lodefalk (2019)).

The ‘behind-the-border’ concept is relevant for both pre-border and post-border costs. However, only 23% (n=41) of the total number of articles included post-border trade costs in their analysis (Hoekman & Nicita, 2011); (Beverelli, Neumueller, & Teh, 2015). This could be the result of a lack of reliable data on the other side of the border, but also suggests that very often researchers limit their interests to the scope of only a single party involved in the trade. Only 30% of the articles focussed solely on the narrow definition of trade facilitation, i.e. border and customs procedures, yet most of the leading institutions involved in implementation of TFA, and the definitions in the Agreement itself, follow the narrow approach to define trade costs.

Definition	Broad		
		Narrow	
Stage	Pre-border	Border	Post-border
Number of articles	86	54	41
%	48%	30%	23%
Example of TFI Group	Aid and FDI	Border and transport efficiency	Aid and FDI
	Business and regulatory environment		Business and regulatory environment
	Environmental regulations		Environmental regulations
	External factors		External factors
	Geography		Geography
	Human capital		Human capital
	Physical infrastructure		Physical infrastructure

Figure 4 Articles featuring a broad or narrow definition of trade facilitation term.

Scale, scope and timing of selected articles

All economic analyses revolved around issues associated with scale (local government, national government and intra-national), scope (single economic sectors to economy wide evaluation), and time (*ex-ante* or *ex-post* policy setting).

This subsection analyses the setting of the studies on trade facilitation. Specifically, it summarises the geographical scope, sectors of an economy, trade flows and trade cost indicators that have been examined in the trade facilitation literature.

Research into trade facilitation has been conducted across the world. As Figure 5 shows, 49% of the articles reviewed (n=89) estimated the impact of trade facilitation on trade using a global dataset without focusing on a particular region or country⁵. Such a global approach can be explained by the general interest of researchers in estimating the impact of a particular trade facilitation indicator on trade flows rather analysing a region. However, this result could also be due to a standard gravity model methodology requirement to use a dataset with a greater variation of the country-pair combinations.

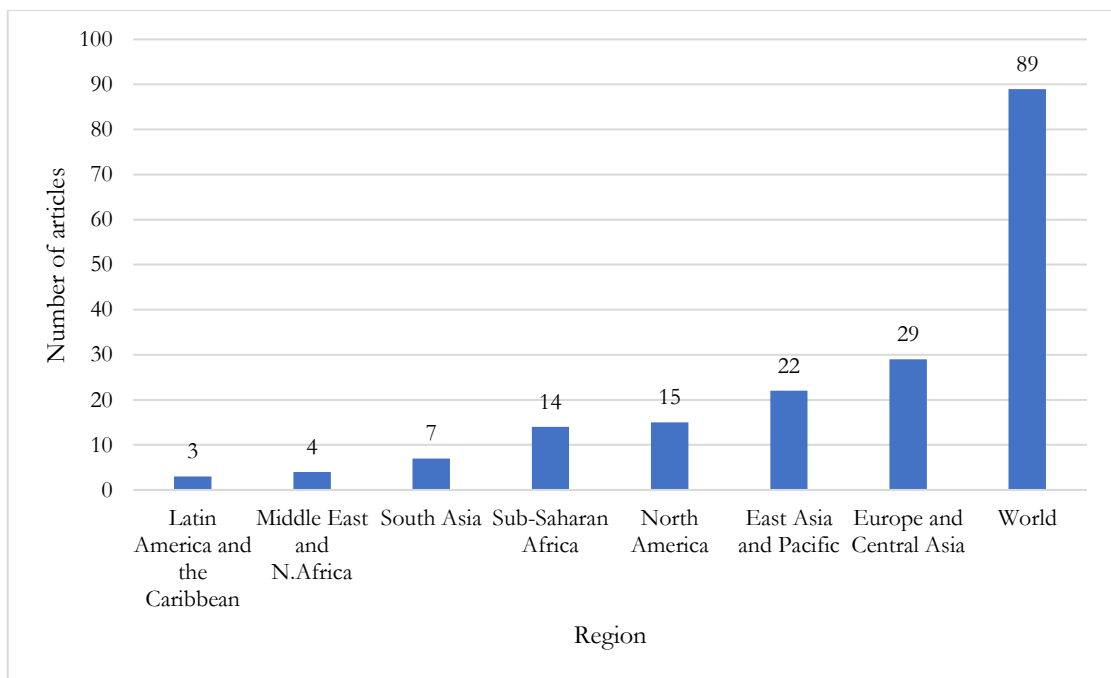


Figure 5 Number of articles per region

Among the articles with a specified region of study, the prevailing number of articles was focused on developed countries. Europe and Central Asia⁶ (n=29), East Asia and the Pacific (n=22) and North America (n=15) received greater attention than other

⁵ World Bank definition

⁶ Here the World Bank definition of the region is followed. The Europe and Central Asia group does not contain any article on Central Asia

parts of the world. Taken together, these three regions shared 36% of total publications.

The regional focus, as defined in the articles, varied, but included:

- states of the Organisation for Economic Co-operation and Development (OECD) (Bandyopadhyay, 1999)
- OECD developed (Van Beers & Van Den Bergh, 1997)
- European Union (Conrad & Schmidt, 1998)
- EU-15 (De Santis, 2012)
- countries under United Nations sanctions (Slavov, 2007)
- North-South, South-South cooperation (Francois & Manchin, 2013).

In more recent articles there appeared a new grouping referred to as the 'BRI-countries', referring to the countries benefitting from China's initiative on infrastructural improvements across the world (Ramasamy & Yeung, 2019).

With regard to the economic sector, studies were predominantly focused on total trade flows (62% of total number of articles), followed by the mixed sector group (i.e. a combination of two different sectors in one article [15%]), and the primary sector (7%). The primary sector was studied across countries in all income groups, except the high-income group. Three out of a total of six articles on trade facilitation in the tertiary sector concerned high income countries (Table 1).

Table 1 Focus sector and countries' income group

Sector	Income group					
	Low	Lower-middle	Upper-middle	High	Mixed	Total
Primary	1	2	4	0	7	14
Secondary	0	3	0	2	6	11
Tertiary	0	1	0	3	2	6
Total trade flows	0	3	8	14	90	113
Mixed	0	1	2	4	21	28
Unspecified	0	0	0	1	8	9
Total	1	10	14	24	134	181

Note: Income-group Mixed consists of two or three different income groups in one article; Sector Mixed: combination of two different sectors in one article.

Overall, studies on trade costs and facilitation have been undertaken all across the world, with the developed countries of Europe, Asia and North America representing the largest focus of analysis. There remains a number of countries (e.g. Australia, Samoa, Kazakhstan, Turkmenistan and others from the Central Asia and Europe and East Asia and Pacific regions) that have zero studies published in peer-reviewed journals.

Some countries may not be studied due to a lack of available data. Out of 181 articles, only one specifically focused on a country from the low-income group (Malawi). The lack of attention to the low-income group raises some concern about how discussions or analysis of the benefits of trade reform for this group of countries can be justified (Negri & Porto, 2016). Some of the mixed studies do explore the potential benefits of trade facilitation for low-income countries as compared to the other income groups (Donaubauer, Glas, Meyer, & Nunnenkamp, 2018); (Vijil, 2014). However, the lack of direct analysis for countries in the low-income groups remains a concern when they are being encouraged to facilitate their trade.

Broadening survey samples to include missing countries, in particular those from the low-income groups, would contribute to a comprehensive global analysis of trade costs and, provide a clearer estimate of the impact of trade facilitation on trade flows. The special treatment in the TFA of LDCs highlights an urgent need for more data (WTO, 2017).

Section II of the TFA contains special and differential treatment provisions that allow LDCs to determine their own implementation schedule of the individual provisions contained in Articles 1 to 12 of the Agreement. Moreover, the LDCs that lack the necessary capacity for provision implementation can request technical assistance and support for capacity building, which may take the form of technical, financial, or any other mutually agreed form of assistance. (WTO, 2017, online)

Ex-ante and *ex-post* studies are evident within the literature. These are generally performed to advise or evaluate policy design and implementation. Greater evidence of this will be provided in the next section on trade cost/facilitation indicators.

Methodology used in the literature

This subsection reports on trade cost indicators, data sources, and the key methods used in the literature to estimate the impact of trade cost and facilitation on trade flows, with an emphasis on regression techniques, and dataset specifications used in the studies. The state of current knowledge and limitations of the methods are discussed.

Trade cost indicators. ‘An economic indicator is a piece of economic data, usually of macroeconomic scale, that is used by analysts to interpret current or future investment possibilities’ (*Investopedia, 2020b, online*). A range of different trade cost indicators has been developed in the literature to assist in evaluating the outcomes of trade facilitation and identifying key areas of change for policy.

Commonly used trade cost variables in various studies were predominantly based on the indicators developed by global institutions, such as the:

- World Bank’s Trading across Borders (TAB)
- Logistics Performance Index (LPI)
- World Economic Forum’s Enabling Trade Index (ETI)
- Organization for Economic Co-operation and Development (OECD) Trade Facilitation Indicators (OECD TFI).

Trading across Borders (TAB). The systematic review revealed that the TAB indicator’s cost- and time-to-export components are the most commonly used indicators in the trade facilitation literature, either as a part of an aggregated variable or directly applied (n=31, 17% of total number of articles under review). Simple composite indicators, such as the TAB’s cost- and time-to-trade indicators are easy to use in a regression but may be subject to concerns about data validity due to the fact that reported data refer only to businesses in the economy’s largest city, and rely on consultancy firms in the capital rather than traders’ actual experience in crossing borders. Recently, there were claims about the data manipulation by World Bank personnel substantially affecting the Doing Business overall ratings of some countries (*The Economist, 2020*). As of August 2020, the World Bank suspended publication of its annual Doing Business report, and is under an internal audit due to:

A number of irregularities have been reported regarding changes to the data in the Doing Business 2018 and Doing Business 2020 reports, published in October 2017 and 2019. The changes in the data were inconsistent with the Doing Business methodology. (World Bank, 2020b)

Logistics Performance Index (LPI). LPI is the second commonly used indicator by researchers, according to the systematic review (n=19, 10%). LPI has been developed by the World Bank as an interactive benchmarking tool to help countries recognize their performance on trade logistics, and how to improve their performance. The

indicator is available for 160 countries and has been published biannually since 2007. It analyses countries through six indicators:

- 1 efficiency of customs and border management clearance
- 2 quality of trade- and transport-related infrastructure
- 3 ease of arranging competitively priced international shipments
- 4 competence and quality of logistics services
- 5 ability to track and trace consignments
- 6 frequency with which shipments reach consignees within the scheduled or expected delivery time.

The LPI was based on a worldwide survey of global freight forwarders and express carriers, who provided feedback on the logistics 'friendliness' in their countries and their trading partner countries (Arvis, Saslavsky, Ojala, Shepherd, Busch, & Raj, 2014)

Enabling Trade Index (ETI). The Enabling Trade Index (ETI) is also a commonly used indicator, and one of the indicators that takes the broad approach in measuring trade facilitation (n=8). The ETI evaluates the development level of institutions, policies, infrastructures and services, which are intended to facilitate cross-border trade. The indicator has been published since 2008, and data are available up to 2016 (as of August 2020), covering 136 economies (Geiger, Attilio, Doherty, & Soininen, 2016).

The ETI was developed within the context of the World Economic Forum's Enabling Trade program (Geiger et al., 2016). The ETI is a composite indicator aggregated from the individual indicators measuring various trade-enabling factors. These factors are organised into seven pillars, which are, in turn, organised into four larger, umbrella groups, called subindices:

- A Market access
- B Border administration
- C Infrastructure
- D Operating environment

The aggregated ETI is based on various sources, including the LPI and TAB. The criticism around the TAB indicator might also raise questions regarding the reliability of the ETI data.

OECD TFI. The OECD developed trade facilitation indicators (TFIs) that identify areas for action and enable the potential impact of reforms to be assessed in order to support the countries to improve their international trade (OECD, 2015). The OECD

TFIs cover the full spectrum of border procedures for more than 160 economies. Each TF indicator is composed from the fact-based variables on trade policies and regulations, and their implementation in practice.

The TFIs take values from 0 to 2, where 2 designates the best performance that can be achieved (OECD, 2015). The OECD TFIs are based on a detailed questionnaire, with the aim of ensuring factual information that is geographically comparable and consistent over time. Data are collected from three sources:

- publicly available information included in the websites of Customs and other relevant border agencies, official publications such as Customs Codes, annual reports, or public databases
- direct submissions from countries
- factual information from the private sector—in particular express industry associations and companies operating worldwide.

It should be noted that some of the TFI indices are based on the TAB indicators, which may also result in overall OECD TFI weakness of data quality. Despite its prominent features, the literature reviewed for this paper resulted in a low number of papers that attempted to use the TFIs for their analysis (n=8).

For the purpose of this study, the diversity of trade cost indicators from the literature was divided into nine groups (Appendix E for more details):

- 1 **Physical infrastructure** contains indicators for the quality and quantity of roads, railways, ports, airports; and it includes indicators related to information, communication and technology (ICT) development. The indicators in this group are a combination of the indices and actual measurement, i.e. kilometres or number of the roads, number of internet users, and other. It is expected that the development of physical infrastructure positively impacts the gains from international trade for a country. The studies by Portugal-Perez and Wilson (2012), Donaldson (2018), Freund and Weinhold (2004) confirm this viewpoint, though the variation and significance of the impact substantially varies across the studies.
- 2 **Business and regulatory environment** includes, but is not limited to, such indicators as government transparency, quality of institutions, as well as exchange rates and rule of law.

This group is the most heterogeneous one, as it groups together a broad number of the indicators, some of which are expected to have a strong positive impact on international trade, whereas the others might have an ambiguous

association with international trade flows. For example, quality of institutions would be positively associated with international trade, whereas the exchange rates can be both positive and negative for trade flows, depending on the specification of the analysis.

- 3 Border and transport efficiency** consists of all the border related trade impediments, for example, transportation costs and time, administrative and unofficial payments at the border.

The group is specific to the costs and time associated with delivering the goods from the exporter to its final destination, as well as the efficiency of the customs procedures. The expectation is that trade facilitation in this category of indicators always has a strong positive impact on trade flows. The indicators developed by the global organisations predominantly focus on elements of this group.

- 4 Aid and foreign direct investment (FDI)** includes all types of direct or indirect aid programs directed towards trade facilitation, as well as inward and outward foreign investments.

It is expected that any external financial or in-kind support towards reduction of trade costs has a positive impact on the international trade of a country. Various government programs and global organisations, including the OECD and WTO, have developed and keep track of specific policies and funds for trade-related development assistance, called 'aid for trade'. Aid for trade supports developing countries to integrate into the global economy by expanding their trade (Massa, 2013).

- 5 Human capital** groups such indicators as migrants' links to trading partners, or level of education and availability of skilled workers.

Human capital or labour force is one the key factors in the economics of production. Labour inputs comprise of number of workers and of their skills (Samuelson, 2010). All the capital goods such as computers, telecommunications devices or new roads can be effectively utilized only by skilled and trained workers. Productivity of labour is greatly dependent on their level of literacy, health, as well as the ability to use advanced technologies. Thus, higher quantity and quality of human capital is expected to have a positive impact on trade flows.

- 6 **Environmental factors** covers various environment regulation policies that affect trade flows.

This group of trade cost/facilitation factors is less studied under the umbrella of trade facilitation literature. However, environmental regulations are emerging as a topic due to the argument that they usually increase cost-to-trade, but research is required. It is expected that a reduction of trade costs due to environmental regulations, as with any other cost, would positively affect trade flows.

- 7 **External factors** includes sanctions, war or terrorist actions that prevent trade and market activities.

Since there is no clear definition of trade facilitation, any factors that potentially impact trade flows were considered in this systematic literature review. Thus, the impact of increased trade costs on trade flows due to external factors have been included in this analysis. It is expected that elimination of these distortions on economic and social life would have a positive impact on the international trade of a country.

- 8 **Geography** consists of indicators related to specific topographic features of countries that may prevent trade, for example, the common mountain chains or time zones of the trading partners. Landlockedness or islands are not included in this group, as these indicators represent standard variables that have previously been proven to have a strong impact on trade (Yotov, Piermartini, Monteiro, & Larch, 2016).

- 9 **Mixed** includes different groups from #1 to #8, when the indicators in the studies were a composition of indicators from different groups. For example, indicators from the Physical infrastructure and the Border and transport efficiency group combined in one aggregated indicator.

Among these groups, the majority of studies focus on trade costs related to business and regulatory environment, border and transport efficiency and human capital (27, 26 and 14% of total number of articles, respectively (Figure 6). Predominantly, analyses drew data from the survey-based reports produced by the World Bank, World Economic Forum and OECD. Three of the studies reviewed conducted independent surveys for the trade cost/facilitation analysis. One study undertook an experimental simulation analysis to estimate the impact of uncertainty related trade

costs by physically transporting the goods over the border in Sub-Saharan Africa (Christ & Ferrantino, 2011).

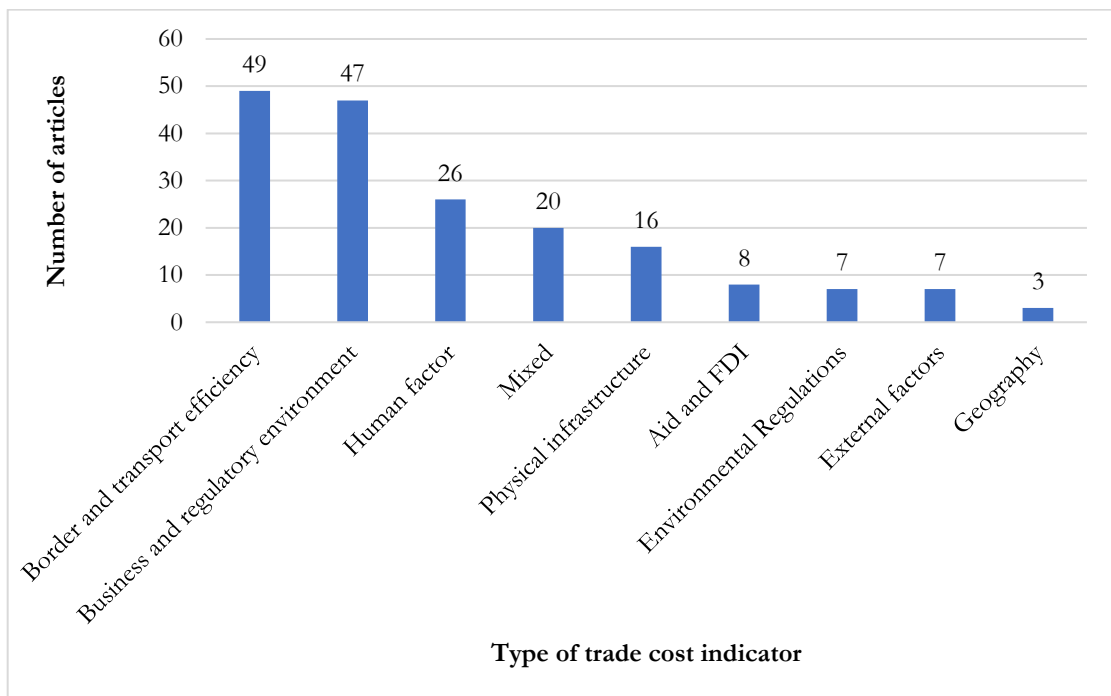


Figure 6 Type of trade cost indicator.

However, as mentioned, the value of indicators for policy guidelines are subject to various assumptions and limitations. Anderson and Wincoop (2004) noted that even the available trade barrier information can be difficult to interpret due to data limitations. For example, simple composite indicators, such as the World Bank’s TAB indicator, are easy to use in a regression, but data validity is becoming an emerging issue.

Nevertheless, this systematic review suggests that the key source for the articles focused on border and transport efficiency related trade costs was the Doing Business’ Trading across Borders indicator (56% of all articles in this category). The 2016 DB report introduced significant changes to the measurement of the TAB indicator. Prior to 2016, the standardised case study across all countries assumed that the goods being traded were one of six preselected products, shipped in 20-foot containers, and that trade was conducted by sea (World Bank, 2008). These assumptions could result in significant overstating of trade costs in relation to coastal nations, as landlocked countries require at least one transit economy to reach the sea, which necessarily adds to their costs (Sharafeyeva, 2019).

The models for analysis of the relationship between trade costs and trade flows.

The PRISMA chart (refer to Figure 1) illustrates the highly quantitative nature of the current literature on trade costs/facilitation. Only 67 articles or 16% investigated for

data extraction were excluded as non-quantitative. The gravity model is the dominant research methodology with which to estimate the impact of trade costs on trade flows (n=156, 85%, Table 2).

Table 2 Quantitative methods used to estimate impact of trade costs on trade flows

Model	Number of articles	%
Gravity model	156	85
General equilibrium model	6	3
Other	21	12

A **general equilibrium model** approach was the most popular alternative to the gravity model. For example, computer general equilibrium (CGE) is used to estimate the effect of a composite index of trade facilitation on trade flows (Zaki, 2013). General equilibrium models have been broadly used in trade policy analysis due to their ability to capture economy wide interactions (Dennis, 2006). However, some specifics of these models, such as the macro-level scope, when many details are left out or a high level of aggregation, makes these models insufficiently detailed for trade facilitation studies. Moreover, the most recent statistical advances, presented in Table 3, can estimate general equilibrium effects by using gravity models (Anderson, Larch, & Yotov, 2015).

Table 3 Key advancements of the gravity model over the years

1962	Tinbergen, Yann	First introduced the Gravity model for international trade
1979	Anderson, James	First mentioning of the multilateral resistance terms (MRT)
1995	McCallum, John	Introduction of the intra-national trade flows to the Gravity models
2003	Anderson, James and van Wincoop, Eric	MRT theoretically proved and popularised
2004	Feenstra, Robert	Importer and exporter fixed effects for MRT
2006	Santos, Silva and Tenreyro, Silvana	The Gravity model theory-consistent qualities of PPML proven and popularized
2007	Baier, Scott and Bergstrand, Jeffrey	Pair fixed effects methods to address the issue of endogeneity of trade policy variables
2008	Chaney, Thomas	Firms' heterogeneity; Intensive and Extensive margins of trade
2012	Olivero, María Pía and Yotov, Yoto	Panel data with intervals should be used instead of data pooled over consecutive years; Exporter-time and Importer-time fixed effects for MRTs
2015	Anderson, James et al.	Estimating general equilibrium effects with Gravity model
2017	Heid, Benedikt et al.	The intra-national trade flows in the Gravity models popularized
2019	Correia, Guimarães and Zylkin, Tom	New command developed for the fast execution of the PPML model with High-Dimensional Fixed Effect (STATA <code>ppmlhdfe</code>)

Estimation techniques and dataset specifications in the gravity model

The literature review suggested that 50% of the gravity model studies were conducted using a panel dataset (69%) with the number of years varying from 2-20 years (70%) up to 130 years in the panel (1 study only) (Table 4).

The current best practice in the literature is to estimate the gravity model using the Poisson Pseudo-Maximum Likelihood (PPML) with a panel dataset containing exporter-time and importer-time and pair-fixed effects as a way to address the multilateral resistance term (MRT) effects. MRTs depend on trade costs across all partners, and, if the model is estimated by PPML with fixed effects, the estimated fixed effects correspond exactly to the MRT (Santos Silva & Tenreyro, 2006). Moreover, it is recommended to include domestic trade flows in the dataset in order to differentiate the trade cost effects on internationally directed trade (Heid et al., 2017). Additionally, the use of the panel dataset is preferred when it is possible, as it enables to apply the pair-fixed-effects methods to address the issue of endogeneity of trade policy variables, as well as allows for a flexible and comprehensive treatment and estimation of the effects of time-invariant bilateral trade costs with pair fixed effects (Yotov et al., 2016).

Table 4 Gravity model specifications in literature

Techniques	Number of incidents	%
OLS	95	60
PPML	27	17
Tobit	6	3
Two-stage Heckman selection model	8	4
Other	42	23
Multilateral Resistance Terms (FE, MRT index, proxy)		
Yes	80	56
No	62	44
Dataset		
Panel	107	69
Cross-sectional	43	28
Panel and Cross-sectional	6	4
Number of years in the panel dataset		
2 to 20	75	70
21 to 40	17	15
41 to 60	3	3
>100	1	1
Missing	12	11
Number of observations in the dataset	Minimum 28; Maximum 670,016	

The literature showed that since a seminal article by Santos Silva and Tenreyro (2006), authors have been employing the PPML regression analysis approach (n=27, 17% of total incidents across the articles). However, despite various proofs of the robustness of the PPML results, the Ordinary Least Squares (OLS) approach overall dominates in gravity model analysis (n=95 incidents, 60%, Figure 7).

Despite the theoretical and empirical proof of the importance of using the MRTs developed by Anderson and Wincoop (2003), over one third of the total incidents in

97 articles published in high-ranking journals (first and second quartile in SJR) failed to implement this strong recommendation. This might be a result of the specific data requirements for the direct calculation of the MRTs, or a need for other techniques. For example, the intra-national trade flows if MRTs are estimated as fixed effects. Otherwise, the fixed effects absorb country specific indicators of interest. Findings presented in the final chapter of this thesis, suggest that violation of this recommendation, and not including country-pair fixed effects may return results with coefficients 10 times higher than in estimates obtained from the model with a full-set of the required fixed effects.

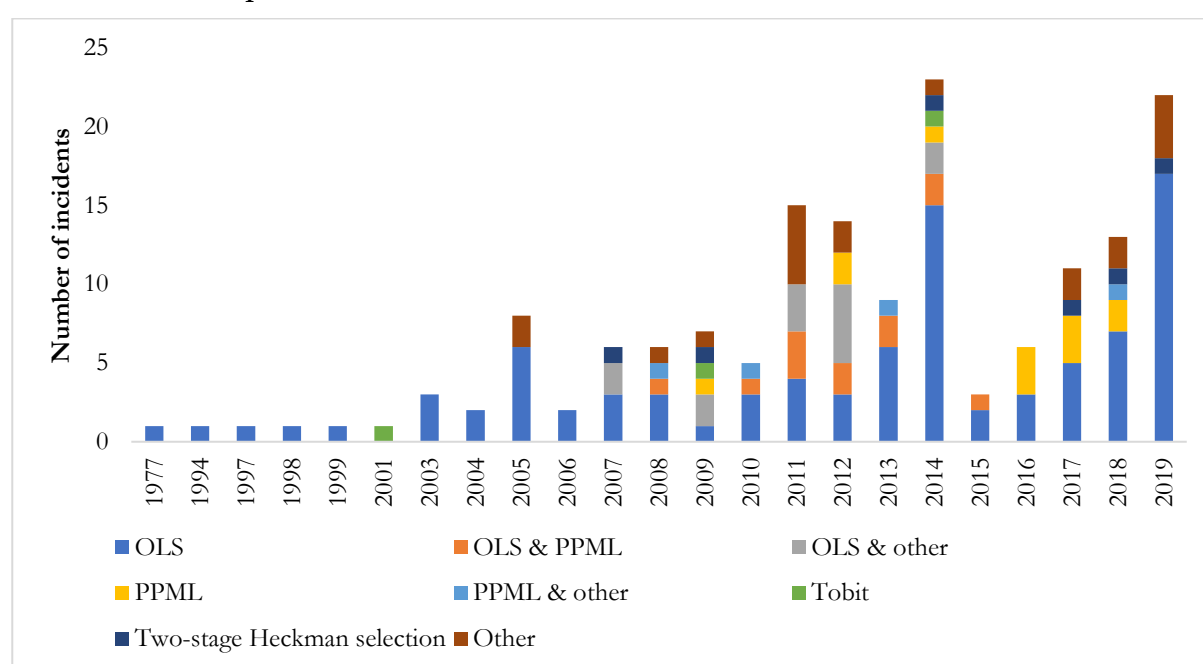


Figure 7 Gravity model estimation techniques over the years.

Yotov et al. (2016), in their handbook on gravity modelling, recommend using imports as the dependent variable for estimation. However, 54% of the total number of incidents explored in this study estimated the impact of trade cost/facilitation in terms of exports, not imports (n=116 incidents, Figure 8). This outcome may reflect the fact that the primary goal of the countries was to improve and diversify their export potential. Only a few studies included domestic trade flows in their analysis in order to differentiate the trade cost effects on internationally directed trade, as recommended in the literature. It is difficult to obtain information on the domestic production of goods in least developed or developing countries, but the information could be used to help calculate intra-national trade flows, and thus obtain more robust results.

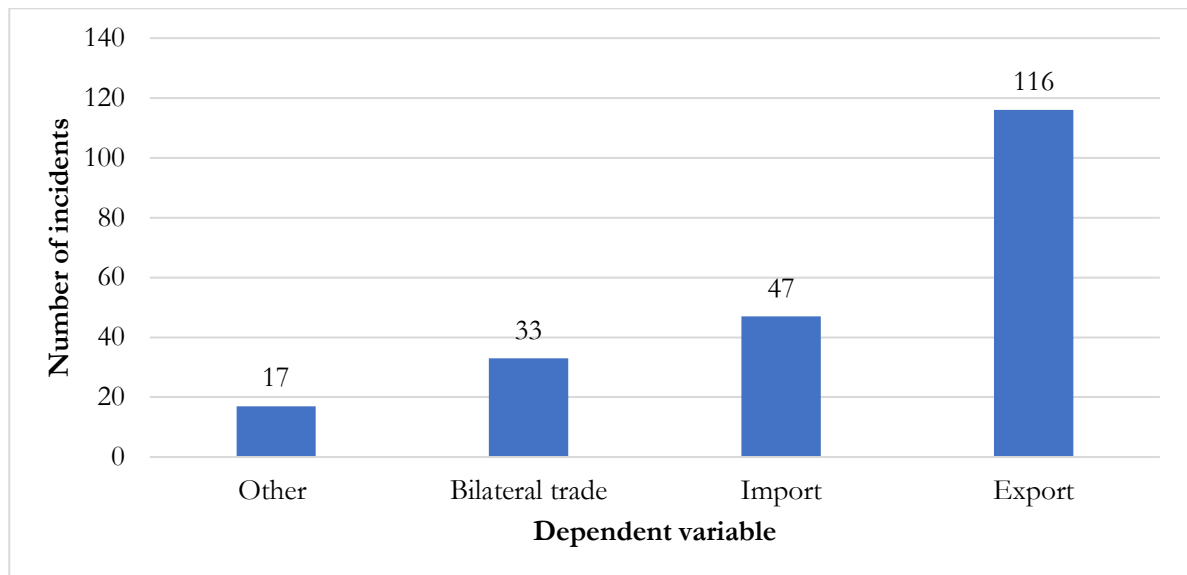


Figure 8 Trade flow (dependent variable).

Note: Incident is the number of regression results across all the articles.

Overall, the systematic literature review demonstrated that the most commonly used approach to analyse the impact of trade cost/facilitation is the gravity model (Anderson, 2011; Chen & Novy, 2011; Host, Pavlić Skender, & Zaninović, 2019). The latest developments have made the model more theoretically grounded. The evidence shows that the research agrees on the use of multilateral resistance terms, most often as a set of fixed effects, and that the regression is run with PPML that is aligned with theory.

However, many studies followed only the basic principles of the gravity model in their analysis (Lawless, 2010; Ramasamy & Yeung, 2019; Hayakawa, Laksanapanyakul, & Yoshimi 2019). This observation begs the question about the quality of studies that did not adopt the best gravity model strategies, but whose findings have played an important role as guidelines for policies and budget allocations across countries.

Critical research findings within the literature

The systematic review produced mixed results across the articles that estimated the impact of trade facilitation on international trade. The majority of empirical studies confirmed the positive impact of trade facilitation on trade flows (Levchenko, 2007; Dasgupta & Mondria, 2018). However, a number of articles reported theory-inconsistent results along with the predicted ones, suggesting that either the data or estimating techniques of the studies were not accurate, or, that not all trade facilitating initiatives bring desirable benefits to trade (Mundra, 2005; Lawless, 2010; Portugal-Perez & Wilson, 2012).

Table 5 shows that 68% of total incidents were consistent with the theoretical expectations of trade facilitation. Whereas 15% and 16% of incidents were found to

be opposite to expectations and not significant results, respectively. This implies that even though 216 regression results proved that an improvement of the trading conditions led to an increase in trade flows, there were 49 theory-inconsistent regression outcomes. These results suggest, counter intuitively, that an improvement of the trading environment, for example simplified border procedures, leads to a decrease in international trade flows. While it can be suggested that in certain cases these nonsensical results are due to poor data, some other factors at play changed the nature of supply (war, famine, etc.).

Table 5 Direction and significance of impact of trade facilitation indicators on trade flows

Trade facilitation groups	Expected relationship	Positive	Negative	Not significant	Total
		n=number of incidents (%)			
Physical infrastructure	One unit of improvement–Positive (n=211, 68%)	33 (72)	2 (4)	11(24)	46
Border and transport efficiency		72 (77)	6 (6)	15 (16)	93
Aid and FDI		13 (65)	6 (30)	1 (5)	20
Human capital		18 (69)	4 (15)	4 (15)	26
Business and regulatory environment		67 (61)	26 (24)	17 (15)	110
External factors		5 (71)	1(14)	1(14)	7
Geography		3 (60)	1 (20)	1 (20)	5
Environmental regulations	One unit of restriction– Negative (n=5, 50%)	3 (30)	5 (50)	2 (20)	10
Total		214 (68)	51 (16)	52 (16)	317

Trade facilitation indicators, such as Aid and FDI, the business and regulatory environment and environmental regulations produced the largest number of the mixed results. In line with expectations, the most ambiguous results were found in studies exploring the business and regulatory environment. This group consists of the most heterogeneous indicators, including the quality of institutions, economic and political stability, exchange rates and access to credit, all of which create the business and regulatory environment of the country, but may have a variety of impacts, good and bad, on trade flows.

For example, without a change of such indicators as the source verification requirements for United States beef, to make it closer to global practice, it was found that the country risked losing export market access (Pendell, Tonsor, Dhuyvetter, Brester, & Schroeder, 2013). Over 10 years the US meat industry would see a decline

of producer surplus of \$1,751 million in case of loss of an export market the size of South Korea's.

Analysis demonstrated that the improvement of factors related to physical infrastructure, border and transport efficiency and human capital had the greatest positive impact on trade flows. These broader groups include indicators, such as the quality of the roads, the level of development of ICT, the ease of customs procedures, as well as migrant's links and the skills of the trading partners' workforces. Improvement of any number of these factors potentially increases trade flow.

Donaubauer et al. (2018) found that countries with improved infrastructure are able to reduce not only bilateral trade costs but also multilateral trade costs, thus improving trade flow. With regard to the human capital factor, there is anecdotal evidence from the post-Soviet countries suggesting that lack of expert capacity may play a significant impediment to international trade (FAO, 2017a). Some studies confirm this observation, indicating that higher labour productivity contributes to export growth at the firm-level (Bastos & Silva, 2012). On the other hand, other studies have shown that migrant workers have a positive impact on exports, regardless of the skill level of the occupations they hold, but with a little higher impact from low-skilled workers (Marchal & Nedoncelle, 2019). Thus, simplifying the recruiting of low-skilled emigrants could be beneficial for the country's exports. To improve expert capacity at regional and country levels, there are global institutions that provide various training opportunities, including those operating under the TFA.

The review, finally, found that external factors, such as war or sanctions imposed by other countries, or environmental regulations, are poorly studied with regard trade facilitation. Nevertheless, the findings confirmed that the elimination of negative impacts from the external factors would benefit trade flow, as would be expected. Environmental regulations, usually expressed as additional costs on trade, have a negative impact on trade flow. It must be recognised, however, that in the long run such regulations might be beneficial for an economy and positively impact international trade as a result of an overall economic improvement.

Conclusion

This paper reported on the systematic review of relevant research (n=181) to identify the key international trade facilitating factors. The quality of information provided for policy makers about trade costs and trade facilitation, methodologies and datasets available for analysis was summarised. The identified gaps can be used to guide research in trade facilitation. Studies reviewed had been undertaken across the world, with a focus on different economic sectors. It was observed that there is a clear

relationship between the increase of quantitative approaches in the trade facilitation literature with the start of the WTO's negotiations on trade facilitation in the early 2000s, recognising the importance of economists in public debate.

The findings of this systematic review support the view that improvement of international trade depends on a complex relationship between social, environmental, and economic factors. The most studied factors that impact trade are border and transport efficiency, business and regulatory environment, as well as factors related to human capital. However, the overall ambiguous results for these and other indicators suggest a need for careful analysis of the existing data on trade costs and facilitation, as well as estimation techniques and dataset specification.

Despite LDCs being identified as the major beneficiaries of the TFA, most studies are focused on developed countries. Consequently, further research needs to understand trade facilitation in developing countries to allow them to maximise public resource allocations during the TFA implementation, increasing developing countries' participation in global value chains.

Finally, the findings demonstrate that the gravity model is the most common approach to analyse the impact of trade costs/facilitation on trade. Moreover, recent advances in econometric techniques can assist in overcoming previous challenges with estimation bias – and have made the model more theoretically justified. However, there is evidence – due to lack of necessary data for rigorous analysis – that not every study was able to apply these advanced techniques and followed only basic principles of the gravity model. Therefore, high quality data on trade costs and trade facilitation, as well as internal and international trade flows, are essential to produce theory-consistent results. To overcome this issue there is a need for global action on collecting harmonised data with the aid of digital technology.

Central Asia: Physical setting, economic and political developments

This chapter introduces the study region - Central Asia - describes its geographical, climate and soil specifics, outlines key political and socio-economic characteristics, as well as analysing the region's economic sectors of comparative advantage. The chapter describes trends in Central Asian international trade and provides an overview of international trade policies, and reviews trade costs and trade facilitation measures in the region. An analysis of Central Asian countries' agricultural sector, as well as countries' participation in the regional and global value chains is also presented in this chapter. The chapter concludes by summarising major factors contributing to high trade costs in Central Asia.

4.1 Physical context

Central Asia, defined as Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, is located in the centre of the Eurasian continent and forms a trade link between China, the Middle East, and Europe. The region shares its borders with China to the east, Russia to the north, the Caspian Sea to the west, Iran and Afghanistan to the south (Figure 4.1). All geographically landlocked, Central Asian countries vary regarding their neighbour countries, territory and population size, natural resources, and historic production specialisation (Mazhikeyev et al., 2015).



Figure 4.1 Map of the Central Asian region. Source: created with mapchart.net

4.1.1 Physical geography

The region has a distinctive landscape that features extensive but fragile mountain-oasis-desert ecosystems (Li, Chen, Li, Deng, & Fang, 2015). Kazakhstan has the largest territory (Table 4.1), with three mountain regions in the northeast, southeast, and the northwest. There are vast stretches of desert and steppe in the centre of the country. Kyrgyzstan and Tajikistan are mountainous, smaller by territory and population and have mountain borders with China and Afghanistan (Mazhikeyev, 2015). The Kara Kum desert occupies over 80% of Turkmenistan's total area.

The topography of Uzbekistan is diverse, with almost 80% of the country's territory of flat deserts and mountain peaks of 4,500 metres above sea level in the country's east. Despite the historical and physical proximity, difficult topographic features are among possible reasons of low intra-regional trade within Central Asia (Kurmanalieva & Parpiev, 2008).

Table 4.1 Land resources of Central Asia, 2016

	Area, hectares (million)	Arable land, hectares (million)	Arable land, percentage of land area	Arable land, hectares per person	Agricultural land (sq. km)
KAZ	270	29	11	1.7	2,160,365
KGZ	19	1	7	0.2	105,413
TJK	14	1	5	0.1	47,277
TKM	47	2	4	0.3	338,380
UZB	43	4	10	0.1	255,777
Total/Average	393	38	10	0.5	2,907,212

Source: World Development Indicators, World Bank (2020a)

Note: here and elsewhere KAZ - Kazakhstan; KGZ – Kyrgyzstan, TJK – Tajikistan, TKM – Turkmenistan, UZB - Uzbekistan

Central Asia has natural boundaries in three directions: geographical borders to the east and west, and to a lesser extent to the south and north. To the southwest lie Turkmenistan's Kara Kum desert and the Kopet Dag mountain range separating the region from Iran (White, 2010). Along the southern and southwestern borders there are Afghanistan's Hindu Kush and Tajikistan's Pamir and Fan ranges. To the east lay the Tien Shan Mountains along the political boundary that separates Kyrgyzstan and Kazakhstan from China. To the northeast, coinciding with the Kazakhstan-China and Kazakhstan-Russia borders rises the Altay range (White, 2010). Topographically, north and northwest of Central Asia are the most accessible routes for

extra-regional trade. To the north, Kazakhstan's border with Russia coincides with a Siberian frontier. To the Northwest, between the Caspian Sea and where the Ural Mountains extend south to Kazakhstan's border with Russia, an exit route from Central Asia. This isolating physical geography creates physical barriers to extra-regional trade. The distances from Central Asia to the closest neighbours and trading partners, the Russian Federation and China, are 2,700 and more than 4,000 kilometres, respectively (Figure 4.2). The distances to the other global markets, such as USA or Brazil, exceed 10,000 kilometres.

The total land area of five Central Asian countries is about 400 million hectares, with arable land area of 38 million hectare (10% of total area), and average per capita arable land area of 0.5 hectare (Table 4.1; Appendix F).



Figure 4.2 Average distance to world capitals from Central Asia, kilometres. Source: created with mapchart.net, distances are from CEPII (2020)

4.1.2 Climate

Central Asia has a continental climate and is one of the most arid areas in the world (Li et al., 2015). In addition to high amplitudes in the seasonal cycle of temperature, there is a constant deficit of humidity. According to Köppen climate classification⁷ there are seven climate zones in Central Asia, varying from the cold desert and cold semi-arid climate to the north of the region, to Mediterranean continental climate in the south (Figure 4.3).

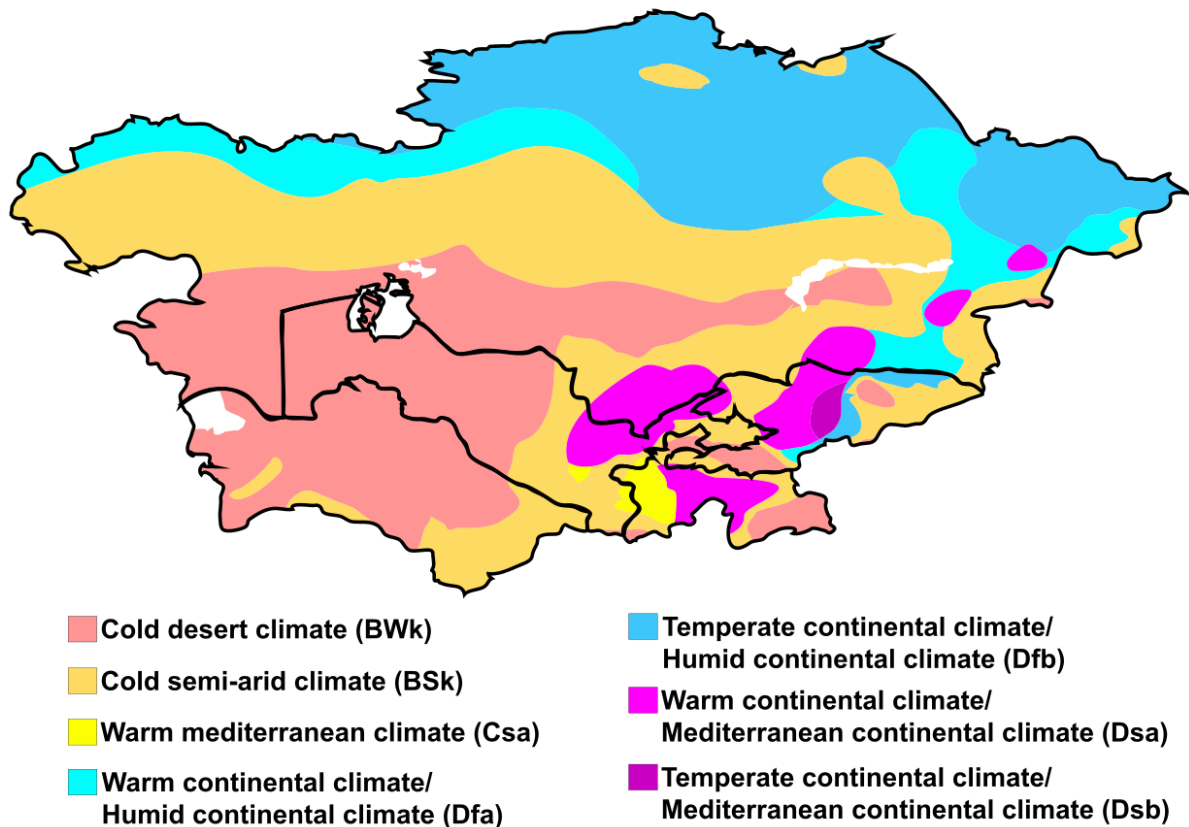


Figure 4.3 Map of the Köppen climate classification in Central Asia.
Source: Creative Commons, Unknown Author, licensed under CC BY-SA

Approximately 90% of Central Asia's area receives less than 400 mm of rainfall per year: 191 mm in Turkmenistan, 264 mm in Uzbekistan, 344 mm in Kazakhstan, 533 mm in Kyrgyzstan, and up to 691 mm in the mountainous region of Tajikistan (Mueller et al., 2014).

The dry and harsh climate in some parts of the region creates obstacles for agricultural development. On the other hand, significant climate variations allow the region as a whole to

⁷ The Köppen climate classification is one of the most widely used climate classification systems (Peel, Finlayson, & McMahon, 2007). The Köppen climate classification divides climates into five main climate groups, with each group being divided based on seasonal precipitation and temperature patterns. The five main groups are A (tropical), B (dry), C (temperate), D (continental), and E (polar).

produce not only two primary crops, wheat and rice, but also a wide variety of products, which include barley, corn, flax, grapes, potatoes, rice, sugar beets, sunflowers, tobacco, apricots, pears, plums, apples, cherries, pomegranates, melons, dates, figs, sesame, pistachios, and nuts (FAO, 2020). Cotton is another important agricultural cash crop grown in Central Asia.

4.2 Political context

This section briefly discusses the political regimes established in the Central Asian countries since the dissolution of the Soviet Union. The socioeconomic development of the region in the most recent years is presented in this section.

4.2.1 Political changes

The Central Asian countries received their independence in 1991. Parallels in their socioeconomic conditions reflect their common history, geographic proximity, and cultural ties (Mazhikeyev, 2015). Historically, all countries had been a colony of the Tsarist Russia and then were part of the Soviet Union for more than 70 years. Central Asia's economic role in the Tsarist empire was supplying cotton, and later, during the Soviet era, cotton was supplemented by minerals and energy products supply.

After gaining independence following the collapse of the Soviet Union, the Central Asian states proposed to reform their political systems in accordance with universally accepted principles of democracy (Kukeyeva & Shkapyak, 2013). However, Turkmenistan, Uzbekistan, and Tajikistan, in particular, never showed a commitment to democracy in the 1990s or even 2000s (Pomfret, 2019a). The countries' Soviet First Secretary became President, except in Tajikistan, which allowed no serious political challenge and established super-presidential regimes in all the countries of the region. In transition from central planning, and despite the dramatic economic changes, over a quarter of a century nothing much changed politically (Pomfret, 2019a).

The first years after the dissolution of the Soviet Union in 1991 were especially economically difficult for Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (Kurmanalieva & Parpiev, 2008). Collapse of the command-and-control economy triggered a

breakdown of trade links among the former Soviet Union republics, shortages of necessary products led to surge of inflation (Pomfret, 2019a).

4.2.2 Socioeconomic development

The population of the five Central Asian countries was estimated at 74 million people in 2019, more than half of whom were living in rural areas (Table 4.2). Unemployment rates had gradually been decreasing since the early 2000s, except for Uzbekistan, where there was a sharp increase between 2017 and 2018, from 5.8% to 9.3% of the total population⁸. Nevertheless, in the informal economy throughout the region, the unrecorded employment and output remains high, particularly in the agricultural sector (Capannelli & Kanbur, 2019).

Table 4.2 Key indicators of social development

	Population, 2019 (million)	Rural population, 2016 (% of total population)	Unemployment, 2018 (% of total labour force)	GDP per capita, 2018 (constant 2010 \$)	GDP 2018, billion (constant 2010 \$)
KAZ	19	42.5	4.8	11,166	204
KGZ	6	63.4	4.5	1,091	7
TJK	9	72.7	6.9 (in 2016)	1,073	10
TKM	6	48.0	4.0 (in 2010)	7,648	45
UZB	34	49.6	9.3	2,374	78
Total/average	74	55.2	5.9	4,670	344

Source: World Development Indicators, World Bank (2020a)

The aggregated GDP of the Central Asian countries was \$344 billion in constant terms in 2018 (Table 4.2). Most of the countries in the region experienced gradual GDP growth from 2010 up to 2014. However, when the 2015 financial crisis hit the Russian Federation as a result of the sharp devaluation of the Russian rouble, Central Asian countries experienced a drop in their GDPs. Moreover, the end of the 2000s commodity boom in 2014 directly hurt Central Asia's undiversified exports, as well as triggering the Russian crisis and fall in remittance flows into the region.

After some decline of GDP growth in the following years, there was recovery from 2017 to 2019. Kazakhstan is the largest economy in the region, due to revenues from natural resources

⁸ State officials reported that this increase is mainly due to improvements in the accounting methodology for the unemployed population, which made it possible to take full account of those who need employment. <https://kun.uz/en/news/2019/01/28/the-unemployment-rate-in-uzbekistan-was-at-93-in-2018-ministry-of-labor>

(Mazhikeyev et al., 2015), where GDP reached \$213 billion, and GDP per capita was \$11,518 in constant terms in 2019. GDPs were considerably lower in Kyrgyzstan and Tajikistan, being \$7 and \$10 billion respectively in 2019 (Figure 4.4, see also Appendix G).

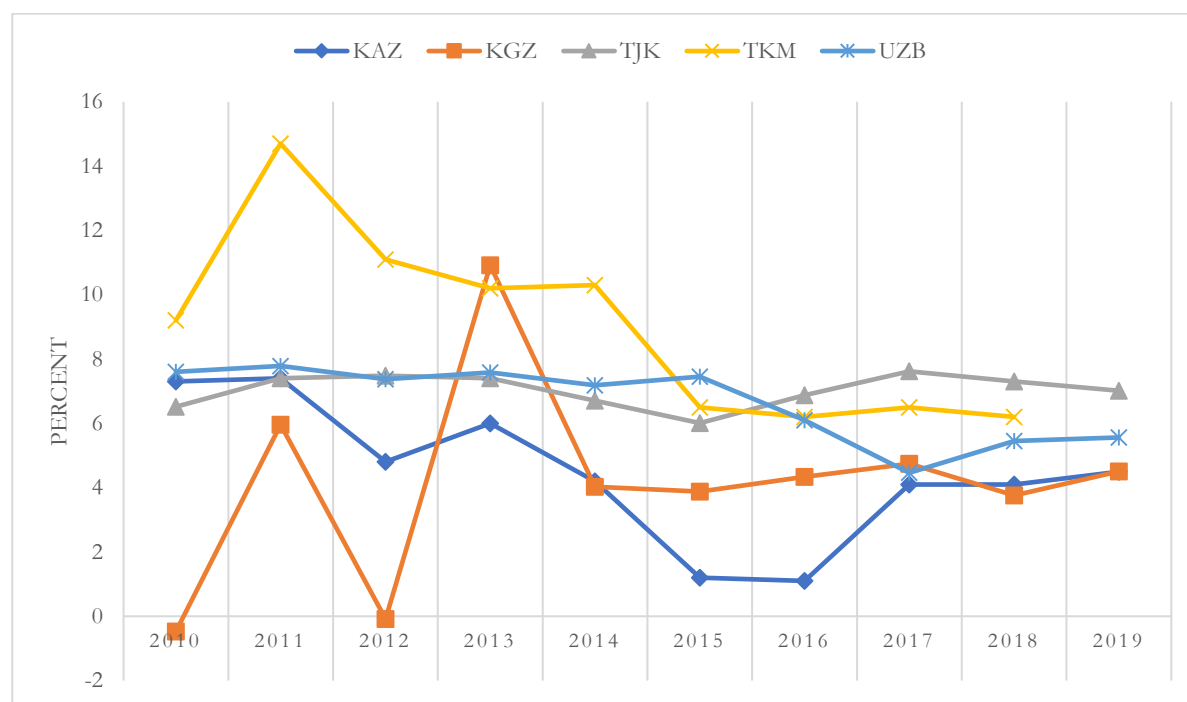


Figure 4.4 Annual GDP growth in Central Asian countries (%).
Source: World Development Indicators, World Bank (2020c)

4.3 Sector analysis

This section briefly reviews the sector shares in Central Asian countries' economies, as well as identifying the sector of comparative advantage based on the calculations following the theoretical revealed comparative advantage methodology. The section then focuses on the development of the agricultural sector in Central Asia, as one of the sectors of strong economic potential for the region.

