The Economic Impact of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership on Canadian and Saskatchewan Economies: A Computable General Equilibrium-Based Analysis

A Thesis Submitted to the College of

Graduate and Postdoctoral Studies

In Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy

In the Department of Agricultural and Resource Economics

University of Saskatchewan

Saskatoon, Saskatchewan

By

Ziad M. Ghaith

[This page intentionally left blank]

Permission to use

In presenting this thesis in partial fulfillment of the requirements for a Postgraduate degree from the University of Saskatchewan, I agree that the libraries of this University may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part for scholarly purposes, may be granted by the professors who supervised my thesis work or, in their absence, by the Head of the Department or the Dean of the College in which my thesis work was completed. It is understood that any copying, publication or use of this thesis, or part thereof for financial gain, shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of Saskatchewan for any scholarly use of any material in my thesis.

Disclaimer

References in this thesis to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favoring the University of Saskatchewan. The views and opinions of the author expressed herein do not state or reflect those of the University of Saskatchewan, and shall not be used for advertising or product endorsement purposes.

Requests for permission to copy or to make other uses of materials in this thesis, in whole or in part, should be addressed to:

Head of the Department of Agricultural and Resource Economics
Agricultural Building, 51 Campus Drive
University of Saskatchewan
Saskatoon, Saskatchewan, Canada
S7N 5A8

OR

Dean
College of Graduate and Postdoctoral Studies
University of Saskatchewan
116 Thorvaldsen Building, 110 Science Place
Saskatoon, Saskatchewan, Canada
S7N 5C9

Abstract

Canada has recently concluded negotiations on the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) with ten Pacific-Rim countries. The CPTPP is a multilateral free trade agreement formerly known as the Trans-Pacific Partnership (TPP). The CPTPP's provisions for market access include lowering trade barriers and eliminating investment obstacles among member countries. In a nutshell, CPTPP addresses trade barriers (NTBs), labour movements, investment protection, environmental standards and telecommunication services. The potential impacts of the CPTPP can be organized into six categories: stimulating competition, encouraging technology and investment flow, enhancing access to all CPTPP countries, generating new opportunities for different economic sectors, generating price advantages for some Canadian exports, and creating benefits for Canadian businesses and workers.

This study assesses the likely economic impact of the CPTPP agreements on Canada's national economy, and on Saskatchewan's provincial economy in 2030. This was accomplished by building two static Computable General Equilibrium (CGE) models: national and subnational, with a particular focus on agricultural sectors. The data for these models were obtained from the Global Trade Analysis Project (GTAP) database. The approach of the subnational CGE model was based on splitting Canada's national database into two databases: Saskatchewan, and the rest of Canada. In this process, Saskatchewan was treated as a separate trading entity with interprovincial and international trade flows, which accounts for the province's total trade. The study modeled the estimated impact of the CPTPP on both Canada's and Saskatchewan's Gross Domestic Product (GDP), exports, imports, and other main economic indicators.

To fulfill the objectives of this study, three scenarios were simulated:

One, Baseline scenario, where a growth projection model was developed to simulate the economic and trade growth in 2030 among the CPTPP countries, the United States and the rest of the world without the CPTPP. In this scenario, the natural growth for all the regions based on past performance in terms of population, labour force, and capital was accounted for. Other trade agreements between member countries, which will be implemented over the coming decade, was also accounted for in this analysis.

Two, In the second scenario called CPTPP scenario, it was assumed that the CPTPP would be fully implemented. Trade barriers were reduced/eliminated between CPTPP member countries as per CPTPP agreement. The goal of this analysis was to capture the potential impact of CPTPP on the members' economies in general, and on Canada and Saskatchewan economies in details.

Three, In the third scenario named TPP, the former TPP agreement was simulated. The goal of this simulation was to evaluate the potential impact of the former TPP if it had been implemented and compare it with the CPTPP impact on Canada and Saskatchewan economies.

All scenarios were simulated under the assumption that the North American Free Trade Agreement (NAFTA) is in place. The national and subnational models indicated that the CPTPP would generate long-term economic gains for Canada and other CPTPP members. Furthermore, the study showed that that the economic gains for Canada and Saskatchewan under CPTPP are greater than TPP. This can be attributed to the fact that Canada's trade with the US is already liberalized as part of NAFTA, thus CPTPP would open new key markets such as Japan (the world's third-largest economy) for Canadian product, while keeping a strong liberalized trade relationship with its largest trade partner, i.e., the US.