4.3.1 Contribution of each economic sector to GDP

The sectors value in Central Asian economies is different across the countries (Table 4.3). In Kazakhstan, services accounted for more than half the country's GDP, whereas contribution

from the agricultural sector was around 4% in 2019. Uzbekistan’s agricultural sector, on the other hand, was 26% of the economy, while in Tajikistan, agriculture made up 19% of GDP. The large share of the industry component in Turkmenistan’s economy (57%) is mainly due to the revenues from the natural gas sector (Pomfret, 2006). Similarly, in Uzbekistan and Kazakhstan the oil and gas, and mining sectors contribute to the large industry share in the countries’ economies. Kyrgyzstan and Tajikistan are relatively under industrialised as a result of smaller reserves of natural resources.

Table 4.3 Sectors value added (% of GDP) and employment in each sector (% of total employment), 2019 (or latest available)

Country Name	Industry (including construction)		Agriculture, forestry, and fishing		Services	
	GDP %	Employment %	GDP%	Employment %	GDP	Employment %
KAZ	33.1	20	4.4	16	55.5	64
KGZ	27.6	24	12.1	21	50.2	55
TJK (2018)	27.4	16	19.2	45	42.1	39
TKM (2015)	57.0	42	9.3	20	28.1	37
UZB	33.2	29	25.5	24	32.2	47

Source: World Development Indicators, World Bank (2020c)

Note: The value-added shares presented in the World Development Indicators for agriculture, industry, and services may not always add up to 100% due to services excluded financial intermediary services indirectly measured and net indirect taxes; Employment is based on International Labour Organization, ILOSTAT database.

4.3.2 Comparative advantage

Krugman et al. (2015) challenge the simple starting point of comparative advantage by arguing that nations trade for two reasons. First, when they have a comparative advantage in producing a particular good at a lower relative opportunity cost; and second, countries trade to achieve economies of scale in production. In other words, comparative advantage is not static, but rather on-going investments (private and public) in technology, labour and capital alter a country’s comparative advantage.

To identify the sectors in which each of the countries of Central Asia enjoyed a comparative advantage over the others, this study employed the methodology of Costinot et al. (2012) for estimating a theory-consistent measure of revealed comparative advantage (RCA), referred to as theoretical revealed comparative advantage (TRCA), using a standard gravity model (Appendix H for model specifications). After controlling for trade costs and market size,

TRCA shows the degree to which a country has a comparative advantage in one sector relative to another country or countries.

Sectors with a strong comparative advantage should enjoy substantial export success, while those that display an increasingly strong advantage relative to a baseline sector can be expected to enjoy such success in the future, if the conditions to support their growth are present. The TRCA decomposes trade growth into a proportion coming from increases in import market size, another coming from changes in bilateral trade costs, and a third coming from exporter specific factors, which are interpreted as productivity-based competitiveness⁹.

The approach of Costinot et al. (2012) is repeated in this analysis using data for 189 countries, including all five Central Asian countries, and 26 goods and services industries in the Eora26 database. Eora26 is a complete global multi-region input-output (MRIO) table harmonized across 26-sector classification for 189 countries from 1990 to 2015 (Lenzen, Kanemoto, Moran, & Geschke, 2012). For the purpose of the current analysis, the data from 2000 to 2015 at five-year intervals are used. In considering results, it is important to consider the nature of comparative advantage. Therefore, all results are expressed relative to a baseline sector, agriculture. So, for cross-country comparisons, the index expresses a country's degree of comparative advantage in one sector relative to agriculture, compared with the same relationship in other countries in the dataset.

To produce the measures of comparative advantage four separate regressions were run, one for each year (2000, 2005, 2010 and 2015), with 710,640 observations and 43,092 independent variables each.

Based on the results obtained (Table 4.4), Tajikistan and Uzbekistan do not have sectors with a strong comparative advantage relative to agriculture; in other words, agriculture itself, typically used as a baseline, is in fact a comparatively advantageous sector. The same is true, but to a lesser degree, in Kyrgyzstan and Turkmenistan, where each has one sector of comparative advantage relative to agriculture - electricity, gas and water for Kyrgyzstan and mining and quarrying, hotels and restaurants for Turkmenistan. Considering Turkmenistan's

⁹ Nevertheless, it should be mentioned that any RCA measure, including TRCA, is essentially backward-looking because the measure is derived from past data. It can be a guide to the future, but it is not a prediction.

closeness for tourists and foreign travellers, this result might represent the popularity of the restaurants among the local people or domestic tourism. Kazakhstan is the only country in the region where there are secondary and tertiary sectors with noticeable degrees of comparative advantage relative to agriculture.

To identify changes in the economies examined the differences in the TRCA indicator between 2000 and 2015 were also examined. In Tajikistan, all sectors lost comparative advantage relative to agriculture. Similarly, in Kazakhstan, all sectors lost comparative advantage relative to agriculture, except for fishing. Uzbekistan's electricity, gas and water, and finance and other manufacturing were the only sectors that did not change, or which improved relative to the agricultural sector.

Results were more mixed for Kyrgyzstan and Turkmenistan, with certain significant losses of competitiveness in some sectors. In both countries, services sectors, along with transport equipment, stand out as having gained comparative advantage relative to agriculture.

When the TRCA indicators presented in Table 4.4 are related to the major exporting sectors in Central Asia (Appendix I), it can be seen that only the extractive industries, mining and quarrying, that have a comparative advantage relative to agriculture in Kazakhstan and Turkmenistan, are among the top five export sectors for those countries. Agriculture, which was theoretically the sector of comparative advantage in most countries in the region, only presented in the top five agricultural exporters because of the production of cotton in Tajikistan, Turkmenistan and Uzbekistan in 2018.

Table 4.4 Theoretical Revealed Comparative Advantage 2015 relative to agriculture, and percentage change between 2000 and 2015

Sector	Kazakhstan		Kyrgyzstan		Tajikistan		Turkmenistan		Uzbekistan	
	TRCA	% change	TRCA	% change	TRCA	% change	TRCA	% change	TRCA	% change
Agriculture	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0
Construction	1.1	-5.3	1.0	3.3	0.9	-6.3	1.0	10.1	0.9	-0.5
Electrical and Machinery	0.6	-9.9	0.7	0.6	0.5	-4.9	0.5	-10.2	0.5	-9.6
Electricity, Gas and Water	1.1	6.5	1.3	6.2	0.7	-26.4	0.8	-6.4	0.9	1.7
Financial Intermediation and Business Activities	1.1	-2.7	0.9	5.6	0.4	-37.9	0.4	-34.0	0.9	0.0
Fishing	1.2	7.8	0.6	-11.4	0.6	-13.5	0.6	-7.7	0.6	-27.9
Food & Beverages	0.7	-16.1	0.7	-12.4	0.6	-24.9	0.6	-17.2	0.6	-15.1
Hotels and Restaurants	0.9	-1.4	0.9	8.5	0.9	-3.5	1.1	11.8	0.7	-1.8
Metal Products	1.2	-4.9	0.7	-21.6	0.8	-16.2	0.5	-13.1	0.8	-11.6
Mining and Quarrying	1.1	-5.8	0.6	-9.0	0.5	-4.0	1.2	25.2	0.7	4.5
Other Manufacturing	0.8	-1.4	0.8	5.5	0.6	-15.8	0.5	-24.4	0.7	-6.0
Petroleum, Chemical and Non-Metallic Mineral Products	0.9	-5.7	0.8	2.6	0.6	-11.2	0.8	0.4	0.7	-7.4
Post and Telecommunications	1.1	-1.3	0.9	8.1	0.9	-5.3	0.9	5.3	0.9	1.2
Recycling	0.8	-4.2	0.8	3.0	0.6	-15.1	0.7	-12.9	0.7	-6.4
Retail Trade	0.9	-7.1	0.8	-4.1	0.8	-7.1	0.8	11.7	0.8	-1.3
Textiles and Wearing Apparel	0.5	-15.8	0.8	-4.6	0.7	-15.9	0.8	-2.7	0.8	-8.3
Transport	1.0	-3.0	0.9	8.2	0.8	-4.2	1.0	13.3	0.8	-0.1
Transport Equipment	0.6	-7.9	0.7	9.4	0.6	-5.4	0.6	-1.2	0.6	-14.8
Wholesale Trade	0.8	-10.3	0.7	-7.9	0.7	-11.9	0.8	1.0	0.7	-5.5
Wood and Paper	0.5	-14.2	0.6	-3.1	0.5	-26.4	0.4	-15.3	0.5	-8.4

Source: Author's calculations. Stata codes adapted from Shepherd (2019)

Note: Boldface indicates sectors where the country in question has a noticeable comparative advantage relative to agriculture, defined as an index score of 1.10 or greater.

4.3.3 The agricultural sector

The review of various economic sectors' contribution to total GDP and comparative advantage estimates suggest that the agricultural sector plays an important role in the economies in Central Asia.

Potential in the sector. According to statements made by representatives of the ministries in interviews, some countries, for example China, are interested in agricultural products from Central Asia as they are attracted by the fact that agricultural production in this region is 'ecologically clean', 'safe' and 'natural' (Buyanov, 2016). This could add value to the agrifood exports from Central Asian countries, given improved conditions for trade. Moreover, changing dietary patterns in China, as well as an extended trade dispute between the USA and China, provides opportunities for Central Asian countries to increase their agrifood market share in China (Reuters, 2018).

According (FAO, 2020) projections, the rising demand for higher value agrifood products in China and Russia at least until 2030 provides a beneficial scenario to plan investments by Central Asian countries for export-oriented development of their agricultural sectors. Specifically, for Kazakhstan, the commodities that are (or can become) competitive in Chinese markets include wheat, sunflower seed, rapeseed, and potentially beef. Kyrgyzstan, Tajikistan and Uzbekistan have a strong potential for increasing horticulture exports to China, namely grapes, apricots (fresh and dry), plums (fresh and dry), walnuts, and cherries, products that are traditionally exported to Russia and Kazakhstan.

The share of agricultural land, the land area that is arable, under permanent crops, and under permanent pasture¹⁰, varied from 34% in Tajikistan up to 80% in Kazakhstan in 2016. Over the years, most of the countries have experienced steady agrifood production growth (Table 4.5)¹¹.

¹⁰ Arable land includes land defined by the FAO STAT as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow.

¹¹ The agricultural production indexes (crop, food, livestock) show the relative level of the aggregate volume of agricultural production for each year in comparison with the base period 2004-2006. They are based on the sum of price-weighted quantities of different agricultural commodities produced after deductions of quantities used as seed and feed weighted in a similar manner. The resulting aggregate represents, therefore, disposable production for any use except as seed and feed. All the indices at the country, regional and world levels are calculated by the Laspeyres formula. Production quantities of each commodity are weighted by 2004-2006 average international commodity prices and summed for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period 2004-2006.

In 2019, almost 18 million people were employed in the agricultural sector in Central Asia, with nearly half the population employed in this sector in Tajikistan.

Table 4.5 Key indicators of agricultural sector in Central Asia, 2016

Country	Ag. land (% of land area)	Crop production index (2004-2006 = 100)	Food production index (2004-2006 = 100)	Livestock production index (2004-2006 = 100)	Cereal production (million metric tons), 2017
KAZ	80.4	167.2	141.4	119.0	20.1
KGZ	55.0	117.5	117.8	111.2	1.7
TJK	34.1	160.5	155.5	128.0	1.4
TKM	72.0	83.2	113.0	117.6	1.2
UZB	62.9	167.1	157.1	134.0	7.0

Source: World Development Indicators, World Bank (2020a)

Kazakhstan leads in cereals production in the region (Table 4.5) and is among the major suppliers of wheat globally. The wheat export from Kazakhstan to the global market was estimated as six million tonnes, or nearly \$1 billion in 2018 (Figure 4.5).

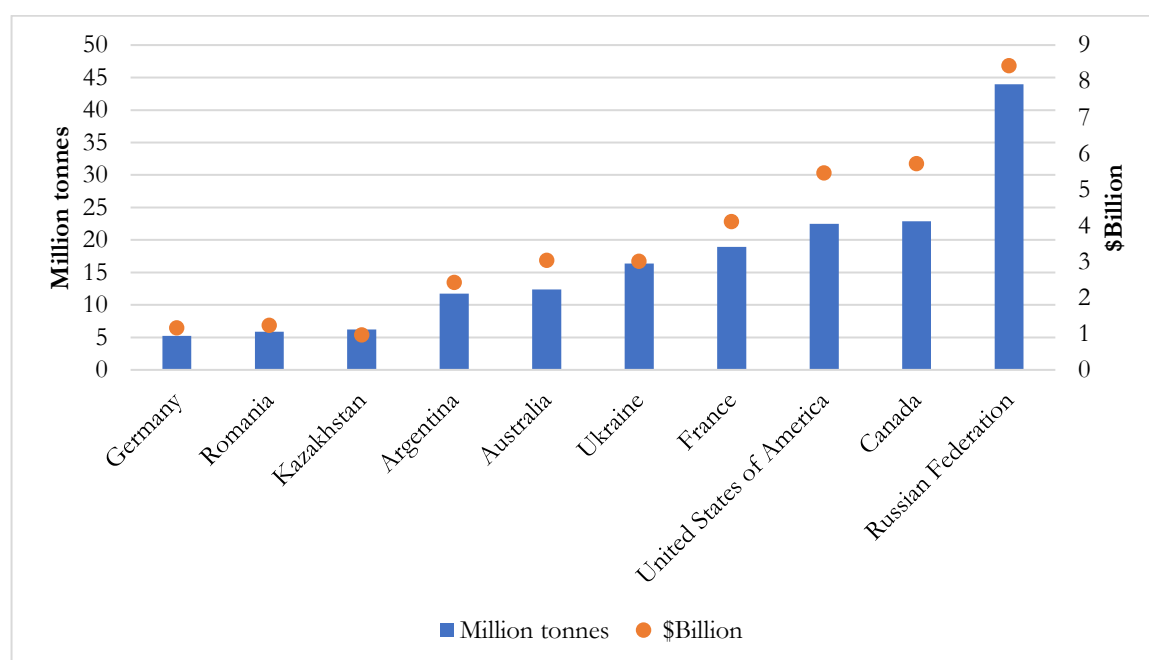


Figure 4.5 Top 10 global exporters of wheat in 2018, volume (million tonnes) and value (\$billion).

Source: based on data from FAOSTAT (August 17, 2020)

Overall, the Central Asian region, which is land abundant with favourable climatic and soil conditions has a capacity for growing variety of crops, and developing the livestock production to become a leading food supplier to the global market (Mueller et al., 2014).

To improve comparative advantage of agricultural goods at global markets the governments of the region provide substantial domestic support to agricultural producers. The volume of state support to agriculture in most countries of the region has been increasing (FAO, 2020). The increase was particularly substantial in Kyrgyzstan where the amount of the funds allocated from the state budget grew between 2016 and 2018 from \$53 million to \$83 million¹² (Table 4.6). Kazakhstan has lowered the amount of direct payment to the processing entities buying domestic cattle since September 2018, and stopped providing partial input subsidies to produce oil, forage and agricultural crops grown under cover. Subsidies in 2018 were only paid to producers of rice, sugar beets and cotton.

Tajikistan began to implement the Integrated Programme for Development of Animal Farming for 2018-2022 that defines an action plan for implementation of the program in animal farming sectors. The share of planned expenditures for agriculture in the state budget structure was 3.17% in 2018. No data are available for Turkmenistan and Uzbekistan.

Table 4.6 The volumes of budget financing for the agricultural sector in Central Asia, 2016-2018, million monetary units

Country	Currency	2016	2017	2018
Kazakhstan*	national currency	279,233.8	392,735.5	n/a
	US dollars	816.1	1,205.0	n/a
Kyrgyzstan*	national currency	3,675.0	4,958.0	5,691.0
	US dollars	52.6	72.0	82.7
Tajikistan***	national currency	430.2	583.4	676.1
	US dollars	48.8	68.2	73.9

Source: Based on FAO (2020)

Notes: * Actual financing;

** Actual financing from federal and regional budgets;

*** Planned financing.

n/a – not available

Obstacles to success. A number of obstacles of an institutional and administrative nature limit the positive conditions for agrifood exports development. Central Asian agrifood exports often face technical barriers for trade (TBT), including compliance with requirements on health, veterinary and phytosanitary safety in the importing markets (Mogilevskii & Kamiljon, 2014). The exports of many Central Asian agrifood products are limited to

¹² For conversion into the US dollars, the average national currency rate to the US dollar was used for all the countries (provided by the country chapter authors).

traditional partners due to their failure to comply with strict or different requirements in the markets of the EU, China and other countries.

Moreover, agrifood products from this region are anticipated to be heavily penalised by high trade costs associated with transportation, border-clearing, transactions, and other costs associated with the fulfilment of non-tariff measures. For example, in Uzbekistan the key constraints for increasing fruit exports include limited infrastructure for certification compliance, fragmented supply chains, and high transport costs (World Bank, 2020f).

While traditionally it has been assumed that Central Asian countries' high trade costs would be due to their landlocked nature and not having direct access to ports (Raballand, 2003), recent literature has challenged that perception and argued that the high costs to trade in Central Asia have been as much due to poor policies and institutions and low-quality infrastructure as to geography (Pomfret, 2016b). This has been partially confirmed with the econometric estimates presented in Chapter 7.

This research primarily focused on trade costs as a result of underdeveloped institutions and does not address the non-tariff barriers (NTBs) imposed by other countries. Removing of the constraints along their agricultural value chains, which requires complementary investments in processing, logistics, trade/export services and infrastructure, would support Central Asian countries turning their natural advantages into competitive advantages in specific export markets (FAO, 2020).

High trade costs have influenced the composition, profitability and future of agrifood industries in Central Asia. For example, Uzbekistan used to have a thriving apple export industry during the Soviet era and earlier, but the combination of deteriorated logistics and time delays at customs borders since the dissolution of the Soviet Union has meant that its apple exports are now arriving to the Russian Federation at twice the average price of locally produced apples (East Fruit News, 2018, quoting FAO). This loss of comparative advantage has contracted Uzbekistan's apple industry.

Comparative advantage in agricultural sector. Throughout Central Asia, the loss of comparative advantage to the Russian Federation has been significant for agrifood products.

Nevertheless, the region has the potential to increase the export of horticultural produce to China and Russia (World Bank, 2020f), given the right circumstances. The current research examined which agricultural products theoretically have a comparative advantage in Central Asian countries, employing the TRCA methodology adopted by Costinot et al. (2012), and explained in section 4.3.2.

To provide a base for the TRCA index, all numbers were expressed relative to raw cotton production, which took a value of 1.00. Due to the large number of comparative advantage indices calculated using this approach, the results presented in Table 4.7 are limited to the products with a TRCA >1.1 , or most improved, compared to the base year = 2010 percent change $>30\%$, or most declined percent change $>-30\%$ at least in one country. Boldface indicates products that have a noticeable comparative advantage relative to raw cotton, or which have changed as compared considerably relative to the base year. The regression results are not reported here, because the model consists exclusively of dummy variables.

First, the results highlight different patterns of comparative advantage across the five Central Asian countries. It is striking that for Tajikistan and Turkmenistan, however, there is no product of comparative advantage relative to raw cotton. In Uzbekistan, only vegetables, provisionally preserved, have some comparative advantage relative to raw cotton. The results support the FAO (2020) finding that exports of cotton dominate agricultural export from Tajikistan and Uzbekistan. Second, Kazakhstan and Kyrgyzstan are more diverse in their TRCA products, most of which are non-perishable, easy to transport crops, such as barley, dried legumes, wheat and meslin.

Third, to identify changes in product structure, the change in TRCA indicators between 2010 and 2018 was examined. The general pattern across the countries suggests that many products lost their comparative advantage to raw cotton (Table 4.7). In Tajikistan, all products have lost comparative advantage relative to raw cotton. There are losses of relative competitiveness of more perishable products, such as grapes, cherries, melons, peaches and tomatoes, that had been popular exports from Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Previously, cherries and grapes had a relatively high RCA based on the Ballassa index in World Bank (2020f). Kazakhstan is the only country in the region in which several products significantly improved their TRCA between 2010 and 2018. These include beef and meat products, milk, some fruits, and vegetables.

Table 4.7 Theoretical Revealed Comparative Advantage 2018 in agriculture relative to raw cotton, all countries

2018/2010	Kazakhstan		Kyrgyzstan		Tajikistan		Turkmenistan		Uzbekistan	
	TRCA	% change	TRCA	% change	TRCA	% change	TRCA	% change	TRCA	% change
Raw cotton	1	0	1	0	1	0	1	0	1	0
Apples & pears	0.5	130.5	0.5	-11.1	0.2	-16.5	0.3	-18.6	0.4	8.1
Barley	1.5	43.5							0.4	
Beef (frozen)	0.6	513.4								
Cucumbers	0.7	39.6	0.4	-34.8			0.6	21.7	0.7	15.0
Fruits, dried	0.6	179.5	1.0	42.0	0.7	-30.3	0.4		1.0	29.4
Grapes	0.6	124.5	0.6	-27.0	0.4	-16.3	0.6	7.7	0.9	24.6
Honey	0.8	93.9	1.2	6.5	0.2	-63.6	0.3		0.6	-12.9
Horses	0.5	65.1	1.1	45.6	0.2				0.3	37.0
Legumes, dried	1.1	134.0	1.3	12.5	0.4	-41.3			0.9	22.5
Melons and papayas	1.0	26.4	0.5	-34.2	0.3		0.4	-30.2	0.8	-27.0
Milk	0.9	92.6	0.8	-6.9					0.3	
Peaches & cherries	0.5	67.3	0.5	-49.1	0.3	-32.6			0.7	-1.3
Sausages	0.8	266.1	0.6						0.3	
Tomatoes	0.7	66.0	0.3	-54.8	0.2	-43.6	0.6	7.3	0.7	3.5
Vegetables, provisionally preserved	0.7	35.4	1.1	-1.9					1.2	46.8
Wheat and meslin	1.5	19.6	0.6	-14.7			0.6	12.1	0.8	17.5

Source: Author's calculations based on data from The Growth Lab at Harvard (2019)

Note: Products are four-digit HS level. The table presents only those products with TRCA >1.1 or most improved as compared to the base year=2010 percent change>30%, or most declined change>-30% at least in one country. Boldface indicates sectors where the country in question has a noticeable comparative advantage relative to agriculture, defined as an index score of 1.10 or greater. The full table is available upon request.

Thus, results suggest that many of the traditionally exported products from Central Asia, such as melons, grapes, tomatoes and cucumbers have lost their comparative advantage to less perishable crops, such as cotton or wheat. Agrifood products from this region are anticipated to be heavily penalized by high trade costs associated with transportation, border-clearing, transactions, and other costs associated with fulfilment of non-tariff measures. Among the constraints for increasing horticultural produce exports are poor logistics, fragmented supply chains, and high transport costs (World Bank, 2020f), as well as administrative hurdles at border crossing points. The econometric estimates for exports of perishable horticultural products reported in Chapter 6 provide more evidence on how these products are affected by high trade costs in Central Asia.

4.4 Trade

This section analyses international trade flows in Central Asia, major export-oriented sectors in the region, and the most dynamic sectors. The key developments in agricultural trade in Central Asia in the last decade are also presented in this section.

4.4.1 Total trade flows

Except for Turkmenistan, all Central Asian countries were net importers of goods and services in 2017. Aggregated across five Central Asian countries, total exports were \$69 billion in 2017, averaging 25% of the exports recorded in the region's GDP (Table 4.8).

Table 4.8 Total exports, imports and trade balance in goods and services in 2017, percentage and \$billion

	Exports of goods and services (% of GDP)	Export (\$billion)	Import (\$billion)	Trade balance (\$billion)
KAZ	32.4	45	47	-2
KGZ	34.3	2	10	-8
TJK	15.7	1	4	-3
TKM	22.5	7	4	2
UZB	21.8	14	16	-2
Average/Total	25.3	69	81	-12

Source: Share of exports in GDP from World Development Indicators, World Bank (2020a); export and imports from The Growth Lab at Harvard (2019)

Table 4.9 (see also Appendix I) presents the total of top-five exports by goods and services¹³ for each Central Asian country. It can be seen from the Table 4.9 that, although there are some similarities in economic structure across regions, there are also substantial differences. This is evident from the fact that there is no goods and services that are present in all five countries. Only two commodities, mineral fuels, oils and waxes and transport, are among the top five exports in four countries of the region. Raw natural resources are the major exporting commodities in all countries. Cotton is the only agricultural commodity represented in the top five exports from Tajikistan, Turkmenistan and Uzbekistan.

Table 4.9 Top five export goods and services for each Central Asian country in 2018, US dollars (thousands)

Exports in US dollars (thousands)	KAZ	KGZ	TJK	TKM	UZB
Mineral fuels, oils and waxes	28,580	112		7,727	2,238
Transport	4,328	218	188		1,362
Precious metals and stones		735	176		4,947
Travel and tourism		472			1,243
Ores, slag and ash	2,821	128	423		
Cotton			96	276	929
Copper	4,056				
Iron and steel	2,657				
Aluminium			161		
Salt, sulphur, lime, cement, etc.				79	
Plastics				67	
Fertilisers				48	

Source: based on exports dataset from The Growth Lab at Harvard (2019)

Note: Yellow indicates the goods and services that are among the top five exports in four countries of the region. Blue colour - indicating the goods and services that are among the top five exports in three or two countries and pink - in one country

4.4.2 Key developments in Central Asian agricultural trade

The aggregated sum of countries' agricultural exports was \$4.4 billion in 2018, with the share of agrifood goods in total exports varying from less than 1% in Turkmenistan to 8% in Kyrgyzstan

¹³ The data classification as reported in The Atlas of Economic Complexity (2020), where the data for services are based on the Extended Balance of Payments Services Classification 2010 (EBOPS 2010) classification. According to EBOPS 2010 'Transport' refers to all modes of transportation services, such as internal passenger transportation, freight transportation, pipeline transport, as well as space transportation. The 'Tourism and Travel' section includes hotels, restaurants and related services, travel agencies and tour operator services – as well as tourist guide services, and other tourism activities.

(Figure 4.6-Figure 4.10). Notably, there was significant drop of agrifood exports between 2010 and 2018 in Tajikistan and Kyrgyzstan.

It was found, when analysing the comparative advantage among the Central Asian countries, that agriculture does not play an important role in their exports, with the exports of the extracting industries accounting for more than 80% of total exports.

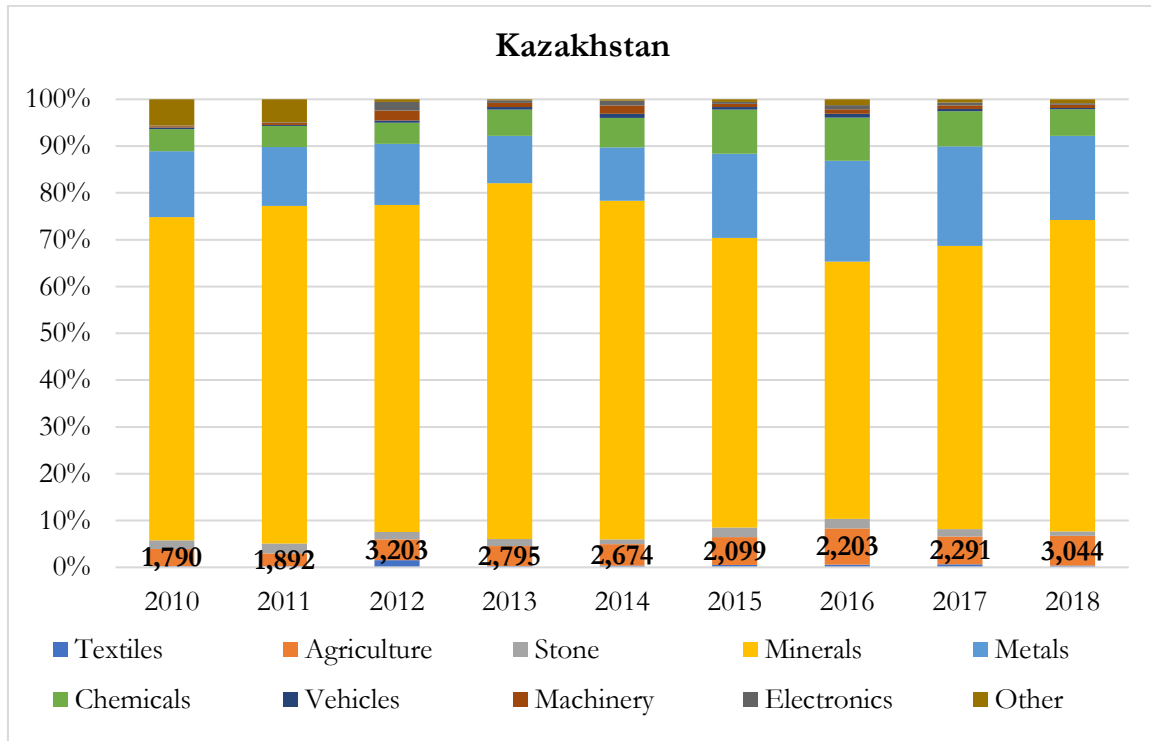


Figure 4.6 Goods exports from Kazakhstan in 2010-2018, percentage and US dollars (million) for Agriculture

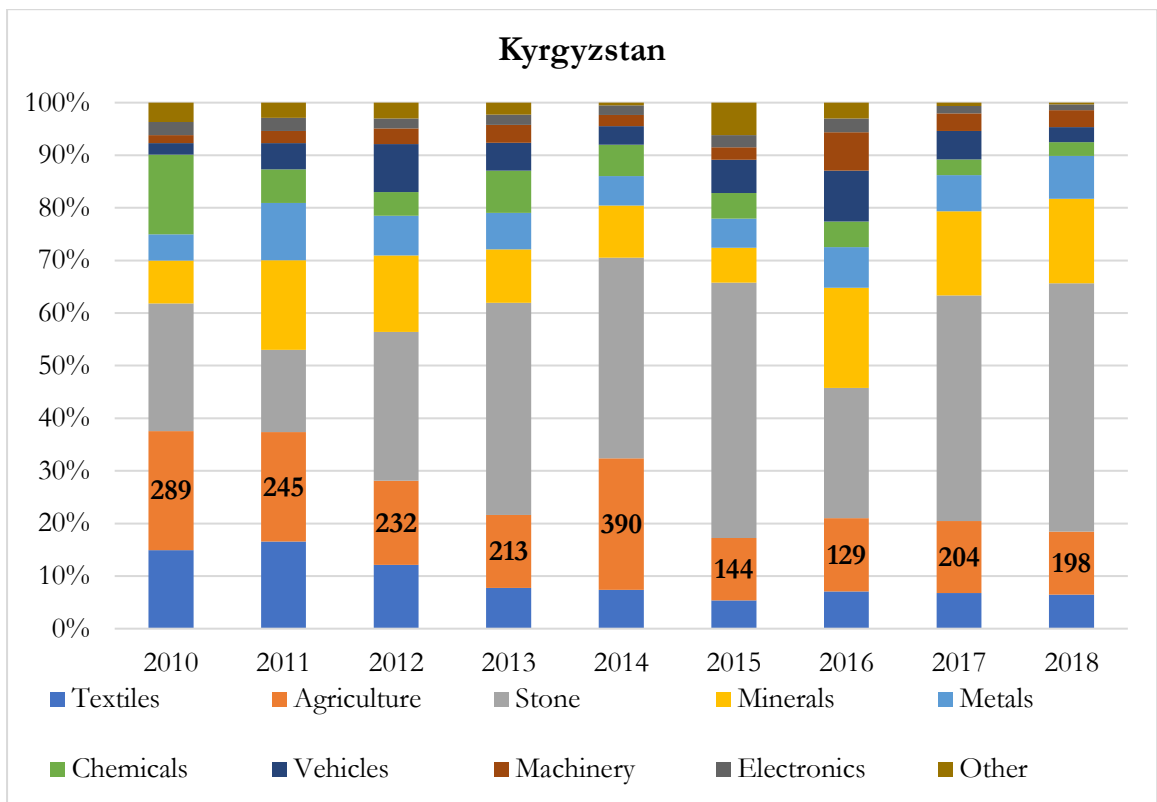


Figure 4.7 Goods exports from Kyrgyzstan in 2010-2018, percentage and US dollars (million) for Agriculture

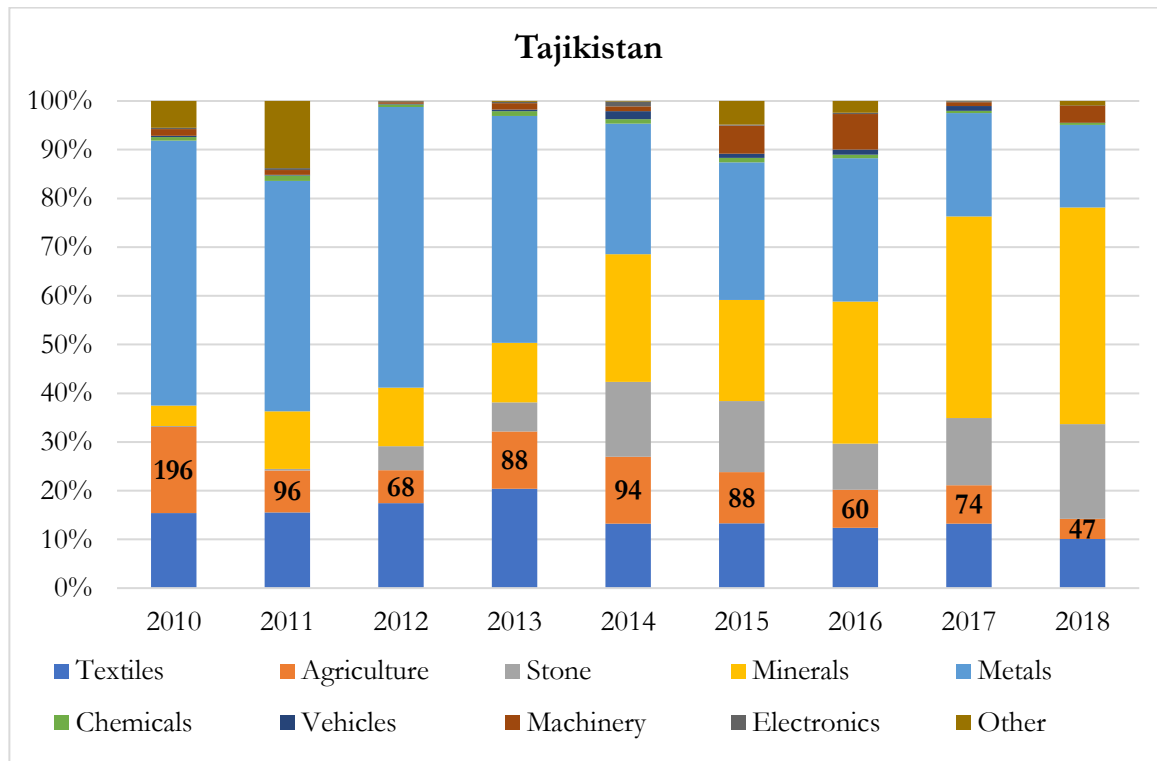


Figure 4.8 Goods exports from Tajikistan in 2010-2018, percentage and US dollars (million) for Agriculture

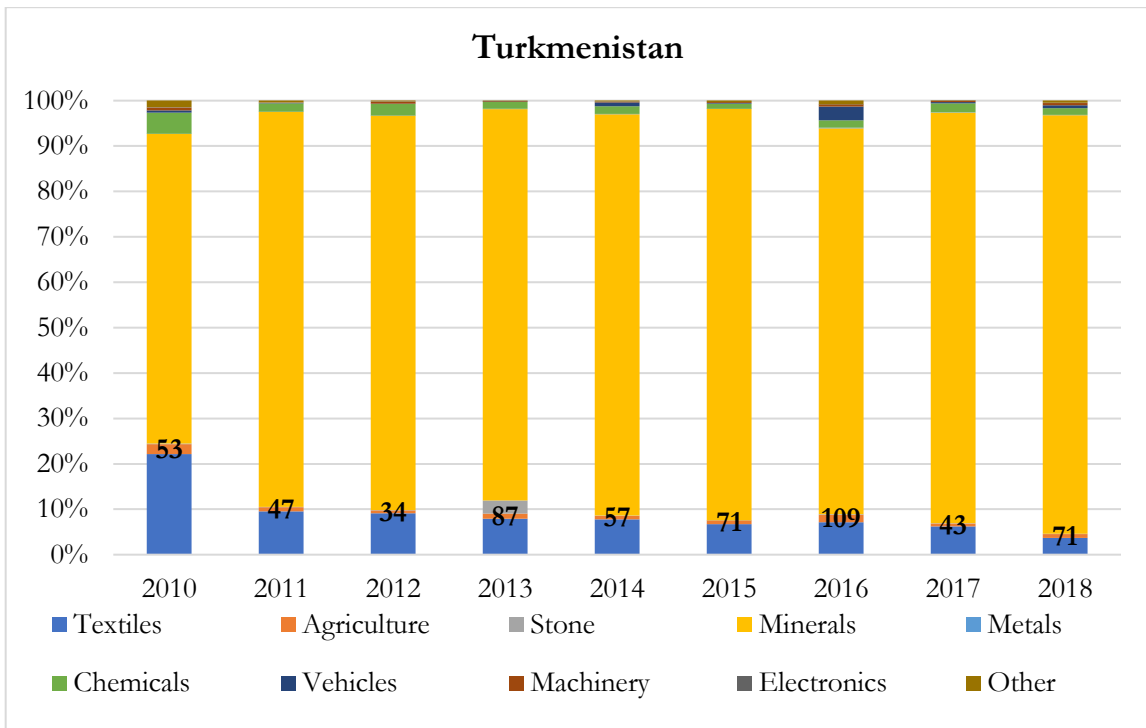


Figure 4.9 Goods exports from Turkmenistan in 2010-2018, percentage and US dollars (million) for Agriculture

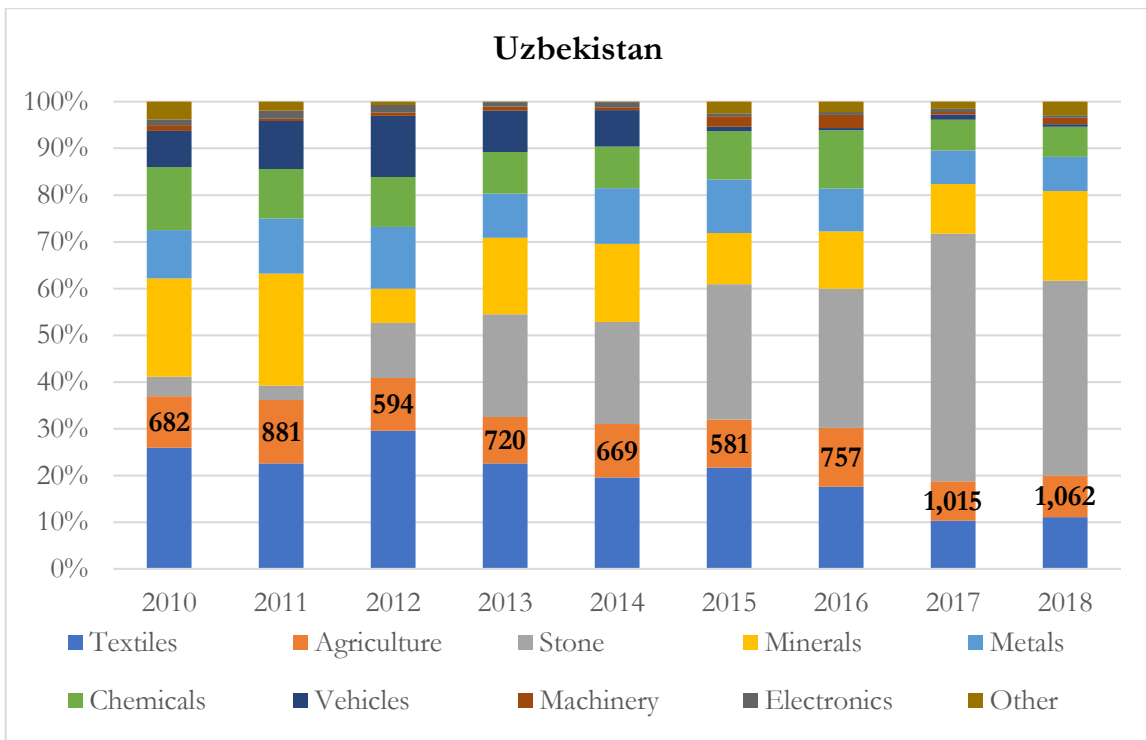


Figure 4.10 Goods exports from Uzbekistan in 2010-2018, percentage and US dollars (million) for Agriculture

Source of all graphs: based on data from The Growth Lab at Harvard (2019)

Agricultural goods continue to be traded pre-dominantly among the Central Asian countries themselves, while exports to the Russian Federation declined from 30% in 2010 to 15% in 2018 (Figures 4.8 a-f). Meanwhile, the Chinese market has played a prominent and increasingly sizeable role since 2014. Its share of agricultural exports in 2018 increased to 18% in Uzbekistan, falling down to 15% in Kyrgyzstan as compared to 30% in 2016, the year after the country's accession to the EEU.

Kyrgyz exports to the Russian Federation increased from 5% in 2015 (the EEU accession year) to 30% in 2018. Notably, China's share in exports of Turkmenistan varied between nearly 50% of total agricultural exports in 2010 and 20% in 2018. The Middle Eastern market takes a greater share of Turkmenistan's agricultural exports than the Central Asian destinations.

The variation of the countries in the top five export destinations during the whole period suggests that Kazakhstan has less diversified its agricultural exports across the trading partners. Some of the trading partners are rather episodic in Central Asia, for example Tajikistan's exports to the Bahamas of poultry in 2014 (The Growth Lab at Harvard, 2019), accounting for 10% of total agricultural export in that year, or \$7 million, which had never occurred before and has not occurred since (Figure 4.11Figure 4.16).

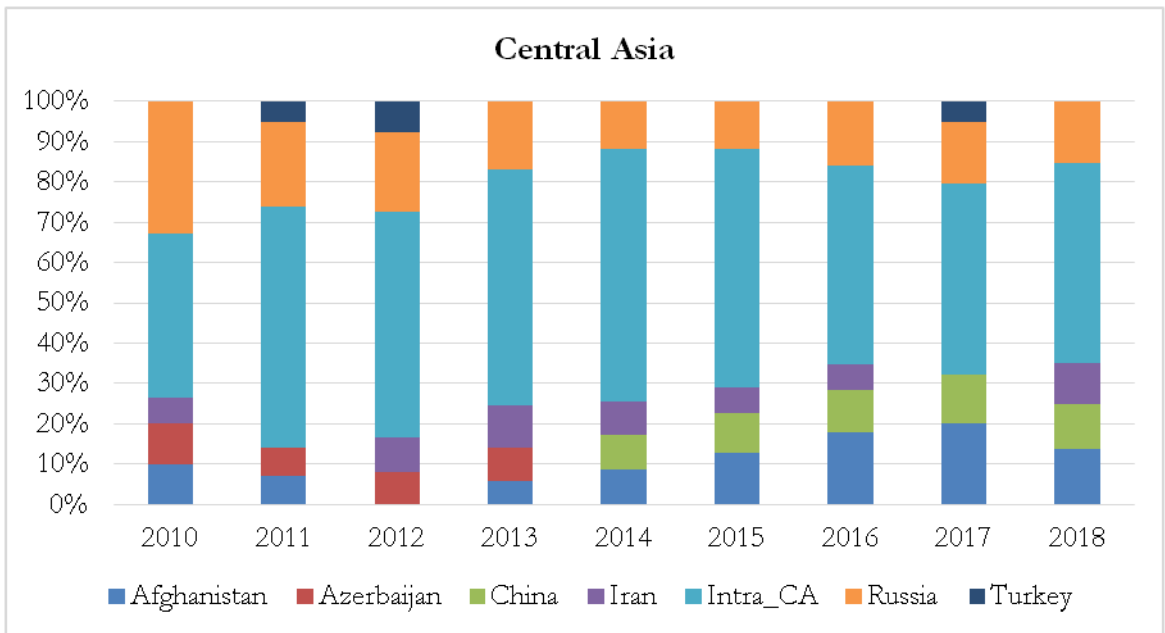


Figure 4.11 Main destinations of agricultural exports from Central Asia, 2010-2018, percentage share.

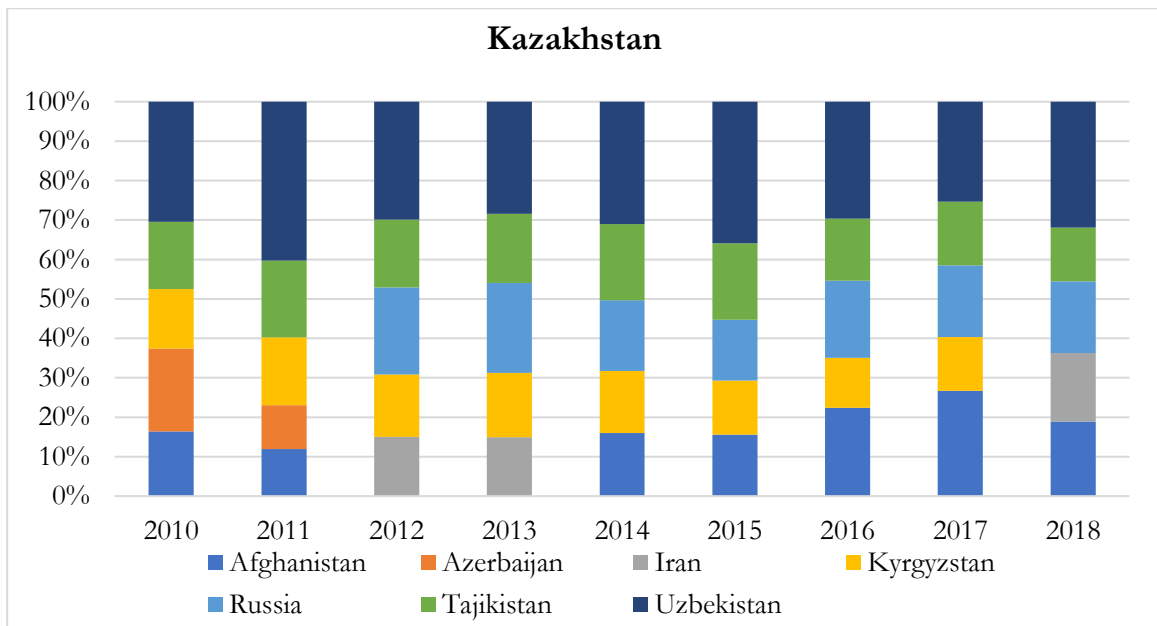


Figure 4.12 Main destinations of agricultural exports from Kazakhstan, 2010-2018, percentage share.

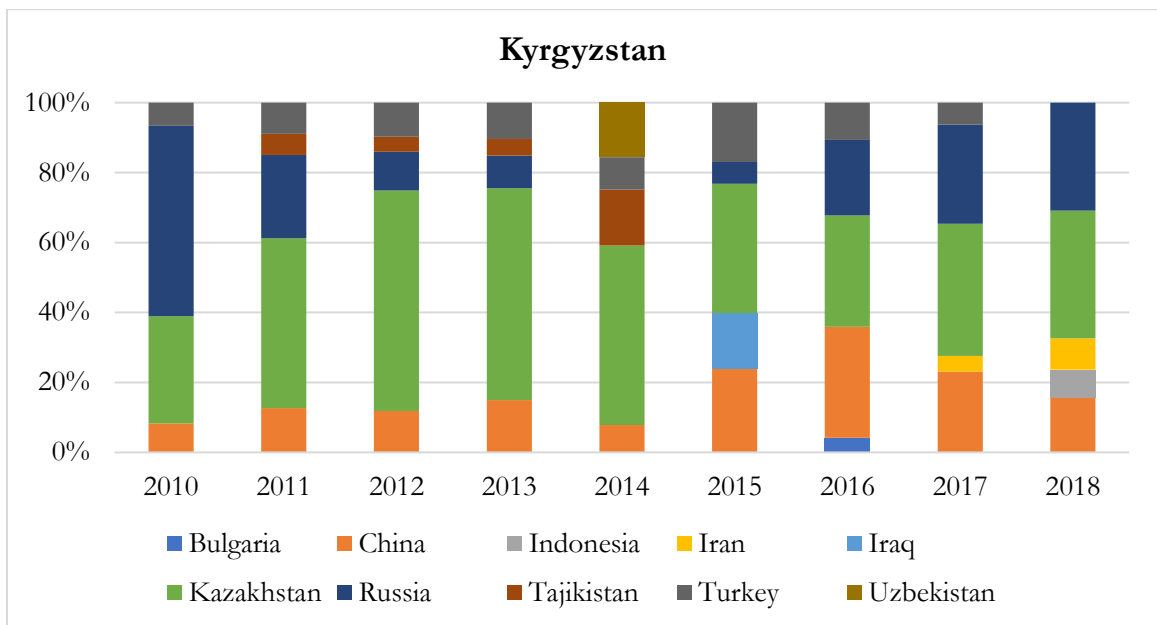


Figure 4.13 Main destinations of agricultural exports from Kyrgyzstan, 2010-2018, percentage share.

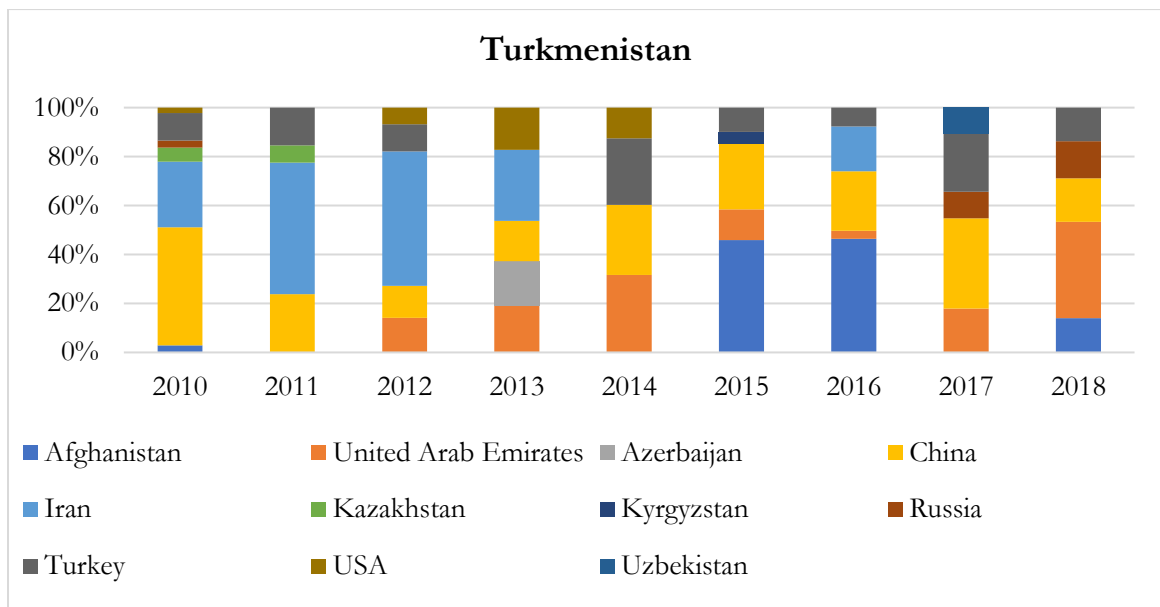


Figure 4.14 Main destinations of agricultural exports from Turkmenistan, 2010-2018, percentage share.

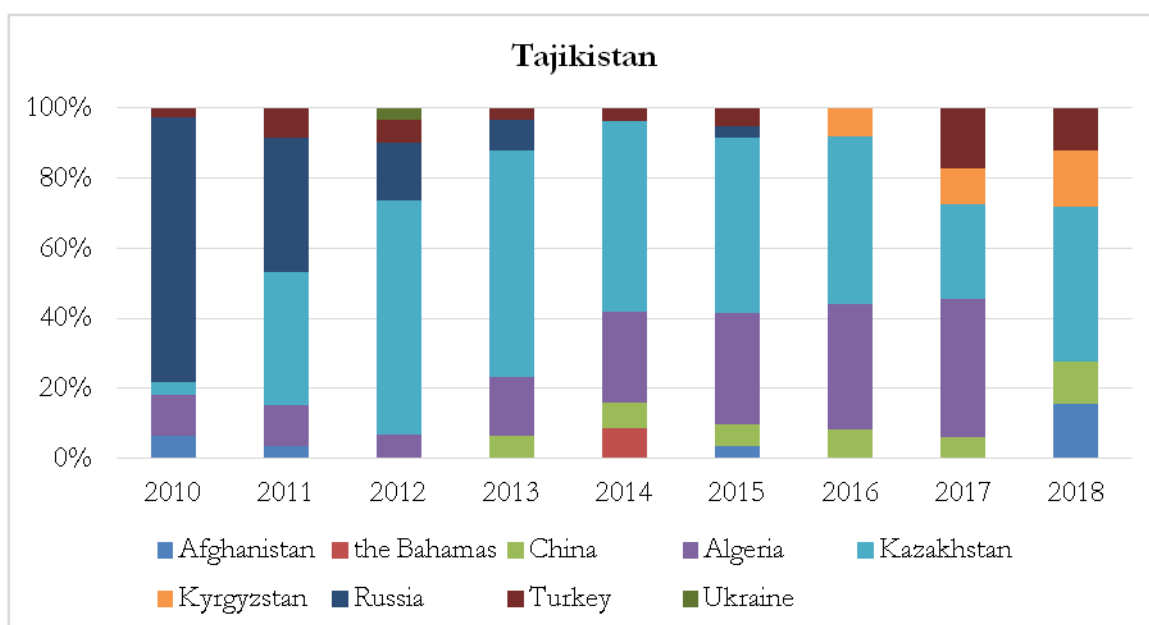


Figure 4.15 Main destinations of agricultural exports from Tajikistan, 2010-2018, percentage share.

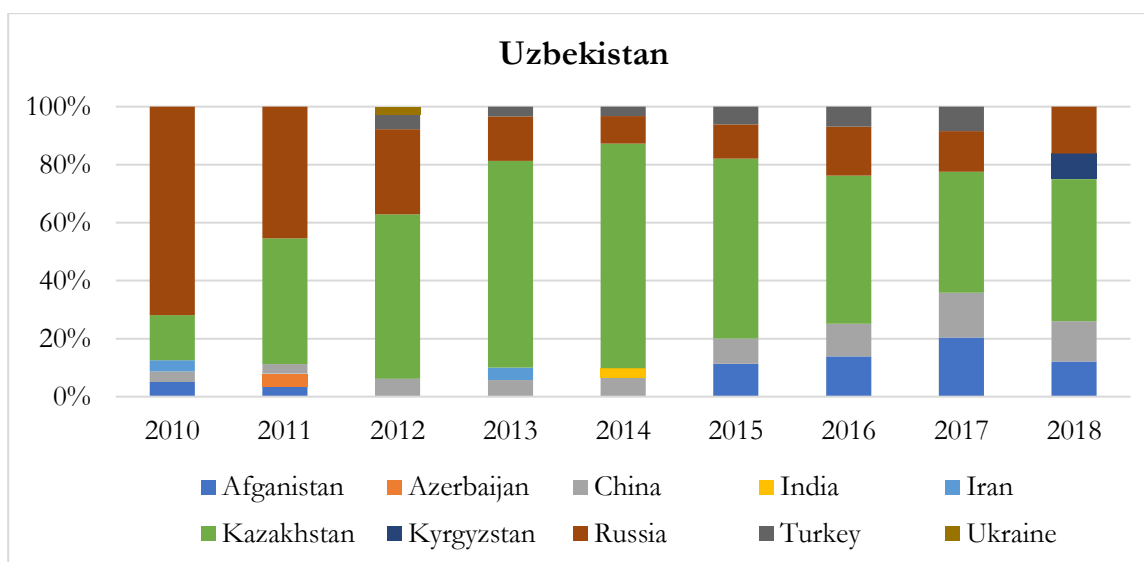


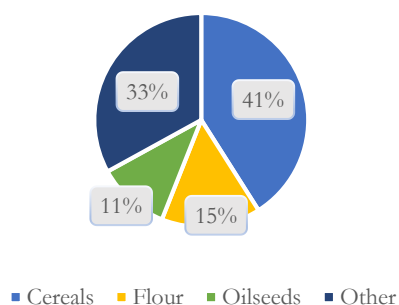
Figure 4.16 Main destinations of agricultural exports from Uzbekistan, 2010-2018, percentage share.

Source of all graphs: based on data from The Growth Lab at Harvard (2019)

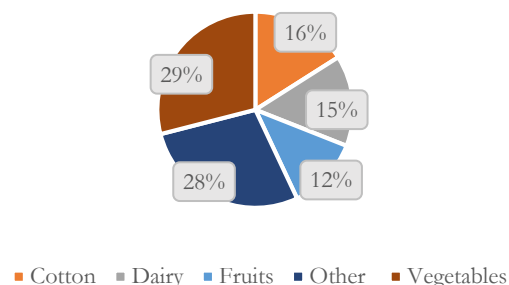
Primary commodities dominate Central Asian agricultural export structure, except for Kyrgyzstan, and value-added goods or services account for most of the imports (FAO, 2020). Wheat from Kazakhstan, and cotton from Tajikistan and Uzbekistan account for over a third of all agrifood exports (Figure 4.17).

According to the FAO (FAO, 2020), the situation has deteriorated in Tajikistan in recent years, although the share of cotton in total exports has continued to increase, up to 86% in 2018. Whereas in Uzbekistan the share of cotton and its products in overall agrifood exports were declining in the last years. Kyrgyzstan is the only country in the region that has a dominant share of the higher value-added products in its export structure.

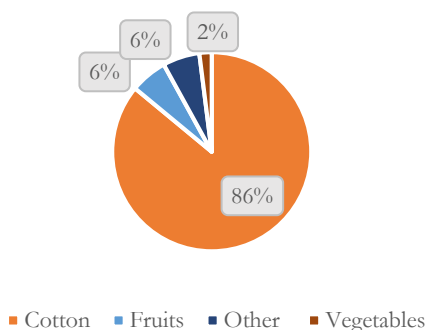
Kazakhstan. Total value \$3.1 billion



Kyrgyzstan. Total value \$216 million



Tajikistan. Total value \$192 million



Uzbekistan. Total value \$2.3 billion

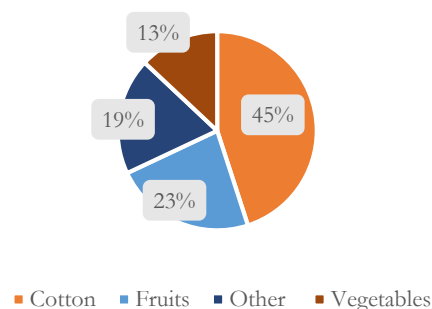


Figure 4.17 Product structure of Central Asian agricultural exports, 2018.

Source: FAO (2020)

Note: The FAO uses the National statistics for this figure, thus the total value in Figure 4.17 does not match the agricultural exports total values in Figure 4.6-Figure 4.10.

Overall, from the overview of the international trade flows it can be concluded that trade remains concentrated in a limited export bundle, predominantly extracting industries in total trade, and primary commodities in agricultural trade. Some changes observable toward export diversification after the end of the resource boom in 2014.

4.4.3 Trade policies

In the transition to the market-based economies Central Asian countries were aiming at creating democratic governments (Gleason, 2001). However, the development paths adopted by them were varied significantly. According to Gleason (2001) Kazakhstan and Kyrgyzstan were the region's 'neo-liberals' implementing the fast move to privatisation of the public goods, monetarisation of the economy, trade liberalisation, currency exchange, and government structural reforms. These two countries were the early supporters of the transition to international standards.

On opposite, Uzbekistan and Turkmenistan followed a 'structuralist'¹⁴ approach, which is a phased and gradual introduction of reform-oriented measures, emphasizing incentive selectivity, dynamic technical efficiency, and government guidance throughout the process of change (Gleason, 2001). Tajikistan's approach lies somewhere between these two. Nevertheless, despite a strong will of countries to reform and implement international standards, those were never properly introduced (Gleason, 2001).

Despite the statements made by the Central Asian countries after gaining independence, to liberalise and open their economies, episodes of illiberal policies were a regular occurrence in all countries of the region during the 1990s and early 2000s (Pomfret, 2005). For example, Uzbekistan in 1996 and Turkmenistan in 1998 reacted to balance of payments difficulties by reintroducing foreign exchange controls, which offset other import restrictions that were in place. In response to 1998 crisis Kazakhstan unexpectedly raised duties on intra-Central Asian trade (Box 4.1). Sometimes the borders could be closed without an advance notice, creating the uncertainty in trading procedures.

The import regulations in the mid-1990s and early 2000s were relatively liberal in Central Asia (Pomfret, 2005). Kyrgyzstan's actual tariffs in 2002 averaged around 5%. Kazakhstan had also liberalized trade policy since mid-1990s, when export duties were removed and the average import tariffs on imports dropped below 8% by 2002, though, there were frequent *ad hoc* impositions which make trade policy unpredictable (Pomfret, 2005). In 1995 Uzbekistan's

¹⁴ Also often referred as a 'gradualist' approach in case of Uzbekistan (Alam and Banerji 2000)

average tariff was around 18% with some high rates. Turkmenistan and Tajikistan, apart from using import tariffs, used to impose a range of export restrictions, often in the form of surrender requirements on foreign exchange earnings (Pomfret, 2005).

Box 4.1 Kazakhstan's response to the 1998 Russian crisis

After the August 1998 Russian crisis, which hit Kazakhstan hardest among the Central Asian countries, Kazakhstan introduced a 20% value-added tax on all personal imports from Russia, the Kyrgyz Republic and Uzbekistan, and then in December 1998 enacted a law on 'Measures to Protect the Domestic Market from Imported Goods'. Under this law, special tariffs as high as 200% were imposed on a number of goods imported from the Kyrgyz Republic and Uzbekistan in February 1999, when a number of other restrictions such as import quotas on cement imports from the Kyrgyz Republic were also introduced. In April 1999 the 200% February tariffs were eliminated, but new licensing procedures, transit fees and mandatory deposits on imports from the Kyrgyz Republic and Uzbekistan were introduced and the Kazakh tenge was floated, which led to an effective 50% devaluation. Also, in early 1999, Uzbekistan tightened its foreign exchange controls and introduced a 5% tax on all purchases of foreign exchange. Turkmenistan closed the commercial banks' foreign exchange window in December 1998, and enacted legislation requiring all export and import contracts to be approved by the State Commodity Exchange.

(Pomfret, 2005)

In the 2010s import tariffs remained relatively low and stable in Central Asia, with a noticeable increase in 2015 (Figure 4.18), coinciding with the beginning of the Russian financial crisis of 2014-15 as a result of sanctions/countersanctions introduced by a number of countries¹⁵, Ruble depreciation and oil price drop (Viktorov and Abramov 2020), which also disrupted the region's economies. Moreover, Kyrgyzstan was obliged to re-negotiate its WTO import tariff rates following its accession to the Eurasian Economic Union in 2015 and the adoption of higher tariff rates as a member of this union (FAO, 2017b). In 2017, Uzbekistan implemented significant tariff changes in the context of broad trade liberalisation. Import duties and excise taxes on key agricultural and food products were reduced or eliminated.

¹⁵ The Russian Federation imposed a ban on the import of agricultural products in 2014 in response to sanctions imposed by a number of countries (the United States of America, the European Union countries, Canada, Australia, the Kingdom of Norway, Ukraine, the Republic of Albania, Montenegro, the Republic of Iceland, the Principality of Liechtenstein and the United Kingdom Great Britain and Northern Ireland).

As of 2018, Kazakhstan and Tajikistan still applied export duties on several products (FAO, 2018b). Kyrgyzstan is actively working on the diversification of its exports, which is reflected in the implementation of the strategic plan to export goods to China and the EU markets (FAO, 2018b). Starting from 2017 Uzbekistan made important changes to agrifood export policies. The ban on exporting fruits and vegetables, potatoes, melons, and grapes using automobile transport was lifted (FAO, 2018b).

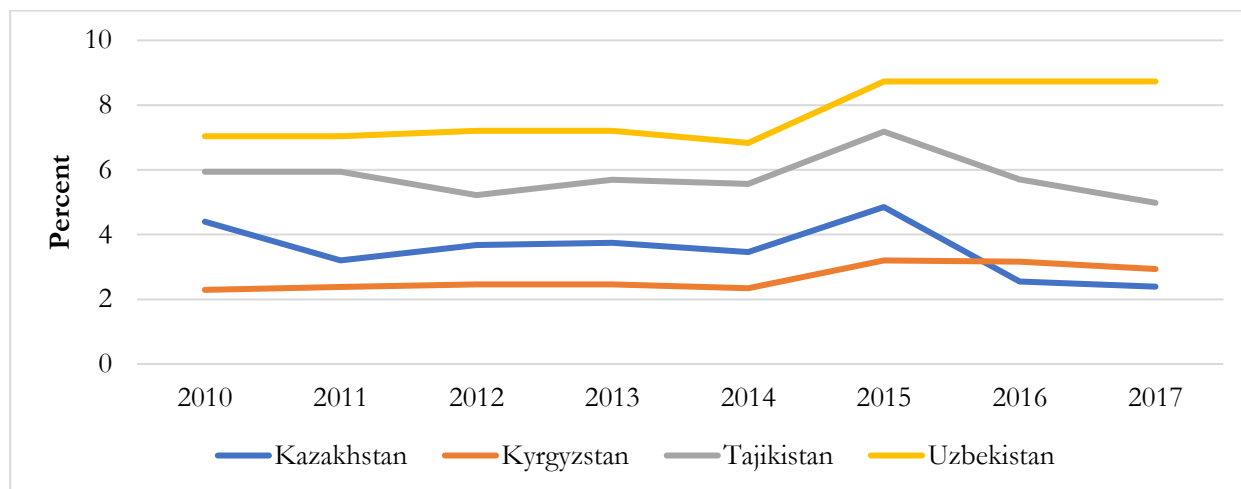


Figure 4.18 Applied tariff rate, weighted mean for all products (%) in Central Asia, 2010-2017
Source: based on the World Development Indicators, World Bank (2020a)
Note: Data for Turkmenistan is not available; see Appendix J, extended table with tariff profiles in Central Asia

Despite the relatively liberal trade policies, non-tariff barriers, such as technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures, as well as customs administration and transport and other infrastructure limitations significantly impede the trade in agricultural goods in Central Asia (Mogilevskii & Kamiljon, 2014). TBT and SPS measures are commonly used as a tool to impose restrictions on intra-regional trade, often on an ad hoc basis.

The most recent events include political issues between Kazakhstan and Kyrgyzstan, with a dramatic increase of waiting time on the border in October 2017, due to spontaneous tension between the heads of the two countries. The Kazakh officials reported that movement of people and goods was constrained as ‘One in eight of trucks moved along the route with gross violations

of the transport legislation of Kazakhstan’ (Kyrgyz News, 2017). As result, heavy trucks with fruits and vegetables stood on the border for several days with all the goods spoiling.

4.4.4 Trade agreements and regional cooperation

After the collapse of the Soviet Union, and despite a short period of disintegration from the early to mid-1990s, many regional trade agreements were signed, and Kyrgyzstan became a WTO member in 1998. Nevertheless, the Central Asian countries were reluctant to pursue regional and multilateral trade policies (Pomfret, 2005). In the 1990s, the Central Asian government’s suspiciousness of international obligations which placed constraints on their policy autonomy were among the reasons for postponing their accession to global organisations.

However, after China’s accession to WTO in 2001 and the Russian Federation’s in 2012, the strong economic links with the Russian Federation encouraged some countries decisions to join the WTO. Thus, Tajikistan joined the organization in 2013 and Kazakhstan in 2015. As of 2020, Kazakhstan, Kyrgyzstan and Tajikistan are the members of the WTO, whereas Uzbekistan re-activated the negotiation process in 2018 (Table 4.10). Turkmenistan submitted its request for observer status in May 2020, indicating its intent to initiate negotiations for WTO accession within a period of five years (WTO, 2020a).

Table 4.10 Central Asian countries WTO accession year, and the import tariff rates for all products (%) in 2017

Country	WTO member since	Average bound tariff, 2017	Most favoured nation, weighted mean
Kyrgyzstan	1998	7.6	5.7
Tajikistan	2013	7.9	7.3
Kazakhstan	2015	6	5.2

Source: World Development Indicators, World Bank (2020d)

Note: Turkmenistan and Uzbekistan are excluded as non-WTO countries

While hesitant to join the WTO, the Central Asian countries were actively seeking for ways to cooperate within the region since the independence. This resulted in a number of bilateral trade agreements (Table 4.11).

Table 4.11 Bilateral trade agreements between Central Asian and other post-Soviet countries, 2018

	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyzstan	Moldova	Russia	Tajikistan	Turkmenistan	Ukraine	Uzbekistan
Kazakhstan	+	-	+	+		+	-	+	-	-	+	-
Kyrgyzstan	+	-	-	-	+		+	-	-	-	+	+
Tajikistan	-	-	-	-	-	-	-	-		-	+	-
Turkmenistan	+	-	-	+	-	-	-	+	-		+	-
Uzbekistan	-	-	-	-	-	+	-	+	-	-	+	

Source: Based on the WTO (2020a) RTAs map

Note: + Bilateral agreement, – No bilateral agreement

These sometimes overlapped with participation in various regional trade agreements (Table 4.12), and most of the time were ineffective because the countries kept rejecting certain provisions and interpreting the meaning of the agreements in their own interest. Often the agreements existed on paper only (Pomfret, 2005).

Table 4.12 Participation in the global or intra-regional agreements.

	SPECA	The Commonwealth of Independent States (CIS)	Eurasian Economic Union (EEU)	Shanghai Cooperation Organization (SCO)	European Union (EU)	Other bilateral agreements and preferences	CAREC	BRI
Kazakhstan	+	+	+	+	CEPA ¹⁶	Common Economic Zone (CEZ) EEU: Viet Nam	+	+
Kyrgyzstan	+	+	+	+	GSP ¹⁷⁺	EEU: Viet Nam	+	+
Tajikistan	+	+	-	+	-	-	+	+
Turkmenistan	+	+	-		-		+	+
Uzbekistan	+	+	-	+	-	-	+	+

Source: Based on the WTO RTAs map¹⁸. Note: + Bilateral agreement, – No bilateral agreement

¹⁶ Comprehensive and Enhanced Partnership Agreement with the European Union

¹⁷ Generalised Scheme of Preferences

¹⁸ https://www.wto.org/english/tratop_e/region_e/rta_participation_map_e.htm Accessed on 11/04/201

There were a number of agreements signed by the Central Asian nations intra and inter-regionally. Among the agreements was one to form the Central Asian Economic Community (CAEC), a forum for resolving disputes within Central Asia, which later became the Central Asian Cooperation Organization (CACO). In 1998, with the support of the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Economic Commission for Europe (ECE), the Special Programme for the Economies of Central Asia (SPECA) was established.

The aim of SPECA was to strengthen the cooperation among its members in order to both stimulate their economic development and facilitate their integration with the economies of Asia and Europe. The program is ongoing and includes trade development issues in the work plan for 2020-21 (SPECA, 2020). However, many of the regional initiatives have not been sustained due to various political and economic issues.

Regional agreements have been popular in Central Asia, not only because of the trade policies, but also due to the necessity of managing regional water resources (e.g. the Aral Sea aridity and as a consequence energy supply issues), security and trade facilitation (Pomfret, 2005). All of these areas are of specific importance to Central Asia and require common action and regional cooperation. However, the economic benefit gained from the participation of the Central Asian countries in the Eurasian Economic Union (EEU) remains questionable, as, apart from the large volumes of trade with the Russian Federation, Kazakhstan's and Kyrgyzstan's trade with other EEU members is insignificant. Joining the EEU in 2015 obliged Kyrgyzstan to increase and re-negotiate its import duties with WTO member countries.

Moreover, even though joining the EEU marginally reduced the trade costs between the member countries, long delays have continued on the Bishkek-Almaty road (CAREC, 2020). For example, during March and April 2019, the Kazakhstan Revenue Committee initiated random checks at Kyrgyz-Kazakh border crossing points with very thorough checks of Kyrgyz trucks carrying goods from China. As the checks included detailed verification of documents and cargo, the

process frequently led to long lines and waiting times. In addition, the Kyrgyz Freight Operator Association reported the extortion of unofficial payments.

On the other hand, since accession to the EEU had profound implications for Kyrgyzstan's economy, the Russian Federation proposed establishing a \$1 billion Russian-Kyrgyz Development Fund (RKDF)¹⁹ to cover adjustment costs, and perhaps to finance public investment projects in Kyrgyzstan (Mogilevskii et al., 2018). Additionally, \$0.2 billion were granted for upgrading of customs infrastructure and meeting EEU regulations. The latter includes, for example, food safety standards on agricultural products, which are equivalent to non-tariff barriers if not effectively addressed.

Other benefits for the EEU Central Asian member countries include formal equivalence recognition of veterinary and phytosanitary systems among the EEU countries. Moreover, the EEU's Combined Nomenclature of Foreign Economic Activity (TN VED EEU) has been aligned with the International Convention on Harmonized Commodity Description and Coding System, which is beneficial for international trade transactions.

As of 2020, the Central Asia Regional Economic Cooperation (CAREC) Program could be regarded as one of the prominent initiatives among the Central Asian countries. The Asian Development Bank (ADB) began the CAREC Program in 1997 to foster economic cooperation and integration in Central Asia (ADB, 2014a). The CAREC Program is a partnership of 11 countries working together to promote development through cooperation, leading to accelerated economic growth and poverty reduction (more details in section 4.5.3).

Despite some scepticism and cautiousness at the earlier stages, participation in the WTO, and other global and regional trade agreements has pushed the Central Asian governments to work towards improving national institutions and align industries with international standards. All countries, however, have been limited in their endeavours by a lack of budgetary resources, weak

¹⁹ The Fund's website and current projects: <http://www.rkdf.org/en/projects>

infrastructure, and the insufficient expertise of state agencies, which combine to hinder trade policy reforms in the Central Asian region (FAO, 2018b).

4.5 Trade costs and trade facilitation in Central Asia

This section evaluates the trade costs in the region, discusses the key factors of high trade costs, as well as reviewing existing policies that facilitate international trade in Central Asia.

4.5.1 Trade costs

Despite the efforts that Central Asian countries have undertaken since the collapse of the Soviet Union, to open and liberalise trade regimes and diversify agricultural exports, the expected gains for exporters have not materialised (FAO, 2018a). High trade costs remain a significant impediment to export development. Low exports from this region are largely due to border and behind-the-border trade costs, such as shortcomings in transport and customs procedures (Lücke & Rothert, 2006). Furthermore, inland transportation within the Central Asian countries still impedes international trade due to geographical and topographical features, including long distances between the main cities and ports (e.g. Kazakhstan) and mountainous routes (e.g. Tajikistan).

The combination of time delays and a lack of reliable storage and refrigeration limits the Central Asian countries' capacity to export primarily raw and perishable agricultural products, including fruits, dairy products, fish and meat (FAO, 2017b). Moreover, the lack of a stable institutional environment for international trade is part of the high cost of doing trade with Central Asian countries, which has been alleviated to some extent by membership of the WTO (Pomfret, 2005). The later, forced countries not only liberalize their tariff regimes, but also work towards harmonisation of their international trade regulations with global standards.

According to the World Bank's Trading across Borders (TAB) rankings, Central Asian countries were among the worst economic performers in Europe and Central Asia (Figure 4.19). The ranking of economies is based on the ease of trading across borders. The rank is a simple average

of the scores for the time and cost for documentary compliance, border compliance and domestic transport to export and import. Kyrgyzstan was ranked 70th, while Kazakhstan was ranked 102nd; Tajikistan, 148th, Uzbekistan, 165th. The rankings were well below the benchmark of the OECD high income countries, which was a rank of 26.

On average, in 2017 it cost only \$200 and 15 hours per shipment to export goods from developed OECD countries, but it cost approximately \$700 and 286 hours to export each shipment from Kazakhstan (IBRD and World Bank, 2018).

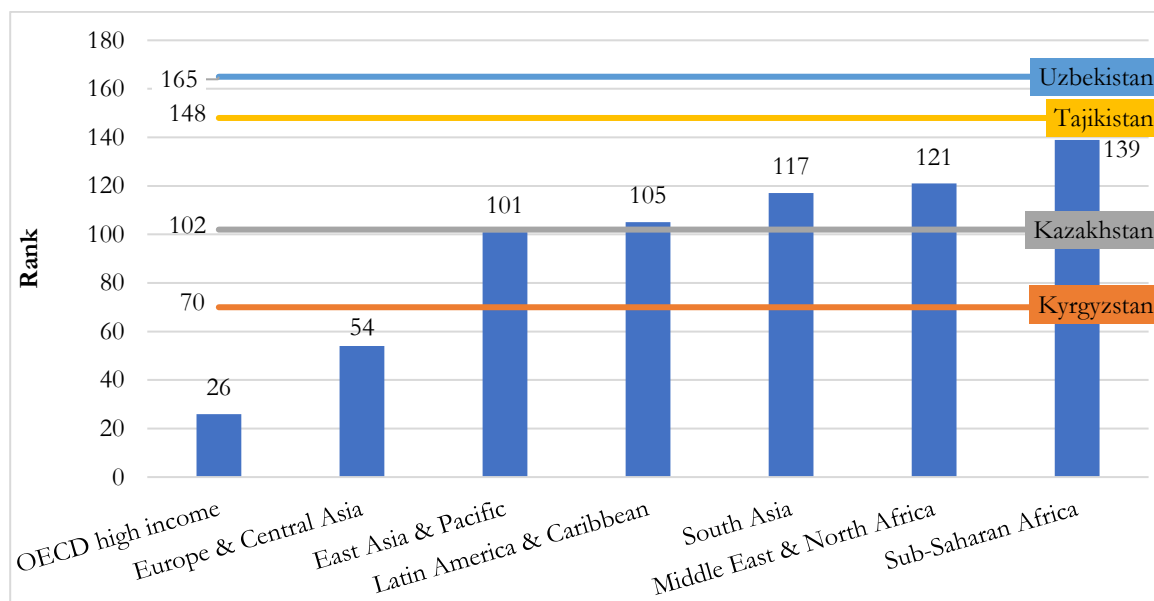


Figure 4.19 Trading Across Borders rank, 2018.

Source: based on Doing Business data, World Bank (2020e)

Note: On the scale of 1-190, where 1 is the best and 190 is the worst performance; data for Turkmenistan is not available.

Several authors in the 2000s, such as Raballand (2003), Cadot (2006), Arvis et al. (2010), emphasised the fact that the region was landlocked as a critical reason for high trade costs. However, there are landlocked countries, such as Switzerland, that are highly successful in trading across borders, ranked 26th in 2020 (World Bank, 2020e). More recently, it has been argued that the high costs of trade in Central Asia have been due as much to poor policies and institutions and low quality of hard infrastructure²⁰ as to geography (Pomfret, 2016a). The relationship between

²⁰ Hard infrastructure, or built infrastructure, is the physical infrastructure of roads, bridges, tunnels, railways, ports, and harbours, among others, as opposed to the soft infrastructure of human capital and the institutions that cultivate infrastructure.

being landlocked and high trade costs applied in the aftermath of the collapse of the Soviet Union, but is not as relevant now, compared with the persistent institutional failure in these countries.

The major trade costs in the region are the result of a complex and inefficient system of regulatory requirements (FAO, 2017a). These complexities in the trading environment create an opportunity for intermediate players to make their business and earn. Trade costs are built up both at-the-border, as well as behind-the-border, in Central Asian countries (FAO, 2017a), including low quality hard infrastructure. Inland roads and railroads are often not well suited for transporting large cargoes, and infrastructure is weak for information technologies in the organisations that are responsible for trade regulations. Trade costs related to the soft infrastructure can be linked to the unfavourable business environment, as well as inefficiency of the border and transport regulations.

Human resource is another obstacle to enhanced trade in the region (FAO, 2017a). Lack of understanding of international rules and technical regulations both at the policy making level and at the operational level has often been noted as one of the barriers to trading efficiently in the post-Soviet countries. In this regard, Duval (2007, p. 5) states:

Human resource development is crucial to enabling implementation of trade facilitation measures. The lack of trained human resources is a recurrent issue in implementing a customs reform programme and related trade facilitation measures [..].

In 2017 three Central Asian countries, members of the WTO, joined the Trade Facilitation Agreement (TFA), which was developed to improve efficiency and decrease the costs of customs procedures. Under the WTO regulations, Kazakhstan, Kyrgyzstan and Tajikistan are devoted to streamlining customs procedures and harmonising regulations in the transport sector²¹. Uzbekistan is also interested in implementation of the trade facilitation measures.

Under the TFA framework, countries are the recipients of various grants and training from the WTO. In return, they are obliged to enhance the transparency of cross-border requirements, remove regulatory and procedural barriers, strengthen business capability to comply with trade

²¹ <https://www.giz.de/en/worldwide/62251.html>

formalities and standards. Uzbekistan, while not a member of the WTO, is also receiving trade facilitation assistance from the WTO, World Customs Organization (WCO) (Global Trade Facilitation Programme²²), and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) through the Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific, a UN treaty designed to accelerate the implementation of digital trade facilitation measures (UNESCAP, 2019).

At the domestic level, to facilitate the trade, all Central Asian countries, except Turkmenistan, have set up export promotion agencies and strategies, started to create networks abroad to facilitate trade and information flows between domestic companies and buyers or investors abroad, and created public export banks and financial programs (OECD, 2018a). Institutions supporting exports, including non-government organisations (NGOs), have emerged in Central Asia (Table 4.13).

Tajikistan is in the process of setting up state entities for export support, such as the Agency for Export Promotion and the Export Bank for Support of Entrepreneurship. The governments of Tajikistan and Uzbekistan have formed special commissions to enhance agricultural export potential. The Single Window Centre for international trade, ‘a facility that allows parties involved in trade and transport to lodge standardized information and documents with a single-entry point to fulfil all import, export, and transit-related regulatory requirements’ (UNECE, 2005, p. 3), functions in Kyrgyzstan; Kazakhstan and Tajikistan are currently setting up similar facilities. Some state institutions provide paid services to businesses engaged in foreign trade. For example, Uztrade, a joint stock commercial entity in Uzbekistan is 51% owned by the state (FAO, 2018b).

There are some NGOs that promote exports in the region. They do not receive public funding, but interact closely with governments (Table 4.13). For example, in Uzbekistan, the Ministry of Foreign Affairs provides assistance to the national Chamber of Commerce and Industry in establishing cooperation with similar Chambers in other countries, foreign investors and partners; assistance is also provided for market studies and market development (FAO, 2018a). In

²² <http://www.wcoomd.org/en/media/newsroom/2019/november/uzbekistan-customs-welcomes-the-global-trade-facilitation-programme.aspx>

Kazakhstan, the non-profit National Chamber of Entrepreneurs ‘Atameken’ and its subsidiary, JSC Chamber of Foreign Trade, are the institutions most active in the field of export promotion.

Table 4.13 Selected export promotion activities in Central Asia

Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan
<p>KazakhExport is the Kazakh EPA.</p> <p>The activity of KazakhExport is carried out under the State Program for Industrial-Innovative Development of Kazakhstan 2015-2019.</p>	<p>Kyrgyzstan has launched the National Export Strategy of the Kyrgyz Republic for 2013-2017.</p> <p>The Investment Agency has recently expanded its activities into export promotion.</p>	<p>A national programme has been designed, the Programme for Export Promotion and Import Substitution 2017-2020 that includes the creation of an export bank and an export credit guarantee scheme.</p>	<p>A national strategy for export growth has been designed.</p> <p>The National Bank of Uzbekistan financially supports companies to export.</p> <p>The Export Promotion Fund (EPF) mostly supports SMEs to export.</p>
<p>Additional support organisations for Kazakhstan’s export development, include DAMU, the Development Bank of Kazakhstan, Atameken and the Centre for Trade Policy Development.</p>		<p>Tajinvest officially participates in export promotion efforts, but no official institution has been designed as an EPA.</p> <p>In 2014 the Centre for Trade Promotion was founded by the Tajik Chamber of Commerce and the United Nations Development Programme (UNDP).</p>	<p>The Chamber of Commerce and Industry of Uzbekistan carries out export promotion activities in and outside Uzbekistan.</p> <p>Sector-specific JSCs are involved in export activities, such as Uzagroexport in agriculture and Uztelsanoat in home appliances.</p>

Source: Adapted from OECD (2018a). Note: EPA—Export Promotion Agency

Central Asian countries implement and tend to diversify export support instruments based on international practices and WTO rules and regulations (Table 4.14). All countries, except Tajikistan, provide credit support and credit guarantees to agricultural exporters, and offer insurance for export risks. Regional exporters receive various types of non-financial assistance, such as support for market research, facilitation of participation in exhibitions and fairs, and promotion of national and regional brands.

For example, exporters can also benefit from funded participation in international exhibitions and fairs (all countries, except Tajikistan). Turkmen and Uzbek export associations receive non-financial state support, as well. Internet portals are one of the types of non-financial export support. In Kazakhstan, the export promotion portal export.gov.kz consolidates information from

all state institutions involved in export support and aims to provide advertising, information, marketing and training services.

Table 4.14 Export promotion instruments in Central Asian countries

Country	Financial instruments		Non-financial instruments				
	Credit guarantee support	Insurance support	Market research	Trade fairs support	Promotion of national and regional brands	Publishing of magazines, booklets, catalogues	Support exporters associations
KAZ	+	+	+	+	+	+	-
KGZ	+	-	+	+	-	+	-
TJK	-	+	+	-	+	-	-
TKM	+	-	-	+	-	+	+
UZB	+	+	+	+	+	+	+

Source: based on FAO (2018a)

Note: + Present or in process of implementation; – Not present

However, despite the advances in the development of export policies, export promotion policies in Central Asia are currently in a formative stage. Sometimes strategic documents on export development are rather declarative and include little practical guidance (FAO, 2018a). Moreover, the instruments of export promotion, for example web portals, sometimes are not available for the exporters due to lack of internet access in remote areas. Thus, sometimes the export development initiatives are conducted without consultation with the exporters and little understanding of their actual experience. The lack of understanding means that exporting procedures are often cumbersome and inefficient. Therefore, expanding advisory services and training capacities for exporters, regular exporter surveys, as well as co-ordination of export promotion activities abroad with embassies, consulates, chambers of commerce and other institutions, and the development of a network of agency offices in target countries would support Central Asian countries in successful realisation of their export promotion policies (OECD, 2018a).

4.5.2 External initiatives

Apart from the global organisations and domestic initiatives toward facilitating international trade in Central Asia, there are external initiatives that play an important role in improving trade conditions in this region. This section reviews the two most recent and prominent initiatives, the

Central Asia Regional Economic Cooperation (CAREC) program and The Belt and Road Initiative (BRI), both supporting greater involvement of Central Asian countries in global trade.

CAREC program. The Asian Development Bank began the CAREC program in 1997 to foster economic cooperation and integration in Central Asia. The CAREC program is a partnership of 11 countries²³ working together to promote development through cooperation, leading to accelerated economic growth and poverty reduction. Most of the CAREC's investments are dedicated to improvement of the transportation, while trade facilitation is mainly funded technical assistance (Kim & Mariano, 2020).

The CAREC transport corridors are key channels for improving connectivity and facilitating cross-border movement in the region. Comprising an extensive, but still underdeveloped, network of roads and railways spanning the region, the six CAREC corridors are intended to expand trade and improve competitiveness, while augmenting regional economic cooperation (Figure 4.20).

²³ The 11 member countries of the CAREC Program are Afghanistan, Azerbaijan, Georgia, and the People's Republic of China (PRC, specifically the Inner Mongolia Autonomous Region and the Xinjiang Uygur Autonomous Region (XUAR), Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

SIX CENTRAL ASIA REGIONAL ECONOMIC COOPERATION CORRIDORS

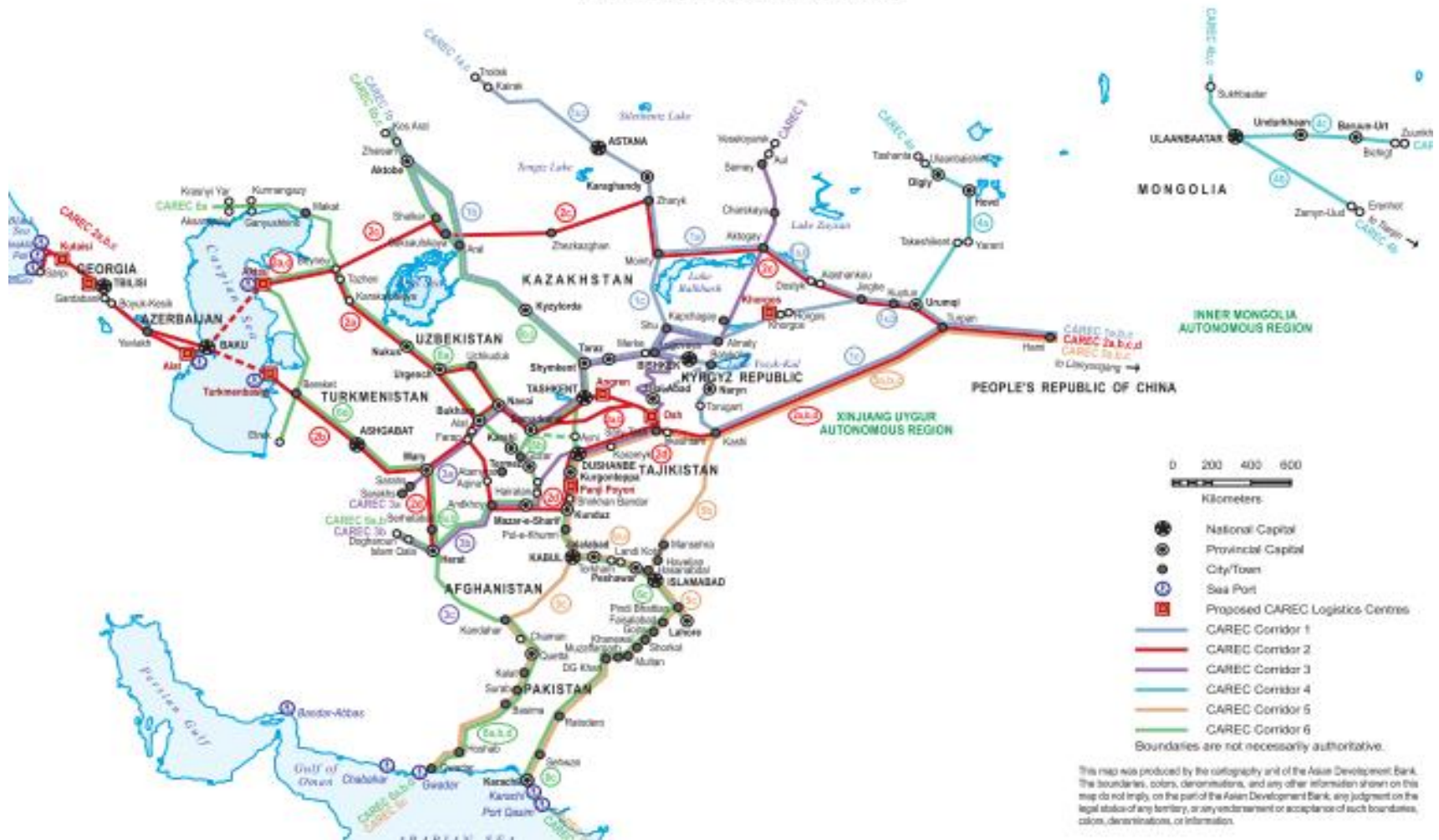


Figure 4.20 Map of the six CAREC corridors. Source: ADB (2014a)

Overall, the CAREC program is aimed at turning the region from the isolated landlocked countries into land-linked economies through reduction of trade costs and improving access to the distant markets (ADB, 2014b). Despite some advances, intraregional trade and market integration in CAREC has not improved significantly in the last few years (Kim & Mariano, 2020). The share of intraregional trade as a percentage of total trade was 3.2% in 2017 compared to 3.1% in 2010, implying that the CAREC countries benefit more from trade outside the region than from trade within. Among the reasons for low intraregional trade are similar production structures, low export diversification, as well as geographic specifics of the countries as impediments to trade.

The Belt and Road Initiative. The BRI, announced by Chinese President Xi Jinping during a visit to Central Asia in 2013 and launched in 2017, is supported with funding from the Asian Infrastructure Investment Bank, and aspires to turn Central Asia from landlocked to land-linked (Pomfret, 2019a). The land bridge rail connections have been established since 2011, connecting China to Europe through Kazakhstan, which was already flourishing before the launch of BRI. It was reported that 2,000 containers passed through Kazakhstan in 2011 travelling from China to Europe, and in 2015, this number had increased to 42,000 containers (Pomfret, 2019a). In 2017 it was reported that more than 3,270 journeys were made between cities in the two continents, and the number of such train trips would reach 4,000 in 2018 (Pomfret, 2019a).

The goal of the BRI is to enhance connectivity between China and the rest of Asia, the Middle East and on to Africa and Europe (Helen, Mathilde, Lebrand, & Venables, 2020). With a total budget of more than \$1 trillion this initiative covers more than 65 countries, which is more than 60% of the world's population (Helen et al., 2020). Central Asia is one of the largest beneficiaries of the infrastructure investments that are strategic transit paths for China.

There are three BRI corridors that pass through Central Asia: the new Eurasian Land Bridge (a northern route, from Urumqi in China to Astana and Moscow); the China-Central Asia-West Asia corridor (Urumqi to Almaty, Tashkent, dividing to Aktau and to Ashgabat, Tehran, Ankara); and the China Pakistan corridor (Urumqi, Almaty, Islamabad, Gwadar) (Reed & Trubetskoy, 2019).

Figure 4.21 indicates these locations and shows the infrastructure improvements on these corridors.

An aggregate real income gain is estimated to be up to around 3% of GDP from BRI projects in Central Asia, with gains for some countries exceeding 5% (Helen et al., 2020). Another study found that if border delays were reduced by half due to BRI initiative, the reduction of shipment times could be around 25.5%, whereas trade costs would fall by 21.6% for the China-Central Asia-West Asia Economic Corridor (CCWAEC) (De Soyres, Mulabdic, Murray, Rocha, & Ruta, 2018). These large effects are not surprising, given the importance of trade facilitation bottlenecks in Central Asian countries.



Figure 4.21 Map of Central Asian transport improvements under BRI. Source: Pomfret (2019b)

4.5.3 Integration of global and regional value chains

This section analyses the importance of countries' participation in the regional value chains (RVCs) and global value chains (GVCs). The literature, as well as estimates presented in this section, suggest that despite the geographic, cultural, and historic closeness, Central Asian countries tend to be more integrated into the GVCs, whereas the RVCs are at a rather rudimentary stage. The high trade costs and lack of intraregional trade policies harmonisation are among the possible reasons for such an outcome.

GVCs and RVCs as an economic driver for developing countries. Since the 1960s, international value chains have gradually been becoming economically essential for international companies searching for low-cost and capable suppliers offshore (Gereffi, 2014). International value chains that involve only regional production partners constitute regional value chains (RVCs), on the one hand, but are considered global value chains (GVCs) when they also involve extra-regional partner countries (Hanzl-Weiss, Leitner, Stehrer, & Stöllinger, 2018). GVCs have been growing exponentially since the 1990s, affecting all the industries from manufacturing industries to food production and all types of services (Gereffi, 2014).

The GVC were beneficial for different regions of the world, including large exporting and importing economies, as well as intermediary locations in global freight distribution (Memedovic, Ojala, Rodrigue, & Naula, 2008). Such emerging economies as Brazil, China, India, the Russian Federation, South Korea, Mexico, Turkey, South Africa and central European countries substantially expanded their global export market shares between 1995 and 2007, overtaking Germany, the US and Japan (Gereffi, 2014). Southeast Asia and other subregions have benefited from participation in GVCs by speeding industrialisation in these regions (Vandenberg & Kikkawa, 2015).

RVCs are of special importance, given that the international organisation of production is predominantly regional in scope (Baldwin, 2011). Among the most developed RVCs are those established among EU countries, as well as the North American Free Trade Agreement (NAFTA)

and the major trading countries in the South East Asia. The shift in end markets from the north to the south in GVCs as a result of the 2008-09 economic crisis encouraged leading firms in developing countries to regionalise their supply chains (Kaplinsky & Farooki, 2011). In sub-Saharan Africa, for instance, South African clothing manufacturers entered neighbouring countries, such as Lesotho and Swaziland, which led to the rise of regional value chains driven by South African retailers.

GVCs and RVCs in Central Asia. In Central Asia, the GVC and RVC phenomenon has been almost absent apart from some rather fragmented success stories of Kyrgyzstan's exports of kidney beans and clothing, mainly due to bazaars as *entrepôts* for inputs imported from China. *Bazaars*, a permanently enclosed marketplace where goods and services are traded, in Central Asia play an important role in regional and national chains of production and distribution, with well-integrated national networks (Kaminski & Mitra, 2012). Thanks to geography, more liberal trade and an 'almost duty-free regime' on *bazaar* imports, Kyrgyzstan has become a major re-exporter of *bazaar*-type products, compared to neighbouring countries, particularly Kazakhstan and Uzbekistan.

Since the beginning of the 2000s, the Kyrgyz apparel industry has shown significant export-driven growth. The exports of clothing from Kyrgyzstan to the Russian Federation and Kazakhstan increased ten-times from between 2002 and 2012 (Jenish, 2014). The fabric used in cloths production was primarily imported from China, and a small share of clothing is made of more costly, higher quality fabric imported from Korea, Turkey and the United Arab Emirates. Noticeably, due to lower quality and higher prices the fabric from neighbouring Uzbekistan and Tajikistan is not imported to Kyrgyzstan. The final products are traded domestically, and exported predominantly to Kazakhstan and Russia (Jenish, 2014). Relatively large Kyrgyz diasporas are among the reasons for the popularity of this country's garments in the Russian Federation and Kazakhstan.

Development of the export-oriented beans industry, predominantly sent to Turkey, in Kyrgyzstan was mainly due to its access to export markets (Tilekeyev et al., 2018), and the existing social network links. Moreover, lack of state regulation was beneficial for this industry to create as a self-regulated cluster with relatively low transaction costs. Favourable weather and soil conditions for growing beans, localised production, and relative proximity of the region to the roads and railroads leading to export seaports also contributed to the industry's development.

Apart from these cases, the region remains poorly integrated into any GVC, and are even less integrated into RVCs. The estimates presented in the following subsection confirm that despite cultural and ethnic similarities, common historical background, and existing functional interdependencies among Central Asian countries, regional value chains are almost not existent. The high trade costs could be among the key reasons for the lack of regional integration. Although, Grafe, Raiser, and Sakatsume (2008) have presented the unexpected finding that national borders do not significantly impact relative prices across different regions in Central Asia; whereas within-country barriers to trade are substantial, and include more than just transportation costs related to the distance between two locations.

While trade agreements may stimulate intraregional trade and capital flows, the economic benefits of trade liberalization may not be fulfilled without joint actions are undertaken to enhance regional infrastructure (Memedovic et al., 2008). Moreover, harmonisation of the national and regional rules and policies for transport, trade facilitation, standardisation and conformity are important for improved regional value chains.

Analysis of the Central Asia's GVCs and RVCs. To analyse the integration of Central Asian countries into value chains the Eora global supply chain database, which consists of a multi-region input-output table was used. The value of gross exports was decomposed into three components: domestic origin value added, regional value added, and value added from other countries. The analysis was performed for 2015, the latest year available in the database. The methodology is set out in the Appendix K. A sector is considered to be more integrated into RVCs the higher the

proportion of regional value added in gross exports. Similarly, it is more integrated into GVCs the higher the proportion of other country value added in gross exports.

The results suggest that there is very little regional value chain development in any sector in Central Asia (Figure 4.22 to Figure 4.27). The largest proportion of gross exports accounted for by regional value added is 4% in the electricity, gas and water sector. The next largest proportion is only 3% in others, and 2% in transport equipment. All other sectors have 1%, or less, of the value of gross exports coming from regional non-domestic value added, which is an extremely low level of RVC integration.

The region appears to be more integrated with other trading partners, the Russian Federation in many cases, than with Central Asian neighbours. Extra-regional value-added accounts for 24% of gross exports in the petroleum, chemical and non-metallic mineral products sector, and just over 20% of gross exports in transport equipment, and metal products. 95% of agriculture exports are coming from domestic value added, which indicates very limited integration into RVCs and GVCs.

Kazakhstan is the least integrated country into regional value chains, whereas Kyrgyzstan records the largest share of regional value added in its gross exports, compared to other countries. Notably, there are some negative values for domestic components in gross exports recorded for Kyrgyzstan, which might reflect the absence of production in particular industries (e.g., fishing). Other negative values reflect the country's *entrepôt* position, allowing for the influx of manufactured goods from China that are then re-exported to neighbouring countries, e.g., wholesale trade is substantially integrated into GVCs (45% of external value added in total exports) and RVCs (10%), while the domestic proportion takes a negative value²⁴. The results demonstrate that Kyrgyz exports of services (e.g., construction, finance and business services, hotel and restaurants) includes 20-30% external value added.

²⁴ Negative values for retail trade and maintenance and repairs may also be related to the country's *entrepôt* position. However, these results should be regarded with caution due to data discrepancies; particularly for small economies such as Kyrgyzstan, Eora data is in some cases estimated rather than directly observed.

Overall, the findings add to previous literature indicating that the Central Asian countries are poorly integrated into global and regional value linkages. The emergence of the New Silk Road, the BRI initiative, could open a window of opportunity for the region to streamline trade between the major economic centres of Asia and Europe (Pomfret, 2017), as well as create an enabling environment for countries' participation in GVCs and RVCs. Central Asia would benefit from investments along the road, e.g., improved computer technology and cold chains, apart from developing the road itself (Vandenberg & Kikkawa, 2015), apart from developing the road itself (Vandenberg & Kikkawa, 2015). In order to benefit from globalisation and participation in GVCs a comprehensive approach to reforms is essential, with industrial policies accompanied by enhancements in trade, education, transport and other policies (Memedovic et al., 2008).