The national model-based analysis suggested that if the CPTPP is fully implemented, Canada's total agricultural imports and exports would increase by 1.22% and 4.78%, respectively, over the baseline scenario; net increase in Canada's total trade is projected under this scenario. In terms of commodity breakdown, meat and dairy products were expected to be most affected. In contrast, the economic gains for Canada if the TPP had been implemented would be relatively less than CPTPP. Overall, Canada's GDP gains would total 3.9 billion USD under the CPTPP, compared with 1.4 billion under the TPP.

The subnational model results showed that CPTPP impact on Saskatchewan would be more noticeable than on Canada. Under the CPTPP scenario, Saskatchewan's total agricultural imports and exports (including interprovincial trade) were projected to increase by 6.02% and 5.64%, respectively, relative to the baseline growth projection scenario. Most of this expansion is due to the growth in agricultural trade with Japan. An improvement in Saskatchewan's agricultural trade

balance was also projected under the CPTPP simulation. Similar to the national model, the economic gains for Saskatchewan if the TPP had been implemented would be relatively less than the CPTPP. Saskatchewan's GDP gains would total 1.1 billion USD under the CPTPP, compared with 679 million USD under the TPP.

This study shows that trade liberalization can affect regions within a country differently depending on their trade relationships, areas of specialization in trade, and their level of dependency on sectors subject to relatively deeper liberalization. Therefore, subnational analysis of trade agreements impact is a valuable approach to capture these differences and to assess the national trade agreements and trade liberalization impact on internal or interprovincial trade flows within a country, which would also be subject to change by these trade agreements.

Acknowledgments

To my family and life-coaches, I owe it all to you. Many thanks!

This thesis would certainly not have been possible without the goodwill and support of my supervisors, Dr. David Natcher and Dr. Suren Kulshreshtha, my committee members (Dr. William Kerr, Dr. Richard Gray and Dr. Donald Gilchrist) and Dr. Mary Burfisher who revealed to me the ideas and paved the road to success. Their generosity and patience were boundless, and my level of gratitude cannot be expressed in words. Throughout my work on this thesis, I received tremendous assistance from friends and colleagues at the University and I would like to acknowledge my appreciation to all. It is, indeed, impossible to mention all of them by name, whether colleagues, administrative staff, or other individuals who have provided me with the materials required for this work. Also, a heartfelt thank you to all my close circle of friends, although I am not able to list all of their names in this acknowledgment. Finally, I endlessly indebted to my wonderful parents and siblings, as well as to Greta Vardazaryan. Their support has been invaluable, they all kept me going and this work has not been possible without them. They are the most precious gifts and blessings I have been given.

Any omission in this brief acknowledgment does not mean lack of gratitude.

Ziad M. Ghaith

February 2019

Table of contents

List of Tables

List of Figures

List of Equations

List of Abbreviations

AVEs	*ad valorem* equivalent
AMAD	Agricultural Market Access Database
C-D	Cobb-Douglas
CDE	Constant Differential of Elasticities
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CETA	Canada-EU Free Trade Agreement
CGE	Computable General Equilibrium
CIF	Cost, Insurance, and Freight
CKFTA	Canada-Korea Free Trade Agreement
COMTRADE	United Nations Commodity Trade Statistics Data
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
CUSFTA	Canada-United States Free Trade Agreement
CV	Compensating Variation
EU	European Union
EV	Equivalent Variation
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FoB	Free on Board
FRED	Federal Reserve Bank of St. Louis Economic Data
FTAs	Free Trade Agreements
GAIN	Global Agricultural Information Network
GAMS	General Algebraic Modeling Software
GDP	Gross Domestic Product
GEMPACK	General Equilibrium Modeling Package
GTAP	Global Trade Analysis Project
HS	Harmonized System
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
ILO	International Labour Organization

IMF	International Monetary Fund
I-O	Input-Output
ITC	International Trade Centre
LDCs	Least Developed Countries
LES	Linear Expenditure System
LILI	Labour Input Loss Index
MAcMap	Market Access Map
MFN	Most Favoured Nation
MIRAGE	Modeling International Relationships in Applied General Equilibrium
MRTAs	Mega-Regional Trade Agreements
MT	Metric Ton
NAFTA	North America Free Trade Agreement
NTBs	Non-Tariff Barriers
OECD	Organisation for Economic Cooperation and Development
PPP	Purchasing Power Parity
RCEP	Regional Comprehensive Economic Partnership
RoC	Rest of Canada
RoW	Rest of World
RTAs	Regional Trade Agreements
SALTER	Sectoral Analysis of Liberalizing Trade in the East Asian Region
SAM	Social Accounting Matrix
TASTE	Tariff Analytical and Simulation Tool for Economists
TPP	Trans-Pacific Partnership
TRQ	Tariff Rate Quota
URAA	Uruguay Round Agreement on Agriculture
US	The United States
USMCA	United States-Mexico-Canada Agreement
WALRAS	World Agricultural LibeRAlisation Study
WTO	World Trade Organization

Chapter 1
Introduction

1.1 Background

Canada has been involved in trade agreements negotiations with several Pacific-Rim countries. In 2016, Canada concluded negotiations on the Trans-Pacific Partnership Agreement (TPP). This agreement was an expansion of the Trans-Pacific Strategic Economic Partnership Agreement, which was signed in 2005 by Brunei Darussalam, Chile, New Zealand, and Singapore. Later on, several other Pacific-Rim countries joined the negotiations. These countries included: Australia, Peru, the United States (US), Vietnam and Malaysia, who joined the negotiations in 2010, whereas Canada and Mexico joined in 2012, with Japan following in 2013. These twelve countries agreed to form the TPP agreement, which was one of the largest and most ambitious free trade agreements in history. Early in 2017, the US formally withdrew from the TPP (Office of the US Trade Representative, 2017). Upon the announcement of the US withdrawal, Canada entered negotiation with the remaining members (Australia, Brunei, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam) and reached the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), which is expected to come into force over the next decade. The key goals of the trade agreements between Pacific-Rim countries are to create new market-oriented rules in a rapidly-changing international commercial environment, foster economic growth, foster investment in a rapidly-growing market, and reduce trade barriers among member countries (Petri & Plummer, 2016).

The CPTPP incorporates the provisions of the TPP, except for the 22 provisions that are related to trade and investment with US and a number of provisions pertaining mainly to intellectual property and investor-state dispute settlement (Government of New Zealand, 2018a). The provisions of CPTPP reflect four main features. Firstly, the agreements is developed to be flexible and able to address any emerging trade issues. Secondly, the provisions for market access would help eliminate barriers to trade and investment among the member countries. Thirdly, the agreements addresses competition and business regulations in order to strengthen economic developments among the member countries; and lastly, they prioritize and encourages innovation and trade of modern products and services (Government of New Zealand, 2018b). These features align with the CPTPP's key objectives, which address tariffs and Non-Tariff Barriers (NTBs),

labour movements, investment protection, environmental standards, intellectual property rights, and telecommunication services (Government of New Zealand, 2018a).

A brief comparison between the size of CPTPP and original TPP shows that both agreements represent major trading blocs in the world. While TPP economies collaboratively contributes to almost half of global economic output, over 40% of world trade, and the combined Gross Domestic Product (GDP) of the twelve-member countries of TPP exceeds 28.5 trillion USD, or 36% of the world's GDP. CPTPP economies together represent a combined GDP of 13.5 trillion USD, nearly 13.5% of the world's GDP (World Bank, 2016a). The CPTPP represents an opportunity for Canada to increase its access to the fast-growing Asia-Pacific region's markets and to benefit from eliminating some tariffs between agreement partners. Access to Asia-Pacific region's market, will allow Canada to be the only G7 nation[1] with preferential trade access to the United States (US), to the European Union (EU), and to the Asia-Pacific market. Therefore, with CPTPP and other trade agreements in place, Canada would have improved access to over 60% of the entire world's economy (Government of Canada, 2018a).

The Canadian Government expects several economic sectors to benefit from the CPTPP, namely: Agricultural and Agri-Food Products, Fish and Seafood, Forestry and Value-added Food Products, Services and Financial Services, Industrial Goods, and Customer Products The expected benefit to these economic sectors can be summarized in six points: stimulating competition, encouraging technology and investment flow, enhancing access to all member countries, generating new opportunities for different economic sectors, generating price advantages for some Canadian exports, and creating benefits for Canadian businesses and workers (Government of Canada, 2018b).