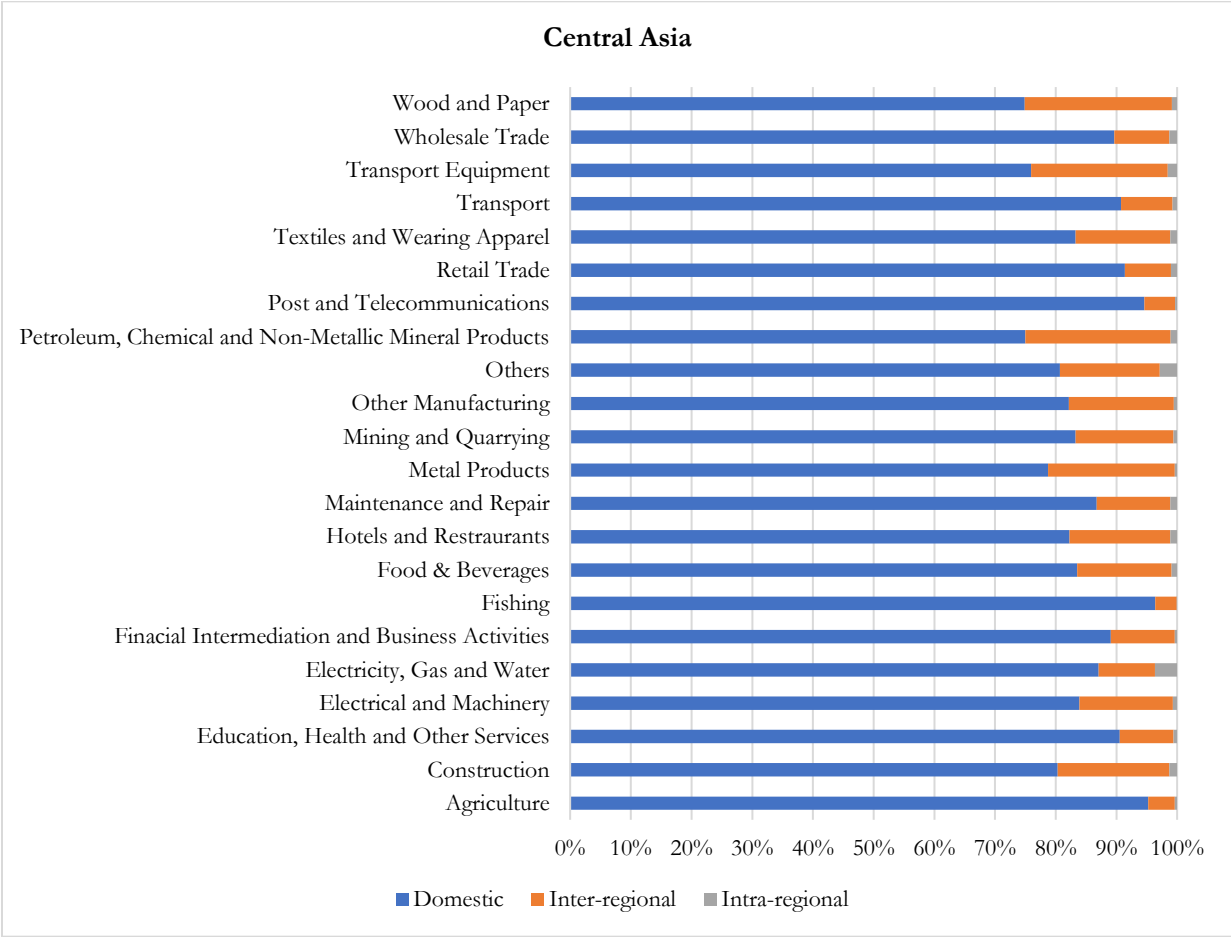


Figure 4.22 Central Asia (all five countries). Value added in gross exports by origin, 2015 (%).
 Source: Eora global supply chain database

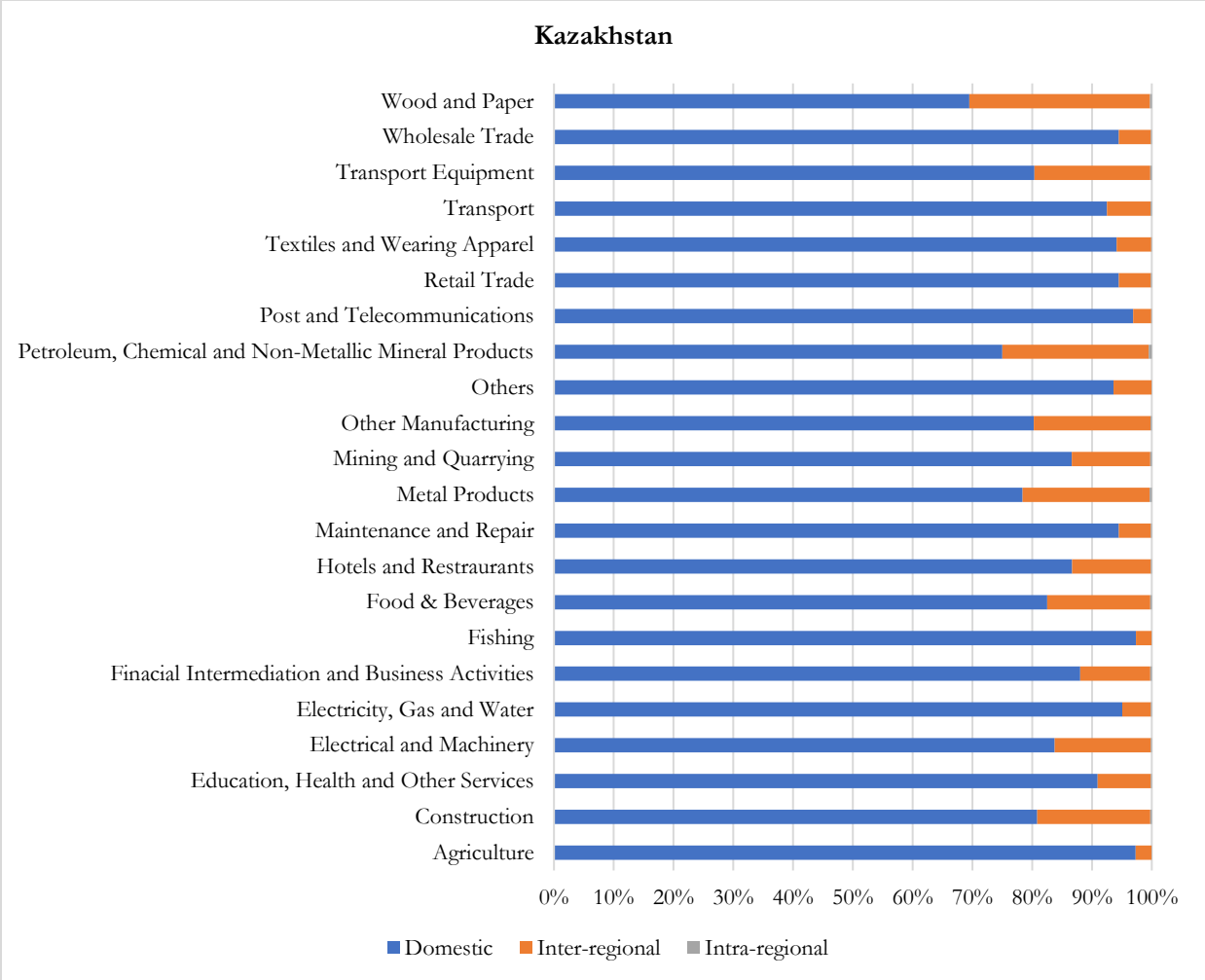


Figure 4.23 Kazakhstan. Value added in gross exports by origin, 2015 (%). Source: Eora global supply chain database

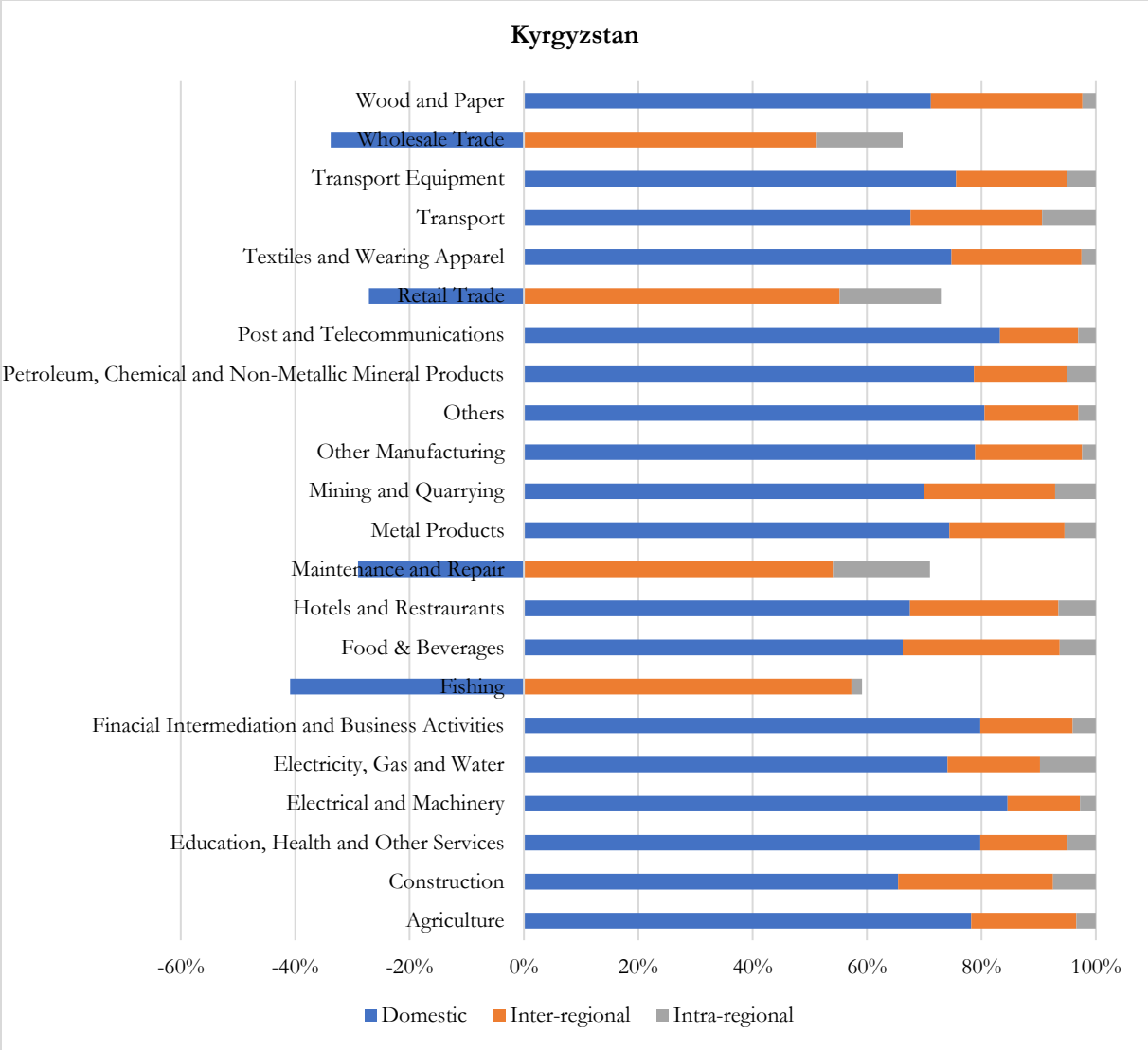


Figure 4.24 Kyrgyzstan. Value added in gross exports by origin, 2015 (%). Source: Eora global supply chain database

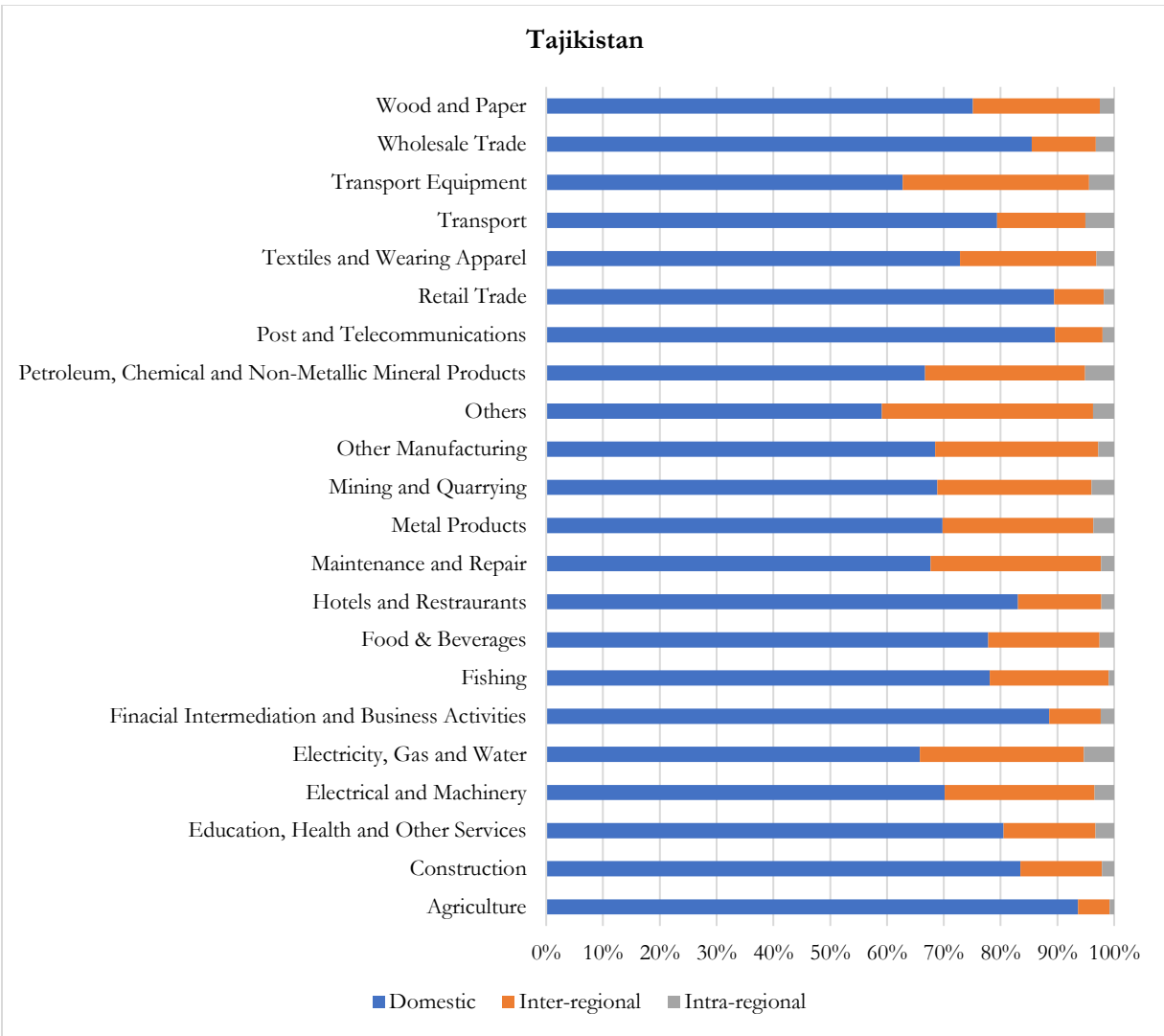


Figure 4.25 Tajikistan. Value added in gross exports by origin, 2015 (%). Source: Eora global supply chain database

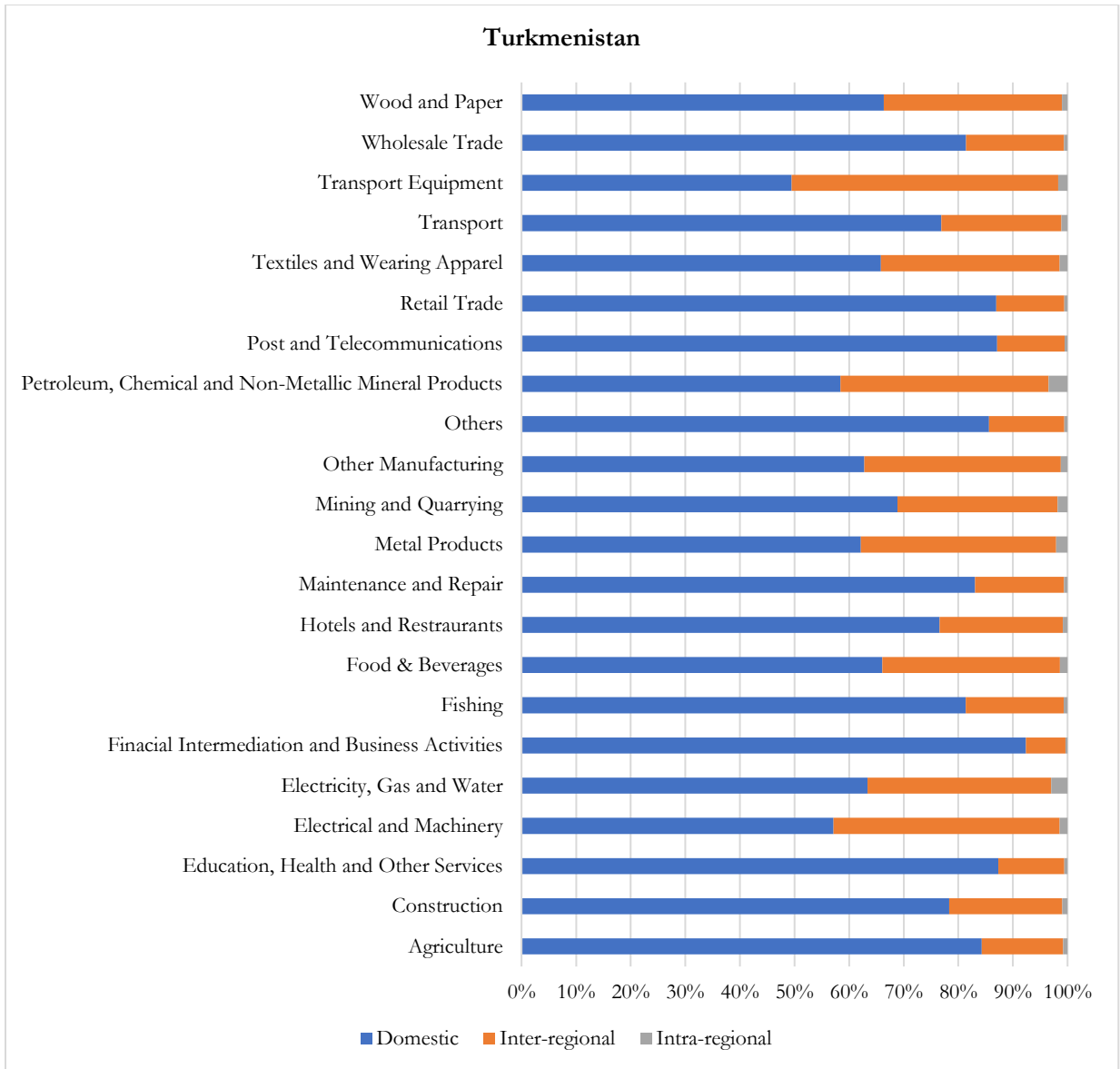


Figure 4.26 Turkmenistan. Value added in gross exports by origin, 2015 (%). *Source:* Eora global supply chain database

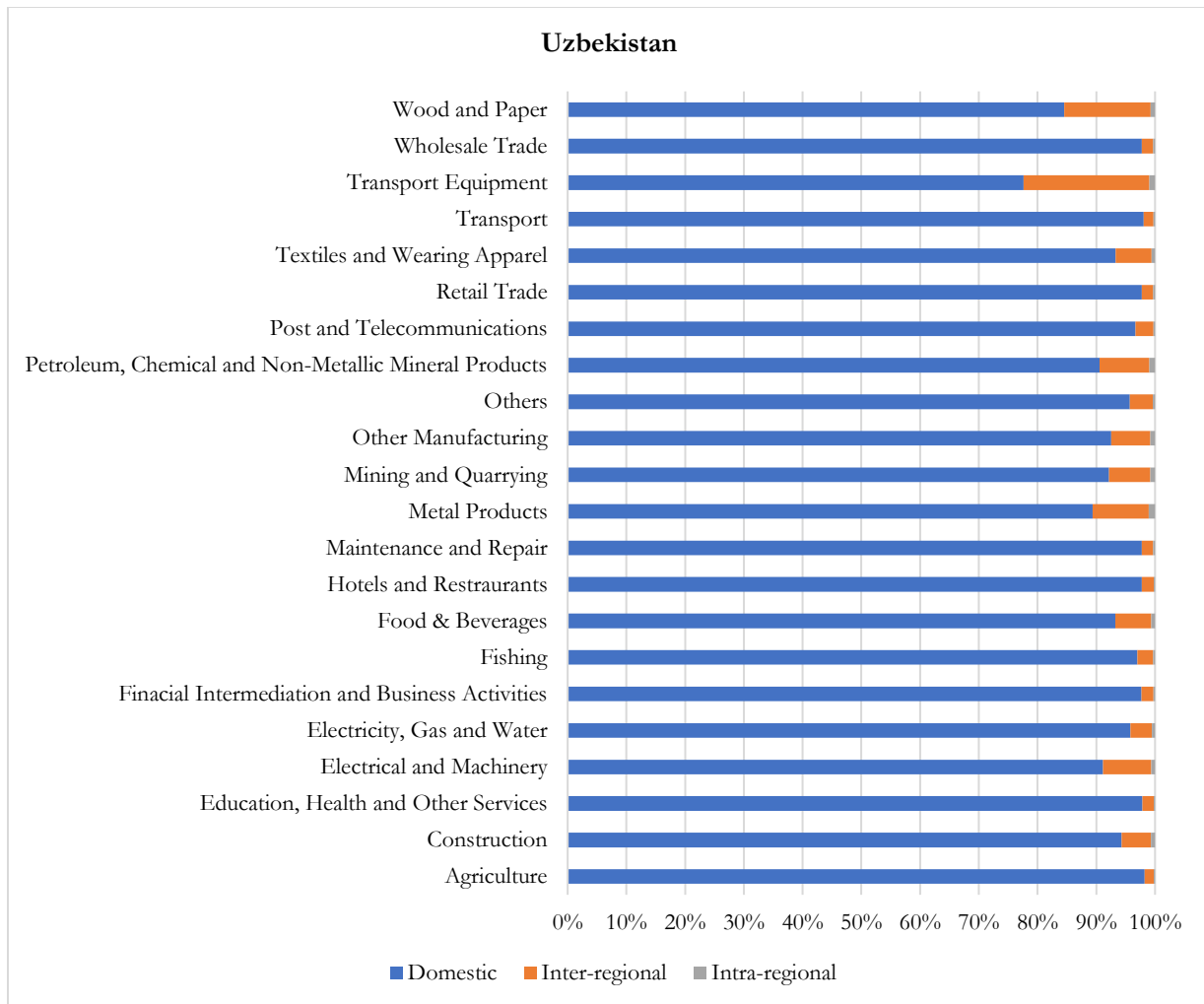


Figure 4.27 Uzbekistan. Value added in gross exports by origin, 2015 (%). *Source: Eora global supply chain database*

4.6 Conclusion

Central Asian countries have the potential to become a land-linked region, despite being landlocked geographically. The region's remoteness from seaports and major global markets is claimed to be the main factor for the high costs of trade and the key obstacle to boosting the region's exports. However, since the late 2010s, there has been growing evidence that poor policy

settings, economic institutions and undeveloped hard infrastructure are the main factors preventing export from Central Asia.

According to FAO (2018b), issues such as population growth, shifting diets, increasing demand for animal proteins, and limited agricultural growth potential in African and Asian countries, could drive agricultural export growth from the Central Asian countries. Moreover, the comparative advantage identified as a result of this study suggests that the agricultural sector has the strongest comparative advantage compared to other industries in several countries of the region.

Nevertheless, Central Asia's agricultural exports potential remains unfulfilled. The high trade costs, both in money terms and time delays, are among the reasons for low agricultural exports due to the sensitivity of these products to long transit times. Thus, the extractive industries continue to play a major role in the region's exports, although the relative growth of exports in other sectors suggests a possible and necessary diversification of the Central Asian economies.

Central Asian countries are actively involved in various global and regional and bilateral trade agreements, which, to some extent, have encouraged them to liberalise their markets and bring their institutions up to international standards or harmonise with their main trading partners. Accession to the WTO has moved slowly in Central Asia, however, although three countries have become members and the other two countries are in the process. Since regional cooperation is critical for Central Asian countries because exports usually transit neighbours, many RTAs have been signed. However, these have had little impact on efforts to cooperate, because often they are overlapping, confusing or only presented on paper.

Central Asian countries are, therefore, hardly involved in regional value chains, although cooperation is needed not just to facilitate export, but also to provide access to the best inputs so that countries can participate in GVCs. Apparently, value chain activity takes place much more significantly with intraregional value added, which could be the result of the homogenous nature of the economies, but also the role of the domestic policies in distorting sourcing decisions, quality

of hard and soft infrastructure, as well as other factors like the functioning of intraregional transport markets.

The export development programs initiated in most Central Asian countries, as well as external initiatives, if successfully implemented, may facilitate the development of high-quality export products and promote relations with new trade partners (FAO, 2018a). At the regional level, improving logistics performance in the lagging countries of the region could support the welfare gain (Memedovic et al., 2008). Well-planned and geographically integrated regional infrastructure could be significant for small and landlocked countries and bring a long-term positive effect.

Overall, although Central Asian countries still face market access problems in the form of TBT and SPS, the main obstacles to export diversification are self-imposed high trade costs, most of which are due to poor institutions and policy regulations. The remainder of the thesis focusses on quantifying the magnitude of trade costs in Central Asia and the extent to which they inhibit agricultural exports from this region, as well as assessing the quality of trade costs measurements for Central Asia.

What does ‘doing business’ really measure? Evidence from trade times

This chapter presents a paper published in Economics Letters (2020)

(<https://doi.org/10.1016/j.econlet.2020.109215>). The text of the paper is as published, with only minor changes to formatting. *Headings, tables and figures have been incorporated into the text, but without chapter designations.* There is naturally some repetition with other chapters of this thesis.

Alfinura Sharafeyeva^a, Ben Shepherd^{b*}

*Corresponding author

^a Centre for Global Food and Resources, Faculty of Professions, University of Adelaide, Adelaide, South Australia 5001. ^b Developing Trade Consultants, 315 W 99th St #7C, New York, NY 10025, USA; alfinura.sharafeyeva@adelaide.edu.au; Ben@Developing-Trade.com

Abstract

The World Bank’s Doing Business project claims to provide “objective measures of business regulations in 190 economies”. In the trade literature, a key use of these data has been to show the impact of border delays on trade performance. We revisit previous results using a structural gravity model and panel data for 2005–2015. Although we confirm the original finding, we also show that trade times have a negative and statistically significant impact on services trade—even though services do not in reality experience border delays. The effect is due to an apparent mixing in the Doing Business data of aspects of a country’s institutional environment with information on trade times. Our results provide a caution for applied researchers, and policymakers using these data to track performance.

Keywords: International trade; Trade policy; Trade facilitation

Statement of Authorship

Title of Paper	What does 'doing business' really measure? Evidence from trade times
Publication Status	<input checked="" type="checkbox"/> Published <input type="checkbox"/> Accepted for Publication <input type="checkbox"/> Submitted for Publication <input type="checkbox"/> Unpublished and Unsubmitted work written in manuscript style
Publication Details	Sharafeyeva, A., & Shepherd, B. (2020). What does 'doing business' really measure? Evidence from trade times. <i>Economics Letters</i> , 109215. https://doi.org/10.1016/j.econlet.2020.109215 .

Principal Author

Name of Principal Author (Candidate)	Alfinura Sharafeyeva		
Contribution to the Paper	Undertook the literature review. Obtained the data from the secondary sources. Contributed to the development of the research question, results interpretation and writing the manuscript.		
Overall percentage (%)	50%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	6.02.2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- i. the candidate's stated contribution to the publication is accurate (as detailed above);
- ii. permission is granted for the candidate to include the publication in the thesis; and
- iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Ben Shepherd		
Contribution to the Paper	Supervised development of work, collaborated on modeling and interpretation of results.		
Signature		Date	6.02.2021

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Please cut and paste additional co-author panels here as required.

Introduction

The World Bank's Doing Business (DB) project has revolutionized comparative economics. Starting with the regulation of market entry Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2002), the project has expanded to cover a wide range of areas with the same basic methodology: surveys of knowledgeable parties, typically law firms or other professionals, asking about the time and cost involved in completing a defined series of steps for a hypothetical transaction. DB's 'Trading Across Borders' (TAB) component became prominent in applied research and policy circles following the seminal contribution of (Djankov et al., 2010). As originally designed, TAB summarizes the time and cost taken to complete trade-related formalities in relation to a hypothetical goods trade transaction, including inland transit, documentation preparation, and border delays. The data come from law firms and freight forwarders, but in some cases, there were no recorded contributors directly involved in trade and logistics (Sharafeyeva, 2019). Reported data refer only to businesses in the economy's largest city, and rely on consultancy firms in the capital rather than traders' actual experience. Despite that, more than 50% of recent studies estimating the impact of cross-border costs on trade flows used TAB for their analysis (Chapter 3).

Djankov et al. (2010) use a gravity model for 2005 to show that an extra day's delay as measured by TAB reduces exports by about 1%. Heid et al. (2017) use current best practice methodology to conclude that an extra day's delay reduces exports by 3.5%. Li (2019) argues that a 10% reduction in export delays could increase sectoral exports by 2.3%–6.2% in OECD countries. Results like these have been influential in policy circles, where reducing border delays has become a key objective. This paper revisits the Djankov et al. (2010) result, using the Heid et al. (2017) identification strategy. Our value added is in highlighting a measurement problem in the TAB data: they capture aspects of a country's governance structure in addition to the strict mechanics of crossing borders. A methodology revision in 2015 only partly responds to this problem. These findings have

major implications for governments that use TAB to track performance over time. Similarly, applied researchers need to be careful to account for confounders such as governance in assessing the impact of time on trade, something that the previous literature has not typically done. The paper proceeds as follows. Section 2 introduces our structural gravity model and relates it to the literature. Section 2 presents and discusses estimation results, and Section 3 concludes.

Structural gravity model

The standard panel gravity model takes the following form:

$$(1) X_{ijt} = F_{it}F_{jt}t_{ijt}^{-\theta} e_{ijt}$$

Where: X_{ijt} is exports from country i to country j in year t ; the F terms are exporter-year and importer-year fixed effects; t is bilateral trade costs; θ is a parameter capturing the sensitivity of demand to cost; and e is an error term satisfying standard assumptions. Arkolakis, Costinot, and Rodríguez-Clare (2012) show that a wide class of trade models have the same macro-level implications for the relationship between trade flows and trade costs, even though their micro-level predictions are different.

To complete the gravity model, we specify a trade costs function:

$$(2) t_{ijt} = b_1 time_{it} * intl_{ij} + b_2 RTA_{ijt} + b_3 \ln(1 + tariff_{jit}) + D_{ij} * t$$

Where: $time$ is the variable of interest, namely export time, interacted with a dummy identifying international trade; RTA is a dummy for membership of a free trade agreement (goods) or an economic integration agreement (services); $tariff$ is the applied bilateral tariff rate; and the D terms are country-pair fixed effects interacted with a time trend. Together (1) and (2) are consistent with the identification strategy for export time due to Heid et al. (2017), which incorporates the latest insights from structural gravity. By using this kind of model, we are identifying the effect of time on trade based on

changes over time, as well as between internal and external trade for each country-pair. The fixed effects formulation is extremely rigorous, and limits simultaneity concerns.

To estimate the model, we use Poisson Pseudo Maximum Likelihood (PPML), for the reasons set out by Yotov et al. (2016). Bilateral trade data for 2005-2015 are sourced from the Eora multi-region input output table. This source contains data on intra-national trade, which is required for the structural gravity model to provide consistent and unbiased estimates, in particular with country-specific regressors (Yotov et al., 2016; Heid et al., 2017). The particular characteristics of internal trade costs are accounted for using pair fixed effects interacted with a time trend (Agnosteva, Anderson, & Yotov, 2019). Data on export times come from TAB. Historical and geographical controls come from CEPIL, while data on trade agreements comes from Mario Larch's RTA database (Egger & Larch, 2008, updated annually). Tariffs are taken from the TRAINS database accessed through the World Bank's WITS server.

Table 1 presents estimation results. Pseudo-R2s are very high because of the large numbers of fixed effects. Columns 1 and 2 use data for 2005, 2008, 2011, and 2014, on the basis that a three-year delta allows for adjustment, and limits problems due to serial correlation in the error term (Yotov et al., 2016). Column 1 shows that trade time has a negative and 1% statistically significant impact on trade times in goods, with the coefficient close to some of the estimates in Djankov et al. (2010) but larger in absolute value than those in Heid et al. (2017), which were estimated using a smaller sample. Column 2 runs the same model for services and finds the same result: trade times seem to have a negative and statistically significant impact on services trade as well, which is counterintuitive because balance of payments services trade data do not involve physical border crossings.

A possible explanation is that the pre-2015 TAB data capture a range of factors in addition to border crossing delays, in particular document preparation, which may reflect the

effect of governance and institutions, which in turn affect services trade. The remainder of the table therefore re-estimates the model using data for 2015 only, taking border crossing time, document preparation time, and total time (their sum). Despite the change in data collection methodology, the result persists: export time not only negatively affects goods trade, but also services trade, despite the lack of border formalities.

To examine the hypothesis that the TAB data are in fact capturing institutions, we include an additional variable: the simple average of the six pillars of governance from the Worldwide Governance Indicators, interacted with a dummy for international observations. Beverelli, Fiorini, and Hoekman (2017) show that governance is an important determinant of services trade.

Results are in Table 2. The problem persists in two of the four services regressions: those using total time pre-2015, and document preparation time for 2015. The problem with these two series cannot be fixed by simply controlling for the impact of governance, although the news is better for the border crossing time series for 2015; we interpret that finding cautiously, however, as it is based on a cross-section.

Table 1 Baseline gravity model estimation results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Goods	Services	Goods	Services	Goods	Services	Goods	Services
	TAB Pre-2015	TAB Pre-2015	TAB 2015 (Total)	TAB 2015 (Total)	TAB 2015 (Border)	TAB 2015 (Border)	TAB 2015 (Documents)	TAB 2015 (Documents)
Log(Time)*Int I	-0.352 ***	-0.476 ***	-0.288 ***	-0.159 ***	-0.462 ***	-0.329 ***	-0.532 ***	-0.479 ***
	(0.029)	(0.048)	(0.034)	(0.034)	(0.067)	(0.049)	(0.035)	(0.043)
FTA	-0.024		-0.105		-0.040		-0.046	
	(0.017)		(0.111)		(0.113)		(0.106)	
Log(1+Tariff)	-0.307 **		-8.771 ***		-8.453 ***		-3.906 **	
	(0.138)		(1.955)		(2.037)		(1.725)	
EIA		0.043 ***		0.616 ***		0.718 ***		0.304 ***
		(0.012)		(0.104)		(0.117)		(0.105)
Constant	20.346 ***	21.564 ***	24.827 ***	24.757 ***	24.904 ***	24.594 ***	24.951 ***	24.778 ***
	(0.019)	(0.006)	(0.430)	(0.350)	(0.521)	(0.393)	(0.365)	(0.309)
Observations	69132	69130	19212	19212	17196	17196	19212	19212
Pseudo-R2	1.000	1.000	0.981	0.995	0.983	0.996	0.983	0.996
Gravity Controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Exp-Yr Imp-Yr Pair*Time	Exp-Yr Imp-Yr Pair*Time	Exp Imp	Exp Imp	Exp Imp	Exp Imp	Exp Imp	Exp Imp

Note: Estimation is by PPML. Robust standard errors adjusted for clustering by country-pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). Gravity controls are: log(distance), and dummies for a colonial link, common colonizer, common language, common border, and international observations.

Table 2 Gravity model estimation results with governance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Goods	Services	Goods	Services	Goods	Services	Goods	Services
	TAB Pre-2015	TAB Pre-2015	TAB 2015 (Total)	TAB 2015 (Total)	TAB 2015 (Border)	TAB 2015 (Border)	TAB 2015 (Documents)	TAB 2015 (Documents)
Log(Time)*Int I	-0.344 ***	-0.473 ***	-0.150 ***	0.050	-0.234 **	0.029	-0.426 ***	-0.181 ***
	(0.029)	(0.049)	(0.041)	(0.036)	(0.092)	(0.051)	(0.062)	(0.057)
FTA	-0.022		-0.073		0.002		-0.040	
	(0.017)		(0.130)		(0.116)		(0.113)	
Log(1+Tariff)	-0.324 **		-4.249 **		-3.609 *		-2.940 *	
	(0.141)		(1.984)		(1.913)		(1.743)	
EIA		0.046 ***		0.363 ***		0.402 ***		0.273 ***
		(0.012)		(0.099)		(0.112)		(0.103)
Gov*Intl	-0.149 ***	-0.091	0.688 ***	1.044 ***	0.690 ***	0.998 ***	0.285 **	0.792 ***
	(0.043)	(0.056)	(0.104)	(0.081)	(0.121)	(0.094)	(0.126)	(0.100)
Constant	20.375 ***	21.569 ***	24.884 ***	24.560 ***	24.990 ***	24.559 ***	24.950 ***	24.600 ***
	(0.020)	(0.008)	(0.463)	(0.388)	(0.575)	(0.402)	(0.391)	(0.355)
Observations	69132	69132	19212	19212	17196	17196	19212	19212
Pseudo-R2	1.000	1.000	0.982	0.996	0.984	0.997	0.983	0.996
Gravity Controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Exp-Yr Imp-Yr Pair*Time	Exp-Yr Imp-Yr Pair*Time	Exp Imp	Exp Imp	Exp Imp	Exp Imp	Exp Imp	Exp Imp

Note: Estimation is by PPML. Robust standard errors adjusted for clustering by country-pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). Gravity controls are: log(distance), and dummies for a colonial link, common colonizer, common language, common border, and international observations.

Conclusion

The policy argument for improving trade facilitation has partly been made using the relationship between delays and exports in Djankov et al. (2010) and subsequent papers. However, TAB trade times seemingly also affect services trade, which is not plausible. The finding persists even when newer, more narrowly defined, data are used. It only disappears when a subset of the newer data is used, and the effect of institutions is controlled for, which has not typically been the case in the literature. Our interpretation is that TAB data in fact capture, in part, a country's general administrative machinery, not specific to trade. This limitation is in addition to the range of issues identified by Volpe Martincus (2016), through a comparison of TAB with richer information sourced from micro-data.

**Feeding your workhorse with quality data:
Analysis of trade costs in Central Asia**

This chapter presents an unpublished manuscript, yet to be submitted to a journal for review. It is formatted in submittable manuscript form, with headings, tables and figures incorporated into the text, but without chapter designations. There is naturally some repetition with other chapters of this thesis.

Alfinura Sharafeyeva

Centre for Global Food and Resources, Faculty of Professions, University of
Adelaide,

Adelaide, South Australia 5001.

alfinura.sharafeyeva@adelaide.edu.au

Abstract

This paper examines the fitness of the World Bank's Trading Across Border (TAB) indicators for an analysis of the impact of trade costs on exports of agrifood products in Central Asian countries between 2005 and 2017. The study employs the workhorse gravity model incorporating the TAB indicators for the cost and time to export to test if their impacts on Central Asian exports are higher than on the rest of the world. Contrary to theory, the impacts during the 2005-2014 period were found to be statistically significant and positive. Since the TAB measurement methodology was revised in 2016, the models were re-estimated using data for 2015-2017. The new impacts during the 2015-2017 period were found to be statistically significant and more negative in Central Asia than the rest of the world. Overall, the findings cast doubt on the suitability of using the pre-2016 TAB indicators to measure trade costs in the Central Asian context.

Keywords: agricultural export; trade costs; gravity model; Central Asia; Doing Business

Statement of Authorship

Title of Paper	Feeding your workhorse with quality data: Analysis of trade costs in Central Asia		
Publication Status	<input type="checkbox"/> Published	<input type="checkbox"/> Accepted for Publication	
	<input type="checkbox"/> Submitted for Publication	<input checked="" type="checkbox"/> Unpublished and Unsubmitted work written in manuscript style	
Publication Details	NA		

Principal Author

Name of Principal Author (Candidate)	Atinura Sharafeyeva		
Contribution to the Paper	Undertook the literature review. Prepared data for analysis and performed econometric data analysis in Stata. Interpreted data and wrote the manuscript.		
Overall percentage (%)	100%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	6.02.2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- i. the candidate's stated contribution to the publication is accurate (as detailed above);
- ii. permission is granted for the candidate to include the publication in the thesis; and
- iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Name of Co-Author			
Contribution to the Paper			
Signature		Date	

Introduction

Data is at the core of almost every business or policy decision made. However, the data quality problems are widespread and reliance on data of inadequate or doubtful quality may lead to less-effective decision-making (Price & Shanks, 2008). This paper highlights the risks of relying on data without carefully exploring how it was collected and failing to understand their collection methods and how definitions evolve over time using the World Bank's annual Trading across Borders indicators (TAB).

The TAB indicators are derived from the Doing Business (DB) reports. The DB reports contain data pertaining to trade costs measurements and have been widely adopted by trade policy analysts. The DB dataset contains data for 190 countries and is available on a time-series basis from 2004. The systematic literature review identified that over 50% of all studies were reliant on the TAB dataset in estimation of the border related costs impact on trade. This includes seminal trade literature by authors including Djankov et al. (2010) and Portugal-Perez and Wilson (2009).

The review brought to the researchers' attention, however, that composite indicators, such as the TAB, may be subject to limitations related to the underlying assumptions of the surveys, which 'hardly makes them representative of the universe of companies as a whole' (Volpe Martincus, 2016, p. 31). Behar (2010), for example, found low correlations between trade facilitation measures from firm-level responses in the World Bank's Enterprise Surveys and the analogous TAB indicators. In addition, Sharafeyeva & Shepherd (2020) found a strong and positive relationship between DB trading time and trade in services, concluding that TAB indicators estimate the business environment in general rather than actual trading time. These limitations then raise the questions about the usefulness of TAB data for economic analysis of trade performance. To date there has been little attempt to document the magnitude of the shortcomings and the biases inherent in the construction of the TAB indicators. An implicit assumption of researchers using the DB data appears to be that the imprecision, becomes a less serious issue as data sample gets larger, which does not

result in systematic biases.

In this paper the two TAB indicators are examined, 'cost-to-export' and 'time-to-export', for the landlocked Central Asian countries Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan between 2005 and 2017. These were chosen due to their exceptionally poor TAB rankings up to 2014 and implausibly large positive changes in the subsequent two DB reports. This region is attempting to reduce trade costs to gain export revenue and stimulate their economic development. If analyses are based on misleading data, then any subsequent policy settings and incentives may lead to a misallocation of resources. In countries with limited resources the opportunity costs from poorly targeted policy are high. By adding clarity to the value of TAB dataset for economic analysis, its value for economic research can be confirmed (theory and applied), or identify definitions, data limitations, or collection issues that need to be addressed to make the TAB dataset valuable to economic research.

The 2016 DB report introduced significant changes to the measurement of the TAB indicator. Prior to the DB2016 report, the standardized case study across all countries assumed that the goods being traded were one of six preselected products, shipped in 20-foot containers, and that trade was conducted by sea (World Bank, 2008). These assumptions could result in significant overstating of trade costs in relation to coastal nations, as landlocked countries require at least one transit economy to reach the sea, which necessarily adds to their costs.

After DB2016 report, referring to the data collected for 2015, natural trading partners, which could be neighbouring economies accessed by land, were assumed to conduct trade by the most widely used mode of transport, whether sea, land, air or some combination of these. The new assumption makes the trade cost indicators more relevant for landlocked economies, such as the Central Asian countries, most of whose international shipments, especially in agrifood, are transported by rail, or road. For example, in Kyrgyzstan, the time taken to export fell from 63 days in 2014 to two days in 2015 and in Tajikistan the cost-to-export fell from \$9,050 to \$643. These startling

changes to time and cost lead to the question of whether changes in indicator definitions and measurement of trade cost variables produce different empirical results for determinants of agrifood exports.

Analysis of the data from the current research does, in fact, demonstrate the sensitivity of the trade cost estimates to the change in measurement of the World Bank's Trading across Borders indicators. The new and old collection and calculation methods create misleading results for trade economists and policy development for emerging economies. The outcomes of the current investigation contribute to a better understanding of how particular policies may benefit agricultural trade flows, as well as informing public policy related to the allocation of resources to maximise the overall gain for the agricultural sector in Central Asia from engaging in international trade.

Although this analysis is focused on Central Asia, the implication is that TAB indicators appear to be limited due to the survey methods by which data are collected, while also being systematically biased in accordance with a country's geographical situation and export bundle; and hence unsuitable for unquestioning use in analysis of global trade.

To address concerns raised in this section, this paper tested the following hypotheses:

- 1 The cost-to-export has a greater impact on agrifood exports in Central Asian countries compared to the rest of the world.
- 2 The impact of time-to-export is higher on perishable as opposed to non-perishable agricultural products.
- 3 The impacts of cost-to-export and time-to-export indicators estimated by gravity model are sensitive to these indicators changing definitions and measurements between 2005-2014 and 2015-2017.

This paper presented as follows. Next section provides an overview of the TAB indicators, followed by description of the methods, data and estimation strategy.

Then, the hypotheses results based on gravity model analysis and discussion are reported, and with concluding remarks completing the paper.

The World Bank's Trading Across Borders indicators

DB measures the time and cost (excluding tariffs and unofficial payments) associated with three sets of procedures - documentary compliance, border compliance and domestic transport - within the overall process of exporting or importing a shipment of goods. These include time and costs for documents, administrative fees for customs clearance and technical control, terminal handling charges and inland transport. The measurement and assumptions for the time and cost indicators have been changing since the dataset was first introduced and most dramatically between the 2015 and 2016 Doing Business reports (Table 1).

The 2016 DB report, states that each economy exports the product for which it enjoys a comparative advantage in relation to its natural export partner, that is, the economy that is the largest purchaser of the product. It is assumed that trade is conducted using the most common mode of transport, whether sea, land, air or some combination of these. Any time and cost attributed to an economy are those incurred while the shipment is within that economy's geographic borders. All of these revisions make the DB closer to the real trading conditions in landlocked Central Asia²⁵. Moreover, because the new methodology also allows for regional trade, it emphasises the importance of customs unions:

An improvement under the new methodology was recorded for Croatia, which is part of the European Union. In the new case study Croatia both exports to a fellow EU member (Austria) and imports from one (Germany), and documentary and

²⁵ The pre-2016 method was an important limitation for landlocked economies as calculations of time and cost included those associated with border processes in transit economies. All Central Asian economies are landlocked, and Uzbekistan is double-landlocked, implying that the TAB indicators would reflect the time and costs associated with transiting at least two borders before the good reaches the sea. However, the natural trading partners for Central Asian countries, especially for perishable goods, are the neighbouring countries that can be reached in shorter times and at lower costs over the land border. The TAB indicators between 2005 and 2014 assumed containerized shipments, which for Central Asian countries would not be the common way of shipping agrifood and other commodities that could be transported by railways or trucks or cars.

border compliance therefore take very little time and cost as measured by Doing Business. (World Bank, 2016b)

Table 1 Comparison of Trading across the border measurement, DB2015 and DB2016

	DB2015	DB2016
A unit of trade	A dry-cargo, 20-foot, full container load	A shipment
Type of the unit of trade	Containerized	Export shipments do not necessarily need to be containerized; 15 tons of noncontainerized products
Traded product	One of the economy's leading export or import products	A product of economy's comparative advantage (defined by the largest export value) to its natural export partner
Set of trading procedures	<ol style="list-style-type: none"> 1. Documentary compliance 2. Customs clearance and inspections 3. Inland transport and handling 4. Port and terminal handling Does not include sea transport Each stage requires a minimum time of 1 day each and cannot take place simultaneously	<ol style="list-style-type: none"> 1. Documentary compliance 2. Border compliance 3. Domestic transport For a coastal economy with an overseas trading partner, domestic transport captures the time and cost from the loading of the shipment at the warehouse until the shipment reaches the economy's port The set of procedures is potentially simultaneous
The mode of transport	Sea	The one most widely used for the chosen export or import product and the trading partner, as is the seaport, airport or land border crossing (truck, train, riverboat)

Source: based on the World Bank (2015, 2016a)

Thus, even if there had been no change in actual trade costs, the Central Asian countries would have received a better TAB score as many goods, especially agricultural products, are mostly traded inside Central Asia. Additionally, all four countries have important free trade agreements, either in the Eurasian Economic Union (Kazakhstan and Kyrgyzstan) or the Commonwealth of Independent States Free Trade Area, to which all four nations belong, which also had to push their scores up.

In the DB reports for 2005 to 2014, the time to complete a single trade was recorded in calendar days, starting from the moment when the trading process was initiated and running until it was completed (World Bank, 2008). It was assumed that document preparation, inland transport and customs clearance and inspections, and port and

terminal handling required a minimum time of one day each and could not take place simultaneously. After 2015, time was measured in hours (one day = 24 hours) and the ‘set of procedures for documentary compliance is potentially simultaneous with those for domestic transport and is highly likely to be simultaneous with port or border handling, with customs clearance and with inspections’ (World Bank, 2016a, p. 150). Thus, an overall reduction of the time to export in this indicator in DB2016 and later is anticipated.

As would be expected, therefore, the new measurement parameters resulted in a significant improvement in the TAB indicators for Central Asian countries. Table 2 illustrates the significant changes of the TAB rankings between 2013-2014 and 2015-2016 for Central Asia. Compared to the more representative countries, such as Germany and USA, it can be seen that no such a significant change occurred in these countries, though some drop of ranking can be observed.

Table 2 Ease of Trading across borders ranking, 2013-2014 vs 2015-2016

Country	Ease of Trading across borders ranking			
	2013	2014	2015	2016
Kazakhstan	186	185	122	119
Kyrgyzstan	182	183	83	79
Tajikistan	188	188	132	144
Uzbekistan	189	189	159	165
USA	22	16	34	35
Germany	14	18	35	38

Source: based on World Bank (2020e)

Note: Ranking among 189 countries in 2014 and 2015, and 190 countries in 2016. The Doing Business reports’ data refer to the situation in the previous June, i.e. the DB2016 numbers refer to trading across borders conditions in 2015. The rankings are for 2013 and 2014 (before changed TAB measurement) vs 2015, 2016 (after changed TAB measurement)

Looking at the TAB components, it can be seen that the time to export in Kyrgyzstan improved from 63 days in DB2015 to two days in DB2016, while in Kazakhstan, it changed from 79 days in 2014 to 11 days in 2015 (Figure 1, right). Similarly, cost to trade also dropped significantly, with the highest reduction in Tajikistan, from US\$9,050 in 2014 to US\$643 in 2015 (Figure 1, left).

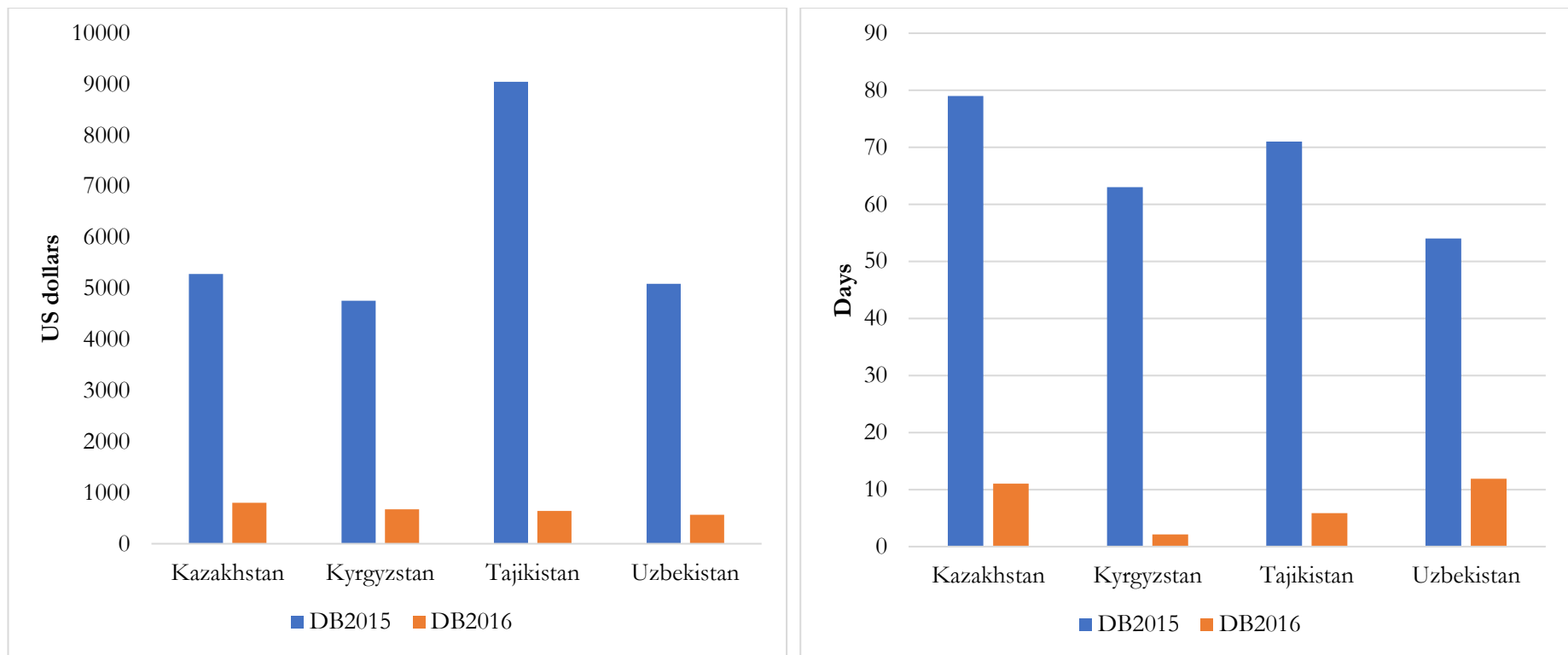


Figure 1 Cost (left) and time (right) to export in DB2015 vs DB2016 for Central Asian countries.
Source: Based on World Bank (2020e)

Finally, the data in each year's DB report indicate that the individuals contributing to the dataset 'are private sector experts in international trade logistics' (e.g. see p.104 IBRD and World Bank (2018)). For Central Asian countries, the percentage of contributors' employers (indicated by company name), who were directly involved in trade and logistics varied between zero and 19% (Table 3). This suggests that the contributors are only data reporters, and that people involved in international trade logistics are under-represented (or not represented at all) in the list of the respondents. The number of trade and logistics practitioners contributing to the Central Asian indicators is low and for DB2016 and later years, it is most often zero, validating the criticism of Behar (2010) that DB relies too much on non-practitioners.