Although the Canadian government expects these benefits to boost the Canadian economy, uncertainty surrounds CPTPP, as Canada was already involved in multiple Free Trade Agreements (FTAs) with CPTPP member counties and the US. In addition, certain social, environmental, and policy concerns were raised. Some economists claimed that the original TPP which was a wider version of the CPTPP was socially controversial agreement, as it is a classified deal that allow

[1] The G7 is a group of seven advanced economies. These countries consist of Canada, France, Germany, Italy, Japan, the United Kingdom, and US (Laub & McBride, 2017).

companies to sue countries if they believe they are seeing profits diminished due to the changes in environmental, health, or other regulations. This in itself is a major issue for some member countries. For instance, a tobacco company might be able to sue a country because the anti-smoking regulations could potentially hurt its profits (Petri & Plummer, 2012). Similarly, the intellectual and patent arrangements might not be in the best interest of the public. According to Faunce and Townsend (2011), the original TPP may have reduced the availability of inexpensive generic drugs, thereby making drugs more costly among partners. In addition to these environmental and policy fears, trade agreements including low-wage and high-wage countries such as the CPTPP could impact trade flows by promoting inexpensive goods from low-wage countries such as Vietnam, Peru, and Chile, into high-wage countries such as Canada and Japan (Rosnick, 2013).

1.2 Economic Background

The economies of Canada and Saskatchewan are highly developed. Although, there may be many similarities, Saskatchewan's economy is distinguished from the Canadian economy in terms of its dependency on resource-based sectors.

Canada has one of the most advanced economies in the world, and one of the largest economies among the Pacific-Rim countries. In 2017, the Canadian economy produced the 10th largest nominal GDP, and the 17th largest GDP based on Purchasing Power Parity (PPP). The real GDP growth rate in Canada between 1962 and 2017 averaged 3.18%. Canada's economy is dominated by the services sector, representing more than 70% of its GDP, and employing approximately three quarters of Canadians (Sawe, 2017). Canada also has one of the most advanced in agricultural sector, ranking 5th in the world among agricultural exporters after EU, the US, Brazil, and China (Agriculture and Agri-Food Canada, 2016). Saskatchewan's economy, on the other hand, is largely resources-based. The province produces most of Canada's potash and uranium, and is the largest agricultural producer in the country, having about 40% of Canada's total arable land (Government of Saskatchewan, 2015). Growth in Saskatchewan is derived mainly from the natural resource sector[2].

[2] The direct and indirect contribution of natural resources sectors represent the bulk of the provincial GDP. For instance, Kulshreshtha and Thompson (2005) estimated the direct and indirect impacts of agricultural production in Saskatchewan, concluding that when the sector is tied to other economic activities, the total direct and indirect

The importance of the CPTPP for Canada and Saskatchewan emerges from four main elements. First, some of the CPTPP countries constitute important export markets for Canada. The CPTPP provides an opportunity to expand trade relationships with these countries. Japan, for example, is a large market for Saskatchewan's agriculture and agri-food products, but it is a country that has been historically very protective of its own market by imposing high tariffs and other restrictions on imports. The CPTPP will remove these trade barriers, which will ultimately bring economic benefits to Canada and Saskatchewan. Second, the CPTPP will create opportunities in emerging markets (Vietnam, Singapore, and Malaysia), these economies are expected to expand at a rate greater than 4%. Trade agreements with such countries would create an opportunity for Canada to get preferential access to these markets with high demand for consumer and producer goods and services. Third, the Organization for Economic Cooperation and Development (OECD) and Food and Agriculture Organization (FAO) projections reveal that the world's consumption of beef and wheat is expected to increase by an annual average of 11% by 2023, but the consumption of these products in some of the CPTPP countries (Chile, Malaysia, and Peru) is projected to increase by 20%. These agricultural products are especially important to Canada and particularly to Saskatchewan; preferential market access would boost Canada's exports. Fourth, the CPTPP would open up markets, increasing the degree of domestic competition due to the presence of competitive partners such as Australia and New Zealand, consequently resulting in an increase in domestic market efficiency (van de Loo, 2018). Canada and Saskatchewan may be able to count on the CPTPP agreement to improve access to foreign market, particularly the larger and protected market of Japan. It is also anticipated that the CPTPP will allow Canada to reap the benefits of its competitive advantage in member countries' market over other exporters.

1.3 Trade with CPTPP Countries and the US

Merchandise trade flow between Canada and Pacific-Rim countries is concentrated within three major trade partners: US, Mexico and Japan. In 2016, Canada's trade with CPTPP countries and the US accounted for 63.86% and 80.71% of its total merchandise imports and exports, respectively. Canada's trade with the US represents roughly half of its imports and two third of its

contribution of the agriculture and food cluster is 16.6% of provincial GDP, which contributes to 26.9% of total provincial employment.

exports. In that same year, Saskatchewan's trade with CPTPP countries and the US was equivalent to 87.21% and 56.5% of the province's total imports and exports, respectively. Similar to the Canadian national economy, Saskatchewan's trade is dominated by the US, which accounted in 2016 for 83.3% of its imports and 47.85% of its exports, followed by Mexico and Japan (Statistics Canada, 2016). Table 1.1 below provides a snapshot of Canada's and Saskatchewan's trade with the CPTPP member countries, the US, and the Rest of World (RoW). There are two main reasons behind this large trade exchange between Canada/Saskatchewan and US/Mexico. The North American Free Trade Agreement (NAFTA)[3] (the trilateral trade agreement between Canada, US and Mexico that permits substantial trade flow), and the fact that Canada's geographic location facilitates merchandise flow between these three countries.

All of Canada's key economic sectors would benefit from trade agreements with Pacific-Rim countries. For Saskatchewan, the natural resources sectors, in particular, would reap economic gains (Government of Canada, 2018b). Trade agreements such as the CPTPP will provide products from Canada and Saskatchewan with preferential access to the member countries' market, and further improve investment among members by reducing regulatory barriers and enhancing the business environment. Under CPTPP tariffs on Canada's key export products would be eliminated or reduced over 10 to 20-year period. Metals, minerals, agricultural equipment, feed wheat and barley, canola seed and oils, forestry products, and many other agricultural products would be guaranteed duty-free market access. Major CPTPP member countries such as Japan and Canada will have a special treatment for meat and dairy products sectors that includes a significant reduction in tariff rates, but not full elimination of them[4]. In Saskatchewan, agriculture and mining are the sectors that would potentially experience major changes due to trade agreements with Pacific-Rim countries. On average between 2015-2017, agricultural products and fertilizers

[3] Canada, Mexico, and the US have recently have come to an agreement in principle to replace NAFTA. The new agreement so called the United States-Mexico-Canada Agreement (USMCA) will replace the original 1994 NAFTA. At the time of writing there is no analysis of USMCA economic impact, but there is no doubt that Canada's dairy sector would be impacted as Canada's dairy industry is one of the critical parts of the USMCA. Canada will grant and expanded 3.6% market access to Canada's domestic market and eliminate competitive dairy classes which will allow the US dairy producers greater market access to sell their goods in Canada (Office of the US Trade Representative, 2018). The USMCA has, at the time of writing, not been ratified by the legislators of any of the three member countries. As of now NAFTA remains in place.

[4] Chapter Three provides detailed description of the CPTTP provisions and tariff elimination and commitment schedules of the member countries. This chapter also provides details on the US tariff concessions commitment under former TPP.

represented over 95% of total Saskatchewan's merchandise exports to the CPTPP member countries (Government of Canada, 2018c).

Table 1.1: Canada and Saskatchewan trade breakdown with the CPTPP member countries, the US, and RoW as a percentage of total trade, 2016

	Canada	
Trade partner	**Imports (%)**	**Exports (%)**
Australia	0.38	0.38
Brunei Darussalam	n/a	n/a
Chile	0.32	0.14
Japan	2.96	2.07
Malaysia	0.49	0.14
Mexico	6.22	1.48
New Zealand	0.12	0.09
Peru	0.46	0.15
Singapore	0.18	0.26
Vietnam	0.93	0.10
United States	52.18	76.28
RoW	35.76	19.29
Total	**100.00**	**100.00**
	Saskatchewan	
Trade partner	**Imports (%)**	**Exports (%)**
Australia	0.08	0.30
Brunei Darussalam	n/a	n/a
Chile	0.06	0.34
Japan	1.17	3.65
Malaysia	0.10	0.95
Mexico	2.27	2.60
New Zealand	0.03	0.12
Peru	0.06	0.70
Singapore	0.03	0.03
Vietnam	0.19	0.26
United States	83.30	47.85
RoW	12.71	43.2
Total	**100.00**	**100.00**

Source: Statistics Canada (2016).