Table 3 Doing Business contributors from Central Asia

Country		DB 2006	DB 2009	DB 2012	DB 2015	DB 2016	DB 2017	DB 2018
Kazakhstan	Total number of respondents	42	39	56	68	100	134	117
	Trade and logistics respondents	1	5	1	3	1	1	0
	Share of trade and logistics firms	2%	13%	2%	4%	1%	1%	0%
	Not identified				1	3	1	2
Kyrgyzstan	Total number of respondents	21	42	33	50	57	52	48
	Trade and logistics respondents	2	2	2	3	2	3	0
	Share of trade and logistics firms	10%	5%	6%	6%	4%	6%	0%
	Not identified		2			4		4
Tajikistan	Total number of respondents	na	19	29	28	34	35	39
	Trade and logistics respondents	na	1	4	4	0	0	2
	Share of trade and logistics firms	na	5%	14%	14%	0%	0%	5%
	Not identified			1		7	1	2
Uzbekistan	Total number of respondents	11	31	31	37	33	28	32
	Trade and logistics respondents	1	4	6	5	0	0	0
	Share of trade and logistics firms	9%	13%	19%	16%	0%	0%	0%
	Not identified		1	1				3

Source: based on the World Bank's Doing Business reports for 2006-2018.

Methods, data, and estimation strategy

To test the hypotheses set up in the introduction, the study employed an augmented gravity model. The traditional gravity model is proposed by Tinbergen (1962) and based on an analogy with Newton's law of gravitation. A mass of goods or labour or other factors of production supplied at country i , Y_i , is attracted to a mass of demand for goods or labour at destination j , E_j , but the potential flow is reduced by the total trade costs between countries i and j , T_{ij}^θ ,

$$(1) X_{ij} = Y_i E_j / T_{ij}^\theta$$

Anderson and Wincoop (2003) derived the structural gravity model of trade with multilateral resistance terms under the assumption of identical constant elasticity of substitution preferences across countries for national varieties differentiated by place of origin (the Armington assumption). Multilateral resistance terms take into account that trade between two partners is subject to the barriers that each country faces with all its trading partners.

$$(2) X_{ij} = \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} Y_i E_j$$

Where:

X_{ij} is exports in value terms from country i to country j

E_j is expenditure in country j

Y_i is production in country i

t_{ij} captures bilateral trade costs

σ is the elasticity of substitution across varieties

P_j is inward multilateral resistance, which captures the dependence of bilateral shipments into j on trade costs across all inward routes

Π_i is outward multilateral resistance, which captures the dependence of bilateral shipments out of i on trade costs across all outward routes.

Not accounting for multilateral resistance terms in a gravity model can lead to biased parameter estimates. At the estimation stage, multilateral resistance terms can be addressed with country-level fixed effects, but one then loses scope for analysis of country-level factors. Most commonly, the model is estimated by PPML with fixed effects, which collapses into the following empirical setup:

$$(3) X_{ij} = \exp(T_{ij}\beta + \pi_i + \chi_j)e_{ij}$$

Where:

T_{ij} is a vector of observables capturing different elements of trade costs

π_i is a set of exporter fixed effects

χ_j is a set of importer fixed effects

e_{ij} is a standard error term.

If a model is estimated with PPML with fixed effects, the estimated fixed effects correspond exactly to the terms required by the structural model (Silva & Tenreyro, 2006). The estimation strategy follows (Yotov et al., 2016) and the benchmark estimation model takes the multiplicative form:

$$(4) X_{ijt} = \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 \ln(Trade\ cost_{it}) * RoW \\ + \beta_4 \ln(Distance_{ij}) * RoW \\ + \beta_5 \ln(FTA_{ijt}) \\ + \beta_6 \ln(Comcol_{ij}) + \beta_7 \ln(Landlocked_i) + \beta_8 \ln(Border_{ij}) \\ + \beta_9 \ln(Language_{ij}) + \beta_{10} \ln(Trade\ cost_{it}) * CA \\ + \beta_{11} \ln(Distance_{it}) * CA + \eta_{jt} + \mu_{jt} + \gamma_{ij} + \varepsilon_{ijt}$$

Where:

The dependent variable (X_{ijt}) is the export values in US dollars

A subscript t stands for year

The trade costs indicator, $\ln(\text{Trade cost}_{it})$, is the vector of the trade costs indicators related to the definition of trade costs:

$$\ln(\text{Trade cost}_{it}) = [\ln(\text{Time_Ex}_{it}); \ln(\text{Cost_Ex}_{it})]$$

Trade cost indicators are measured as time-to-export in days (Time_Ex_{it})

Cost-to-export in US dollars (Cost_Ex_{it}).

Interactions of the trade cost indicators and distance with the variables CA and RoW were used to differentiate the impact on Central Asian countries and on the rest of the world, and thus, address the first hypothesis.

The independent variables included the classic set of trade explaining variables—the GDPs of the exporter and importer in current US dollars (GDP_{it} and GDP_{jt}) and the geographic distance between the capital cities of the trading partners (Distance_{ij}).

There was also a set of commonly included dummy variables, such as:

- landlockedness (Landlocked_i)
- common language (Language_{ij})
- common colonizer (Comcol_{ij})
- common border (Border_{ij})
- bilateral trade agreements (FTA_{ijt}).

The dependent variable is the export value in current US dollars at HS four-digit products classification: grapes (HS0806) and tomatoes (HS0702), standing for the group of perishable commodities; wheat (HS1001) and cotton (HS5201), standing for the non-perishable products. All the 'classic' variables, GDPs, distance, common border and language, free trade agreement (FTA) and landlockedness, came from CEPII database²⁶. Trade cost variables were the time and cost-to-export components of the TAB indicator. The datasets were separated into two time periods, 2005-2014

²⁶ The Centre d'Études Prospectives et d'Informations Internationales,
<http://www.cepii.fr/CEPII/en/cepii/emploi.asp?IDemploi=11>

(reflecting the earlier TAB methodology) and 2015-2017 to analyse the effect of the updated methodology. The detailed definition and data sources are in Appendix L.

The estimation approach was as follows. A benchmark model (equation 4) was estimated with a PPML exporter-year and importer-year fixed effects to control for multilateral resistance terms²⁷. The lack of internal trade data would not support the use of the traditional approach recommended in the most recent literature. The exporter-year and importer-year fixed effects that are commonly recommended by the literature absorb the estimates for all the time varying variables, including trade cost indicators. Despite that, the theory consistent coefficients for time invariant variables obtained in such a set up act as a benchmark for all other estimation techniques (Appendix M).

The next step was to estimate the model with exporter-importer and year fixed effects only, which resulted in close estimates for time-invariant variables compared to the benchmark results. Thus, it was safe to assume that such an approach would provide results similar to the theory-consistent outcome. Therefore, the results reported here were obtained from the PPML estimator with exporter, importer and time fixed effects.

A panel dataset with four periods (2005, 2008, 2011, and 2014) was used instead of consecutive years for the 2005-2014 dataset analysis. This approach allowed for adjustment in bilateral trade flows in response to trade policy or other changes in trade costs (e.g. Yotov et al., 2016). The model estimated separately for each product. The number of observations in each dataset varied between 262,602 and 270,600 for the selected four products (Appendix N).

A similar approach was used to estimate the impact of trade costs based on the data from 2015-2017. However, due to the small number of years in the panel, consecutive years, instead of periods were used. The number of observations for this period varied

²⁷ All the regressions were run using the specific STATA command developed by Correia, Guimarães, and Zylkin (2019) for high dimensional fixed effects with PPML. The OLS was estimated at the early stage of the analysis, but, since the literature consensus is in using the PPML, only results obtained with PPML are presented in this paper.

from 79,218 to 89,268. The regression was run twice for each product, with cost-to-export and time-to-export indicators appearing separately in the models, to avoid potential collinearity problem between them (correlation coefficient=0.66, detailed summary statistics and correlation coefficients in Appendix O, and Appendix P, respectively).

Results and discussion

With the global dataset, the standard gravity variables are statistically significant and have the expected signs; export values are positively related to partners' GDP and negatively related to distance. The trade policy variable, FTA between trading partners, plays a positive and statistically significant role for exports of perishable products, but coefficients are not significant for the non-perishable commodities, wheat and raw cotton. The estimation results prove that long distances to meet global markets play a significant role for Central Asian countries' agrifood exports.

However, the coefficients for the trade cost indicators, cost-to-export and time-to-export, yield mixed outcomes, some of which are contrary to expectations, and others are not significant. Table 4 reports the estimates for perishable (tomatoes and grapes) and non-perishable (wheat and raw cotton) products for 2005-2014, using PPML with exporter, importer, and year fixed effects. The first hypothesis tested whether higher cost-to-export has a stronger impact on trade in Central Asian countries than on the rest of the world. However, the trade cost coefficient result is only significant and negative for exports of tomatoes at the global level. In Central Asia, the coefficient of the trade cost indicator is significant and negative for exports of wheat. Counterintuitively, the results for raw cotton for Central Asia are positive and significant. With such a mixed and theory-inconsistent outcome, it fails to conclude that Central Asian agrifood exporters suffer more than global exporters due to higher costs to export.

Table 4 Gravity model results for perishable and non-perishable products at HS 4-digits level estimated with PPML exporter, importer and year fixed effects, 2005-2014

	(1)	(2)	(3)	(4)
	Tomatoes (HS 0702)	Grapes (HS 0806)	Wheat (HS 1001)	Raw Cotton (HS 5201)
GDP exporter	0.093	0.316	0.407	0.201
	(0.231)	(0.160)**	(0.220)*	(0.273)
GDP importer	1.196	1.088	0.200	0.523
	(0.228)***	(0.147)***	(0.152)	(0.289)*
Distance RoW	-2.016	-1.053	-1.923	-0.965
	(0.242)***	(0.129)***	(0.122)***	(0.164)***
Cost RoW	-0.974	0.067	0.124	0.009
	(0.217)***	(0.150)	(0.269)	(0.234)
Time RoW	-0.386	-0.306	0.051	-0.818
	(0.203)*	(0.119)**	(0.209)	(0.561)
Distance CA	-2.492	-3.251	-3.626	-2.026
	(0.730)***	(0.390)***	(0.444)***	(0.581)***
Cost CA	1.149	0.609	-1.350	0.810
	(0.962)	(0.534)	(0.786)*	(0.293)***
Time CA	1.336	-0.065	9.411	2.205
	(1.555)	(1.448)	(3.314)***	(2.629)
Common border	0.033	0.536	0.065	0.696
	(0.273)	(0.202)***	(0.164)	(0.279)**
Common language	1.337	0.155	0.242	0.353
	(0.511)***	(0.170)	(0.178)	(0.309)
Common colonizer	0.860	-0.064	0.767	0.355
	(0.391)**	(0.394)	(0.299)**	(0.331)
FTA	1.795	1.251	0.222	0.158
	(0.298)***	(0.148)***	(0.142)	(0.190)
Constant	1.710	-14.004	15.623	7.643
	(10.484)	(6.071)**	(7.503)**	(8.368)
N	88,915	93,586	89,385	86,317

Standard errors in parentheses * p < 0.10, ** p < .05, *** p < .01; Standard errors clustered by country-pair

The explanation of such results may be due to the assumptions behind the cost-to-export indicator. This indicator is based on a full 20-foot container of dry cargo, loaded with the economy's leading export products and shipped by sea. Such a specification excludes the heterogeneity of trade cost options. This, especially, applies to perishable

agricultural commodities, where refrigeration might be required. A positive relationship between the export value of raw cotton and the cost-to-export indicator may be due to the specifics of raw cotton trading procedures.

Next, the results are also not sufficient to answer the second hypothesis, whether the impact of time-to-export is higher on perishable as opposed to non-perishable goods. Time-to-export is negative and significant only for perishable products, tomatoes and grapes at the global level. The results are not significant for the non-perishable group. In Central Asia, time-to-export is only significant with a high positive coefficient for wheat, implying longer times are associated with the greater export value of wheat. This result may be due to: 1) assumptions about the traded good; 2) the mode of transport specified in the TAB measurement, which assumed that the good is containerised and shipped by sea, none of which applies to Central Asia, where wheat is usually sent by trucks or trains, not in sea freight containers.

In the case of landlocked countries, goods shipped by sea must pass at least one extra border before reaching a seaport, which implies an overestimation of trade costs for Central Asian wheat, where up to 50% is traded once it crosses the border. This is likely to cause the unexpected and non-theoretically consistent result of a positive association between time indicators and exports of wheat. Apart from this, a lack of variation in the value of exports among Central Asian countries by export market for each of the selected products could also be a reason for insignificant results.

To answer the third hypothesis, testing if changing definitions and measurement of the same trade cost indicator from one period to another affects the gravity model results, the models were re-estimated by using data from 2015 to 2017. Table 5 reports the trade cost and distance related results. The distance-related variable is in line with expectations with somewhat higher coefficients as compared to the previous period results.

The trade cost variables reveal strikingly different results. For Central Asia cost-to-export turns out to be highly negative for both tomatoes and grapes at a 1% level of

significance, with the point estimate being a 1% increase of cost-to-export associated with a 16 and 12% decrease in exports of tomatoes and grapes, respectively. The impact of high trade costs on the export of grapes is four times greater for Central Asia compared to the rest of the world. Moreover, the coefficient for Central Asian raw cotton changed the high positive sign in the previous dataset analysis to a negative and significant coefficient in the latest trade cost specification. These results are much more plausible than those in Table 4.

Finally, the time-to-export is negative and significant for exports of grapes and raw cotton in Central Asia, with a point estimate being a 1% increase of time associated with a 6% decrease in grape exports. This can be translated, as on average 2-hours border delay would reduce grapes exports by \$9 million per year. Whereas the same increase of exporting time is associated with 3% decrease in export of cotton. Thus, these results support hypotheses (1) and (2) that Central Asian horticulture is more affected by higher costs to export, as well as proving that perishable agricultural products are more vulnerable to longer times to export than non-perishable crops.

Overall, the drastic change of the signs and the trade cost coefficients demonstrate the high sensitivity of the gravity model results regarding the impact on export values due to changing definitions and measurement of trade cost variables. The results advise that gravity estimates are sensitive to the changing trade cost measurement and, models using the TAB indicators after 2015 obtain more theory-consistent outcomes.

A changed definition of the export goods from pre-selected products to products with comparative advantage allows selection of the products at a disaggregated level. Next, the extension of the assumption about the transportation mode from containerised sea shipments to 'the most widely used for the chosen export product (truck, train, or riverboat)' and assuming a 'natural' partner provide more relevant indicators for landlocked countries. This is an important improvement for the analysis of Central Asian countries, where the goods, agrifood in particular, are traded by trucks and

railroads, and most of the trade, especially of the perishable products, occurs intraregionally.

Table 5 Gravity model results for perishable and non-perishable products at HS 4-digits level estimated with PPML exporter, importer and year fixed effects, 2015-2017

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tomato1	Tomato2	Grapes1	Grapes2	Wheat1	Wheat2	Raw_Cotton1	Raw_Cotton2
RoW_distance	-3.031	-3.031	-1.302	-1.302	-1.495	-1.495	-1.169	-1.169
	(0.220)***	(0.220)***	(0.158)***	(0.158)***	(0.153)***	(0.153)***	(0.175)***	(0.175)***
RoW_cost	1.184	1.184	1.651	1.654	-1.610	-1.614	-1.413	-1.426
	(0.659)*	(0.660)*	(1.579)	(1.579)	(0.763)**	(0.763)**	(0.961)	(0.961)
RoW_time	-0.622	-0.622	-0.393	-0.393	1.902	1.899	1.773	1.806
	(0.541)	(0.541)	(0.183)**	(0.183)**	(1.172)	(1.172)	(0.748)**	(0.757)**
CA_distance	-2.042	-2.042	-2.716	-2.716	-6.634	-6.634	-1.479	-1.479
	(0.811)**	(0.811)**	(0.562)***	(0.562)***	(0.953)***	(0.953)***	(0.630)**	(0.630)**
CA_cost	-16.366		-12.497		0.268		-4.158	
	(0.711)***		(3.854)***		(0.685)		(1.164)***	
CA_time		-73.012		-6.388		1.313		-2.905
		(67.977)		(3.043)**		(5.754)		(1.262)**
N	64,251	64,251	68,229	68,229	58,056	58,056	52,761	52,761

Note: Standard errors in parentheses * p < 0.10, ** p < .05, *** p < .01; Standard errors clustered by country-pair

Conclusion

The goal of the study was to examine the suitability of the TAB indicators for an analysis of the impact of trade costs on exports of agrifood products in Central Asian countries. The gravity model analysis revealed mixed and sometimes theory-inconsistent outcomes across products as well as across trade cost indicators for the pre-2016 TAB dataset. Using the after 2016 TAB indicators, the results were more in line with theory consistent compared to results derived from earlier datasets.

These findings suggest that the commonly used gravity model and pre-2016 TAB indicators are not well suited for disaggregated agricultural products and not for Central Asia, where actual agrifood commodities logistics may differ from the assumed practices. Consequently, past policy formulation based on the 2005-2014 TAB data must be revisited for Central Asian countries. Additionally, any policy globally based on this data, especially other landlocked countries, may have created a misallocation of resources. This implies that any anticipated gains from trade costs reduction policies may have outcomes far less than anticipated.

Issues of improving the export policies of the Central Asian countries are becoming ever more relevant as national strategies and programs for export development have been developed or are under development, with a special role given to agrifood exports (FAO, 2018a). Often these strategies are not effective, which is expressed, in particular, in the insufficient development of export support institutions, primarily non-governmental organisations, such as chambers of commerce or associations of exporters, and underestimation of their potential in promoting products to foreign markets. A closer analysis of the pre-border, border and behind-the-border costs to trade will contribute to better resource allocations in order to promote exports in Central Asia. The discontinuity of the TAB indicators suggests that there is a need to find alternative data sources and estimation techniques to assess the impact of trade costs on perishable and non-perishable products in Central Asia.

CPMM as a direct measure of trade costs

This chapter uses an alternative database on trade costs developed within the Central Asia Regional Economic Cooperation (CAREC) Program to understand whether intra-regional trade and market integration have improved and why, or why not. The previous chapter showed that Doing Business Trading across Borders (TAB) indicators are flawed for Central Asia. Therefore, the results of the impact of trade costs on agrifood exports in Central Asia using TAB indicators and the workhorse gravity model were unconvincing. Thus, in this chapter it was tested whether the trade cost measurements from the CAREC program that are based on the actual experience of traders and freight forwarders²⁸ yield more theory-consistent results on the effect of trade costs on exports than the TAB indicators.

7.1 Background

The Asian Development Bank (ADB) began the CAREC Program in 1997 to foster economic cooperation and integration in Central Asia (ADB, 2014a). The program is a collaboration of 11 countries working together to promote development through cooperation, leading to accelerated economic growth and poverty reduction. Much of CAREC's investment focuses on transportation - reflecting the importance of increasing connectivity - while trade facilitation has received substantial funding through technical assistance (Kim & Mariano, 2020). The CAREC six transport corridors (Box 7.1) are key routes intended to improve connectivity and to facilitate cross-border movement, as well as expand trade and regional economic cooperation (Appendix Q: Maps for each corridor).

²⁸ A company that receives and ships goods on behalf of other companies (Definitions from Oxford Languages).

Box 7.1 Six CAREC corridors

Corridor 1: Europe–East Asia (Kazakhstan, Kyrgyzstan, and XUAR)

Corridor 1 is the most active corridor for CAREC export, import and transit traffic by both road and rail, including high growth in trade between Europe and China. The completion of the Khorgos, a second China-Kazakhstan rail line in the early 2010s alleviated capacity problems and provided a more direct link between China and population centres such as Almaty, Bishkek and Shymkent. Corridors 1b and 1c are near large populations, and have economic connectivity potential, as they pass through Nursultan (Astana) and Almaty (1b), and Bishkek and Kashi (1c) (Figure 8.1).

Corridor 2: Mediterranean–East Asia (Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, and XUAR)

Corridor 2 includes the EU-sponsored Transport Corridor Europe–Caucasus–Asia (TRACECA) corridor, with links across the Caspian Sea to Azerbaijan and Georgia and then across the Black Sea to Europe. Trade prospects along the corridor are very good. The transport pattern is currently dominated by oil products, but that will change over time with the construction of new pipelines. This corridor offers strong connectivity to both economic and population centres throughout Central Asia.

Corridor 3: Russian Federation–Middle East and South Asia (Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan)

North-south rail lines are important between Central Asia and Russia, but there is only limited transit volume between Russia and Bandar Abbas through the CAREC region. Prospects are good for the export of timber, minerals, and metals from Russia and Kazakhstan, with general goods coming from the Persian Gulf. There is good connectivity to population and economic centres, and between northern forest and mining areas, and the oil-producing Persian Gulf.

Corridor 4: Russian Federation–East Asia (IMAR, Mongolia, and XUAR)

Corridor 4 does not pass through the Central Asian countries.

Corridor 5: East Asia–Middle East and South Asia (Afghanistan, Kyrgyzstan, Pakistan, Tajikistan, and XUAR)

Traffic varies along stretches of Corridor 5, but remains low in Kyrgyzstan and Tajikistan. Transport through Afghanistan is limited by high trade costs and will not be dealt with much in this chapter. There are substantial prospects for the China-Pakistan trade via this corridor, which is an alternative to the Karakoram Highway.

There is also potential for increased economic exchange between China and Pakistan. Pakistan has been the largest recipient of funding under China's Belt and Road Initiative, and exporters from Kyrgyzstan and Tajikistan use the Karakoram Highway in preference to transiting Afghanistan. However, crossing the Himalayas is not an easy route, and impassable in winter.

Corridor 6: Europe–Middle East and South Asia (Afghanistan, Kazakhstan, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan)

Rail traffic along Corridor 6 is relatively high along the Uzbek and Kazakh sections and at the Afghan-Pakistani border.

ADB (2014a)

Corridors 1, 3 and 6 could compete with the all-sea route between China and Europe, especially for some countries between the two sides, due to close connections between landlocked CAREC countries (ADB, 2014a). There is potential for increased economic exchange between northern Europe and the Gulf region, but because of the many border crossings and railway gauge changes, the corridor scores low on this criterion. An ongoing civil insecurity in Afghanistan and the inefficiency

of the Pakistani railway system may limit the prospects for improvement (ADB, 2014a).

However, despite some improvements, according to Kim and Mariano (2020), intraregional trade share in CAREC's total trade between 2010 and 2017 improved only by 0.1%. Such a small improvement implies that the CAREC countries benefit more from trade outside the region than from trade within. Among the reasons for low intraregional trade, along with geographic impediments, are similar production structures, and low export diversification (Kim & Mariano, 2020).

7.2 CAREC trade facilitation indicators

There was a gap in evaluating trade facilitation interventions in the Central Asian region due to lack of the continuous time series data that tracks the changes in border crossing times and other transport and transit measures over time (ADB, 2014a). Prior the CAREC initiative, the impact of interventions (e.g., development projects) was usually measured before and after a shock to a system had been introduced, which could evaluate only *ad hoc* impacts at particular border crossing points (BCP) and corridor performance, and could not provide a picture for the whole region.

In 2010 the CPMM Trade Facilitation Indicators (TFIs) were implemented to track and analyse the impact of improved border crossing services on the regional economy and trade in Central Asia (ADB, 2014a). The CPMM methodology is a modified original UNESCAP Time/Cost/Distance (TCD) methodology that have optimised its ability to measure and effectively monitor the border crossing, and CAREC corridor performance over time.

TCD data are usually collected over the phone interviews with either a freight forwarder or a transport operator engaged in transit activities (ADB, 2014a). The TCD framework seeks to track the changes in time (measured in hours or days) and cost (measured in US dollars) over distance (measured in kilometres). As the data

are entered in a Microsoft *Excel* spreadsheet, a chart will display the changes of time or cost over distance as presented on Figure 7.1 (UNESCAP, 2003).

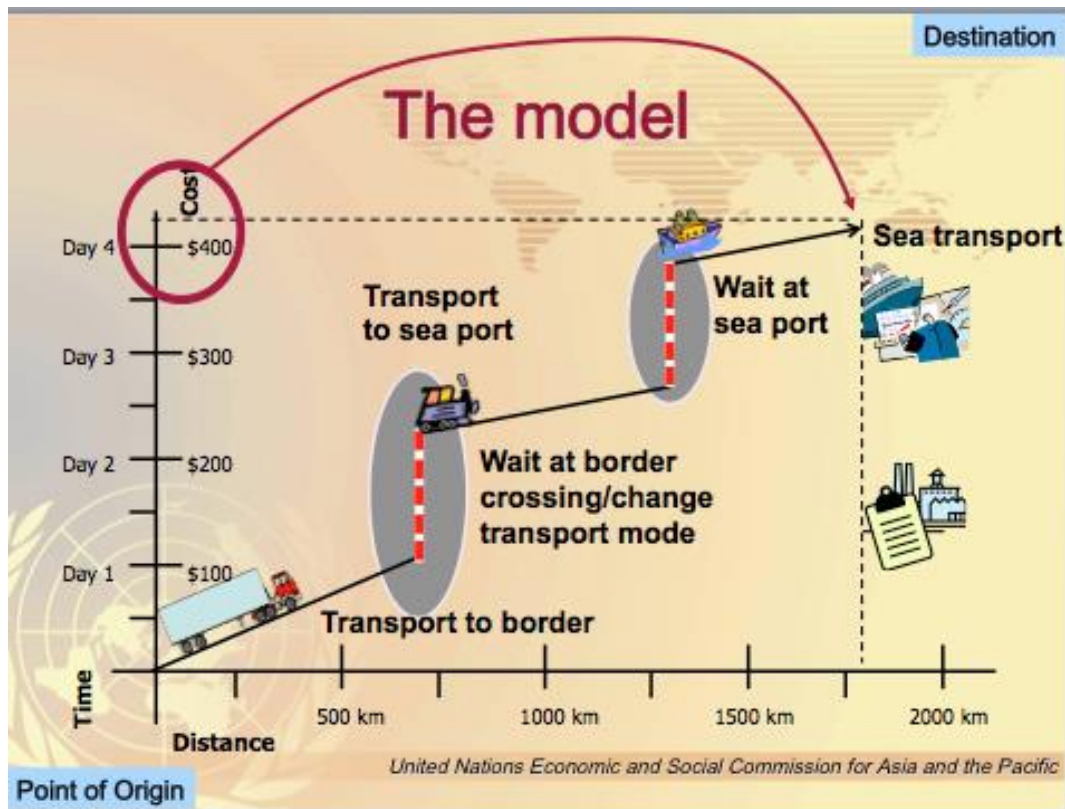


Figure 7.1 UNESCAP time/cost/distance chart.
Source: UNESCAP (2003)

The CPMM data are collected from drivers directly, and therefore time and cost for each sampled shipment are measured with greater accuracy. Common transport corridors are selected and data on TCD are recorded by drivers or consultants along the route. CPMM specifies a thorough list of possible activities related to border clearance inspections and other inspections along the corridors and seeks to quantify the time- and costs of each activity (ADB, 2014a). In addition, where possible, data are collected relating to the extent of unofficial payments. Besides the distance, time, and cost of a shipment, data such as tonnage carried, use of TIR carnets, and other key details are collected and provided in the annual reports that have been published by the CAREC Secretariat since 2011.

Based on the information received, four TFIs (Appendix R for definitions) are being monitored and reported regularly to analyse the changes of TFIs along the CAREC

corridors over time. To standardise transport cost, CPMM adopts 500 kilometres as a unit of distance, and 20 tons as a unit of weight. This creates a standardised unit for comparisons between road shipments across different corridors and different shipments with varying distance and weight. The decision on these units was based on the statistical mode of the early samples of CPMM.

The CPMM involves four major stakeholders:

- Drivers and freight forwarders record data and fill out the customised CPMM data collection forms, which are submitted to the national transport association.
- National transport associations initially provide the customised CPMM data collection forms to drivers; then receive the completed CPMM data forms after each trip. The transport associations, and the national carrier and forwarder associations also conduct training in CPMM for national transport associations and drivers, enter data or fill out the TCD template, visit BCPs when necessary, and coordinate activities between drivers.
- International consultants work in the field to audit the work of the transport associations. They design the CPMM methodology, review the TCD templates submitted monthly and forward them to the ADB secretariat.
- The ADB secretariat aggregates monthly submissions, advises on key changes in methodology or policies under CPMM, organises CPMM workshops, and processes payments for verified TCD samples (ADB, 2014a).

The CPMM TFIs are more representative of the CAREC region as compared to any other indicators of this type, because data by mode of transportation (road and rail) and by BCPs are available for all of the six CAREC transport corridors (Appendix Q), as well as commodity groups (Appendix S). Moreover, the frequency of the data is both quarterly and annual.

This contrasts with the globally available trade cost/facilitation indicators, which are usually released only on an annual or biennial basis, and thus limit timely analysis. Finally, other measurement methodologies, such as World Bank's TAB or logistics

performance indicator (LPI), measure the perceptions of respondents, who are generally not traders, and which could be subjective. CPMM, on the other hand, collects real-life and well-defined data to quantify each indicator (ADB, 2014a).

7.3 The dataset

The raw dataset used in this work consisted of 23,204 observations, reported by 15 exporter countries and 16 importer countries. The observations included cities of origin and destination, modes of transport and commodity class for 2011-2018 (see the description of each variable in Appendix T). After cleaning, aggregating and balancing the dataset for the seven trading partners of interest in the CAREC region (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, China and Russia), 44% of possible observations (n=171 out of N=392) were recorded as unavailable (Table 7.1). Since the dataset mainly reflects border crossing points, the unavailable observations were generally for non-contiguous countries, such as country-pairs Turkmenistan-China, Uzbekistan-China, and Tajikistan-Turkmenistan.

Table 7.1 Number of years with unavailable data for key variables (cost-to-export and time-to-export) from 0=all years available; to 8=all 8 years unavailable

		Importers						Total	
		CHN	KAZ	KGZ	RUS	TJK	TKM		UZB
Exporters	CHN	5	0	0	2	0	2	4	13
	KAZ	6	4	0	4	6	6	0	26
	KGZ	0	0	5	0	2	5	5	17
	RUS	0	3	0	8	6	7	6	30
	TJK	7	5	4	6	2	8	8	40
	TKM	8	0	0	7	0	7	0	22
	UZB	8	0	4	5	0	0	6	23
Total		34	12	13	32	16	35	29	171

Note: same exporter-importer country-pair (e.g. CHN-CHN) reports the costs incurred while exporting goods in-transit

Notably, there are plentiful records for all years for the border crossing points (BCPs) where goods crossing come from China to Central Asia, but only a few observations of goods going the other direction. For example, Khorgos, a BCP between China and Kazakhstan, has complete records for goods coming to Kazakhstan from China, but only 152 observations for exports from Kazakhstan to China between 2013 and 2017.

The reason for such data discrepancy is that trucks return empty from Central Asia to China due to the trade imbalance, meaning that no substantial border crossing information is obtained (CAREC, 2017). The lack of continuous data can be a significant limitation when it comes to the econometric analysis of costs to export in Central Asia. Finally, the trade cost incurred at the rail outbound BCPs are largely restricted to Kazakhstan (Appendix U), in part because some countries, for example, Kyrgyzstan and Tajikistan, have hardly any rail track.

On average, the number of BCPs that each Central Asian country has to cross to export its goods within the region and adjacent neighbours varies from three in Kazakhstan and Kyrgyzstan, to five in Turkmenistan (Figure 7.2). Notably, despite the largest number of BCPs on its way and lengthiest exporting-importing times, Turkmenistan had the largest share of trade with CAREC countries (excluding China) in 2017 (Kim & Mariano, 2020).

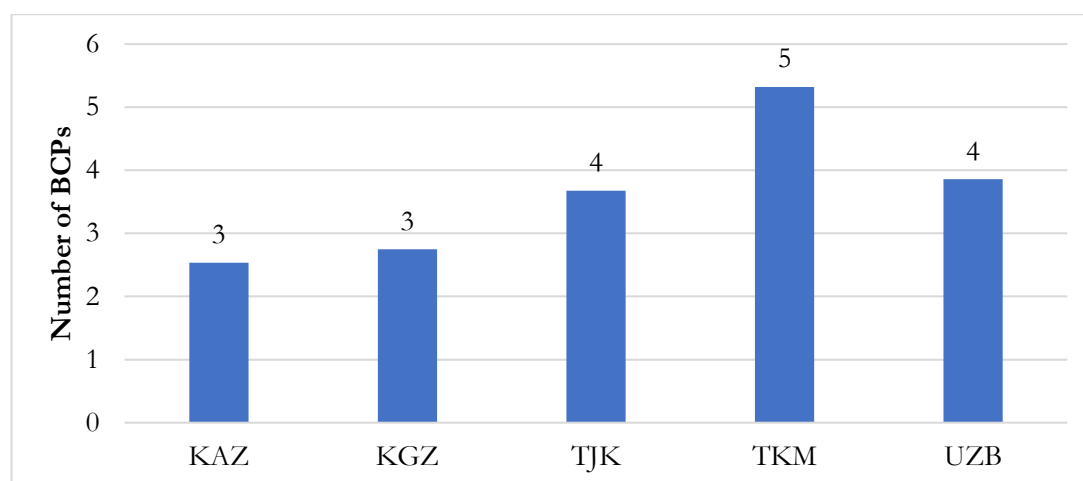


Figure 7.2 Number of the outbound BCPs (mean across all years).
Source: Based on CPMM dataset

7.4 Trade costs and political context

This section analyses the cost and time-to-export trends in Central Asia and relates them to key events that potentially could affect the exports and trade costs in this

region. Figure 7.3 and 7.4 demonstrate that CPMM measures of both time- and cost vary by year with no clear trend of falling trade costs.

Overall, the longest times to export are recorded for Turkmenistan and Uzbekistan as compared to other countries of the region, with a slight decline over the years. The average time-to-cross all BCPs²⁹ varied from six hours in 2013 in Kyrgyzstan to almost 60 hours in Uzbekistan in 2017 (Figure 7.3). In Kazakhstan, on opposite, there was an increase of export time by two hours in 2018 as compared to 2013.

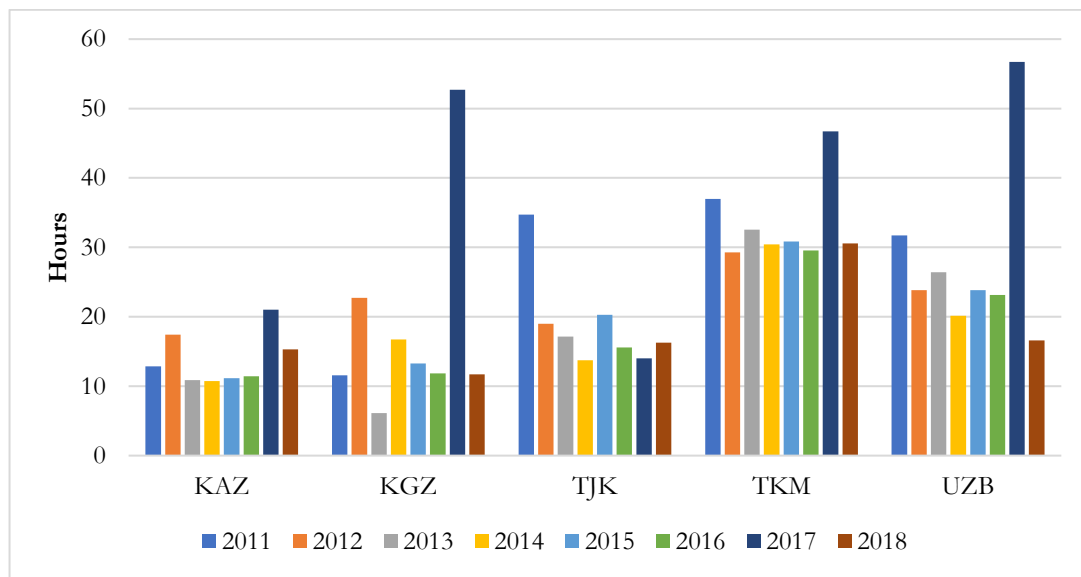


Figure 7.3 Average time-to-export spent at BCPs, hours.
Source: based on the CPMM raw dataset

For all Central Asian countries, the mean BCPs cost was \$304, with the lowest average in Kazakhstan (\$188) and the highest in Turkmenistan (\$433 on average, and reaching \$500 in some years) (Figure 7.4). Some countries recorded significant reduction of BCPs costs over the years. For example, Kyrgyzstan improved from \$366 in 2011 to \$110 in 2018. In Kazakhstan, on the other hand, after relative stability, the cost-to-export increased in 2018.

²⁹ Key border crossing activities **1.** Border Security / Control, **2.** Customs Clearance, **3.** Health/Quarantine, **4.** Phytosanitary, **5.** Veterinary Inspection, **6.** Visa/Immigration, **7.** Vehicle inspection/Traffic Inspection, **8.** Police Checkpoint / Stop, **9.** Transport Inspection, **10.** Weight/Standard Inspection, **11.** Vehicle Registration, **12.** Emergency Repair, **13.** Escort/Convoy, **14.** Loading/Unloading, **15.** Road Toll, **16.** Waiting/ Queue

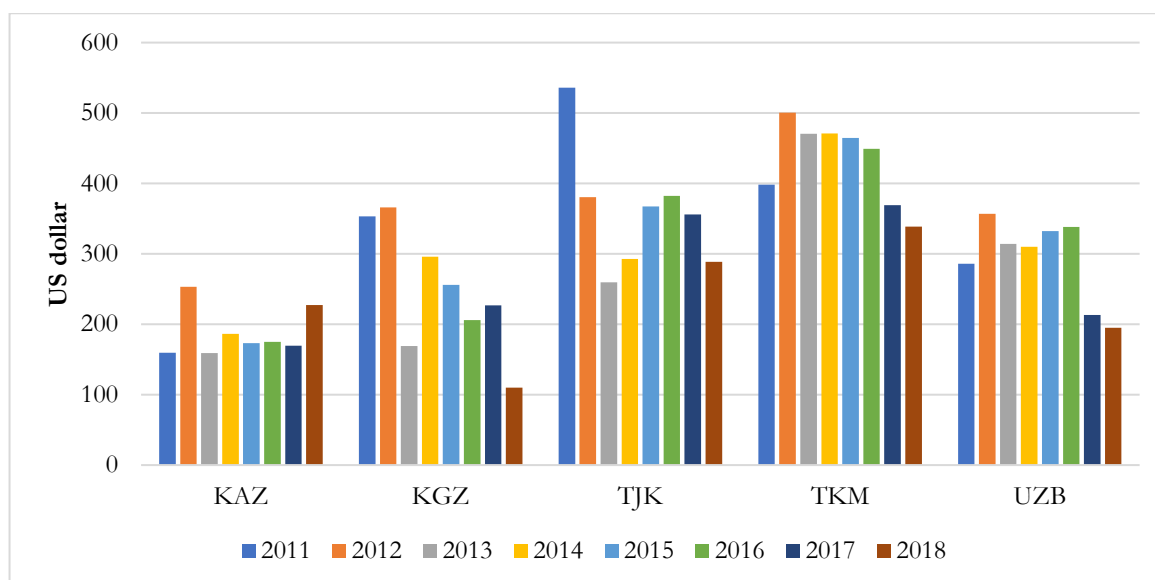


Figure 7.4 Average cost-to-export, US dollars spent at BCPs (official payments only).
Source: based on the CPMM raw dataset

Overall, the financial costs appear to have been less volatile than the time costs between 2011 and 2018. The high variability of time cost creates an uncertain trading environment, which has been calculated to be associated with an effect that is slightly stronger than just the mean or median time to trade (Ansón et al., 2020).

Before beginning the analysis of costs, major regional and geopolitical events that occurred in Central Asia between 2010 and 2018 were summarised (Appendix V), as they could have potentially facilitated or impeded trade regardless of cost. The events included joining the Eurasian Economic Union (EEU) by Kazakhstan in 2010 and Kyrgyzstan in 2015, sanctions and countersanctions in the Russian Federation in 2014. The later led to tightened customs controls by the Russian authorities at the borders with EEU members in 2017. Finally, in 2017, with a new president, Uzbekistan started actively liberalising its economy, which could be expected to positively affect cross-border trade.

According to the CPMM estimates, after the formation of the Kazakhstan-Russia-Belarus Customs Union (CU) in 2010, the border crossing patterns have changed significantly for Kazakhstan since then (ADB, 2014a). Time-to-cross-border between CU members has shortened significantly but lengthened at the borders of

neighbouring non-CU economies. Similarly, after Kyrgyzstan accessed the Eurasian Economic Union (EEU) in 2015, border crossing with Kazakhstan became simple (CAREC, 2018). For instance, trucks crossing Ak Tilek-Korday BCP could clear the border in less than one hour, because customs controls were removed and only border security control and phytosanitary inspection remained. The decline in hours spent at BCPs in 2015-2016 is evident in Figure 7.5.

The spike in 2017 was mostly a result of the political issues between Kazakhstan and Kyrgyzstan, with a dramatic increase of waiting time on the border in October 2017, due to spontaneous tension between the heads of the two countries (Figure 7.5, top). The Kazakh officials reported that movement of people and goods were constrained as ‘One in eight of trucks moved along the route with gross violations of the transport legislation of Kazakhstan’ (Kyrgyz News, 2017). As a result, heavy trucks with fruits and vegetables stood on the border for several days with all the goods rotting.

Nevertheless, this episode did not affect the cost-to-export. The graph illustrates that the EEU membership facilitated the reduction of the official payments at BCPs between Kyrgyzstan and the union counterparts (Figure 7.5, bottom). On the other hand, export costs in US dollar³⁰ terms were slightly higher and gradually increasing between Kyrgyzstan and non-Union partners.

³⁰ Note, costs are captured in the local currency and then converted into US dollars using the prevailing exchange rate to facilitate comparison

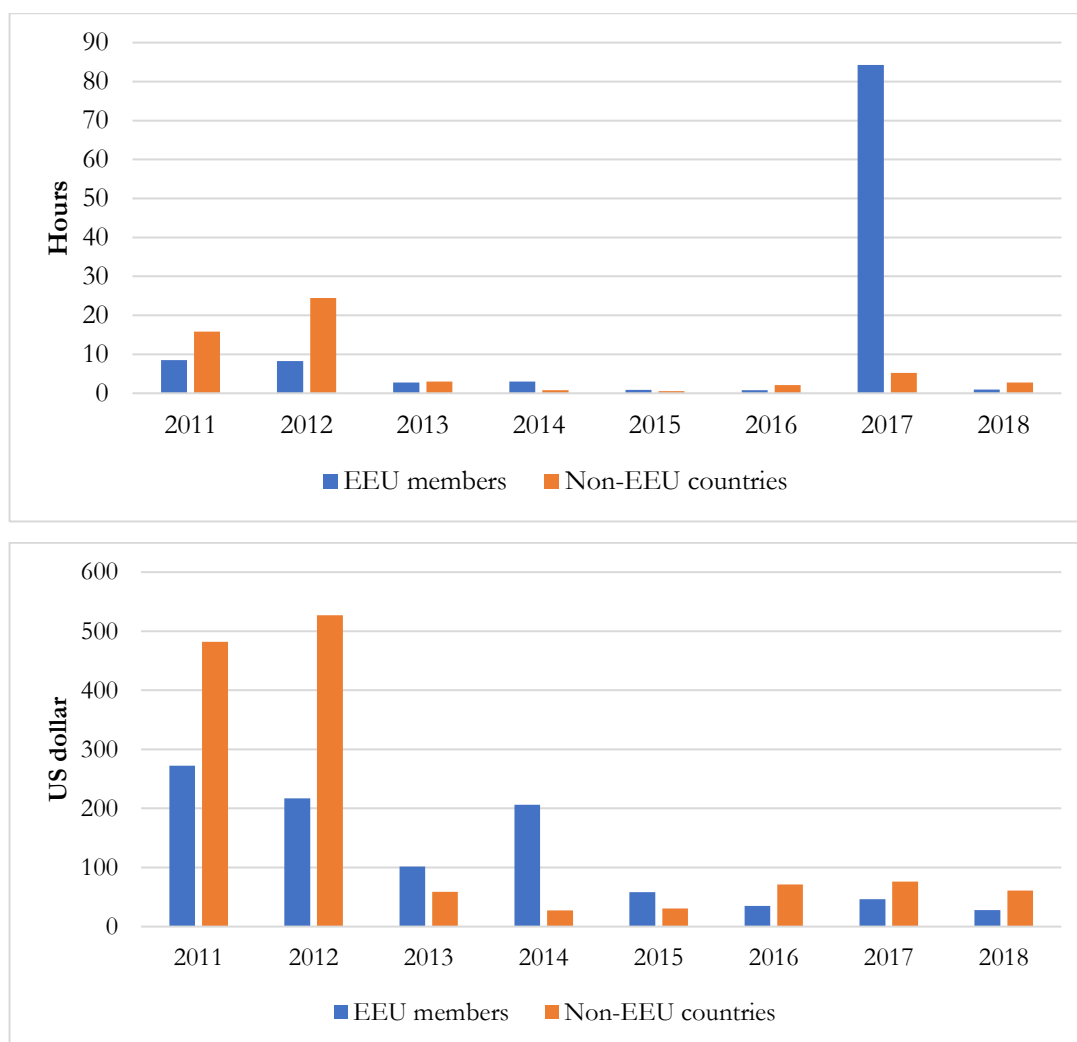


Figure 7.5 Kyrgyzstan: Time-to-export, hours at BCP (top); Cost-to-export, US dollars at BCP (bottom).
Source: based on the data from the CAREC annual reports³¹

However, not only Kazakhstan and Kyrgyzstan, but other Central Asian countries, except Tajikistan, had a spike of BCP exporting time in 2017 (back to Figure 7.3). Apart from the tension at the Kazakh-Kyrgyz border that potentially affected the trucks in transition, the spike is a reflection of the changing rules requested by the Russian Federation on the re-export of goods from EEU member-countries on goods that were sent from the countries under Russian sanctions. This resulted in additional checks for the certificates at the BCPs between the union members, which, in turn, increased overall exporting time. The spillover effect from neighboring Kazakhstan and Kyrgyzstan could have impacted the spikes in waiting time in double-landlocked

³¹ Note: The EEU members in this sample are Russia and Kazakhstan, non-EEU members are China, Tajikistan, Turkmenistan and Uzbekistan

Uzbekistan. According to CAREC (2020) substantial delays continued to affect road border crossings, despite improving road and transport conditions within the country. Turkmenistan is an important transit country for Iran–Uzbekistan cargo movements. However, road border crossing times have deteriorated largely due to the waiting and actual time for customs controls and various inspection activities.

In 2014, the year of the beginning of the Russian-Ukrainian conflict, the Russian sanctions and countersanctions, and consecutive financial crises had affected Central Asian countries in many ways (FAO 2018), which also was reflected in the increase of BCP costs in that year. Noticeably, the 2015 currencies depreciations in most countries of the region and overall vulnerability of the region to the ongoing geopolitical tensions in the following year are not reflected in the CPMM TFIs changes in US dollar terms. Costs slightly decreased or remained stable, except for Tajikistan, where costs increased until 2016. Relative stability of trade costs in US dollar terms in relation to external shocks justifies findings by Kim and Mariano (2020) that costs in terms of time, not money, have the greater impact on trade flows between Central Asian countries.

In 2017, the new government of Uzbekistan proactively worked towards trade liberalisation. Trade opened with import and export tariffs removed on a list of commodities, and new trade agreements were signed with Afghanistan and Kazakhstan. Liberalisation resulted in a reduction of outbound BCP trade costs in 2017 from an average \$338 to \$213 as compared to 2016. In 2018 Uzbekistan recorded a significant reduction of exporting time as well.

7.5 CPMM TFIs vs TAB indicators

TAB indicators are commonly used by researchers due to their convenience for conducting a global analysis of the impact of trade costs on trade flows. The current research, however, indicated that composite indicators, such as the TAB, may actually be subject to limitations related to the underlying assumptions of the

surveys. Results based on TAB indicators ‘hardly makes them representative of the universe of companies as a whole’ (Volpe Martincus, 2016, p. 31).

Behar (2010), for example, found low correlations between trade facilitation measures from firm-level responses in the World Bank’s Enterprise Surveys and the analogous TAB indicators. In addition, TAB indicators may not be relevant for the analysis of trade in Central Asian countries and need to be treated with caution due to the fact that aspects of a country’s institutional environment get mixed by the TAB with information on trade (Sharafeyeva & Shepherd, 2020). The TAB indicators’ perception-based method of measurement has been suggested as one of the reasons for such issues.

Based on the actual experience of drivers and other stakeholders directly involved in exporting and importing procedures, the number of respondents to CPMM each year in Central Asia varies between 72 (Turkmenistan 2013) and 1,100 (Kyrgyzstan, 2014) (Appendix U). In comparison, TAB analysis relying on the number of respondents directly involved in trade and forwarding activities in Central Asia varied from zero (in various years and countries) to a maximum of six (in Uzbekistan in 2012) (Sharafeyeva, 2019). Moreover, the detailed nature of the CPMM dataset compared to the TAB, such as information on the different components of trade costs, sectors and transport modes provides greater opportunities for detailed analyses.

Table 7.2 illustrates the noticeable differences between the two measurement indicators. The cost-to-export results from the two datasets can vary by up to a factor of six in some cases (Tajikistan in 2012), while time-to-export was 30 times higher for the TAB compared to the CPMM in Kazakhstan in 2013. In 2016 the TAB changed the way it measured the trade cost indicators, which led to an improvement in the indicators for landlocked countries, beginning with the reports for 2015. For example, cost-to-export dropped by 15 times in Tajikistan from one year to another after the CPMM was introduced. This massive discontinuity in the TAB series in

2015 is not present in the CPMM series, which makes the latter dataset more suitable for Central Asian countries.