The Government of Canada anticipates that CPTPP should provide the country with advantages due to increased market access and integration with the Asia-Pacific Region. The Government of Canada in its strategic and economic analysis of the CPTPP stated that "The Agreement will generate significant economic benefits for Canada, including access to Japan (the world's third-largest economy) as well as fast-growing markets such as Malaysia and Vietnam"

(Government of Canada, 2018a). On the other hand, the CPTPP should provide new opportunities for Saskatchewan exports by eliminating or reducing tariffs on almost all of the province's major exports including: agricultural and agri-food products, industrial goods, and forestry products and value-added wood products. Saskatchewan's agricultural producers rely heavily on trade. On average, between 2015 and 2017, Saskatchewan's agricultural exports to the CPTPP member countries represented about 83% of its total exports to these countries (Government of Canada, 2018c). According to the former Saskatchewan Premier Brad Wall, much of the province's future growth would depend on having reliable access to the Asia-Pacific Region[5] (cited in CBC, 2015). Metals, minerals and agricultural products, such as canola seed and oils, wheat, barley, malt, dried peas, beans, and honey, would have the most potential for growth given preferential access to the Asia-Pacific market.

1.4 Need for the Study

Sixty-four percent of Canada's national GDP is generated through trade (World Bank, 2016a). The CPTPP, alongside other FTAs, would guarantee Canada's access to over 60% of the world's economy (Government of Canada, 2018a).

Over the years, within the field of applied economics, trade agreements analysis has become routine when estimating the impact of FTAs on a given country's national economy (e.g., Burfisher *et al.*, 2001; Cox & Harris, 1992; Petri & Plummer, 2016; Burfisher *et al.*, 2014) and, it must be said, with considerable success. However, estimating the subnational or provincial impact, or the impact on a particular sector(s), remains one of the hot topics in applied economics research and has become a standard input to policy deliberation in several countries (Madden & Giesecke, 2013). In many cases, such studies simply do not exist. Few studies are available that focus on the impact of economic shocks on regional and national policy changes at the provincial level in

[5] As for Saskatchewan, CPTPP alongside other free trade agreements such as Canada-European Union: Comprehensive Economic and Trade Agreement, as well as the Canada-South Korea Agreement, aligned with Saskatchewan Plan for Growth, which specifically calls for an increase in provincial exports. Saskatchewan Plan for Growth was announced in 2012, and included the Government of Saskatchewan's vision for growth in 2020. The general goal of the plan is "to secure a better quality of life for all Saskatchewan people" by fostering economic growth, further developing the infrastructure, developing natural resources, and investing in education (Government of Saskatchewan, 2012). Part of the government's vision is to secure Saskatchewan's role as an international leader in the agriculture sector, and as a source for food security in the world. Thus, the government has set one of the plan's goals of food products' growth from C$10 billion in 2011 to C$15 billion in 2020. Improving and enhancing market access, particularly large markets, and increasing the number of FTAs, would be a highly supportive measure for Saskatchewan Plan for Growth to increase exports.

Canada (e.g., Alavapati *et al.*, 1996; Millington, 2016). However, in general, almost all previous studies of FTAs and policy changes in Canada have been carried out for the country as a whole. This gap in knowledge is caused by three major factors:

i. Canada has recently concluded negotiations on the CPTPP. At the time of writing there was no study examined the economic impact of the CPTPP on Canada and other member countries, or the impact of this agreement on a specific sub-region within a country. The current available studies (e.g., (Burfisher *et al.*, (2014); Todsadee *et al.*, (2012); Kawasaki (2016); Petri & Plummer 2016; and Cheong, 2013) are all based on the former TPP agreement and not specifically focused on the Canadian economy. Further, no study was conducted to analyses the economic impact of the CPTPP (or TPP) at provincial level in Canada;

ii. To date, no study has developed an economic model to compare the economic impact of the CPTPP to the impact of the former TPP, if it had been implemented, on both Canada and Saskatchewan economies;

iii. Saskatchewan has its own growth plan, whereby the CPTPP agreement could be complementary through increased exports. No study has addressed the potential economic impact of these changes on Saskatchewan's economy.

Based on the aforementioned setting, a number of questions need to be answered. These include: What are the economic impacts of the CPTPP on Canada and Saskatchewan economies, particularly on their major economic sectors? How would the withdrawal of the US from the TPP agreement affect Canada and Saskatchewan economies? Would the impact of the CPTPP on Saskatchewan's provincial economy differ from the impact on the Canadian national economy?