Table 7.2 Cost and time-to-export in Central Asia: TAB indicators vs CPMM TFIs

	Cost-to-export (\$)		Time-to-export (hours)	
KAZ	TAB	CPMM	TAB	CPMM
2011	4,094	816	1,824	68
2012	5,212	1,379	1,944	83
2013	5,185	1,631	1,944	66
2014	5,285	1,948	1,896	66
2015	804	1,726	265	63
2016	694	1,762	261	75
2017	694	1,828	261	95
	Cost-to-export (\$)		Time-to-export (hours)	
KGZ	TAB	CPMM	TAB	CPMM
2011	4,357	2,924	63	55
2012	4,610	3,145	63	108
2013	4,500	3,049	63	67
2014	4,760	2,555	63	73
2015	675	2,027	51	39
2016	590	1,824	41	30
2017	590	3,011	41	111
	Cost-to-export (\$)		Time-to-export (hours)	
TJK	TAB	CPMM	TAB	CPMM
2011	5,093	1,951	71	29
2012	9,864	1,707	71	31
2013	9,027	2,798	71	23
2014	9,050	3,073	71	14
2015	643	1,299	141	12
2016	643	1,044	141	14
2017	643	3,475	141	45
	Cost-to-export (\$)		Time-to-export (hours)	
UZB	TAB	CPMM	TAB	CPMM
2011	6,458	2,211	70	146
2012	6,005	2,075	73	145
2013	5,458	1,832	72	90
2014	5,090	2,195	54	87
2015	570	1,767	286	89
2016	570	1,723	286	132
2017	570	1,722	286	240

Sources: Doing Business reports for TAB and raw dataset for CPMM indicators

The correlation between TAB and CPMM indicators has low negative values (Table 7.3). Notably, the CPMM time- and cost-to-export indicators are strongly correlated.

Table 7.3 Correlation between CPMM and TAB trade cost indicators

	CPMM_cost_exp	CPMM_time_exp	TAB_cost_exp	TAB_time_exp
CPMM Cost-to-export (\$)	1			
CPMM Time-to-export (hours)	0.515***	1		
TAB Cost-to-export (\$)	-0.237*	-0.411***	1	
TAB Time-to-export (hours)	-0.246*	-0.307**	0.891***	1

Note: * p < 0.05, ** p < 0.01, *** p < 0.001

The sample mean calculations based on 78 observations that matched both TAB and CPMM datasets reveal very close values for CPMM and TAB cost-to-export indicators of around \$2,288 (Table 7.4). On the other hand, the mean time-to-export difference between these datasets is quite significant, 112 hours for CPMM and 682 hours for TAB.

Table 7.4 The sample mean values for CPMM and TAB indicators

Mean estimation	Number of obs =78			
	Mean	Std. Err.	[95% Conf. Interval]	
CPMM cost-to-export (\$)	2,287	111	2,065	2,509
CPMM time-to-export (hours)	111	8	94	128
TAB cost-to-export (\$)	2,288	261	1,767	2,808
TAB time-to-export (hours)	681	75	531	832

Note: the sample covers 7 years and includes 11 exporters

Figure 7.6 suggests some normality of distribution of both CPMM indicators, whereas the TAB means are not normally distributed. The Shapiro-Wilk and Shapiro-Francia tests suggest normal distribution for the CPMM cost-to-export indicator, while normal distribution is rejected for CPMM time and both TAB indicators (Appendix W).

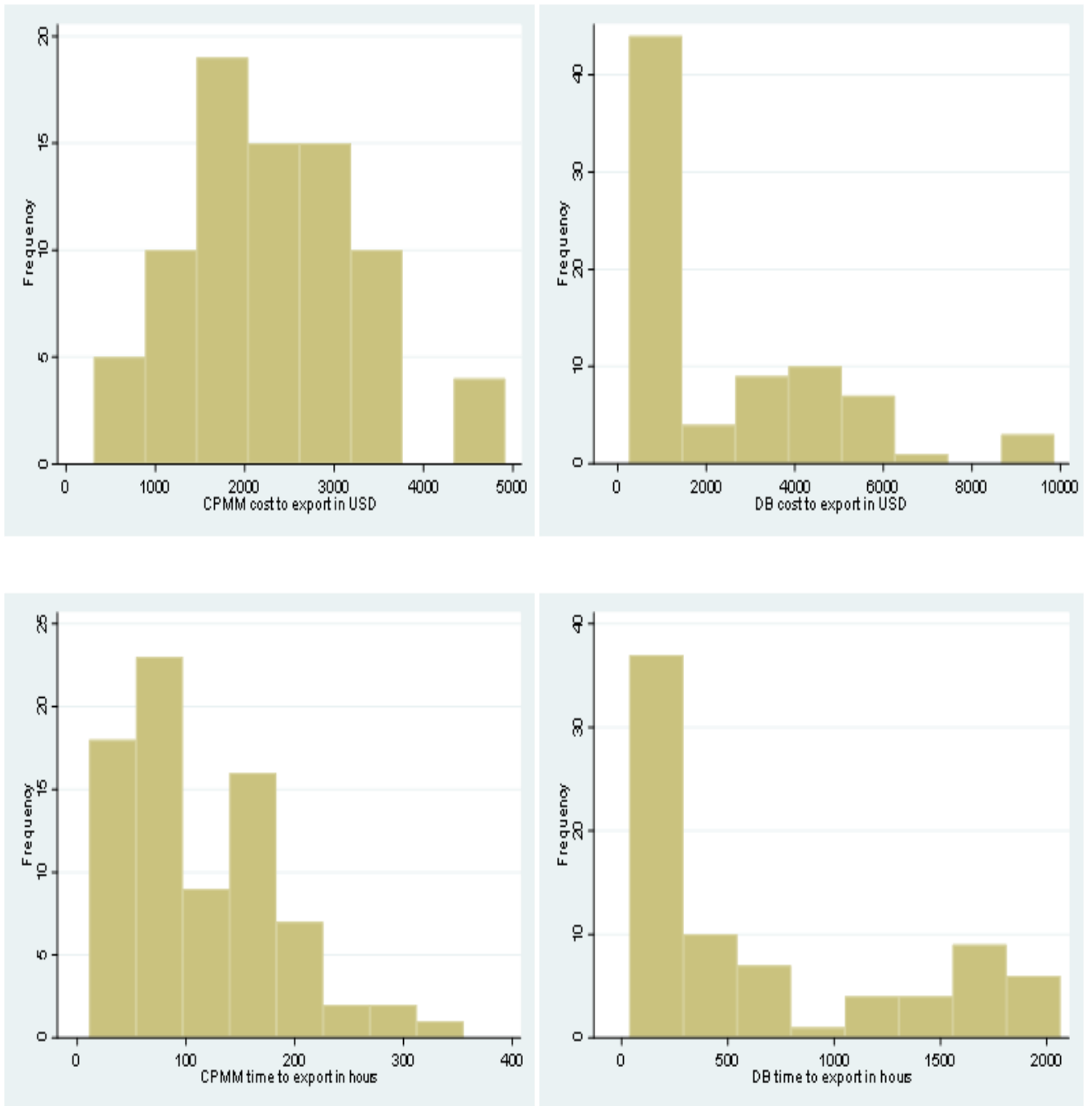


Figure 7.6 Histogram of means distribution for CPMM and TAB indicators.

To test the hypotheses that sample means of the paired CPMM and TAB cost-to-export and time-to-export indicators are equal, a t-test was conducted (Table 7.5). Because of a very small p-value, the null hypothesis that the TAB and CPMM time-to-export means are equal was rejected (0.01 significance level). However, the observation that the cost-to-export in two samples is equal was not rejected.

Table 7.5 T-test for CPMM and TAB cost and time-to-export indicators, full sample

	CPMM (n=78)	TAB (n=78)	Two sample t-test (p-value)
cost-to-export (\$)	2,287.70	2,288.35	0.99
time-to-export (hours)	111.70	681.73	0.00

To control the effect of the TAB's changed measurements in 2016, the datasets were split into two groups:

- Group 1 years up to 2015 observations
- Group 2 2015 and after (Table 7.6)

The null hypotheses tested whether the sample mean values of the CPMM and TAB indicators were equal by periods. According to the results, with a very small p-value, the null hypotheses were rejected (0.01 significance level) for both time- and cost-to-export indicators.

Table 7.6 T-test for CPMM TFI and TAB cost-to-export and time-to-export indicators, samples split by periods

	Group 1 (n=42)	Group 1 (n=36)	Two sample t-test (p-value)
cost-to-export (\$)	-1,543.74	1,799.63	0.00
time-to-export (hours)	-1,039.78	-22.00	0.00

To conclude, despite near-equal sample mean values for the full sample of the CPMM and TAB's cost-to-export indicators, the t-test results obtained by periods provide evidence of no similarity between the mean values of the two datasets.

7.6 Gravity model analysis of trade costs and trade flows using CPMM TFIs

The final step in this analysis was to estimate the effects of TFIs on exports using the CPMM dataset. It was hypothesised that use of the CPMM TFIs data would produce more plausible results than those obtained from the TAB indicators (Chapter 6), which were not all theoretically consistent.

Currently, there are few papers that quantitatively estimate the impact of trade costs on trade flows for Central Asia, mainly due to data limitations. Among the most recent analyses is the paper by Tanabe, Shibasaki, and Kato (2016) who used the data from the Multimodal International Cargo Simulation model for Central Asia and

a Computable General Equilibrium model to estimate the effect of infrastructure development on international transportation costs and trade flows in a land transit network.

Kim and Mariano (2020) used the gravity model and the most recent CPMM datasets to estimate the impact of BCP time and cost to trade on bilateral trade in CAREC countries. Their dataset is based on the CPMM quarterly data and IMF aggregated bilateral trade data. Estimation techniques followed Heckman (1979) method that addresses the sample selection bias, as well as pooled and panel OLS regression analysis.

Unlike Kim and Mariano (2020), the present study used CPMM's total time- and cost-to-export, not only border crossing time and cost. The most advanced and rigorous gravity model techniques, such as the PPML, which is highly recommended in the literature, were employed, with a full-set of fixed effects (Yotov et al., 2016) and disaggregated sectoral level data.

7.6.1 Dataset preparation

Due to CPMM data limitations outlined in section 7.3, several steps were taken to construct the missing observations in order to prepare the dataset for the baseline gravity model analysis using the balanced dataset for five Central Asian countries and its key trading partners (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan and China and Russia).

The first step was to check the cities' titles and match them with correct country names, where needed, and aggregate the dataset by country-pairs. The STATA based multiple imputation approach was used first to fill the large number of missing observations for key variables of interest (Table 7.7), which resulted in nonsensical numbers, with negative or big spikes in imputed numbers.

Table 7.7 Number and percentage of the missing observations by variable in CPMM dataset

Variable	Missing	Total	% Missing
year	0	392	0
exporter	0	392	0
importer	0	392	0
cost_to_export	171	392	43.62
time_to_export	171	392	43.62

Thus, the next step was to fill in the data based on consistent assumptions. The strategy was as follows:

- 1 The data for country-pairs with totally missing observations across entire periods, for example, costs to export from Uzbekistan to China, were calculated as an average sum of trade costs for potential transit stops: $UZB/CHN = \text{Average}[(UZB/KGZ + KGZ/CHN) (UZB/KAZ + KAZ/CHN)]^{32}$
- 2 In other cases with totally missing observations, where it could be assumed that export and import had similar costs, the data were mirrored from what is available. For example, data for exports from Tajikistan to Uzbekistan was missing, so the cost/time-to-export from Uzbekistan to Tajikistan were copied, which were presented in full.
- 3 Some country-pairs had data for one year only, for example, cost-to-export from Turkmenistan to Russia. In this case, the observation was expanded using the available year's data without change to cover the entire period.
- 4 The remaining missing observations were filled in using the simple averages for the previous (or later) two years.
- 5 The original dataset also contains costs and time-to-export for domestic routes, except for Russia. Since this information on internal costs could be useful at the regression stage, they were kept in the dataset, while the data for Russia was computed as the simple average of all internal trade costs available in the matrix.

³² At the gravity model estimation stage, it was tested either route through Kazakhstan or Kyrgyzstan would impact the trade cost coefficients. The results suggested that overall regional exports are not sensitive to changed trade costs due to different routes for Uzbekistan-China exports.

The full matrices for eight years (2011-2018) are presented in Appendix X. Total time- and cost-to-export are the sums of the time and cost spent on all activities: transportation, border crossing points, and other activities. Trade cost variables are as follows:

- Total duration of shipment (transit + activities) in hours, which is split into duration of transit (total traveling time), duration of activities at BCPs (time-to-cross the border).
- Total cost of shipment (transit + activities) in nominal US dollar terms include cost of transit (vehicle operating cost), cost of activities at BCPs (cost to cross the border), and unofficial payments to activities spent at BCPs).

Two sources for trade flow data are used: Eora input-output dataset that includes intra-national trade and available for 1990-2015, and UN Comtrade sourced from The Growth Lab at Harvard (2019), which is available up to 2018, but does not contain the data for the internal trade. The standard gravity controls, such as GDPs, distance, colonial links, common language and participation in regional trade agreements are from CEPIL.

7.6.2 Gravity model specification

The impact of trade costs is estimated with the structural gravity model that takes the following form:

$$X_{ijt} = F_{it}F_{jt}t_{ijt}^{-\theta} e_{ijt} \quad (1)$$

Where:

X_{ijt} is exports from country i to country j in year t

$F_{it} F_{jt}$ are exporter-year and importer-year fixed effects

t is bilateral trade costs

θ is a parameter capturing the sensitivity of demand to cost

e is an error term satisfying standard assumptions.

The k subscripts are added to the sector-specific models.

To complete the gravity model, a trade costs function is specified as follows:

$$t_{ijt} = b_1 time_{ijt} + b_2 cost_{ijt} + D_{ij} * t \quad (2)$$

Where:

$time_{ijt}$, $cost_{ijt}$ are the key cost and time-to-export variables, respectively (aggregated or disaggregated by components in different model set-ups)

D terms are country-pair fixed effects interacted with a time trend.

Together these equations are consistent with recent gravity model estimation techniques justified in papers such as Heid, Larch, and Yotov (2017).

This form of model specification is able to identify the effect of time and cost on trade based on differences within country-pairs over time, as well as between internal and external trade for each country-pair. A use of panel dataset helps to attenuate simultaneity bias.

To estimate the model defined by (1) and (2), Poisson Pseudo Maximum Likelihood (PPML) estimation was used for the range of reasons set out by Yotov et al. (2016). The model (Equation 1) was estimated for total exports of goods, as well as macro and micro sectors as the dependent variable (Appendix Y for list of aggregated sectors).

7.6.3 Estimation approach

The estimation procedures were as follows.

First, the CPMM matrix constructed for Central Asian countries as explained in section 8.6.1 was combined with the export flows sourced from the Eora multi-region input-output table. Eora contains data on intra-national trade, which is required for the structural gravity model to provide consistent and unbiased estimates. Additionally, the trade flows in this dataset were reported by total trade, intermediate and final goods. Intermediate products are those goods and services that are used as factor inputs by firms in producing other goods or services. For example, steel is an intermediate good that has a variety of end-uses, including motor car bodies, washing

machine shells, nuts and bolts, etc³³. An intermediate good is a product used to produce a final good or finished product, referred to as a consumer good.

The data in this dataset did not go beyond 2015, restricting the analysis up to that year, despite the availability of the CPMM TFIs up to 2018. After combining aggregated CPMM and Eora datasets for Central Asian countries, only 245 observations for the years 2011-2015 remained to be used for preliminary regression analysis. Due to a strong correlation between CPMM time-to-export and cost-to-export indicator, the model was run separately for each variable. To compare results between different trade data sources, the UN Comtrade aggregated exports were used as dependent variables, which provided the dataset for 2011-2015 and 210 total observations. There were no internal trade flows, and hence, no recommended country-pair fixed effects approach could be applied. The standard gravity controls, such as exporter-importer GDPs, distance, and dummies for colonial link, common language, common border and regional trade agreement were used for this regression.

Second, since the estimates in the UN Comtrade and no pair-fixed effects approach resulted in time-to-export coefficients 12 times higher than Eora exports and a full-set of fixed effects regression, the sensitivity of the trade cost indicators to relaxed fixed effects specification using the Eora dataset were tested. The Eora and CPMM datasets were regressed without country-pair fixed effects, but with distance as a country-pair control variable.

Third, to compare the CPMM and TAB indicators, the CPMM time-to-export and cost-to-export were aggregated by year-exporter-sector, resulting in the average trade cost indicators for the exporting country, which were combined with the Eora macro sector exports dataset. It should be acknowledged, however, that such an aggregation of the CPMM TFIs may not represent the actual trade cost faced by the Central Asian countries when exporting to non-CAREC countries that are also in the

³³ <https://financial-dictionary.thefreedictionary.com/intermediate+products;>
<https://www.investopedia.com/terms/i/intermediate-good.asp>

sample. The aggregation brings them closer to the TAB specification of trade costs. Only the matching CPMM, TAB and Eora observations were kept in the combined dataset. The regressions were run separately for TAB and CPMM indicators using a full-set of fixed effects.

Finally, after confirming the more theory-consistent outcome of CPMM trade cost indicators at the aggregated and macro level as compared to the TAB estimates, the sensitivity of micro sectors to the CPMM trade costs were analysed. The Eora micro sectors (Appendix Y) and aggregated CPMM indicators from step three were used.

7.7 Gravity model results

The first set of results is presented in Table 7.8 and reported for aggregated trade in goods at the total, intermediate and final products level, where the regressors are the time- and cost-to-export indicators from the constructed CPMM dataset. All regressions came out with very high Pseudo-R²s due to the large numbers of fixed effects and the estimation results are statistically significant with expected signs. Notably, time-to-export coefficients obtained with Eora exports and applying full-set of fixed effects are nearly 12 times higher than those obtained with the UNComtrade exports and no country-pair fixed effects. The latter is closer to the average border crossing time estimates found by Kim and Mariano (2020).

Unlike in Kim and Mariano (2020), who found that aggregated exports (based on IMF quarterly data) are more sensitive to time-to-export than to cost-to-export (expressed in US dollars), results obtained in this study suggest that aggregated goods exports are slightly more sensitive to cost-to-export than to time-to-export. What is more striking, is that the results obtained by Kim and Mariano (2020) are three to five times higher than the results in Table 7.8.

Table 7.8 Structural gravity model results obtained with constructed CPMM dataset for Central Asia using Eora (columns 1-6) and UN Comtrade (columns 7 and 8) exports, 2011-2015

Time-to-export (hours)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: exports	Total	Final	Intermediate	Total	Final	Intermediate	Total	Total
	Eora	Eora	Eora	Eora	Eora	Eora	UN Comtrade	UN Comtrade
Time-to-export	-0.030 **	-0.029 ***	-0.026 *				-0.354 ***	
	(0.012)	(0.009)	(0.015)				(0.136)	
Cost-to-export				-0.051 **	-0.054 ***	-0.051 **		-0.108
				(0.020)	(0.019)	(0.024)		(0.171)
Constant	22.962 ***	21.260 ***	22.775 ***	22.964 ***	21.263 ***	22.777 ***	39.642 **	53.171 **
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(18.852)	(26.661)
Observations	245	245	245	245	245	245	210	210
pseudoR ²	1.000	1.000	1.000	1.000	1.000	1.000	0.975	0.973
Gravity Controls	No	No	No	No	No	No	Yes	Yes
Fixed Effects	Exporter-Year Importer-Year Pair-Year	Exporter-Year Importer-Year Pair-Year	Exporter-Year Importer-Year Pair-Year	Exporter-Year Importer-Year Pair-Year	Exporter-Year Importer-Year Pair-Year	Exporter-Year Importer-Year Pair-Year	Exporter-Year Importer-Year	Exporter-Year Importer-Year
Number of years	5	5	5	5	5	5	5	5
Country-pairs	49	49	49	49	49	49	49	49

Note: Time-to-export and cost-to-export were tested separately due to collinearity of the two variables (correlation coefficient=0.5). Estimation is by PPML. Robust standard errors adjusted for clustering by country-pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). Gravity controls are: exporter importer GDPs, log(distance), and dummies for colonial link, common language, common border and regional trade agreement.

Due to significant difference between the Eora with full-set fixed effects and UNComtrade and no country-pair fixed effect, the model is tested for the sensitivity of the CPMM trade cost variables to the changed fixed effects. The results in Table 7.9 demonstrate high sensitivity of the CPMM trade costs variable suggesting that the variables capture other things that impact the exports. On average, the coefficients for time to and cost-to-export indicators are ten times higher, when there are no country-pair fixed effects (Table 7.9) as compared to the results obtained with a recommended full-set fixed effects (refer again to Table 7.9, columns [1-6]). This raises questions about policy recommendations made by other studies, where the underlying estimates were based on the less rigorous fixed effects specification, which are now becoming the standard in the gravity model literature.

Table 7.9 Sensitivity test of the CPMM TFIs to the changing fixed effects specification

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Final	Intermed.	Total	Final	Intermed.
Distance	0.245	0.130	0.271	-0.143	-0.135	-0.100
	(0.225)	(0.211)	(0.245)	(0.243)	(0.269)	(0.234)
Cost-to-export	-0.926 ***	-0.818 ***	-0.958 ***			
	(0.257)	(0.234)	(0.277)			
Time-to-export				-0.808 **	-0.853 *	-0.889 **
				(0.389)	(0.436)	(0.359)
Constant	22.996 ***	21.300 ***	22.807 ***	22.997***	21.300 ***	22.809 ***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Observations	245	245	245	245	245	245
pseudoR2	0.999	0.999	0.999	0.999	0.999	0.999

Note: Estimation is by PPML, exporter-year and importer-year fixed effects. Robust standard errors adjusted for clustering by country-pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). Gravity control: Distance. Years: 2011-2015

Next, to compare the impact of aggregated CPMM and TAB trade cost datasets, the indicators are estimated for Eora-based macro exports of 11 CAREC countries to their 189 exporting destinations. The macro sectors are agriculture, mining and manufacturing. First, similar to findings in Chapter 6, in many instances both TAB indicators - time-to-export and cost-to-export (Table 7.10 and Table 7.11, columns 4, 5, and 6) demonstrate theory-inconsistent positive statistically significant coefficients. Second, the CPMM time-to-export indicator has

only significant result for exports of the final manufacturing products. Third, CPMM cost-to-export has a statistically significant negative impact on exports of all types of mining commodities and final products in the manufacturing sector.

Finally, both CPMM indicators, time- and cost-to-export came out statistically not significant for agriculture exports, though most of them did have an expected negative sign. Overall, this set of results provides some evidence that CPMM indicators for Central Asian countries can generate more theory-consistent results than the TAB indicators.

Table 7.10 Structural gravity model results for CPMM TFIs and TAB Time-to-export indicators with Eora macro sectors exports for CAREC^o countries

Time-to-export	(1)	(2)	(3)	(4)	(5)	(6)
	CPMM			TAB		
	Total	Intermed.	Final	Total	Intermed.	Final
Agriculture	-0.039 (0.064)	0.023 (0.055)	-0.070 (0.091)	-0.005 (0.010)	-0.006 (0.012)	-0.008 (0.013)
Mining	0.123 (0.094)	0.145 (0.105)	0.066 (0.073)	0.124 * (0.073)	0.121 (0.074)	0.106 ** (0.050)
Manufacturing	0.055 (0.036)	0.058 (0.039)	-0.103 ** (0.044)	0.025 * (0.015)	0.021 (0.016)	0.041 *** (0.008)
Constant	20.206*** (0.026)	20.208 *** (0.019)	18.318 *** (0.049)	20.207*** (0.022)	20.220 *** (0.014)	18.261*** (0.036)
Observations	14,931	14,931	14,931	14,931	14,931	14,931
pseudoR ²	1.000	1.000	1.000	1.000	1.000	1.000

Note: The table presents results for the interactions between industry and time-to-export. Estimation is by PPML. Robust standard errors adjusted for clustering by country-pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). Fixed Effects: Exporter-Year-Sector, Importer-Year-Sector, Pair-Year-Sector. Years: 2011, 2013, 2015.

◊Turkmenistan is not in the sample as TAB does not have data for this country

Table 7.11 Structural gravity model results for CPMM TFIs and TAB Cost-to-export indicators with Eora macro sectors exports for CAREC^o countries

Cost-to-export	(1)	(2)	(3)	(4)	(5)	(6)
	CPMM			TAB		
	Total	Intermed.	Final	Total	Intermed.	Final
Agriculture	-0.033 (0.020)	-0.014 (0.014)	-0.023 (0.045)	-0.004 (0.021)	0.020 (0.015)	-0.031 (0.030)
Mining	-0.212 ** (0.095)	-0.186 ** (0.085)	-0.283 ** (0.112)	0.109 *** (0.039)	0.117 *** (0.038)	0.095 *** (0.036)
Manufacturing	0.031 (0.074)	0.066 (0.078)	-0.265 *** (0.042)	0.060 *** (0.017)	0.057 *** (0.018)	0.050 *** (0.012)
Constant	20.334*** (0.050)	20.265 *** (0.040)	18.727*** (0.126)	20.193 *** (0.014)	20.201 *** (0.011)	18.258*** (0.029)
Observations	14,931	14,931	14,931	14,931	14,931	14,931
pseudoR ²	1.000	1.000	1.000	1.000	1.000	1.000

Note: The table presents results for the interactions between industry and cost-to-export. Estimation is by PPML. Robust standard errors adjusted for clustering by country-pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). Fixed Effects: Exporter-Year-Sector, Importer-Year-Sector, Pair-Year-Sector. Years: 2011, 2013, 2015.

◊Turkmenistan is not in the sample as TAB does not have data for this country

Finally, to estimate the impact of CPMM TFIs on different micro sectors in the CAREC region, the regression is run for the further disaggregated Eora dataset (Table 7.12). First, similarly, to the TAB's results in Chapter 6, some of the estimates have unexpected positive signs. However, the underlying reasons for such results should be interpreted differently due to the difference in measurement of the TAB and CPMM indicators. Among the possible explanations is an endogeneity problem: because the trade costs indicators are based on actual times and costs reported by operators, an unexpected positive shock to trade creates congestion on the route, which takes reported data up. Therefore, there can be a positive correlation between trade and the observed time. For example, the spontaneous closure of the customs at the Kazakh and Kyrgyz border in 2017 that was mentioned in section 7.4 of this chapter, delayed the transportation of trucks with agrifood produce for several days. The fact that the positive association between trade cost indicators and exports is recorded only for the time-to-export indicator and not cost-to-export indicator supports this view.

Second, columns (5) and (6) in Table 7.12 demonstrate the sensitivity of more perishable commodities to the cost-to-export. For example, 1% increase in cost-to-export could reduce the exports of intermediate (raw) agricultural produce by 1.35%, whereas to exporters of textiles and apparel commodities the same increase would cost only 0.31%.

Table 7.12 Structural gravity model results for CPMM TFIs and selected^o Eora micro sectors exports for CAREC countries

	(1)	(2)	(3)	(4)	(5)	(6)
	Time-to-export			Cost-to-export		
	Total	Intermed.	Final	Total	Intermed.	Final
Agriculture	0.059 ***	0.019	0.076 ***	0.026	-0.135 ***	0.220 ***
	(0.015)	(0.020)	(0.015)	(0.045)	(0.036)	(0.067)
Constant	20.377***	19.579 ***	19.797***	20.379***	19.603 ***	19.749***
	(0.002)	(0.002)	(0.002)	(0.010)	(0.006)	(0.018)
Observations	4,914	4,914	4,914	4,914	4,914	4,914
pseudoR ²	1.000	1.000	1.000	1.000	1.000	1.000
Food & Beverages	0.008	-0.020	0.024	-0.055 **	-0.085 ***	-0.043
	(0.012)	(0.012)	(0.020)	(0.027)	(0.015)	(0.040)
Constant	20.095***	19.271 ***	19.575***	20.120***	19.306 ***	19.595***
	(0.003)	(0.003)	(0.004)	(0.011)	(0.007)	(0.015)
Observations	3,213	3,213	3,213	3,213	3,213	3,213
pseudoR ²	1.000	1.000	1.000	1.000	1.000	1.000
Textiles & Wearing Apparel	0.067 ***	0.006	0.190 ***	-0.008	-0.031 ***	0.034
	(0.010)	(0.008)	(0.022)	(0.020)	(0.010)	(0.044)
Constant	19.220***	17.435 ***	19.390***	19.314***	17.577 ***	19.460***
	(0.011)	(0.018)	(0.012)	(0.045)	(0.042)	(0.049)
Observations	3,213	3,213	3,213	3,213	3,213	3,213
pseudoR ²	1.000	1.000	1.000	1.000	1.000	1.000
Wood and Paper	0.130*	0.041	0.141	-0.049***	-0.040 ***	-0.054***
	(0.069)	(0.036)	(0.088)	(0.003)	(0.004)	(0.002)
Constant	19.296***	15.934 ***	19.331***	19.377***	16.075 ***	19.400***
	(0.025)	(0.044)	(0.026)	(0.002)	(0.010)	(0.001)
Observations	3,024	3,024	3,024	3,024	3,024	3,024
pseudoR ²	1.000	1.000	1.000	1.000	1.000	1.000

Note: Estimation is by PPML. Robust standard errors adjusted for clustering by country-pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). Fixed Effects: Exporter-Year-Sector, Importer-Year-Sector, Pair-Year-Sector. Years: 2011, 2013, 2015.

oExtended table of results in Appendix Z.

7.8 Conclusion

Overall, the findings mostly support the suitability of the CPMM TFIs for analysing and measuring trade costs in Central Asian countries. Not only are they suitable but appear superior to the TAB indicators. The used estimation approach includes very strong fixed effects specifications, which deals with omitted variables. For example, the results in Table 7.12, have pseudo R² equal to 1, meaning potential omitted variables that account for the dependent variable are not likely) - thus the results are robust to omitted variable bias.

First, the more detailed nature of the CPMM allows researchers and governments to qualitatively evaluate which border crossing points create the major obstacles to trade in Central Asia. For example, using the CPMM indicators allows time-to-export to be tracked and to be monitored to reveal time-to-export changes in response to economic and political shocks. This is knowledge that would allow policy makers to strengthen facilitation efforts on the most vulnerable routes and border crossing points, instead of randomly spending budget monies.

Moreover, the continual time-series nature of the CPMM indicators makes it possible to quantitatively estimate the impact of time- and cost-to-export in Central Asian nations. The estimates at the aggregated exports level confirmed the superiority of the CPMM indicators for use in the analysis of trade facilitation in Central Asia when compared to the perception-based TAB indicators. At the same time, positive results for time-to-export coefficients at the disaggregated exports level suggest a need for careful examination and interpretation of the outcomes that are based on actual-experience indicators. Some real-life *ad hoc* situations increase the time-to-export and lead to the positive association between export values and trade cost indicators. Nevertheless, the findings confirm that improved trade facilitation is particularly beneficial for perishable agricultural products compared to other commodity groups.

Furthermore, the sensitivity of the CPMM indicators to the changing estimation techniques, such as a full-set of fixed effects between the country-pairs, warns researchers to follow the most recent advances in gravity modelling.

The result of this study is important from a policy perspective, because of the need to be realistic when dealing with policymakers in terms of what the implications of improving trade facilitation in fact are. While the potential gains from trade facilitation are undoubtedly large, the findings of these research suggest that they are not so large when compared to the findings in similar studies that policymakers should be too ambitious with reforms. Finally, the results also suggest that there is a need for better quality data in-country, not only for trade cost

indicators, but also for internal trade that would allow researchers apply the best gravity model techniques in these circumstances.

Conclusions and policy recommendations

The goal of this chapter is to draw key conclusions based on the findings within the analytical sections of the thesis. Specifically, the chapter summarises the objectives and reviews the seven research questions addressed in this study. The key findings, and their implications are highlighted, followed by several policy recommendations corresponding to each question. The chapter concludes with comments about the limitations of this study, as well as providing directions for future research.

8.1 Summary of the thesis

The research reported in this thesis involved a comprehensive analysis of the impact of trade costs and trade facilitation on trade flows, focussing particularly on agrifood exports from the Central Asian countries. Additionally, the findings of this research complement the existing literature by providing in-depth analysis of trade facilitation definitions, measurements of trade cost indicators and commonly used estimation techniques and econometric models in trade facilitation studies.

Specifically, the following research questions were investigated:

- 1 How trade costs and trade facilitation are defined, and what is their impact on trade?
- 2 What trade facilitating factors and trade cost indicators are commonly studied by researchers, and how do they differ across world regions and industry sectors?
- 3 What economic sector has a comparative advantage to export in Central Asia?
- 4 To what extent is Central Asia integrated into global and regional value chains?
- 5 To what extent is the impact of trade costs, expressed in money and time terms, greater for perishable than non-perishable goods?
- 6 How do changed measurements of the same trade cost indicator, as well as changed estimation techniques, affect gravity model estimates?

7 Do trade cost indicators based on real experience provide a better estimate than those based on perceptions for Central Asian countries?

To answer these research questions a systematic literature review, the theoretically revealed comparative advantage (TRCA) model, as well as a workhorse gravity model were employed. The two primary sources of trade cost indicators employed for this research were World Bank's Trading Across Borders indicators, and CPMM trade facilitation indicators developed for Central Asian countries by the Asian Development Bank (ADB). The trade flows data came from the UN Comtrade, The Growth Lab at Harvard (2019) and Eora input-output tables.

8.2 The outcomes

The key results and their implications are reported in broader sub-sections: the systematic literature review findings, the sectors of comparative advantage and GVC-RVCs participation of Central Asian countries, and the workhorse gravity model-based results.

8.2.1 Systematic literature review and critical analysis

1 How are trade costs and trade facilitation defined, and what is their impact on trade?

This research defined trade facilitation as a policy objective and the process to reduce trade costs. The definition of trade costs varies from narrow border-related impediments to trade to broad behind-the-border obstacles. Thus, in literature the scale and scope of trade facilitation wide-ranging from border-crossing related trade costs only to transportation, customs, human capital and environmental costs, among others. Measurement of trade facilitation remains challenging as it depends on construction and estimation of trade cost indicators. The academic literature advocates for a need of all-inclusive, broad assessment of the trade costs on trade flows. However, the time-series data that is publicly available and harmonised across the world are predominantly represented by the narrowly defined trade costs indicators. Thus, majority of the studies, including this thesis, provide the estimates for the impact of the narrowly defined trade cost on trade volume.

The systematic review reported in Chapter 3 produced mixed results across the articles that estimated the impact of trade facilitation on international trade. The majority of empirical

studies, 68% of incidents or the number of regression results across all the articles, confirmed the positive impact of trade facilitation on trade flows. Trade facilitation indicators, such as improvement of factors related to physical infrastructure, border and transport efficiency and human capital had the greatest positive impact on trade flows. These groups include indicators, such as the quality of the roads, the level of development of ICT, the ease of customs procedures, as well as migrant's links and the skills of the trading partners' workforces. Improvement of any number of these factors potentially increases trade flow.

However, counter intuitively, 15% of incidents returned theory-inconsistent results, suggesting that an improved trading environment, for example through simplified border procedures, leads to a decrease in international trade flows. Trade facilitation factors related to Aid and the FDI, the business and regulatory environment and environmental regulations produced the largest number of the mixed results. Overall, even though, the studies confirm the positive impact from trade facilitation on trade flows, there are still some ambiguities in the research findings that require a careful examination of the reasons behind non-sensical outcomes. This could be an issue of the underlying techniques and data used, or trade facilitation, indeed, not always brings a positive outcome for international trade. Thus, a cross-disciplinary discussion between various stakeholders involved in trade facilitation processes globally, is required.

2 What trade facilitating factors and trade cost indicators are commonly studied by researchers, and how do they differ across world regions and industry sectors?

The findings of the systematic review support the view that improvement of international trade depends on a complex relationship between social, environmental, and economic factors. The most studied factors that impact trade are border and transport efficiency, business and regulatory environment, as well as factors related to human capital. From the nine groups generated for the purposes of this research, the majority of the studies were focussed on either trade costs and trade facilitation in the business and regulatory environment (27%), on border and transport efficiency (26%), or human capital (14%).

Predominantly, analyses drew data from the survey-based reports produced by the World Bank, World Economic Forum and OECD. The most commonly used trade cost indicators were based

on the World Bank's Trading Across Borders (TAB) indicators. Most of the analysed studies tend to evaluate the impact of trade cost/facilitation on trade with a workhorse gravity model, though many studies did not use the most advanced techniques that are recommended in the literature.

Finally, it was observed that trade facilitation research has been focussed on the developed countries and aggregated trade flows. Few studies have analysed the impact of trade facilitation on the most cost-sensitive trade sectors, such as the agricultural sector, with only 14 articles, or 7% of the total number of articles focused on the primary sector. There remains a number of countries, particularly developing and less developed countries that have nil studies published in peer-reviewed journals.

8.2.2 Theoretically revealed comparative advantage

3 What economic sector has a comparative advantage to export in Central Asia?

The results based on a theoretical model of comparative advantage suggest that agriculture itself, typically used as a baseline, is in fact a comparatively advantageous sector in most Central Asian countries. Kazakhstan is the only country in the region where there are manufacturing and services sectors with noticeable degrees of comparative advantage relative to agriculture.

Between 2000 and 2015 all sectors lost comparative advantage relative to agriculture in Tajikistan and Kazakhstan, except for fishing for the latter. Uzbekistan's electricity, gas and water, and finance were the only sectors that did not change, or which improved relative to the Uzbek agricultural sector. Kyrgyzstan and Turkmenistan stand out as having gained comparative advantage in their services sectors, along with transport equipment, relative to their agriculture.

It was only the extractive industries, mining and quarrying, that had a comparative advantage relative to agriculture in Kazakhstan and Turkmenistan. Extractive industries are among the top five export sectors for those two countries. Agriculture in Central Asia is theoretically the sector with the greatest comparative advantage throughout the region. However, the exports of

this sector are not among the most exported goods of the region. In 2018 agricultural produce was only recorded among the top five exports from Tajikistan, Turkmenistan and Uzbekistan because of cotton production. Cotton is not a particularly time-sensitive agricultural export.

Finally, it was found that within the agricultural sector, some traditional horticultural products such as melons, grapes, tomatoes and cucumbers lost their comparative advantage over the years as a result of increasing costs to export these commodities. Throughout Central Asia, the loss of comparative advantage to the Russian Federation, because of the longer transportations and high logistics costs, has been significant for agrifood products.

There is a noticeable lack of export diversification among the Central Asian countries due to the high trade costs for most of their products. While oil and gas and minerals remain valuable enough internationally that the cost of trade is not prohibitive, nor are they time-sensitive, Central Asian agricultural products are not valuable enough to be able to overcome the costs to trade, except for less-perishable products like cotton and wheat. Until specific policy changes are made to address the trade cost issues, Central Asia's agricultural export potential will remain unfulfilled.

4 To what extent is Central Asia integrated into global and regional value chains?

The results presented in Chapter 4 suggest that there is very little regional value chain development in any sector in Central Asia. The largest proportion of gross exports accounted for by regional value added is 4% in the Electricity, Gas and Water sectors. The next largest proportion is 2% in transport equipment that are coming from the region.

Central Asian countries appear to be more integrated with other trading partners, the Russian Federation in many cases, than they are with themselves. The value-added from the countries outside of the region accounts for 24% of gross exports in the Petroleum, Chemical and Non-Metallic Mineral Products sector, and just over 20% of gross exports in Transport Equipment, and Metal Products. 95% of agriculture exports are produced from domestic resources, which indicates very limited integration into RVCs and GVCs. Kazakhstan is the least integrated

country into regional value chains, whereas Kyrgyzstan records the largest share of regional value added in its gross exports across the region, compared to other countries.

Overall, the findings add to previous literature indicating that the Central Asian countries are poorly integrated into global and regional value linkages. The emergence of the BRI initiative with its infrastructure development projects could open a window of opportunity for the region to streamline trade between the major economic centres of Asia and Europe (Pomfret, 2017), as well as create an enabling environment for countries' participation in GVCs and RVCs.

8.2.3 The workhorse gravity model

5 To what extent is the impact of trade costs, expressed in money and time terms, greater for perishable than non-perishable goods?

There were many attempts, various approaches and datasets used to provide a quantitative answer to this question in this research. The findings based on the CPMM TFIs and structural gravity model demonstrated the sensitivity of more perishable commodities to the cost-to-export. Specifically, for the CAREC region covered by CPMM TFIs this thesis estimated that a 10% increase in cost-to-export could reduce the exports of intermediate (raw) agricultural produce by 1.35%, whereas to exporters of textiles and apparel commodities the same increase would cost only 0.31%.

Using a post-2016 TAB dataset and gravity model, it was found that the time-to-export indicator is two times higher for the exports of grapes as compared to the exports of cotton in Central Asia. However, it should be noted that results were non-sensical positive coefficients for the exports of tomatoes and wheat at the global level, which suggests treating the TAB results with caution.

6 How do changed measurements of the same trade cost indicator, as well as changed estimation techniques, affect gravity model estimates?

This question is reported in two parts, first, the issue of changed measurements of the same trade cost indicator, second, changed estimation techniques.

First, *how do changed measurements of the same trade cost indicator affect gravity model estimates?* The systematic review reported in Chapter 3 revealed that the TAB indicators are

the most commonly used indicators in the trade facilitation literature, either as a part of an aggregated variable or directly applied (17% of total number of articles under review, 50% of articles estimating the impact of border-crossing related obstacles on trade). However, as noted in Chapter 6, contrary to international trade theory that argues that high trade costs are negatively associated with trade flows, the results for TAB 2005-2014 suggest otherwise and are statistically significant, for both time-and cost-to-export. Because the methodology of calculating TAB indicators was considerably revised by the World Bank in 2016, the models were re-estimated in this research using data for 2015-2017. The re-estimation produced statistically significant and negative coefficients for the time- and cost-to-export variables in Central Asia, in accordance with international trade theory. Thus, although the tabulated data are easy-to-use, the pre-2016 TAB indicators on trade costs may not be appropriate to a particular research question. The TAB numbers are based on assumptions, which may not be relevant, and the discontinuities after the 2015 changes can distort research conclusions. Overall, the drastic change of the signs from positive to negative and the trade cost coefficients demonstrate the high sensitivity of the gravity model results to the way the trade cost indicators are measured. The results advise that gravity estimates are sensitive to the changing trade cost measurement and, models using the TAB indicators developed after 2015 obtain more theory-consistent outcomes.

Overall, these findings raise questions about past policy formulation in Central Asia, and other landlocked countries globally, based on the 2005-2014 TAB data. It is logical to assume that resource misallocation may have occurred, and the outcome of trade cost reduction policies will have been less than anticipated.

Second, do *changed estimation techniques, affect gravity model estimates?* According to the systematic literature review, the current best practice is to estimate the gravity model using the Poisson Pseudo-Maximum Likelihood (PPML) with a panel dataset containing exporter-time and importer-time and pair-fixed effects as a way to address the multilateral resistance term (MRT) effects. The use of the PPML estimator is justified on various grounds (Santos Silva & Tenreyro, 2006). For example, the PPML estimator allows to account for heteroscedasticity,

handles the presence of zero trade flows, as well as ensures that the gravity fixed effects are identical to their corresponding structural terms.

MRTs depend on trade costs across all partners, and, if the model is estimated by PPML with fixed effects, the estimated fixed effects correspond exactly to the MRT (Santos Silva & Tenreyro, 2006). Therefore, it is recommended that domestic trade flows be included in the dataset in order that the trade cost effects on internationally directed trade can be differentiated from and compared to domestic trade (Heid et al., 2017). However, as reported in Chapter 3, despite the theoretical and empirical proof of the importance of using the MRTs developed by Anderson and Wincoop (2003), over one third of the total incidents in 97 articles published in high-ranking journals (first and second quartile in SJR) failed to adopt this strong recommendation. Robustness tests confirmed the sensitivity of different models that used CPMM indicators with the changed estimation techniques, such as including a full-set of fixed effects between the country-pairs in a regression. On average, the coefficients for time- and cost-to-export indicators are ten times higher, when there are no country-pair fixed effects as compared to the results obtained with a recommended full-set of fixed effects. This outcome should be a warning to researchers to follow the most recent advances in gravity modelling.

7 Do trade cost indicators based on real experience provide a better estimate than those based on perceptions for Central Asian countries?

Research was conducted using an alternative database of trade costs. The data had been collected by the Central Asia Regional Economic Cooperation (CAREC) program and was based on the actual experience of traders and freight forwarders since 2010. In analysing this data, the CPMM indicators yielded more international trade theory-consistent results on the effect of trade costs on exports of Central Asian countries compared to the TAB indicators. Moreover, the continual time-series nature of the CPMM indicators made it possible to quantitatively estimate the impact of time- and cost-to-export in Central Asia.

The estimates at the aggregated exports level confirmed the superiority of the CPMM indicators for use in the analysis of trade facilitation in Central Asia when compared to the perception-based TAB indicators. At the same time, positive results for time-to-export coefficients at the

disaggregated exports level suggest a need for careful examination and interpretation of the outcomes that are based on actual-experience indicators. Some real-life *ad hoc* situations increase the time-to-export and lead to the positive association between export values and trade cost indicators.

8.3 Policy implications

One of the main aims of the WTO Trade Facilitation Agreement has been to reduce trade costs was by eliminating time delays and ease uncertainty in agricultural trade. Improved trade facilitation can support countries in achieving Sustainable Development Goal 2 to end hunger and improve food security (Tripoli & Schmidhuber, 2018). Comprehensive analysis presented in this thesis could guide policymakers during their deliberations over ways to facilitate trade and maximise the gains of their agriproduct.

The Central Asia's remoteness from seaports and major global markets is usually considered to be the main factor for the high cost of trade and the key obstacle to boosting exports. However, since late 2010s, there has been growing evidence that poor policy settings and economic institutions, along with undeveloped hard infrastructure are among the main factors preventing international trade in Central Asia. The findings of this thesis confirm that self-imposed high trade costs, both in monetary terms and time delays, are among the reasons for low agricultural exports due to the sensitivity of these products to long transit times.

Therefore, national governments must create an enabling environment to support agrifood exports in Central Asia. There is a need for policy emphasis on improved logistics, both transportation facilities as well as ICT development, easier border crossing and other elements associated with high trade costs. This includes attraction of private investments in cold chain storage and post-harvest processing capacity. In addition, investing in public goods is required, modernising food safety and quality control systems, investing in R&D, and export promotion initiatives. Improved communication technologies are critical if Central Asian exporters want to participate more actively in e-commerce to access new markets.

Digital technologies can play a key role in improving trade facilitation and contribute to transparent agricultural supply chains, as well as provide traceability and transparency for food safety (Tripoli & Schmidhuber, 2018). Together with improved institutions in international trade, digitalisation and automatization of the processes can reduce costs and better facilitate trade transactions by improving process efficiency, and risk mitigation in Central Asia. Recent developments such as contactless inspection, artificial intelligence image sensing, robots or big data could benefit international trade, if implemented at the customs of Central Asian countries.

The export development programs that seek to minimise unnecessary transactions, which increase cost and time to trade, initiated in most Central Asian countries, as well as external initiatives, such as China's BRI, if successfully implemented, could facilitate the development of high-quality export products, and promote relations with new trade partners. Moreover, strengthening of the diaspora linkages between Central Asian countries and their key trading partners could facilitate reduction of transaction costs.

Training and adequate number of personnel would also contribute to trade facilitation in Central Asian countries. Anecdotal evidence from author's own experience suggested that despite the availability of expensive state-supported export promotion websites, calls went unanswered and there was no technical support or assistance from the website online assistants. Upgrading the ICT will be of little value without the availability of responsible staff, whose training would benefit the international trade in the region.

At the regional level, improving underlying factors of logistics performance, by encouraging foreign capital and by bringing in international logistic companies, in the lagging countries of the region could support the welfare gain. Well-planned and geographically integrated regional infrastructure could be significant for small and landlocked countries and bring a long-term positive effect.

Finally, for Central Asia and at the global scope, this thesis identified a serious data issues in the broadly used sources, including, but not limited, the World Banks's Trading across the

border indicators, or UN Comtrade data, which are poor for some Central Asian countries due to reporting and measurement issues.

Given current digital technology developments, it seems to be increasingly possible to collect actual, not perceptions-based, data on trade cost indicators from the traders' and freight forwarders' experience. The CPMM dataset, based on the truck drivers' actual experience, is a promising source for analysis of trade facilitation in Central Asia. However, CPMM has flaws, such as missing country-pair data, for example Uzbekistan-China, and the small number of country-pair variations, which are desirable for more robust gravity model estimates. Other sources of data, such as the Time Release Study (TRS) by The World Customs Organization (WCO), offer internationally recognised tools to measure the efficiency and effectiveness of international trade flows. Additionally, up-to-date intra-trade data for a broader list of countries is becoming important for application of theory-consistent gravity model techniques.

8.4 Limitations

Although this thesis has provided new and useful information about trade facilitation and agrifood exports in Central Asia, it is not without limitations. This section highlights the challenges faced, how they were dealt with, and the possible effect on the results. Limitations included potential missing information in the systematic review, trade facilitation definitions and data and modelling limitations.

In general, despite an attempt to provide a broader analysis of the impact of trade costs on trade flows, the actual impact is calculated for the narrowly defined, border related costs on exports. Nevertheless, even with a narrow focus of the estimates, the findings provide a strong evidence that trade costs in Central Asia have a high impact on exports of agrifood products.

Chapter 3, the systematic literature review, was limited to the online available articles in the peer-reviewed journals, thus, some important findings of not-peer-reviewed articles may be omitted in the review. Also, the articles in languages other than English were excluded, as well as only studies with quantitative estimates of trade costs/facilitation on trade were analysed.

Thus, the review may have missed some important findings of excluded works. Despite these limitations, however, it was concluded that the selected articles represented a good sample of the literature on the relationship between trade costs/facilitation and trade flows.

In Chapter 6, lack of data related to internal trade flows resulted in partial-fixed effects estimation approach of the main regression, which is still a common method to such an analysis, although it can result in some overestimation of the outcomes. The baseline regression was regressed with full-set fixed effects and control variables, such as countries' GDPs, and came out with coefficients close to those in the main regression analysis, thus allowing it to be assumed that the model findings are close to true values.

In Chapter 7 due to missing data for some country-pairs in the CPMM TFIs dataset, for example, Uzbekistan-China, trade costs were calculated based on consistent assumptions. Advances in methods to estimate the determinants of international trade, in particular those in the gravity model, allowed the execution of a theory-consistent econometric analysis. However, there is a need for high quality and detailed data on trade cost/facilitation and trade flows that would allow researchers to obtain reliable results and make more precise predictions.

8.5 Future research

Beyond improvements in data and techniques, future research needs to analyse the impact of trade facilitation on variables beyond trade, including, but not limited to, living standards (socio-economic indicators) and environmental issues. For example, the growth of global welfare has been estimated by simulating improved transparency in trade in the Asia Pacific Economic Cooperation region by means of a computable general equilibrium model (Abe & Wilson, 2008).

Shapiro (2016) provides a theoretical and empirical framework to quantify the environmental costs of international trade due to CO², and analyse the welfare consequences of policies that would regulate the CO² emissions from shipping. Among the most recent research, Head and Mayer (2019) used gravity model coefficients of trade costs in a general equilibrium model to

determine spatial production patterns in the car industry. Others have illustrated how infrastructure investment had a differential spatial impact along latitude lines during the Industrial Revolution in England (Trew, 2020), or noted the impact of Belt and Road Initiative investments on the infrastructure and welfare of the Central Asian countries (Venables et al., 2020).

Thus, it would be beneficial to extend trade facilitation research beyond the simple paradigm of reduced trade costs leading to increased market integration and gains from trade, in order to allow for general equilibrium and agglomeration effects and differential impacts on wellbeing. Moreover, there is a need for more studies to investigate individual trade facilitation policies on trade performance, for a specific sector or commodity. This is more on the micro-level and would need a proper research design to elicit the causal effect of trade facilitation. Finally, more research focused particularly on less developed countries/regions would benefit a proper budget allocation in trade facilitating programs in those regions.

This thesis contributes to the literature by comprehensively assessing the data quality issues of commonly used trade cost measurements and the consequences of such issues in the estimation of trade facilitation effects on exports from the Central Asian region. This thesis further provides recommendations based on empirical evidence derived from quality data measurements and rigorous data analyses for international trade policy and program design so as to facilitate and enhance agricultural exports from Central Asia. Given careful and thoughtful implementations of appropriate trade facilitation programs, there is a strong potential for the landlocked Central Asia to become a land-linked agrifood supplier to the global markets.

References

- Abe, K., & Wilson, J. (2008). Governance, corruption and trade in the Asia Pacific Region. *Discussion Paper Series*. APEC Study Center Columbia University, 62.
- ADB. (2014a). CAREC corridor performance measurement and monitor: A forward looking retrospective. Asian Development Bank, Mandaluyong City, Philippines. Retrieved from <https://www.adb.org/publications/carec-corridor-performance-measurement-and-monitoring-forward-looking-retrospective>
- ADB. (2014b). *From landlocked to linked in: The Central Asia Regional Economic Cooperation Program*. Asian Development Bank, Mandaluyong City, Philippines. Retrieved from <https://www.adb.org/publications/landlocked-linked-central-asia-regional-economic-cooperation-program>
- Agnosteva, D. E., Anderson, J. E., & Yotov, Y. V. (2019). Intra-national trade costs: Assaying regional frictions. *European Economic Review*, 112, 32-50. doi:<https://doi.org/10.1016/j.euroecorev.2018.11.008>.
- Alam, A., & Banerji, A. (2000). *Uzbekistan and Kazakhstan: a tale of two transition paths*. World Bank Policy Research Working Paper (2472). The World Bank, Washington, DC.
- Álvarez, I. C., Barbero, J., Rodríguez-Pose, A., & Zofío, J. L. (2018). Does institutional quality matter for trade? Institutional conditions in a sectoral trade framework. *World Development*, 103, 72-87.
- Anderson, & Wincoop, E. v. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, 93(1), 170-192. doi: 10.1257/000282803321455214.
- Anderson, J. (2011). The gravity model. *Annual Review of Economics*, 3(1), 133-160. doi:10.1146/annurev-economics-111809-125114.
- Anderson, J., & Marcouiller, D. (2002). Insecurity and the pattern of trade: An empirical investigation. *The Review of Economics and Statistics*, 84(2), 342-352. doi:10.1162/003465302317411587.
- Anderson, J., & Wincoop, E. (2004). Trade costs. *Journal of Economic Literature*, 42(3), 691-751. Retrieved from <http://links.jstor.org/sici?sici=0022-0515%28200409%2942%3A3%3C691%3ATC%3E2.0.CO%3B2-%23>.
- Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *The American Economic Review*, 69(1), 106-116. Retrieved from <http://www.jstor.org/stable/1802501>.
- Anderson, J. E., Larch, M., & Yotov, Y. (2015). Estimating general equilibrium trade policy effects: GE PPML.
- Ansón, J., Arvis, J. F., Boffa, M., Helble, M., & Shepherd, B. (2020). Time, uncertainty and trade flows. *The World Economy*.
- Arkolakis, C., Costinot, A., & Rodríguez-Clare, A. (2012). New trade models, same old gains? *American Economic Review*, 102(1), 94-130. doi:10.1257/aer.102.1.94.
- Arvis, J.-F., Duval, Y., Shepherd, B., Utoktham, C., & Raj, A. (2016). Trade costs in the developing world: 1996–2010. *World Trade Review*, 15(03), 451-474. Retrieved from https://EconPapers.repec.org/RePEc:cup:wotrrv:v:15:y:2016:i:03:p:451-474_00.

- Arvis, J.-F., Raballand, G., & Marteau, J.-F. (2010). *The cost of being landlocked: Logistics costs and supply chain reliability*. The World Bank, Washington, DC.
- Arvis, J.-F., Saslavsky, D., Ojala, L., Shepherd, B., Busch, C., & Raj, A. (2014). *Connecting to compete 2014: Trade logistics in the global economy--the logistics performance index and its indicators*. Washington, DC. Retrieved from <https://openknowledge.worldbank.org/handle/10986/20399>.
- Aslam, A., Novta, N., & Rodrigues-Bastos, F. (2017). *Calculating trade in value added*. International Monetary Fund.
- Bacchetta, M., Beverelli, C., Cadot, O., Fugazza, M., Grether, J.-M., Helble, M., Piermartini, R. (2008). A practical guide to trade policy analysis. *UNCTAD and World Trade Organization*.
- Baier, S. L., & Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade? *Journal of International Economics*, 71(1), 72-95. doi:<https://doi.org/10.1016/j.jinteco.2006.02.005>.
- Baldwin, R. E. (2011). 21st century regionalism: Filling the gap between 21st century trade and 20th century trade rules. Available at SSRN 1869845.
- Bandyopadhyay, U. (1999). Trade and the distribution sector: Some evidence from OECD countries. *Canadian Journal of Economics*, 1299-1312.
- Bastos, P., & Silva, J. (2012). *Networks, firms, and trade*. The World Bank, Washington, DC.
- Behar, A. (2010). Do managers and experts agree? A comparison of alternative sources of trade facilitation data. Department of Economics, University of Oxford.
- Beverelli, C., Fiorini, M., & Hoekman, B. (2017). Services trade policy and manufacturing productivity: The role of institutions. *Journal of International Economics*, 104, 166-182. doi:<https://doi.org/10.1016/j.jinteco.2016.11.001>.
- Beverelli, C., Neumueller, S., & Teh, R. (2015). Export diversification effects of the WTO trade facilitation agreement. *World Development*, 76, 293-310.
- Bojnec, Š., & Fertő, I. (2011). Information and communication infrastructure development and agro-food trade. *Agricultural Economics*, 57(2), 64-70.
- Bojnec, Š., Fertő, I., & Fogarasi, J. (2014). Quality of institutions and the BRIC countries agro-food exports. *China Agricultural Economic Review*, 6(3), 379-394. doi:10.1108/CAER-02-2013-0034.
- Buayanov, S. (2016). Казахстан сможет поставлять в Китай продукты премиум-класса. *Forbes Kazakhstan*.
- Cadot, O. (2006). *Landlockedness, infrastructure and trade in Central Asia*. The World Bank.
- Capannelli, G., & Kanbur, R. (2019). *Good jobs for inclusive growth in Central Asia and the South Caucasus: Regional report*. Asian Development Bank.
- CAREC. (2017). *CAREC Corridor Performance Measurement and Monitoring Annual Report 2016*. Retrieved from [https://www.carecprogram.org/?page_id=21&paged=1&content_source\[\]=carec&publication_type\[\]=research-and-reports](https://www.carecprogram.org/?page_id=21&paged=1&content_source[]=carec&publication_type[]=research-and-reports).
- CAREC. (2018). *CAREC Corridor Performance Measurement and Monitoring Annual Report 2017*. Retrieved from

[https://www.carecprogram.org/?page_id=21&paged=1&content_source\[\]=carec&publication_type\[\]=research-and-reports](https://www.carecprogram.org/?page_id=21&paged=1&content_source[]=carec&publication_type[]=research-and-reports).

- CAREC. (2020). *CAREC Corridor Performance Measurement and Monitoring Annual Report 2019*. Retrieved from [https://www.carecprogram.org/?page_id=21&paged=1&content_source\[\]=carec&publication_type\[\]=research-and-reports](https://www.carecprogram.org/?page_id=21&paged=1&content_source[]=carec&publication_type[]=research-and-reports).
- CEPII. (2020). *GeoDist*. Retrieved from: http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp.
- Chaney, T. (2008). Distorted gravity: The intensive and extensive margins of international trade. *American Economic Review*, 98(4), 1707-1721.
- Chen, N., & Novy, D. (2011). Gravity, trade integration, and heterogeneity across industries. *Journal of International Economics*, 85(2), 206-221. Retrieved from <https://EconPapers.repec.org/RePEc:eee:inecon:v:85:y:2011:i:2:p:206-221>.
- Christ, N., & Ferrantino, M. J. (2011). Land transport for export: The effects of cost, time, and uncertainty in sub-Saharan Africa. *World Development*, 39(10), 1749-1759.
- Conrad, K., & Schmidt, T. F. (1998). Economic effects of an uncoordinated versus a coordinated carbon dioxide policy in the European Union: An applied general equilibrium analysis. *Economic Systems Research*, 10(2), 161-182.
- Correia, S., Guimarães, P., & Zylkin, T. (2020). Fast Poisson estimation with high-dimensional fixed effects. *The Stata Journal*, 20(1), 95-115.
- Coşar, A. K., & Demir, B. (2016). Domestic road infrastructure and international trade: Evidence from Turkey. *Journal of Development Economics*, 118, 232-244.
- Costinot, A., Donaldson, D., & Komunjer, I. (2012). What goods do countries trade? A quantitative exploration of Ricardo's ideas. *The Review of Economic Studies*, 79(2), 581-608.
- Dasgupta, K., & Mondria, J. (2018). Inattentive importers. *Journal of International Economics*, 112, 150-165.
- De Santis, R. (2012). Impact of environmental regulations on trade in the main EU countries: Conflict or synergy? *The World Economy*, 35(7), 799-815.
- De Soyres, F., Mulabdic, A., Murray, S., Rocha, N., & Ruta, M. (2018). *How much will the Belt and Road Initiative reduce trade costs?* World Bank Policy Research Working Paper, (8614).
- Debie, J., & Steck, B. (2001). Theoretical reevaluation of the concept of enclavement and its application to West Africa. [L'enclavement, réévaluation théorique et application à l'Afrique de l'Ouest]. *L'Espace géographique*, 30(1), 26-36. Retrieved from https://www.cairn-int.info/article-E_EG_301_0026--theoretical-reevaluation-of-the-concept.htm.
- Djankov, S., Freund, C., & Pham, C. (2010). Trading on time. *The Review of Economics and Statistics*, 92(1), 166-173. Retrieved from <https://EconPapers.repec.org/RePEc:tpr:restat:v:92:y:2010:i:1:p:166-173>.
- Djankov, S., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2002). The regulation of entry. *The Quarterly Journal of Economics*, 117(1), 1-37. doi:10.1162/003355302753399436.
- Donaldson, D. (2018). Railroads of the Raj: Estimating the impact of transportation infrastructure. *American Economic Review*, 108(4-5), 899-934.

- Donaubauer, J., Glas, A., Meyer, B., & Nunnenkamp, P. (2018). Disentangling the impact of infrastructure on trade using a new index of infrastructure. *Review of World Economics*, 154(4), 745-784.
- Duval, Y. (2007). Trade facilitation beyond the Doha Round of negotiations. Asia-Pacific Research and Training Network on Trade (ARTNeT) Working Paper (50).
- East Fruit News. (2018). Логистика - одна из главных причин убыточности выращивания яблок в Узбекистане для экспорта. *East Fruit*. Retrieved from <http://east-fruit.com/article/logistika-odna-iz-glavnykh-prichin-ubytochnosti-vyrashchivaniya-yablok-dlya-eksporta-v-uzbekistane>.
- Egger, P., & Larch, M. (2008). Interdependent preferential trade agreement memberships: An empirical analysis. *Journal of International Economics*, 76(2), 384-399. doi:<https://doi.org/10.1016/j.jinteco.2008.08.003>.
- FAO. (2017a). Regional workshop on the WTO Trade Facilitation Agreement impact on agrifood trade. Retrieved from <http://www.fao.org/europe/events/detail-events/en/c/882093/>.
- FAO. (2017b). *Review of agricultural trade policies in post-Soviet countries 2015-16 (summary report)*. Food and Agriculture Organization of the United Nations. Rome, Italy.
- FAO. (2018a). *National programs and strategies in support of agri-food exports in the post-Soviet countries* [Available in Russian]. Food and Agriculture Organization of the United Nations. Rome, Italy. Retrieved from <http://www.fao.org/3/CA0958RU/ca0958ru.pdf>.
- FAO. (2018b). *Review of agricultural trade policies in post-soviet countries 2016-17 (summary report)*. Food and Agriculture Organization of the United Nations. Rome, Italy.
- FAO. (2020). *Review of Agricultural Trade Policies in the post-Soviet countries 2017-2018*. Food and Agriculture Organization of the United Nations. Rome, Italy. Retrieved from <https://doi.org/10.4060/ca7674en>.
- Feenstra, R. (2004). *Advanced international trade: Theory and evidence*. Princeton University Press.
- Francois, J., & Manchin, M. (2006). Institutional quality, infrastructure, and the propensity to export. Unpublished, January, World Bank, Washington, DC. <http://siteresources.worldbank.org/INTTRADECOSTANDFACILITATION>.
- Francois, J., & Manchin, M. (2013). Institutions, infrastructure, and trade. *World Development*, 46, 165-175.
- Freund, C., & Rocha, N. (2010). *What constrains Africa's exports?* Retrieved from <https://EconPapers.repec.org/RePEc:wbk:wbrwps:5184>.
- Freund, C., & Weinhold, D. (2004). The effect of the Internet on international trade. *Journal of International Economics*, 62(1), 171-189.
- Geiger, T., Attilio, D., Doherty, S., & Soinen, I. (2016). *The global enabling trade report 2016*. Paper presented at the World Economic Forum and Global Alliance for Trade Facilitation.
- Geraci, V. J., & Prewo, W. (1977). Bilateral trade flows and transport costs. *The Review of Economics and Statistics*, 67-74.
- Gereffi, G. (2014). Global value chains in a post-Washington consensus world. *Review of International Political Economy*, 21(1), 9-37.
- Gleason, G. (2001). Foreign policy and domestic reform in Central Asia. *Central Asian Survey*, 20(2), 167-182.

- González, J. L., Munro, L., Gourdon, J., Mazzini, E., & Andrenelli, A. (2019). Participation and benefits of SMEs in GVCs in Southeast Asia. doi:<https://doi.org/10.1787/3f5f2618-en>.
- Gould, D. M. (1994). Immigrant links to the home country: Empirical implications for US bilateral trade flows. *The Review of Economics and Statistics*, 302-316.
- Grafe, C., Raiser, M., & Sakatsume, T. (2008). Beyond borders—Reconsidering regional trade in Central Asia. *Journal of Comparative Economics*, 36(3), 453-466. doi: <https://doi.org/10.1016/j.jce.2008.03.004>.
- Grigoriou, C. (2007). *Landlockedness, infrastructure and trade: New estimates for Central Asian countries*. The World Bank Development Research Group Trade Team, WPS4335.
- Hanratty, J. (2018). *What is the difference between a systematic review and a meta-analysis?* Retrieved from <http://meta-evidence.co.uk/difference-systematic-review-meta-analysis/>.
- Hanzl-Weiss, D., Leitner, S. M., Stehrer, R., & Stöllinger, R. (2018). *Global and regional value chains: How important, how different?* wiiw Research Report, No. 427, The Vienna Institute for International Economic Studies (wiiw), Vienna. Retrieved from <https://www.econstor.eu/bitstream/10419/204199/1/wiiw-research-rep-427.pdf>.
- Harrigan, J. (1993). OECD imports and trade barriers in 1983. *Journal of International Economics*, 35(1-2), 91-111. Retrieved from <https://EconPapers.repec.org/RePEc:eee:inecon:v:35:y:1993:i:1-2:p:91-111>.
- Hatzigeorgiou, A., & Lodefalk, M. (2019). Migration and servicification: Do immigrant employees spur firm exports of services? *The World Economy*, 42(11), 3368-3401.
- Hayakawa, K., Laksanapanyakul, N., & Yoshimi, T. (2019). How does import processing time impact export patterns? *The World Economy*, 42(7), 2070-2088.
- Head, K., & Mayer, T. (2019). Brands in motion: How frictions shape multinational production. *American Economic Review*, 109(9), 3073-3124.
- Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1), 153-161. doi:10.2307/1912352.
- Heid, B., Larch, M., & Yotov, Y. (2017). Estimating the effects of non-discriminatory trade policies within structural gravity models.
- Helen, J., Mathilde, B., Lebrand, S. M., & Venables, A. J. (2020). *The Belt and Road Initiative: reshaping economic geography in Central Asia?* Economics Series Working Papers 897, University of Oxford, Department of Economics.
- Hoekman, B., & Nicita, A. (2011). Trade policy, trade costs, and developing country trade. *World Development*, 39(12), 2069-2079. doi: <https://doi.org/10.1016/j.worlddev.2011.05.013>.
- Host, A., Pavlič Skender, H., & Zaninović, P. A. (2019). Trade logistics—The gravity model approach. *Zbornik radova Ekonomskog fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu*, 37(1), 327-342.
- Hummels, D. (2007). Transportation costs and international trade in the second era of globalization. *Journal of Economic perspectives*, 21(3), 131-154. doi:doi: 10.1257/jep.21.3.131.
- Hyun, H.-J. (2018). Institutional quality and trade in intermediate goods. *Journal of Korea Trade*.
- IBRD and World Bank. (2018). *Doing business 2018*. Retrieved from <https://www.doingbusiness.org/en/reports/global-reports/doing-business-2018>

- Investopedia (2020a) Cost, Insurance, and Freight – CIF Definition. Retrieved from [https://www.investopedia.com/terms/c/cif.asp#:~:text=Cost%2C%20insurance%2C%20and%20freight%20\(CIF\)%20is%20an%20expense,named%20in%20the%20sales%20contract.](https://www.investopedia.com/terms/c/cif.asp#:~:text=Cost%2C%20insurance%2C%20and%20freight%20(CIF)%20is%20an%20expense,named%20in%20the%20sales%20contract.)
- Investopedia (2020b) Economic indicator Definition. Retrieved from [https://www.investopedia.com/terms/e/economic_indicator.asp#:~:text=An%20economic%20indicator%20is%20a,current%20or%20future%20investment%20possibilities.&text=Such%20indicators%20include%20but%20aren.Gross%20domestic%20product%20\(GDP\).](https://www.investopedia.com/terms/e/economic_indicator.asp#:~:text=An%20economic%20indicator%20is%20a,current%20or%20future%20investment%20possibilities.&text=Such%20indicators%20include%20but%20aren.Gross%20domestic%20product%20(GDP).)
- Jenish, N. (2014). Export-driven SME development in Kyrgyzstan: The garment manufacturing sector. Institute of Public Policy and Administration Working Paper (26).
- Jordaan, A. C. (2014). The impact of trade facilitation factors on South Africa's exports to a selection of African countries. *Development Southern Africa*, 31(4), 591-605.
- Kaminski, B., & Mitra, S. (2012). *Borderless bazaars and regional integration in Central Asia: Emerging patterns of trade and cross-border cooperation*. The World Bank.
- Kang, K. (2018). The effect of immigrants on the extensive and intensive margins of trade. *Applied Economics Letters*, 25(2), 92-95.
- Kaplinsky, R., & Farooki, M. (2011). What are the implications for global value chains when the market shifts from the north to the south? *International Journal of Technological Learning, Innovation and Development*, 4(1-3), 13-38.
- Kim, K., & Mariano, P. (2020). *Trade impact of reducing time and costs at borders in the Central Asia Regional Economic Cooperation Region*. Retrieved from Tokyo: <https://www.adb.org/publications/trade-impact-reducing-time-costs-borders-carec-region>.
- Krugman, P. R., Obstfeld, M., & Melitz, M. J. (2015). *International economics: Theory and policy*. 10th edition. Paul R. Krugman, Maurice Obstfeld, Marc J. Melitz. ed.: Pearson.
- Kukeyeva, F., & Shkapyak, O. (2013). Central Asia's transition to democracy. *Procedia-Social and Behavioral Sciences*, 81, 79-83.
- Kurmanalieva, E., & Parpiev, Z. (2008). *Geography and trade in Central Asia*. Available at SSRN 1824933.
- Kyrgyz News. 24.KG. (2017). *Kyrgyzstan - Kazakhstan: complicated border issue*. Retrieved from https://24.kg/english/66125_Kyrgyzstan_-_Kazakhstan_complicated_border_issue/.
- Lal, R. (2007). *Soil and environmental degradation in Central Asia*. Taylor and Francis London.
- Lawless, M. (2010). Deconstructing gravity: Trade costs and extensive and intensive margins. *Canadian Journal of Economics/Revue canadienne d'économique*, 43(4), 1149-1172.
- Lenzen, M., Kanemoto, K., Moran, D., & Geschke, A. (2012). Mapping the structure of the world economy. *Environmental Science & Technology*, 46(15), 8374-8381. doi:10.1021/es300171x.
- Levchenko, A. A. (2007). Institutional quality and international trade. *The Review of Economic Studies*, 74(3), 791-819. doi:10.1111/j.1467-937X.2007.00435.x.
- Li, W. C. (2019). Time barrier to export for OECD countries. *Economics Letters*, 175, 106-112. doi:10.1016/j.econlet.2018.10.019.
- Li, Z., Chen, Y., Li, W., Deng, H., & Fang, G. (2015). Potential impacts of climate change on vegetation dynamics in Central Asia. *Journal of Geophysical Research: Atmospheres*, 120(24), 12345-12356.

- Limao, N., & Venables, A. J. (2001). Infrastructure, geographical disadvantage, transport costs, and trade. *The World Bank Economic Review*, 15(3), 451-479.
- Lücke, M., & Rothert, J. (2006). *Central Asia's comparative advantage in international trade*. Kiel Economic Policy Papers.
- Maki, A., Cohen, M. A., & Vandenberg, M. P. (2018). Using meta-analysis in the social sciences to improve environmental policy. In *Handbook of sustainability and social science research* (pp. 27-43): Springer.
- Marchal, L., & Nedoncelle, C. (2019). Immigrants, occupations and firm export performance. *Review of International Economics*, 27(5), 1480-1509.
- Martinez-Zarzoso, I., & Márquez-Ramos, L. (2008). The effect of trade facilitation on sectoral trade. *The B.E. Journal of Economic Analysis & Policy*, 8(1). doi:10.2202/1935-1682.1927.
- Massa, I. (2013). Aid for trade facilitation in lower-income countries. *ODI Report*.
- Maur, J.-C., & Wilson, J. S. (2010). Trade costs and facilitation: Open trade and economic development.
- Mazhikeyev, A. (2015). *Central Asia: Colonial ties, economic performance & trade costs*. Loughborough University.
- Mazhikeyev, A., Edwards, T. H., & Rizov, M. (2015). Openness and isolation: The trade performance of the former Soviet Central Asian countries. *International Business Review*, 24(6), 935-947.
- McCallum, J. (1995). National borders matter: Canada-US regional trade patterns. *The American Economic Review*, 85(3), 615-623.
- Memedovic, O., Ojala, L., Rodrigue, J.-P., & Naula, T. (2008). Fuelling the global value chains: What role for logistics capabilities? *International Journal of Technological Learning, Innovation and Development*, 1(3), 353-374.
- Mogilevskii, R., & Kamiljon, A. (2014). Trade in agricultural and food products in Central Asia. Institute of Public Policy and Administration Working Paper 27.
- Mogilevskii, R., Thurlow, J., Yeh, A., Tilekeyev, K., Abdrazakova, N., Dzhumaeva, S., Toktomushev, K. (2018). Kyrgyzstan's accession to the Eurasian Economic Union: Measuring economy-wide impacts and uncertainties. University of Central Asia Institute of Public Policy and Administration, Working Paper 44.
- Moisé, E., Orliac, T., & Minor, P. (2011). *Trade facilitation indicators*. OECD Publishing.
- Mueller, L., Suleimenov, M., Karimov, A., Qadir, M., Saparov, A., Balgabayev, N., Lischeid, G. (2014). Land and water resources of Central Asia, their utilisation and ecological status. In *Novel measurement and assessment tools for monitoring and management of land and water resources in agricultural landscapes of Central Asia* (pp. 3-59). Springer.
- Mundra, K. (2005). Immigration and international trade: A semiparametric empirical investigation. *The Journal of International Trade & Economic Development*, 14(1), 65-91.
- Nguyen, A. T., Nguyen, T. T., & Hoang, G. T. (2016). Trade facilitation in ASEAN countries: Harmonisation of logistics policies. *Asian-Pacific Economic Literature*, 30(1), 120-134. doi:10.1111/apel.12130.
- OECD. (2015). OECD trade facilitation indicators: An overview of available tools. Retrieved from <http://www.oecd.org/trade/topics/trade-facilitation/>

- OECD. (2018a). *Enhancing competitiveness in Central Asia*. OECD Publishing, Paris, doi:<https://doi.org/10.1787/9789264288133-en>.
- OECD. (2018b). *Trade facilitation and the global economy*. OECD Publishing, Paris, <https://doi.org/10.1787/9789264277571-en>.
- OECD. (2020). *Why trade facilitation matters in today's global economy*. Retrieved from <http://www.oecd.org/trade/topics/trade-facilitation/#:~:text=When%20policymakers%20talk%20about%20%E2%80%9Ctrade.country%20to%20be%20traded%20internationally.>
- Olivero, M. P., & Yotov, Y. V. (2012). Dynamic gravity: Endogenous country size and asset accumulation. *Canadian Journal of Economics/Revue Canadienne D'économique*, 45(1), 64-92.
- Peel, M. C., Finlayson, B. L., & McMahon, T. A. (2007). Updated world map of the Köppen-Geiger climate classification.
- Pendell, D. L., Tonsor, G. T., Dhuyvetter, K. C., Brester, G. W., & Schroeder, T. C. (2013). Evolving beef export market access requirements for age and source verification. *Food Policy*, 43, 332-340.
- Pomfret, R. (2005). Trade policies in Central Asia after EU enlargement and before Russian WTO accession: Regionalism and integration into the world economy. *Economic Systems*, 29(1), 32-58. doi:<https://doi.org/10.1016/j.ecosys.2005.01.002>.
- Pomfret, R. (2006). Resource abundance, governance and economic performance in Turkmenistan and Uzbekistan. In *Energy, wealth and governance in the Caucasus and Central Asia* (pp. 91-107). Routledge.
- Pomfret, R. (2016a). *Improved infrastructure and agricultural exports from Central Asia*. Paper presented at the Regional and International Cooperation in Central Asia and South Caucasus: Recent Developments in Agricultural Trade, Samarkand, Uzbekistan.
- Pomfret, R. (2016b). *International trade: theory, evidence and policy*. World Scientific Publishing Company.
- Pomfret, R. (2017). Improved infrastructure and agricultural exports from Central Asia. *ECONOMIA AGRO-ALIMENTARE*, 19, 35-57. doi:10.3280/ECAG2017-001003.
- Pomfret, R. (2018). The Eurasian land bridge: The role of service providers in linking the regional value chains in East Asia and the European Union.
- Pomfret, R. (2019a). *The Central Asian economies in the twenty-first century: Paving a New Silk Road*. Princeton University Press.
- Pomfret, R. (2019b). Die wichtigsten Eisenbahnverbindungen zwischen China und Europa. ZENTRALASIEN-ANALYSEN 137.
- Pomfret, R., & Sourdin, P. (2010). Why do trade costs vary? *Review of World Economics*, 146(4), 709-730. doi:10.1007/s10290-010-0072-8.
- Portugal-Perez, A., & Wilson, J. S. (2009). Why trade facilitation matters to Africa. *World Trade Review*, 8(03), 379-416. Retrieved from https://EconPapers.repec.org/RePEc:cup:wotrrv:v:8:y:2009:i:03:p:379-416_00.
- Portugal-Perez, A., & Wilson, J. S. (2012). Export performance and trade facilitation reform: Hard and soft infrastructure. *World Development*, 40(7), 1295–1307. doi:10.1016/j.worlddev.2011.12.002.

- Price, R., & Shanks, G. (2008). Data quality and decision making. In *Handbook on decision support systems 1: Basic themes* (pp. 65-82). Berlin, Heidelberg: Springer Berlin Heidelberg.
- Raballand, G. (2003). Determinants of the negative impact of being landlocked on trade: An empirical investigation through the Central Asian case. *Comparative Economic Studies*, 45(4), 520-536.
- Raballand, G., Kunth, A., & Auty, R. (2005). Central Asia's transport cost burden and its impact on trade. *Economic Systems*, 29(1), 6-31.
- Ramasamy, B., & Yeung, M. C. (2019). China's One Belt One Road Initiative: The impact of trade facilitation versus physical infrastructure on exports. *The World Economy*, 42(6), 1673-1694.
- Reed, T., & Trubetskoy, A. (2019). *Assessing the value of market access from Belt and Road projects*. World Bank Policy Research Working Paper 8815.
- Reuters. (2018). *China gives go-ahead to rapeseed meal imports from Kazakhstan*. Retrieved from <https://www.reuters.com/article/us-china-agriculture-kazakhstan/china-gives-go-ahead-to-rapeseed-meal-imports-from-kazakhstan-idUSKBN1O90P5>.
- Samuelson, P. A. (2010). *Economics*. Tata McGraw-Hill Education.
- Santos Silva, J., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, 88(4), 641-658. Retrieved from <https://EconPapers.repec.org/RePEc:tpr:restat:v:88:y:2006:i:4:p:641-658>.
- Schuler, P. (2003). *Institutions and the changing composition of international trade in the post-socialist transition*. Paper presented at the Annual conference of the international society of new institutional economics, Budapest.
- Shapiro, J. S. (2016). Trade costs, CO 2, and the environment. *American Economic Journal: Economic Policy*, 8(4), 220-254. <https://doi.org/10.1016/j.econlet.2020.109215>.
- Sharafeyeva, A. (2019). *Feeding your workhorse with quality data: Analysis of trade costs in Central Asia*. University of Adelaide Jean Monnet Centre of Excellence in International Trade and Global Affairs Discussion Paper. Retrieved from https://iit.adelaide.edu.au/system/files/media/documents/2020-02/Discussion%20Paper%202020-01%20Feb%202020%20A%20Sharafeyeva.final_.pdf.
- Sharafeyeva, A., & Shepherd, B. (2020). What does 'doing business' really measure? Evidence from trade times. *Economics Letters*, 109215.
- Shepherd, B. (2019). Productivity and trade growth in services: How services helped power factory Asia.
- Slavov, S. T. (2007). Innocent or not-so-innocent bystanders: Evidence from the gravity model of international trade about the effects of UN sanctions on neighbour countries. *World Economy*, 30(11), 1701-1725.
- Sourdin, P., & Pomfret, R. (2012). *Trade facilitation: Defining, measuring, explaining and reducing the cost of international trade*. Cheltenham, Gloucestershire: Edward Elgar Publishing.
- SPECA. (2020). SPECA Work Plan for 2020-21. Special Programme for the Economies of Central Asia.
- Staples, M., & Niazi, M. (2007). Experiences using systematic review guidelines. *Journal of Systems and Software*, 80(9), 1425-1437.

- Tanabe, S., Shibasaki, R., & Kato, H. (2016). Impact assessment model of international transportation infrastructure development: Focusing on trade and freight traffic in Central Asia. *Asian Transport Studies*, 4(1), 159-177.
- The Economist. (2020). The World Bank's business-rankings mess. *The Economist*, September 3 2020.
- The Growth Lab at Harvard, U. (2019). *Growth projections and complexity rankings*. Retrieved from: <https://doi.org/10.7910/DVN/XTAQMC>.
- Tilekeyev, K., Mogilevskii, R., Abdrazakova, N., & Dzhumayeva, S. (2018). Production and exports of kidney beans in the Kyrgyz Republic: Value chain analysis.
- Tinbergen, J. (1962). Shaping the world economy; suggestions for an international economic policy.
- Trew, A. (2020). Endogenous infrastructure development and spatial takeoff in the First Industrial Revolution. *American Economic Journal: Macroeconomics*, 12(2), 44-93.
- Tripoli, M., & Schmidhuber, J. (2018). Emerging opportunities for the application of blockchain in the agri-food industry. *FAO and ICTSD: Rome and Geneva. Licence: CC BY-NC-SA*, 3.
- UNECE. (2005). *Recommendation and guidelines establishing a single window*. United Nations Economic Commission for Europe, Geneva, Retrieved from <http://tfig.unece.org/contents/single-window-for-trade.htm>.
- UNESCAP. (2003). Time/cost - distance methodology. United Nations Economic and Social Commission for Asia and the Pacific, Bangkok, Thailand.
- UNESCAP. (2019). *Readiness assessment for cross-border paperless trade: Uzbekistan*. Retrieved from Bangkok, Thailand.
- Van Beers, C., & Van Den Bergh, J. C. (1997). An empirical multi-country analysis of the impact of environmental regulations on foreign trade flows. *Kyklos*, 50(1), 29-46.
- Vandenberg, P., & Kikkawa, K. (2015). Global value chains along the new Silk Road. ADBInstitute policy brief 2. Retrieved from <https://www.adb.org/sites/default/files/publication/160572/adbi-pb2015-2.pdf>.
- Venables, A., Bird, J., & Lebrand, M. (2020). *The Belt and Road Initiative: Reshaping economic geography in Central Asia?* Economics Series Working Papers 897, University of Oxford, Department of Economics. Retrieved from <https://ideas.repec.org/p/oxf/wpaper/897.html>.
- Viktorov, I., & Abramov, A. (2020). *The 2014–15 Financial Crisis in Russia and the Foundations of Weak Monetary Power Autonomy in the International Political Economy*. *New Political Economy* 25 (4):487-510. doi: 10.1080/13563467.2019.1613349.
- Vijil, M. (2014). Aid for trade effectiveness: Complementarities with economic integration. *World Economy*, 37(4), 555-566. doi:10.1111/twec.12140.
- Volpe Martincus, C. (2016). *Out of the border labyrinth: An assessment of trade facilitation initiatives in Latin America and the Caribbean*. Inter-American Development Bank.
- Volpe Martincus, C., Carballo, J., & Graziano, A. (2015). Customs. *Journal of International Economics*, 96(1), 119-137. Retrieved from <https://EconPapers.repec.org/RePEc:eee:inecon:v:96:y:2015:i:1:p:119-137>.
- White, K. D. (2010). Geography, policy, and barriers to international trade in Central Asia. *Central Asia Business Journal*, 3, 44-54.

- Wilson, J. S., Mann, C. L., & Otsuki, T. (2003). Trade facilitation and economic development: A new approach to quantifying the impact. *The World Bank Economic Review*, vol. 17(3), 367-388. doi:10.1093/wber/lhg027.
- Wilson, J. S., Mann, C. L., & Otsuki, T. (2005). Assessing the benefits of trade facilitation: A global perspective. *The World Economy*, 28(6), 841-871. Retrieved from https://econpapers.repec.org/article/blaworlde/v_3a28_3ay_3a2005_3ai_3a6_3ap_3a841-871.htm.
- World Bank. (2008). *Doing business 2008*. Retrieved from 20433: <https://www.doingbusiness.org/content/dam/doingBusiness/media/Annual-Reports/English/DB08-FullReport.pdf>.
- World Bank. (2015). *Doing business 2015*. Washington DC. Retrieved from <https://www.doingbusiness.org/en/reports/global-reports/doing-business-2015>.
- World Bank. (2016a). *Doing business 2016*. Washington DC. Retrieved from [doingbusiness.org/en/reports/global-reports/doing-business-2016](https://www.doingbusiness.org/en/reports/global-reports/doing-business-2016).
- World Bank. (2016b). *What is changing in doing business?* Washington DC. Retrieved from <https://www.doingbusiness.org/content/dam/doingBusiness/media/Annual-Reports/English/DB16-Chapters/DB16-What-is-Changing-in-Doing-Business.pdf>.
- World Bank. (2020a). *Agriculture & rural development*. Retrieved from <https://data.worldbank.org/topic/1>.
- World Bank. (2020b). *Doing business–Data irregularities statement*. Retrieved from <https://www.worldbank.org/en/news/statement/2020/08/27/doing-business---data-irregularities-statement>.
- World Bank. (2020c). *National accounts data*. Retrieved from <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD>.
- World Bank. (2020d). *Tariff rate, applied, simple mean, all products*. Retrieved from <https://data.worldbank.org/indicator/TM.TAX.MANF.SM.AR.ZS?locations=S1>.
- World Bank. (2020e). *Trading across borders*. Retrieved from <https://www.doingbusiness.org/en/data/exploretopics/trading-across-borders>.
- World Bank. (2020f). *Central Asia's Horticulture Sector: Capitalizing on New Export Opportunities in Chinese and Russian Markets*. World Bank, Washington, DC. Retrieved from <https://openknowledge.worldbank.org/handle/10986/33652WTO>.
- WTO. (2001). *The Doha Declaration explained*. Retrieved from https://www.wto.org/english/tratop_e/dda_e/dohaexplained_e.htm
- WTO. (2015). *World trade report 2015*. Retrieved from https://www.wto.org/english/res_e/publications_e/wtr15_e.htm
- WTO. (2017). *Trade facilitation*. Retrieved from https://www.wto.org/english/tratop_e/tradfa_e/tradfa_e.htm
- WTO. (2020a). *Members endorse Turkmenistan's WTO observer status*. Retrieved from https://www.wto.org/english/news_e/news20_e/acc_22jul20_e.htm
- WTO. (2020b). *Third anniversary of Trade Facilitation Agreement sees increasing implementation rate*. Retrieved from https://www.wto.org/english/news_e/news20_e/fac_22feb20_e.htm#:~:text=TRADE%20FACI

LITATION-

.Third%20anniversary%20of%20Trade%20Facilitation%20Agreement%20sees%20increasing%20implementation%20rate,steady%20progress%20in%20its%20implementation.

Yotov, Y. V., Piermartini, R., Monteiro, J.-A., & Larch, M. (2016). *An advanced guide to trade policy analysis: The structural gravity model*. World Trade Organization, Geneva.

Zaki, C. (2013). Trade facilitation and corruption: A CGE model of Egypt. *The Journal of North African Studies*, 18(1), 70-111. doi:10.1080/13629387.2012.731165.

Appendices

Appendix A

Definitions of trade facilitation

a) Academic literature	
Study	Definition
Duval (2007)	Trade facilitation involves increasing the efficiency of trading processes. Trade facilitation involves making customs, transport, and banking and insurance (services and infrastructure) more efficient. Trade facilitation cannot simply be limited either to at-the-border or to customs control processes, since these two sets of processes are only two of a number of other processes (e.g., payment and logistics) that affect the efficiency of a trade transaction.
Persson (2013)	Trade facilitation refers to making it easier for traders to move goods across borders by making cumbersome cross-border trade procedures more efficient.
Portugal-Perez and Wilson (2012)	Trade facilitation measures can be undertaken along two dimensions: a 'hard' dimension related to tangible infrastructure such as roads, ports, highways, telecommunications, as well as a 'soft' dimension related to transparency, customs management, the business environment, and other institutional aspects that are intangible.
Pomfret and Sourdin (2010)	We define trade facilitation as a reduction in trade costs. Trade costs refer to the difference between the domestic and international trade other than those costs related to traditional trade policy instruments such as import duties. Traded costs include transport costs and the costs of clearing borders, but there is a grey area concerning which behind-the border costs should be included in a measurement of trade costs.
Zaki (2014)	Trade facilitation includes five main elements: 1) simplification of trade procedures and documentation; 2) harmonization of the trade practices and rules; 3) more transparent information and procedures of international flows; 4) recourse to new technologies to promote international trade; 5) more secured means of payment for international commerce.
b) International organizations	
Institution/source	Definition
Asia-Pacific Economic Cooperation (APEC)	Trade facilitation refers to the simplification and rationalization of customs and other administrative procedures that hinder, delay or increase the cost of moving goods across international borders.
European Commission	Trade facilitation can be defined as the simplification and harmonization of international trade procedures including import and export procedures. Procedures in this context largely refer to the activities (practices and formalities) involved in collecting, presenting, communicating and processing the data required for movement of goods in international trade.
International Chamber of Commerce (ICC)	Improvements in the efficiency of the processes associated with trading in goods across national borders.

Organisation for Economic Co-operation and Development (OECD)	Trade facilitation refers to policies and measures aimed at easing trade costs by improving efficiency at each stage of the international trade chain.
United Nations Economic Commission for Europe (UNECE)	The simplification, standardization and harmonization of procedures and associated information flows required to move goods from seller to buyer and to make payment.
United Nations Conference on Trade and Development (UNCTAD)	Trade facilitation seeks to establish a transparent and predictable environment for cross-border trade transactions based on simple, standardized customs procedures and practices, documentation requirements, cargo and transit operations, and trade and transport arrangements.
WTO Trade Facilitation Agreement	Trade facilitation is elimination of paperwork, modernisation of trade procedures and harmonisation of customs requirements, towards reduction of the costs and time needed to trade goods across the border.

Source: adapted from WTO (2015)

Appendix B

Selected studies on the effect of trade facilitation on trade flows

Study	Model	Assumption/Scenario	Dependent Variable	Independent variable(s) (TFIs)	Impact on trade flows
Wilson, Mann, Otsuki (2003)	Gravity	APEC members with below-average indicators improve capacity halfway to the average for all members shows that intra-APEC trade	Exports (manufactured goods among APEC member nations)	Port efficiency, customs environment, regulatory environment and E-business usage	+ \$US 254 billion, or 21% of intra-APEC trade flows
Wilson, Mann, Otsuki (2005)	Gravity	'Below-average' countries 'halfway' to global average	Exports (manufactured goods)	Port efficiency, customs environment, regulatory environment and service sector infrastructure (proxied by the Internet and e-commerce use by business)	+ \$US 377 billion in global trade (10% in total trade among these countries)
Kazutomo and Wilson (2008)	CGE	Raising transparency to the average in the region.	Export	Transparency improvement in the trade	+11% increase of trade in the region; +\$US 406 billion global welfare
Shepherd and Wilson (2009)	Gravity	Scenario 1, the quality of maritime port infrastructure is improved so that no country scores below the current regional average; Scenario 2, performs the same exercise for airport infrastructure Scenarios 3 and 4, improvements in the control of irregular payments and competition among Internet Service Providers; Scenario 5 considers a cut in applied tariffs to the current regional average	Import	Port infrastructure, air transport infrastructure, services sector development, and customs administration	Trade gain: (1) +\$US 22,404.1 (7.5%) (2) +\$US 124,959.4 (42.1%) (3) +\$US 6,814.7 (2.3%) (4) +\$US 17,021.8 (5.7%) (5) +\$US 6,295.3 (2.1%)
Decreux and Fontagné (2011)	CGE	50% reduction in AVE cost of time at the border, soft infrastructure.	Export	Trade facilitation, port efficiency, sectoral initiatives and sectoral initiatives	+ \$US 359 billion (1.9%) of global trade flows
Dennis and Shepherd (2011)	Gravity	10% reduction in costs of (1) exporting (2) international transport (3) market entry.	Export variety	Costs of exporting, international transport or market entry	Export diversification (1) +3% (2) +4% (3) +1%

Portugal-Perez and Wilson (2012)	Gravity	Improve border and transport efficiency halfway to top performer in the region.	Export	(i) physical infrastructure and (ii) information and communications technology (ICT); (iii) border and transport efficiency; (iv) the business and regulatory environment.	Chad: +17% Mongolia: +3% Kazakhstan: +23% Venezuela: +4%; Global impact is positive and significant
Zaki (2014)	Gravity and CGE (two steps)	50% reduction in AVE cost of time to import and export.	Export	Bureaucracy, internet coverage, corruption, and geographical barriers on the time to trade	EU: +10.6% US: +3.9 Japan: +2.1% SSA: +22.3% Asia: +16.2% LAC: +16.2%

Source: Modified and updated table from the WTO (2015)

Appendix C

Diary of building the search term combination

Source of search	Search term combination	No. of abstracts yielded	Limiters applied	Example of relevant articles
Date of search: 3/04/2018				
Web of Science (https://apps.webofknowledge.com)	'Trade facilitation'	135	Category: Economics, International relations; Political science; Research area: Business Economics; International relations; Transportation; Public Administration; Timespan: 1900 to 2018; Documents type: Articles; Language: English; [excluding] research areas: energy fuels or geography or food science technology or health care sciences services or psychology or nutrition dietetics or social sciences other topics or environmental sciences ecology	Wilson, JS; Mann, CL; Otsuki, T Assessing the benefits of trade facilitation: A global perspective
Date of search: 29/05/2018				
Web of Science (https://apps.webofknowledge.com)	'Trade facilitation'	175	Language: English Document types: article Category: economics or international relations or transportation or business or agricultural economics policy or political science Research areas: business economics or international relations or government law or public administration or transportation or agriculture Timespan: all years.	

Source of search	Search term combination	No. of abstracts yielded	Limiters applied	Example of relevant articles
Scopus (https://www.scopus.com)	'Trade facilitation' AND 'International trade' and 'Facilitaiton'	156	Language: English; Russian Document types: Article Subject area: sociology, economics, business, agriculture Timespan: all years	
Date of search: 15/06/2018				
Scopus (https://www.scopus.com)	'Trade facilitation' AND 'Trade flows' AND 'Export and 'Gravity model'	35	Language: English Document types: Article Timespan: all years	
Scopus (https://www.scopus.com)	'Trade costs' AND 'Trade flows' AND NOT 'Import tariffs' AND NOT 'Export tariffs'	35	Document types: Article Subject area: economics	
Date of search: 19/06/2018				
Web of Science (https://apps.webofknowledge.com)	'Trade facilitation' AND 'Trade flows'AND 'International trade'	12	Document types: Article Category: economics, international relations Timespan: All years	
Web of Science (https://apps.webofknowledge.com)	'Trade facilitation' AND 'Trade flows'	19	Document types: Article Category: economics, international relations Timespan: All years	
Web of Science (https://apps.webofknowledge.com)	'Trade facilitation'	163	Document types: Article Language: English; Category: economics, international relations, planning development	

Source of search	Search term combination	No. of abstracts yielded	Limiters applied	Example of relevant articles
Web of Science (https://apps.webofknowledge.com)	'Trade costs' AND NOT 'Import tariffs' AND NOT 'Export tariffs' AND 'International trade AND 'Trade flows'	303	Document types: Article Category: economics, international relations	
Business Source Complete (EBSCOhost) (https://www.ebsco.com/products/ebscohost-platform)	'Trade facilitation'	66	References Available; Scholarly (Peer Reviewed) Journals; Publication Type: Academic Journal; Document Type: Article; Language: English; PDF Full Text	
Business Source Complete (EBSCOhost) (https://www.ebsco.com/products/ebscohost-platform)	'Trade costs' AND 'Trade flows' AND NOT 'Import tariffs' AND NOT 'Export tariffs'	527	Full Text; References Available; Scholarly (Peer Reviewed) Journals; Publication Type: Academic Journal; Document Type: Article; Language: English	
Emerald insight (Emerald) (https://www.emeraldinsight.com/)	'Trade facilitation'	42	Subject: Economics; International economics; International trade Type: Research paper	
Emerald insight (Emerald) (https://www.emeraldinsight.com/)	'Trade costs' AND 'Trade flows' AND NOT 'Import tariffs' AND NOT 'Export tariffs'	92	Subject: Economics; International economics; International trade Type: Research paper	
Date of search: 06/01/2020				
Web of Science (https://apps.webofknowledge.com)	'Trade facilitation'	54	Document types: (article or early access) and web of science categories: (economics or international relations or political science or public administration or transportation) and languages: (English) Timespan: 2018-2020.	

Source of search	Search term combination	No. of abstracts yielded	Limiters applied	Example of relevant articles
Web of Science (https://apps.webofknowledge.com)	'Trade costs' NOT TOPIC: (import tariffs) NOT TOPIC: (Export tariffs) AND TOPIC: (international trade) AND TOPIC: (trade flows)	58	Web of science categories: (economics) and document types: (article or early access) and web of science categories: (economics or international relations or business finance or political science or business) and languages: (English) and research areas: (business economics or international relations or development studies) Timespan: 2018-2020.	
Scopus (https://www.scopus.com)	'Trade facilitation	54	Language: English Document types: article Timespan: 2017 < 2021 Subject areas: Sociology economics, business	
Scopus (https://www.scopus.com)	'Trade cost' AND 'International trade' AND NOT 'Trade liberalization' AND NOT 'Import tariffs' AND NOT 'Export tariffs'	34	Language: English Document types: article Timespan: 2017 < 2021 Subject areas: Sociology economics, business	

Appendix D

Sample of excluded literature

Result #	Reference	Exclusion Criteria
1	RefID: 1, The Log of Gravity Santos Silva, João, Tenreyro, Silvana Level: 1, State: Excluded	Not International trade (Theory/Models)
2	RefID: 2, Reputation and Coalitions in Medieval Trade: Evidence on the Maghribi Traders A. Greif Level: 1, State: Excluded	Not International trade
3	RefID: 3, Information technology and national trade facilitation: guide to best practice R. Schware, P. Kimberley Level: 2, State: Excluded	No impact of trade costs/trade facilitation on trade flows
4	RefID: 4, Information technology and national trade facilitation: making the most of global trade R. Schware, P. Kimberley Level: 2, State: Excluded	No quantitative methods applied
5	RefID: 5, The interplay of facilitation and competition in plant communities M. Holmgren, M. Scheffer, M.A. Huston Level: 1, State: Excluded	Not International trade
6	RefID: 6, Facilitation of advanced manufacturing technology: Implementation and transfer M.P. Hottenstein, M.S. Casey, S.C. Dunn Level: 1, State: Excluded	Not International trade
7	RefID: 7, The ASEAN free trade area C.S. Yue Level: 1, State: Excluded	No trade costs/trade facilitation
8	RefID: 8, Food safety regulation and trade in food products N.H. Hooker Level: 2, State: Excluded	No quantitative methods applied
9	RefID: 9, TRIPS Agreement: benefits and costs for developing countries R.M. Sherwood Level: 2, State: Excluded	No impact of trade costs/trade facilitation on trade flows
10	RefID: 10, Combined effects of shade and drought tulip poplar seedlings: Trade-off in tolerance or facilitation? M. Holmgren Level: 1, State: Excluded	Not International trade
11	RefID: 11, Divided struggle M. Subhan Level: 1, State: Excluded	Did not meet other selection criteria
12	RefID: 12, Aussies sign MOU with China Level: 1, State: Excluded	Not International trade

Appendix E

Definitions of the trade facilitation groups

TFI Group	Indicators included (as specified in the articles)
Physical infrastructure	Quality and quantity of roads, railways, ports, airports; ICT (number of internet-users, technology absorption, etc); Technological Achievement Index (TAI), services trade facilitation index (STFI)
Business and regulatory environment	Government transparency; Public trust for government; any types of irreg. payments (corruption); Government E-Readiness; favouritism of gov.to well-connected firms; institutional development; Business mobility imports; exchange rates; Standards and conformity; information availability; IIT index; voice and accountability, political stability, government effectiveness, control of corruption, regulatory quality and rule of law; revolutions, terrorism; national uncertainty-aversion; price volatility
Border and transport efficiency	Cost to export/import; number of documents to export/import; inland transportation time; time to export/import; transport cost; administrative payments; customs procedures; hidden export barriers;
Aid and FDI	All types of aid programs; Inward and outward direct investments
Human factor	Number of migrants (emigrants and immigrants); Level of education (E-Readiness of population); Workers' skills
External factors	UN sanctions; War in neighbouring countries; terrorist attacks
Environment	Environmental Regulations, CO2 tax
Geography	Common mountain chains, time zones, genetic proximity of population

Appendix F

Area, 100 thousand square kilometres, and distance to world capitals from Central Asian countries, kilometres.

Country	Area	AUS	BRA	CHN	DEU	EGY	JPN	KAZ	KGZ	KOR	RUS	TJK	TKM	TUR	USA	UZB
KAZ	27	12,235	13,414	3,656	3,885	4,055	5,565		950	4,553	2,271	1,410	1,795	3,214	9,553	1,116
KGZ	2	11,523	13,838	3,472	4,560	4,083	5,530	950		4,423	2,986	678	1,477	3,465	10,493	480
TJK	1	11,649	13,417	4,053	4,461	3,558	6,136	1,410	678	5,009	2,987		917	3,084	10,730	295
TKM	5	12,391	12,504	4,940	3,802	2,642	7,007	1,795	1,477	5,894	2,510	917		2,214	10,343	999
UZB	4	11,785	13,424	3,944	4,307	3,619	6,008	1,116	480	4,896	2,790	295	999	3,054	10,480	

Source: geographic distances CEPII, 2020

Appendix G

GDP: growth, constant and per capita

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	<i>GDP growth (annual percentage)</i>									
KAZ	7.3	7.4	4.8	6.0	4.2	1.2	1.1	4.1	4.1	4.5
KGZ	-0.5	6.0	-0.1	10.9	4.0	3.9	4.3	4.7	3.8	4.5
TJK	6.5	7.4	7.5	7.4	6.7	6.0	6.9	7.6	7.3	7.0
TKM	9.2	14.7	11.1	10.2	10.3	6.5	6.2	6.5	6.2	
UZB	7.6	7.8	7.4	7.6	7.2	7.4	6.1	4.5	5.4	5.6
	<i>GDP (constant 2010 US dollars, billion)</i>									
KAZ	148	159	167	177	184	186	188	196	204	213
KGZ	5	5	5	6	6	6	6	7	7	7
TJK	6	6	7	7	7	8	8	9	10	10
TKM	23	26	29	32	35	37	40	42	45	
UZB	47	50	54	58	62	67	71	74	78	83
	<i>GDP per capita (constant 2010 US dollars)</i>									
KAZ	9,070	9,603	9,923	10,368	10,646	10,617	10,583	10,868	11,166	11,518
KGZ	880	921	905	984	1,004	1,021	1,044	1,072	1,091	1,116
TJK	750	787	827	868	904	936	976	1,025	1,073	1,121
TKM	4,439	5,006	5,463	5,910	6,399	6,694	6,987	7,318	7,648	
UZB	1,634	1,715	1,814	1,922	2,025	2,139	2,230	2,290	2,374	2,459

Source: World Development Indicators, World Bank (2020a)

Appendix H

Theoretical revealed comparative advantage

Costinot et al. (2012) developed a simple method for analyzing patterns of comparative advantage, which can be reduced to a gravity-like relation, predicting that bilateral trade flows by sector should satisfy the following relation:

$$(1) \ln x_{ij}^k = d_{ij} + d_j^k + \theta \ln z_i^k + e_{ij}^k$$

Where: x_{ij}^k is exports from country i to country j in sector k ; d_{ij} is a country-pair fixed effect capturing structural features of the model, such as trade costs; θ is a parameter from the theory capturing intra-industry heterogeneity in productivity; z_i^k is the fundamental productivity of sector k in country i , taking account of factors like climate, infrastructure, and institutions that affect all producers within a country; and e_{ij}^k is an error term satisfying standard assumptions.

Due to lack of the productivity data, in particular for developing countries, the productivity variable is replaced with an exporter-sector fixed effect:

$$(2) \ln x_{ij}^k = d_{ij} + d_j^k + d_i^k + e_{ij}^k$$

Once the estimates have been obtained, using the PPML estimator of Santos Silva and Tenreyro (2006), a value of θ (6.53) is used to construct revealed productivity measures by exponentiation, i.e. $z_i^k = \exp(d_i^k/\theta)$. The revealed productivity measure can be interpreted in terms of a theoretical RCA measure. As in the original paper, all estimates are expressed relative to the revealed productivity level in agriculture in each country.

Appendix I

Central Asian exports by goods and services, 2018, US dollars, and comparison with 2010 (% change)

KAZ			KGZ			TJK			TKM			UZB		
Sector	Export, \$million	% change	Sector	Export, \$million	% change	Sector	Export, \$million	% change	Sector	Export, \$million	% change	Sector	Export, \$million	% change
Mineral fuels, oils and waxes	28,580	-7	Precious metals and stones	735	145	Ores, slag and ash	423	1,582	Mineral fuels, oils and waxes	7,727	376	Precious metals and stones	4,947	1,887
Transport	4,328	90	Travel	472	196	Transport	188	11	Cotton	276	-38	Mineral fuels, oils and waxes	2,238	77
Iron and steel	4,056	25	Transport	218	44	Precious metals and stones	176	14,963	Salt, sulphur, lime, cement, etc.	79	23101	Transport	1,362	
Ores, slag and ash	2,821	30	Ores, slag and ash	128	126087	Aluminium	161	-73	Plastics	67	-27	Travel	1,243	
Copper	2,657	17	Mineral fuels, oils and waxes	112	16	Cotton	96	-35	Fertilisers	48	1061	Cotton	929	-34
Travel	2,451	144	ICT	93	-67	Salt, sulphur, lime, cement, etc.	48	40,727	Other	39	15	Copper	557	15
Inorganic chemicals	2,281	7	Copper	76	191	ICT	44	-79	Lac and other vegetable extracts	33	496	Fruits and nuts	514	63
Cereals	1,246	51	Vegetables	45	-45	Articles of stone, plaster, cement, etc.	43		Apparatuses (optical, medical, etc.)	32	3239	Plastics	434	414
Zinc	750	54	Industrial Machinery	44	151	Apparatuses (optical, medical, etc.)	38	1,797	Ships	30	575	Other	350	49

KAZ			KGZ			TJK			TKM			UZB		
Salt, sulphur, lime, cement, etc.	572	66	Apparel, knit	38	7	Mineral fuels, oils and waxes	30	39	Vehicles	22	174	Vegetables	226	12
Precious metals and stones	428	-49	Glass and glassware	31	1503	Other base metals	27	97,271	Other made up textile articles	20	-31	Apparel, knit	196	80
Other	400	-85	Iron and steel	31	76	Fruits and nuts	17	-83	Industrial Machinery	13	-10	Fertilisers	159	-5
Oil seeds and oleaginous fruits	399	1,215	Diary products	29	-7	Apparel, not knit	16	-5	Inorganic chemicals	9	-31	Zinc	150	54
Flours, starches and malts	399	-23	Cotton	28	1	Other	10	-83	Leather and skins	9	65	Iron and steel	115	500
ICT	394	-46	Vehicles	26	3	travel	9	277	Vegetables	8	1,089	Inorganic chemicals	114	-80
Aluminium	359	7	Salt, sulphur, lime, cement, etc.	26	222	Vegetables	9	-81	Animal or vegetable fats, oils or waxes	7	259	Apparatuses (optical, medical, etc.)	111	928
Other base metals	300	64	Plastics	20	168	Leather and skins	8	17	Wool	6	70	ICT	106	
Industrial Machinery	270	135	Fruits and nuts	20	-78	Oil seeds and oleaginous fruits	6	-9	Diary products	4	78,504	Leather and skins	85	735
Lead	263	42	Electrical machinery and equipment	19	-40	Inorganic chemicals	4	922	Electrical machinery and equipment	4	74	Electrical machinery and equipment	65	-12

Source: Calculations based on exports dataset from The Growth Lab at Harvard (2019).

Note: Purple highlighting indicates sectors that are among the top five exports in all five countries of the region (not present); Yellow-in four countries, blue three or two countries, pink-only one; Grey most dynamic sectors.

Appendix J

Import tariff rates in Central Asia

Kazakhstan	Tariff rate, most favoured nation, simple mean, all products (%)	Tariff rate, applied, weighted mean, all products (%)	Tariff rate, applied, weighted mean, manufactured products (%)	Tariff rate, applied, weighted mean, primary products (%)
1996	9.44			
2004	2.83	1.91	1.49	3.35
2008	5.52	2.22	2.41	1.49
2010	8.63	4.4	4.81	2.88
2011	8.64	3.2	3.66	1.84
2012	8.81	3.68	4.16	2.06
2013	8.68	3.75	4.3	1.84
2014	8.06	3.46	3.71	2.33
2015	7.52	4.85	4.87	4.72
2016	6.53	2.55	2.78	1.74
2017	6.31	2.39		
Kyrgyzstan	Tariff rate, most favoured nation, simple mean, all products (%)	Tariff rate, applied, weighted mean, all products (%)	Tariff rate, applied, weighted mean, manufactured products (%)	Tariff rate, applied, weighted mean, primary products (%)
1995	0	0	0	0
2000	2.78	2.78	2.94	2.54
2001	3.33	3.33	3.59	2.98
2002	6.8	6.8	7.17	6.34
2003	4.31	4.31	2.9	6.19
2006	3.91	1.18	1.41	0.9
2007	3.87	1.06	1.43	0.69
2008	4.32	2.32	2.81	1.24
2009	4.52	2.38	2.68	1.7
2010	4.35	2.29	3.43	0.95
2011	4	2.38	3.58	0.72
2012	4.14	2.46	3.62	0.67
2013	4.14	2.46	3.62	0.67
2014	3.91	2.34	3.38	0.69
2015	6.6	3.2	4.14	1.58
2016	5.83	3.16	3.91	0.95
2017	5.71	2.93		

Tajikistan	Tariff rate, most favored nation, simple mean, all products (%)	Tariff rate, applied, weighted mean, all products (%)	Tariff rate, applied, weighted mean, primary products (%)	Tariff rate, applied, weighted mean, manufactured products (%)
2006	8.02	3.97		5.53
2010	7.75	5.94	1.99	7.84
2012	7.66	5.22	1.83	7.11
2013	7.64	5.69	1.37	7.36
2014	7.5	5.56	1.7	7.22
2015	7.48	7.18	1.66	4.72
2016	7.5	5.7	9.91	7.36
2017	7.53	4.98	0.85	
Uzbekistan	Tariff rate, most favored nation, simple mean, all products (%)	Tariff rate, applied, weighted mean, all products (%)	Tariff rate, applied, weighted mean, primary products (%)	Tariff rate, applied, weighted mean, manufactured products (%)
2001	10.67	5.83	4.23	6.19
2006	11.99	7.54	5.09	8.11
2007	12.22	6.91	2.69	8.14
2008	12.77	8.58	3.94	9.23
2009	12.02	7.04	2.33	8.28
2012	12.25	7.21	2.59	8.73
2014	12.34	6.83	3.14	7.99
2015	13.66	8.73	12.71	8.43

Source: World Development Indicators, World Bank (2020b)

Appendix K

Value chain linkages

The following exposition of the Leontief inverse approach to trade in value added decomposition follows Aslam, Novta, and Rodrigues-Bastos (2017).

A matrix algebra can be used to represent the production system for G countries and N sectors as follows, where each matrix is appropriately dimensioned:

$$(1) AX + Y = X$$

Where X is the gross output matrix, A is the matrix of input-output coefficients, and Y is the matrix of goods used for final demand. Thus, AX is the intermediate use matrix as in the example above. In Eora notation, AX is called T , and Y is called FD . However, in what follows the more common notation from the IO literature is used.

Equation (1) can be rearranged by grouping terms and solving for X :

$$Y = X - AX = X(I - A)$$

$$(2) \therefore X = (I - A)^{-1}Y \equiv BY$$

Matrix B is the Leontief inverse. From basic matrix algebra suggests:

$$(3) (I - A)^{-1} = I + A + A^2 + A^3 + \dots$$

Considering the structure of the A matrix, this means that each element of the Leontief inverse captures the full direct and indirect output requirements in one sector of a unit of output from another sector.

In a standard MRIO context, AX can be obtained but not A . Therefore, there is need to recover A in order to form the Leontief inverse. To do that, element-wise division is used. For any element (i,j) of A , there is:

$$(4) a_{ij} = \frac{(AX)_{ij}}{X_i}$$

Calculating the elements of a in this way makes it possible to recover the whole matrix, and then in turn to calculate the Leontief inverse B .

Next, \hat{V} is defined as the matrix of value-added shares, or the value added coefficients matrix. This matrix is obtained by summing across rows in A , putting those elements on the diagonal of a square matrix, and subtracting it from an appropriately dimensioned identity matrix. In other words:

$$(5) \hat{V} = I - \text{diag} \left(\sum_i^{GN} a_{i,1} \dots \sum_i^{GN} a_{i,12} \right)$$

The next step is to calculate a matrix T_v as follows:

$$(6) T_v = \hat{V}BE = \begin{bmatrix} \hat{v}_1 & 0 & \dots \\ 0 & \hat{v}_2 & 0 \\ \vdots & 0 & \ddots \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} & \dots \\ b_{21} & b_{22} & \dots \\ \vdots & \vdots & \ddots \end{bmatrix} \begin{bmatrix} e_1 & 0 & \dots \\ 0 & e_2 & 0 \\ \vdots & 0 & \ddots \end{bmatrix}$$

Where E is a matrix with gross exports on the diagonal and zeros elsewhere.

T_v contains the value-added content of production in each country shipped to each other country. In other words, it provides a combination of domestic and foreign value added depending on the country-pair chosen.

Each diagonal element represents domestic value added in exports (DVA), while the sum of the remaining elements in each column represents foreign value added in exports (FVA). The computation makes it possible to compute summary measures, such as total DVA and FVA, by country or by country-sector. But applying appropriate sums makes it possible to calculate other measures of interest, such as FVA for particular regions (e.g., the immediate sub-region and the rest of the world), or DVA and FVA from services only.

The analysis in the main text is based on appropriately aggregated elements of T_v , with interpretations as given there. The key insight is that off block diagonal elements of T_v give value added contributions from other country-sector combinations, and so represent backward linkages, or the use of imported intermediates to produce export.

Appendix L

Data and sources used for the analysis

Variable	Definition	Notation	Source
Exports (dependent variable)	Exports from country i to country j in time t Perishable: grapes (HS0806); tomatoes (HS072); Non-perishable: wheat (HS1001); cotton (HS5201)	X_{ijt}	(The Growth Lab at Harvard, 2019)
Common language	Dummy variable equal to one for countries that have a common official language.	Language _{ij}	CEPII
Common colonizer	Dummy variable equal to one for countries that have a common colonizer post 1945	Comcol _{ij}	CEPII
Landlocked	Dummy variable equal to one if country is landlocked.	Landlocked _i	CEPII
Distance	Population weighted distance between country i and country j.	Distance _{ij}	CEPII
FTA	Dummy variable equal to one for country-pairs that are members of the same regional trade agreement.	FTA _{ijt}	CEPII
GDP exporter	GDP of exporter in current US\$ dollars	GDP _{it}	CEPII (2005-14) World Bank (2015-17)
GDP importer	GDP of importer in current US\$ dollars	GDP _{jt}	CEPII (2005-14) World Bank (2015-17)
Time to export	Number of days to export 20-foot container (2005–2014), and unit of shipment (2015-2017)	Time_Ex _{it}	World Bank Doing Business database
Cost to export	US\$ dollars to export a 20-foot container, and a unit of shipment (2015-2017)	Cost_Ex _{it}	World Bank Doing Business database
Central Asia	Dummy variable equal to one if exporting country is Kazakhstan, Kyrgyzstan, Tajikistan or Uzbekistan	CA	
Rest of the World	Dummy variable equal to one if exporting country is not CA	ROW	

Appendix M

Baseline results for perishable and non-perishable products at HS 4-digits level estimated with PPML exporter-year, importer-year fixed effects, 2005-2014

	(1)	(2)	(3)	(4)
	Tomato	Grapes	Wheat	Raw Cotton
GDP exporter				
GDP importer				
Distance RoW	-2.020 (0.244) ^{***}	-1.065 (0.128) ^{***}	-1.969 (0.125) ^{***}	-1.070 (0.173) ^{***}
Cost RoW				
Time RoW				
Distance CA	-3.245 (0.756) ^{***}	-3.825 (0.467) ^{***}	-3.475 (0.447) ^{***}	-1.978 (0.580) ^{***}
Cost CA				
Time CA				
Common border	0.027 (0.273)	0.540 (0.201) ^{***}	0.105 (0.168)	0.693 (0.261) ^{***}
Common language	1.330 (0.519) ^{**}	0.152 (0.171)	0.253 (0.178)	0.387 (0.299)
Common colonizer	0.897 (0.400) ^{**}	-0.021 (0.396)	0.886 (0.299) ^{***}	0.406 (0.309)
FTA	1.820 (0.309) ^{***}	1.223 (0.155) ^{***}	0.193 (0.163)	-0.101 (0.206)
Constant	30.698 (2.039) ^{***}	25.173 (1.143) ^{***}	34.605 (1.079) ^{***}	28.309 (1.519) ^{***}
N	69,203	74,776	63,983	64,678

Standard errors in parentheses * p < 0.10, ** p < .05, *** p < .01; Standard errors clustered by country-pair. Due to the exporter-year, importer-year fixed effects, the GDPs and other variables that change over time were dropped at the regression stage

Appendix N

Descriptive statistics for gravity model analysis, 2005-2014 full dataset

Variable	Obs	Mean	Std. Dev.	Min	Max
HS0702					
year	267,320	2009.5	2.872287	2005	2014
Export value (\$million)	267,320	0.3	0.0	0.0	1.9
Distance (weighted distance (pop-wt, km))	267,320	8,030	4,490	94	19,700
Common border	267,320	0	0	0	1
Common language	267,320	0	0	0	1
Common colonizer	267,320	0	0	0	1
GDP of exporter (\$billion)	265,853	385	1,420	0.105	17,400
GDP of importer (\$billion)	265,853	385	1,420	0.105	17,400
Cost to export (\$)	267,320	1,930	1,720	416	17,600
Time to export (days)	267,320	24	16	6	102
Landlocked	267,320	0	0	0	1
FTA	267,320	0	0	0	1
HS0806					
year	270,600	2009.5	2.872287	2005	2014
Export value (\$million)	270,600	0.3	6.6	0.0	832
Distance (weighted distance (pop-wt, km))	270,600	8,030	4,490	94	19,700
Common border	270,600	0	0	0	1
Common language	270,600	0	0	0	1
Common colonizer	270,600	0	0	0	1
GDP of exporter(\$billion)	269,124	383	1,410	0	17,400
GDP of importer (\$billion)	269,124	383	1,410	0	17,400
Cost to export (\$)	270,600	1,930	1,710	416	17,600
Time to export (days)	270,600	24	16	6	102
Landlocked	270,600	0	0	0	1
FTA	270,600	0	0	0	1
HS1001					
year	264,060	2009.5	2.872287	2005	2014
Export value (\$million)	264,060	1.4	22.3	0.0	1,970.0

Variable	Obs	Mean	Std. Dev.	Min	Max
Distance (weighted distance (pop-wt, km))	264,060	7,940	4,450	94	19,700
Common border	264,060	0	0	0	1
Common language	264,060	0	0	0	1
Common colonizer	264,060	0	0	0	1
GDP of exporter(\$billion)	262,602	387	1,420	0	17,400
GDP of importer (\$billion)	262,602	387	1,420	0	17,400
Cost to export (\$)	264,060	1,940	1,720	416	17,600
Time to export (days)	264,060	24	16	6	102
Landlocked	264,060	0	0	0	1
FTA	264,060	0	0	0	1
HS5201					
year	267,320	2009.5	2.872287	2005	2014
Export value (\$million)	267,320	0.5	18.9	0.0	3,290.0
Distance (weighted distance (pop-wt, km))	267,320	7,980	4,469	94	19,650
Common border	267,320	0	0	0	1
Common language	267,320	0	0	0	1
Common colonizer	267,320	0	0	0	1
GDP of exporter(\$billion)	265,853	385	1,420	0	17,400
GDP of importer (\$billion)	265,853	385	1,420	0	17,400
Cost to export (\$)	267,320	1,940	1,718	416	17,581
Time to export (days)	267,320	24	16	6	102
Landlocked	267,320	0	0	0	1
FTA	267,320	0	0	0	1

Appendix O

Descriptive statistics for gravity model analysis, 2015-2017 full dataset

Variable	Obs	Mean	Std. Dev.	Min	Max
HS0702					
year	87,210	2016	0.816501	2015	2017
Export value (\$million)	87,210	0.3	12.8	0.0	1,930.0
Distance (weighted distance (pop-wt, km))	87,210	8,000	4,500	94	19,700
Common border	87,210	0	0	0	1
Common language	87,210	0	0	0	1
Common colonizer	87,210	0	0	0	1
GDP of exporter(\$billion)	87,210	1,030	5,480	0	80,900
GDP of importer (\$billion)	87,210	1,030	5,480	0	80,900
Cost to export (\$)	87,210	530	434	0	2,918
Time to export (days)	87,210	110	111	1	816
Landlocked	87,210	0	0	0	1
FTA	87,210	0	0	0	1
HS0806					
year	89,268	2016	0.816501	2015	2017
Export value (\$million)	89,268	0.3	7.6	0.0	920
Distance (weighted distance (pop-wt, km))	89,268	7,933	4,484	94	19,650
Common border	89,268	0	0	0	1
Common language	89,268	0	0	0	1
Common colonizer	89,268	0	0	0	1
GDP of exporter(\$billion)	89,268	1,020	5,450	0	80,900
GDP of importer (\$billion)	89,268	1,020	5,450	0	80,900
Cost to export (\$)	89,268	529	432	0	2,918
Time to export (days)	89,268	109	111	1	816
Landlocked	89,268	0	0	0	1
FTA	89,268	0	0	0	1

HS1001					
year	82,170	2016	0.816502	2015	2017
Export value (\$million)	82,170	1.3	20.1	0.0	1,800.0
Distance (weighted distance (pop-wt, km))	82,170	7,805	4,413	94	19,650
Common border	82,170	0	0	0	1
Common language	82,170	0	0	0	1
Common colonizer	82,170	0	0	0	1
GDP of exporter(\$billion)	82,170	1,060	5,560	0	80,900
GDP of importer (\$billion)	82,170	1,060	5,560	0	80,900
Cost to export (\$)	82,170	530	438	0	2,918
Time to export (days)	82,170	109	112	1	816
Landlocked	82,170	0	0	0	1
FTA	82,170	0	0	0	1
HS5201					
year	79,218	2016	0.816502	2015	2017
Export value (\$million)	79,218	0.4	10.7	0.0	880.0
Distance (weighted distance (pop-wt, km))	79,218	7,689	4,398	115	19,650
Common border	79,218	0	0	0	1
Common language	79,218	0	0	0	1
Common colonizer	79,218	0	0	0	1
GDP of exporter(\$billion)	79,218	1,080	5,610	0	80,900
GDP of importer (\$billion)	79,218	1,080	5,610	0	80,900
Cost to export (\$)	79,218	521	438	0	2,918
Time to export (days)	79,218	108	112	1	816
Landlocked	79,218	0	0	0	1
FTA	79,218	0	0	0	1

Appendix P

Correlation between independent variables for gravity model analysis, 2015-2017 full dataset




	Distance	Common border	Common language	Common colonizer	GDP of exporter	GDP of importer	Cost to export	Time to export	Landlocked	FTA
Distance	1									
Common border	-0.2066	1								
Common language	-0.0668	0.1242	1							
Common colonizer	-0.0242	0.0666	0.3663	1						
GDP of exporter	0.0604	-0.0027	0.0174	-0.0217	1					
GDP of importer	0.0604	-0.0027	0.0174	-0.0217	0.0187	1				
Cost to export	0.0845	0.0085	0.0959	0.0682	0.0374	-0.0003	1			
Time to export	0.0278	0.0155	0.0433	0.0584	-0.0637	-0.0024	0.664	1		
Landlocked	-0.0767	0.0244	-0.0168	-0.0218	-0.032	0.0002	-0.1818	0.0464	1	
FTA	-0.3312	0.2065	0.068	0.0123	-0.0241	-0.0241	-0.1412	-0.1634	-0.0675	1

Appendix Q

Six CAREC corridors

CORRIDOR 1



-  Автомобильные и железные дороги коридора ЦАРЕС
Road and railway along CAREC Corridor
-  Железные дороги, не совпадающие с автомобильными
Railway not coinciding with road
-  Автомобильные дороги, не совпадающие с железными дорогами
Road not coinciding with railway

CORRIDOR 2






CORRIDOR 3

Коридор проходит через Казахстан, Кыргызскую Республику, Узбекистан, Таджикистан, Афганистан и Туркменистан.

The corridor passes through Kazakhstan, the Kyrgyz Republic, Uzbekistan, Tajikistan, Afghanistan, and Turkmenistan



-  Автомобильные и железные дороги коридора ЦАРЭС
Road and railway along CAREC Corridor
-  Железные дороги, не совпадающие с автомобильными
Railway not coinciding with road
-  Автомобильные дороги, не совпадающие с железными дорогами
Road not coinciding with railway

CORRIDOR 4



Коридор соединяет Российскую Федерацию с Восточной Азией через Монголию и Китайскую Народную Республику




The corridor connects the Russian Federation to East Asia via Mongolia and the People's Republic of China

CORRIDOR 5

Маршрут следует через Китайскую Народную Республику, Кыргызскую Республику, Таджикистан и Афганистан.

The route covers the People's Republic of China, the Kyrgyz Republic, Tajikistan, and Afghanistan



-  Автомобильные и железные дороги коридора ЦАЭСС
Road and railway along CAREC Corridor
-  Железные дороги, не совпадающие с автомобильными
Railway not coinciding with road
-  Автомобильные дороги, не совпадающие с железными дорогами
Road not coinciding with railway

CORRIDOR 6

Включает три маршрута, связывающих Европу и Российскую Федерацию с портами Карачи на Аравийском море и Гвадар или Бандар Аббас в Персидском заливе.

Corridor includes three routes linking Europe and the Russian Federation to the Arabian Sea port of Karachi and Gwadar or Bandar Abbas in the Persian Gulf.



Source: ADB (website)

Appendix R

CAREC four TFIs based on ADB (2014)

TFI1: Time taken to clear a BCP. This TFI refers to the average length of time (hours) it takes to move cargo across a border from the exit point of one country to the entry point of another. The entry and exit points are typically primary control centres where customs, immigration, and quarantine are handled. Along with the standard clearance formalities, this measurement includes waiting time, unloading or loading time, and time taken to change rail gauges, among other indicators. The intent is to capture both the complexity and the inefficiencies inherent in the border crossing process. 5 The three sets of indicators of the CAREC results framework are: CAREC countries' development outcomes (level 1), CAREC priority sector outputs (level 2), and operational and organizational effectiveness (level 3).

TFI2: Costs incurred at a BCP. This is the average total cost, in US dollars, of moving cargo across a border from the exit point of one country to the entry point of another. Both official and unofficial payments are included. This indicator assumes 20 tons of cargo, so that the average costs across various samples are comparable.

TFI3: Costs incurred while traveling along a corridor section. This is the average total costs, in US dollars (\$), incurred for a unit of cargo traveling along a corridor section within a country or across borders. A 'unit of cargo' refers to a cargo truck or train with 20 tons of goods. A 'corridor section' is defined as a stretch of road 500 kilometres (km) long. Both official and unofficial payments are included.

TFI4: Speed of travel along a corridor section. This is the average speed, in kilometres per hour (kph), at which a unit of cargo travels along a corridor section within a country or across borders. Again, a 'unit of cargo' refers to a cargo truck or train with 20 tons of goods, and a 'corridor section' refers to a stretch of road 500 km long. Speed is calculated by dividing the total distance travelled by the duration of travel. Distance and time measurements include border crossings.

Appendix S

Summary statistics of the CPPM commodity groups for 2011-2017

Commodity	Freq.	%	Cum.
CC01 Animals	448	1.93	1.93
CC02 Agricultural	3,592	15.48	17.41
CC03 Animal Fats	92	0.4	17.81
CC04 Beverages	1,185	5.11	22.92
CC05 Minerals	338	1.46	24.37
CC06 Chemicals	934	4.03	28.4
CC07 Plastics	496	2.14	30.53
CC08 Hides and Skins	84	0.36	30.9
CC09 Wood	1,099	4.74	35.63
CC10 Pulp and Paper	374	1.61	37.25
CC11 Textiles	1,686	7.27	44.51
CC12 Shoes	379	1.63	46.14
CC13 Industrial Materials	1,997	8.61	54.75
CC14 Precious Stones	33	0.14	54.89
CC15 Base Metals	1,915	8.25	63.15
CC16 Machineries	3,369	14.52	77.67
CC17 Vehicles	487	2.1	79.77
CC18 Instruments	56	0.24	80.01
CC19 Arms	1	0	80.01
CC20 Manufactured Items	961	4.14	84.15
CC21 Antiques	2	0.01	84.16
CC22 Mixed Cargoes	738	3.18	87.34
CC23 Others	3	0.01	87.36
HS-S00-LCL/LTL (Mixed)	268	1.16	88.51
HS-S01-Live animals; animal products	43	0.19	88.7
HS-S02-Vegetable products	714	3.08	91.77
HS-S03-Animal or vegetable fats	34	0.15	91.92
HS-S04-Prepared foodstuffs	116	0.5	92.42
HS-S05-Mineral products	75	0.32	92.74
HS-S06-Chemical products	158	0.68	93.42
HS-S07-Plastics	69	0.3	93.72
HS-S08-Raw hides and skins	9	0.04	93.76
HS-S09-Wood	34	0.15	93.91
HS-S10-Pulp and paper	34	0.15	94.05
HS-S11-Textiles	231	1	95.05
HS-S12-Footwear and headgear	17	0.07	95.12
HS-S13-Industrial materials	119	0.51	95.63
HS-S15-Base metals	186	0.8	96.44
HS-S16-Machinery and mechanical appli.	569	2.45	98.89
HS-S17-Vehicles and transport equipment	112	0.48	99.37
HS-S18-Instruments	22	0.09	99.47
HS-S20-Misc. manufactured articles	94	0.41	99.87
HS-S21-Art and antiques	1	0	99.88
HS-S22-NEC	29	0.12	100
Total	23,203	100	

Appendix T

Definitions of the CPMM variables

Year	Year of shipment
Country of Origin	Code and name
City of Origin	Name, there are issues with different spelling of the cities
Country of Destination	Code and name
City of Destination	Name, there are issues with different spelling of the cities
Number	Number of BCPs the shipment passed through from origin to destination
Number of stops, including BCPs	Count number from 2 to 30
Mode of transport	Rail, road, multimodal,
Commodity classification code	Commodity class CC01-CC23 for 2011-2017 and HS classification for 2018
Total distance travelled	Hours
Total duration of shipment (transit + activities)	Hours TFI1: Time taken to clear a border crossing point (BCP) (in hours). This TFI refers to the average length of time (hours) it takes to move cargo across a border from the exit point of one country to the entry point of another. The entry and exit points are typically primary control centers where customs, immigration, and quarantine are handled. Along with the standard clearance formalities, this measurement includes waiting time, unloading or loading time, and time taken to change rail gauges, among other indicators. The intent is to capture both the complexity and the inefficiencies inherent in the border crossing process.
Duration of transit	Hours
Duration of activities	Hours
Duration of activities spent at BCPs (time to cross the border)	Hours. Timekeeping starts upon reaching the border. Hence queuing to enter the border facility is included.
Total cost of shipment (transit + activities)	US dollar, nominal TFI3: Costs incurred while traveling along a corridor section. This is the average total costs, in US dollars, incurred for a unit of cargo traveling along a corridor section within a country or across borders. A 'unit of cargo' refers to a cargo truck or train with 20 tons of goods. A 'corridor section' is defined as a stretch of road 500 kilometers (km) long. Both official and unofficial payments are included. Cost of transporting the goods from the previous stop include the driver's wage, fuel cost, depreciation cost of the truck or trailer, repair and maintenance cost, and insurance; but this excludes the cost of the activities, such as SPS inspections, customs clearance and other.

Year	Year of shipment
Cost of transit (vehicle operating cost)	US dollar, nominal
Cost of activities	US dollar, nominal
Unofficial payments to activities spent at BCPs	US dollar, nominal
Speed without delay	km/h TFI4: Speed of travel along a corridor section. This is the average speed, in kilometers per hour (kph), at which a unit of cargo travels along a corridor section within a country or across borders. Again, a 'unit of cargo' refers to a cargo truck or train with 20 tons of goods, and a 'corridor section' refers to a stretch of road 500 km long. Speed is calculated by dividing the total distance traveled by the duration of travel. Distance and time measurements include border crossings.
Speed with delay	km/h

Source: ADB(2014b)

Appendix U

Sample size (number of respondents) at each outbound road BCP based on the annual CPMM reports, 2013-2017

KAZ	BCP_exp	importer	BCP_imp	mode	corridor		2013	2014	2015	2016	2017	Total
1	Khorgos	CHN	Khorgos	road	1	Sample size (# of observations per BCP/year)	2	150				152
2	Korday	KGZ	Ak-Zhol	road	1				1	46		47
3	Merke	KGZ	Chaldovar	road	6		7	45	13		8	73
4	Aul	RUS	Veseloyarsk	road	3		7	11	10	4	1	33
5	Kairak	RUS	Troitsk	road	1				3	1	1	5
6	Karasu	RUS	Troitsk	road	1,2		23	43	152	79		297
7	Kurmangazy	RUS	Krasnyi Yar	road	6		82	6	47	10	42	187
8	Taskala	RUS	TBC	road	6		17	19	18	20	18	92
9	Zhaisan	RUS	Kos Aral	road	1		2	2			7	11
10	Saryagash	UZB	Keles	road	1,3		7	15				22
11	Tazhen	UZB	Dautota	road	6		49	63	57	59	62	290
12	Zhana-Zhol	UZB	TBC	road	1,6			2.0				2
KAZ	Total						196	356	301	219	139	1211
KGZ												
1	Irkeshtan	CHN	Irkeshtan	road	2	Sample size	1			35	12	48
2	Torugart	CHN	Torugart	road	1		6	15	9	1	1	32

3	Ak-Tilek	KAZ	Korday	road	1		44	103	60	23	10	240
4	Karamik	TJK	Karamik	road	3,5		83		6	62	24	175
KGZ	Total						134	118	75	121	47	495
TJK												
1	Nizhni Pianj	AFG	Shirkhan Badar	road	3,5,6	Sample size	247	238	245	219	120	1069
2	Karamik	KGZ	Karamik	road	5		9			6	1	16
TJK	Total						256	238	245	225	121	1085
TKM												
1	Saraks	IRN	Sarakhs	road	2	Sample size	3	1		1		5
2	Farap	UZB	Alat	road	2,3		47	71	76	71	72	337
TKM	Total						50	72	76	72	72	342
UZB												
1	Dautota	KAZ	Tazhen	road	3,6	Sample size	84	83	88	90	82	427
2	Keles	KAZ	Saryagash	road	3		1	1				2
3	Yallama	KAZ	Konysbaeva	road	2,3,6		69	80	84	85	85	403

4	Karasu/Dustlik	KGZ	Karasu	road	2			9				9	
5	Oibek	KGZ	Fotehobod	road	6			8	38	57	21	5	129
6	Sarasiya	TJK	Dusti	road	3			22	50	51	93	139	355
7	Alat	TKM	Farap	road	2,3			47	59	58	57	59	280
UZB	Total							231	320	338	346	370	1605
					TOTAL			867	1104	1035	983	749	4738

Number of observations collected from the drivers at each outbound rail BCP based on the annual CPMM reports, 2013-2017

KAZ	BCP_exp	importer	BCP_imp	mode	corridor	Sample size	2013	2014	2015	2016	2017	Total	
1	Altynkol	CHN	Khorgos	rail	1			4					4
2	Dostyk	CHN	Alashankou	rail	1,3			29					29
3	Merke	KGZ	Chaldovar	rail	1,3			2					2
4	Saryagash	UZB	Keles	rail	1			4	15				19
	Total							39	15				54

Appendix V

Major regional and geopolitical events occurred in Central Asia between 2010 and 2018

2010	<p>Kazakhstan entered into a customs union with Belarus and Russia. The first, relatively easy step in the implementation of the customs union was accomplished in 2010 with the adoption of a common external tariff, with varying exceptions in each of the three member countries.</p> <p>One area where the governments are working to deepen integration is in trade facilitation. It is the announced intention of the governments to eliminate customs posts between Russia and Kazakhstan and to reduce the costs of other aspects of trade between the countries—such as the number of required documents and the difficulty of obtaining them. Some freight forwarders in Kazakhstan, however, complain of seeing little progress in this area as of the spring of 2011 (World Bank 2012). http://documents1.worldbank.org/curated/en/836181468293149924/pdf/NonAsciiFileName0.pdf</p>
2014-2020	<p>International sanctions were imposed during the Russo-Ukrainian War by a large number of countries against Russia and Crimea following the Russian invasion of Ukraine, which began in late February 2014. The sanctions were imposed by the United States, the European Union (EU) and other countries and international organizations against individuals, businesses and officials from Russia and Ukraine. Russia responded with sanctions against a number of countries, including a total ban on food imports from the EU, United States, Norway, Canada and Australia.</p> <p>The sanctions by the European Union and United States continue to be in effect as of May 2019. In December 2019, the EU announced the extension of sanctions until 31 July 2020</p> <p>The sanctions contributed to the collapse of the Russian ruble and the Russian financial crisis https://www.export.gov/apex/article2?id=Russia-Prohibited-Restricted-Imports</p>
2015	<p>On August 20, 2015 the government of Kazakhstan and the National bank of Kazakhstan announced the introduction of a free floating exchange rate and abandoned the peg band that was revised on July 15, 2015 and was widely expected to last until the end of the year. The subsequent sharp depreciation of the tenge, which had been a stable currency for a long time, has surprised foreign investors and financial analysts worldwide. (Central Asia Economic Papers https://app.box.com/s/5o6rga2i3mcb04axsm8il6ne35b7x8dr).</p>
2015	<p>On August 12, the Treaty on the Accession of the Kyrgyz Republic to the Treaty on the Eurasian Economic Union (the EEU) came into force. Kyrgyzstan has become a full-fledged member of the Union along with Armenia, Belarus, Kazakhstan and Russia.</p> <p>Accession of Kyrgyzstan to the EEU was preceded by major joint efforts to ensure integration and convergence. The accession to the EEU opened up new opportunities for Kyrgyzstan. No more barriers to the free movements of goods, services, capital and workforce. The new investment opportunities and prospects to develop major infrastructure projects, primarily in the energy industry, transportation and agriculture, are opened up. The citizens of Kyrgyzstan now gain the right to be employed in any state of the Union on equal terms with citizens of their employment state. http://www.eurasiancommission.org/en/nae/news/Pages/12-08-2015-1.aspx</p> <p>However, this coincided with a sharp decline in oil prices and the imposition of economic sanctions on Russia, which contributed to the depreciation of the Kyrgyz currency and the contraction of its economy. These events affected Kyrgyzstan's trade, remittances and investment inflows. https://www.sipri.org/commentary/topical-background/2017/eurasian-economic-union-policies-and-practice-kyrgyzstan</p>

2016-2017	<p>Following the ban on Western food products, Russian interdepartmental mobile groups of customs officers, border guards, police and inspectors of Rosselkhoz nadzor (Russian Federal Service for Veterinary and Phytosanitary Surveillance) began patrolling territories bordering Belarus and Kazakhstan in order to put a barrier on the way of embargoed products. As of March 2017 more than 40 mobile groups were functioning, half of them at the Belarusian border. Border patrolling undermines the spirit of the Eurasian Economic Union envisaging 2 removal of controls over commodity movements.</p> <p>http://east-center.org/wp-content/uploads/2018/01/Section-3-EAEU.pdf</p>
2017	<p>Uzbekistan new President and active market liberalization policies. The liberalization policies included removal of most import and export tariffs, signing of trade agreements.</p> <p>https://www.worldbank.org/en/country/uzbekistan/publication/economic-update-summer-2019</p>

Appendix W
Shapiro-Wilk W test for the normality distribution of the CPMM
and TAB indicators

Variable	Observation	W	V	z	Prob>z
CPMM cost- to-export	78	0.978	1.469	0.841	0.2
CPMM time- to-export	78	0.937	4.207	3.144	0.0
TAB cost- to-export	78	0.780	14.815	5.898	0.0
TAB time- to-export	78	0.815	12.405	5.509	0.0

Appendix X

Constructed CPMM matrices for Central Asian countries

2011

Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$						
CHN	167	123	91	110	128	363	630	CHN	2,312	4,503	4,036	989	4,407	6,895	2,475
KAZ	42	72	31	67	109	86	105	KAZ	2,184	568	1,218	1,517	1,088	735	1,707
KGZ	32	37	19	83	17	97	54	KGZ	908	1,451	906	3,835	2,290	3,641	2,558
RUS	302	70	78	96	236	170	184	RUS	1,988	742	3,406	1,704	4,036	3,144	2,949
TJK	128	116	35	265	150	83	71	TJK	4,407	4,386	733	4,175	3,811	1,246	758
TKM	288	142	141	112	83	70	95	TKM	3,509	2,037	2,101	2,128	1,246	1,215	1,315
UZB	193	115	161	190	71	81	95	UZB	2,194	1,739	1,286	3,000	758	1,219	1,412

2012

Importer	CHN	KAZ	KGZ	RUS	TJ K	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$						
CHN	36	205	113	130	79	372	408	CHN	1,722	6,225	1,792	1,843	5,111	6,671	4,145
KAZ	61	88	32	54	93	99	146	KAZ	1,673	1,186	1,190	1,761	2,188	2,677	1,843
KGZ	49	35	93	97	28	127	78	KGZ	731	1,374	907	3,139	1,777	3,104	2,427
RUS	187	54	98	71	218	170	201	RUS	1,553	1,462	3,304	1,552	3,539	3,144	2,600
TJK	79	95	35	236	27	98	51	TJK	5,111	3,629	733	4,036	1,618	1,353	573
TKM	248	118	154	112	98	70	92	TKM	3,225	1,825	2,476	2,128	1,353	1,215	1,281
UZB	156	125	107	182	51	93	114	UZB	1,944	1,742	1,214	2,707	573	1,252	2,664

2013

Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$						
CHN	101	196	45	187	95	389	340	CHN	2,017	5,400	2,170	5,075	7,785	7,182	4,815
KAZ	80	49	29	39	101	92	101	KAZ	877	1,447	1,208	1,578	1,638	1,706	1,854
KGZ	32	26	58	84	27	20	66	KGZ	1,624	1,095	900	3,633	2,301	1,420	2,493
RUS	163	39	67	67	227	170	193	RUS	1,497	1,855	3,529	1,712	3,788	3,144	2,775
TJK	85	105	36	218	21	90	25	TJK	7,050	4,007	1,779	3,539	2,657	1,303	1,987
TKM	252	132	145	112	90	70	86	TKM	4,201	2,161	2,193	2,128	1,303	1,215	1,328
UZB	166	114	134	186	25	84	104	UZB	2,873	1,888	1,250	2,853	1,987	1,245	2,038

2014

Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$						
CHN	69	183	34	180	115	343	232	CHN	1,869	4,029	1,933	5,331	6,116	6,960	4,202
KAZ	68	35	39	96	97	95	90	KAZ	1,317	3,161	1,946	1,696	1,913	2,192	1,945
KGZ	33	35	93	92	24	81	72	KGZ	1,548	1,782	907	3,293	1,752	2,721	2,460
RUS	169	110	93	65	222	170	197	RUS	1,393	2,022	3,703	2,094	3,663	3,144	2,687
TJK	115	100	34	115	13	80	49	TJK	6,116	3,818	1,728	3,953	3,063	1,307	4,491
TKM	229	121	123	112	80	70	76	TKM	4,042	1,879	2,019	2,128	1,307	1,215	1,262
UZB	153	105	120	112	49	69	109	UZB	2,780	1,895	1,232	2,100	4,491	1,178	2,351

2015

Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$							
CHN	85	152	32	245	103	343	112	CHN	1,943	4,587	1,456	6,953	6,529	10,373	2,686	
KAZ	42	61	36	64	99	94	106	KAZ	2,304	1,590	1,648	1,638	1,775	1,949	1,851	
KGZ	33	32	66	69	37	76	69	KGZ	1,066	1,453	905	4,653	2,028	2,415	2,476	
RUS	144	71	83	67	225	170	195	RUS	1,383	2,163	3,082	1,524	3,725	3,144	2,731	
TJK	103	103	89	166	12	80	55	TJK	6,529	3,913	2,152	3,746	1,299	1,357	2,072	
TKM	232	121	125	112	80	70	72	TKM	3,561	1,907	2,053	2,128	1,357	1,215	1,255	
UZB	160	110	127	168	55	68	107	UZB	2,306	1,864	1,241	2,665	2,072	1,172	2,195	

2016

Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$							
CHN	77	137	33	225	90	327	298	CHN	1,906	3,074	1,546	6,972	4,294	5,538	5,264	
KAZ	48	58	33	63	98	95	105	KAZ	2,375	1,846	1,652	1,668	1,844	2,071	1,842	
KGZ	24	29	78	63	23	59	71	KGZ	1,719	1,578	905	4,566	1,448	2,185	2,468	
RUS	152	71	77	67	223	170	196	RUS	1,374	2,447	3,093	1,510	3,694	3,144	2,709	
TJK	90	101	29	141	12	82	226	TJK	4,294	3,865	2,174	3,849	918	1,409	1,785	
TKM	224	111	125	112	82	70	76	TKM	4,293	1,805	1,987	2,128	1,409	1,215	1,338	
UZB	148	110	124	162	226	69	108	UZB	2,955	1,872	1,236	2,581	1,785	1,229	2,273	

2017

Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$							
CHN	81	163	45	209	66	404	296	CHN	1,925	3,116	1,856	6,945	3,253	4,646	4,695	
KAZ	35	51	136	66	98	94	106	KAZ	1,589	2,011	2,879	1,645	1,810	2,010	1,858	
KGZ	27	166	202	224	23	72	70	KGZ	780	2,899	915	6,253	1,297	2,441	2,472	
RUS	143	83	73	92	224	170	196	RUS	1,157	4,735	7,207	1,754	3,710	3,144	2,720	
TJK	66	102	45	154	39	81	501	TJK	3,253	3,889	3,475	3,798	2,228	1,417	1,787	
TKM	275	103	122	112	81	70	75	TKM	3,107	1,713	1,877	2,128	1,417	1,215	1,278	
UZB	200	109	172	157	501	70	107	UZB	1,829	1,845	1,049	2,550	1,787	1,299	2,234	

2018

Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	Importer	CHN	KAZ	KGZ	RUS	TJK	TKM	UZB	
Exporter	TIME TO EXPORT, HOURS							Exporter	COST TO EXPORT, \$							
CHN	82	187	69	200	111	427	315	CHN	2,138	3,779	3,764	6,745	5,030	5,328	5,606	
KAZ	49	51	27	72	98	94	86	KAZ	2,779	2,152	1,691	1,662	1,827	2,040	2,721	
KGZ	21	26	98	59	24	69	20	KGZ	721	1,484	906	4,593	1,398	2,347	871	
RUS	156	71	63	72	224	170	196	RUS	1,161	2,204	4,953	1,771	3,702	3,144	2,715	
TJK	111	113	22	147	21	68	68	TJK	5,030	3,200	925	3,824	1,964	1,798	1,865	
TKM	96	97	102	112	68	70	56	TKM	2,926	2,482	2,661	2,128	1,798	1,215	1,389	
UZB	40	83	19	150	68	61	107	UZB	1,537	2,171	816	2,474	1,865	1,594	2,253	

Appendix Y

Eora macro and micro sectors and matching CPMM commodity groups

Eora macro sector	Eora micro sector	CPMM commodities	
Agriculture	Agriculture	CC01 Animals	
		CC02 Agricultural	
		CC08 Hides and Skins	
	Food & Beverages	CC03 Animal Fats	
		CC04 Beverages	
		CC10 Pulp and Paper	
	Wood and Paper	CC09 Wood	
		Transport Equipment	CC17 Vehicles
			CC18 Instruments
CC19 Arms			
Manufacturing	Electrical and Machinery	CC16 Machineries	
		CC13 Industrial Materials	
		CC20 Manufactured Items	
	Other Manufacturing	CC21 Antiques	
		CC22 Mixed Cargoes	
		CC23 Others	
	Textiles and Wearing Apparel	CC11 Textiles	
		CC12 Shoes	
		Mining	Metal Product
Mining and Quarrying	CC05 Minerals		
	CC14 Precious Stones		
Petroleum, Chemical and Non-Metallic Mineral Products	CC06 Chemicals		
	CC07 Plastics		

Appendix Z

Structural gravity model results for CPMM trade cost indicators with Eora micro sectors exports for CAREC countries

	(1)	(2)	(3)	(4)	(5)	(6)
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Agriculture	0.059 ***	0.019	0.076 ***	0.026	-0.135 ***	0.220 ***
	(0.015)	(0.020)	(0.015)	(0.045)	(0.036)	(0.067)
Constant	20.377 ***	19.579 ***	19.797 ***	20.379 ***	19.603 ***	19.749 ***
	(0.002)	(0.002)	(0.002)	(0.010)	(0.006)	(0.018)
Observations	4,914	4,914	4,914	4,914	4,914	4,914
R2	1.000	1.000	1.000	1.000	1.000	1.000
	(1)	(2)	(3)	(4)	(5)	(6)
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Electrical and Machinery	0.046	0.071	0.028	-0.228***	-0.269 ***	-0.188***
	(0.029)	(0.049)	(0.020)	(0.036)	(0.037)	(0.035)
Constant	20.530***	19.102 ***	20.328** *	20.930***	19.734 ***	20.598***
	(0.028)	(0.061)	(0.016)	(0.056)	(0.074)	(0.046)
Observations	5,103	5,103	5,103	5,103	5,103	5,103
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Food & Beverages	0.008	-0.020	0.024	-0.055 **	-0.085 ***	-0.043
	(0.012)	(0.012)	(0.020)	(0.027)	(0.015)	(0.040)
Constant	20.095***	19.271 ***	19.575** *	20.120***	19.306 ***	19.595***
	(0.003)	(0.003)	(0.004)	(0.011)	(0.007)	(0.015)
Observations	3,213	3,213	3,213	3,213	3,213	3,213
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Metal Products	0.117 ***	0.014	0.121 ***	0.044	-0.200 ***	0.052
	(0.035)	(0.063)	(0.035)	(0.034)	(0.031)	(0.034)
Constant	20.670***	16.245 ***	20.682** *	20.686***	16.694 ***	20.692***
	(0.014)	(0.074)	(0.013)	(0.025)	(0.068)	(0.023)
Observations	4,347	4,347	4,347	4,347	4,347	4,347

	(1)	(2)	(3)	(4)	(5)	(6)
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Mining and Quarrying	0.094 ***	0.090 ***	0.099 ***	-0.120 **	-0.186 ***	-0.132 **
	(0.010)	(0.018)	(0.014)	(0.050)	(0.006)	(0.059)
Constant	15.523***	11.822 ***	15.501** *	16.520***	13.123 ***	16.588***
	(0.031)	(0.051)	(0.042)	(0.301)	(0.036)	(0.354)
Observations	1,512	1,512	1,512	1,512	1,512	1,512
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Other Manufacturing	-0.062***	-0.020	-0.082***	-0.166***	-0.142 ***	-0.092 **
	(0.016)	(0.023)	(0.027)	(0.026)	(0.027)	(0.045)
Constant	17.709***	16.610 ***	17.494** *	18.073***	17.146 ***	17.562***
	(0.025)	(0.056)	(0.024)	(0.072)	(0.111)	(0.069)
Observations	3,969	3,969	3,969	3,969	3,969	3,969
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Petroleum, Chemical and Non-Metallic Mineral Products	-0.104***	-0.007 **	-0.121***	-0.164***	-0.054 ***	-0.187***
	(0.028)	(0.004)	(0.035)	(0.024)	(0.012)	(0.030)
Constant	20.983***	17.252 ***	20.988** *	21.057***	17.348 ***	21.063***
	(0.012)	(0.004)	(0.013)	(0.017)	(0.023)	(0.020)
Observations	3,591	3,591	3,591	3,591	3,591	3,591
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Textiles and Wearing Apparel	0.067 ***	0.006	0.190 ***	-0.008	-0.031 ***	0.034
	(0.010)	(0.008)	(0.022)	(0.020)	(0.010)	(0.044)
Constant	19.220***	17.435 ***	19.390** *	19.314***	17.577 ***	19.460***
	(0.011)	(0.018)	(0.012)	(0.045)	(0.042)	(0.049)
Observations	3213	3213	3213	3213	3213	3213
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Intermediate	Final	Total	Intermediate	Final
Transport Equipment	0.201 ***	0.517 ***	0.222 ***	-0.078***	-0.092 **	-0.047***
	(0.054)	(0.084)	(0.059)	(0.015)	(0.042)	(0.017)
Constant	20.165***	18.484 ***	19.966** *	20.259***	18.828 ***	20.023***
	(0.016)	(0.044)	(0.011)	(0.007)	(0.033)	(0.005)
Observations	2,646	2,646	2,646	2,646	2,646	2,646
R2	1.000	1.000	1.000	1.000	1.000	1.000
	Time to export			Cost to export		
	Total	Intermediate	Final	Total	Intermediate	Final
Wood and Paper	0.130 *	0.041	0.141	-0.049***	-0.040 ***	-0.054***
	(0.069)	(0.036)	(0.088)	(0.003)	(0.004)	(0.002)
Constant	19.296***	15.934 ***	19.331** *	19.377***	16.075 ***	19.400***
	(0.025)	(0.044)	(0.026)	(0.002)	(0.010)	(0.001)
Observations	3,024	3,024	3,024	3,024	3,024	3,024
R2	1.000	1.000	1.000	1.000	1.000	1.000

(Extended results for Table 7.12)