This study was undertaken to fill these gaps. By answering the three above-mentioned questions, this study could be used as a planning and decision support tool by government regulatory institutions and agencies. In the same context, the study will add an important contribution to the current literature on regional economic models, and how they can be utilized to track the exogenous changes in policy (particularly in trade) on the regional/provincial economy.

1.4.1 Research Problem Statement

The CPTPP agreement is expected to have economic and/or social impacts on several economic sectors, both at the national and provincial levels. Knowledge of such impacts would be of value, not only to the policymakers, but also to the public at-large. Estimating and quantifying such impacts on Canada's economy, and teasing out impacts on Saskatchewan's provincial economy, could be of interest, particularly due to the fact that a large portion of Canada's and Saskatchewan's GDP depends on trade. The scheduled changes in trade can affect the economy's structure, demand, supply, and employment. At the provincial level, the economy could respond differently than at level of national economy, but it depends on the province's trade relationships with CPTPP member countries. However, subnational analysis faces difficulties ranging from data availability to interprovincial trade, and its response to the international trade changes. Assessing the possible economic impacts of the CPTPP would be a decision support policy tool that can be utilized to project the CPTPP agreement's impacts on Canada and Saskatchewan economies, and on their major economic sectors. In addition, a comparison between the CPTPP and TPP economic impact would also be of interest and it can enrich the literature on the economic impact analysis of CPTPP and the former TPP agreements.

1.4.2 Study Goals and Objectives

The overall goal of the study is to assess the likely economic impact of the CPTPP agreement and compare it with the former TPP is hypothetical impact on Canada and Saskatchewan economies, by assessing and quantifying the economic implications for these economies. In order to achieve the overall objective, the following specific objectives need to be achieved:

i. To assess and quantify the economic impact of the CPTPP and compare it to the impact of the former TPP agreement, if it was implemented, on both Canada and Saskatchewan economies;

ii. To assess whether or not the changes associated with the CPTPP agreement would impact Canada's and Saskatchewan's imports and exports, particularly on major economic sectors and commodities, and how these changes might affect Saskatchewan's

exports goals, and compare it to the impact of the former TPP, if it had been implemented; and

iii. To provide policy insight pertaining to the agreement.

By achieving the above-mentioned objectives, in-depth knowledge on the economic impact of the CPTPP and the US withdrawal from the TPP (as the major trade partner for Canada) on Canada and Saskatchewan economies would be acquired. Such information can be utilized as decision-making supportive information for Canadian and Saskatchewan provincial officials.

1.5 Organization of the Study

This study consists of seven chapters and is organized as follows: Chapter 2 provides a review of the studies related to the economic impact analysis of trade agreements. This review includes a summary of advantages and disadvantages of each approach that has been used for analysis. Chapter 3 includes a detailed description of the CPTPP agreement trade provisions, and the associated tariff and other trade barriers concessions. Chapter 4 outlines the detailed methodology of the study, and descries the scenarios, data sources, and the structure of the study models. Chapter 5 reports the national model simulation results for the Canadian economy resulting from reducing/eliminating tariffs between CPTPP member countries and compare it to the impact of the former TPP agreement, if it had been implemented. In Chapter 6, the results of a subnational model for Saskatchewan in terms of economic impact of the CPTPP agreement on the province economy are reported and compared to the results of to the impact of the former TPP agreement, if it had been implemented. Chapter 7 provides a general summary of the work, lists the potential policy implications of this research, and discusses potential future research.

Chapter 2

Literature Review

2.1 Background

The applied economic literature has a long list of studies (e.g., Binh *et al.*, 2011; Martinez-Zarzoso, 2003; Berck *et al.*, 1991; Canning & Tsigas, 2000; Burfisher *et al.*, 2014) which attempted to capture the economic impact of trade policy changes by using a variety of methodological approaches, including econometric techniques, household and industry-level analysis, case studies, partial equilibrium approaches, and computable general equilibrium (CGE) approaches. Each of these methodologies had its own strengths and weaknesses. Analyzing the effect of a trade policy can be grouped in different ways based on the geographical area, level, depth, and time of the analysis[6]. A very broad category can be considered, which includes all these groups: *ex ante* and *ex post* analysis (literally meaning 'before and after the trade agreement'). The following sections review studies in these categories, including their application in estimating the impact of the changes in the trade policies, as well as trade liberalization[7].

2.2 *Ex Post* Approach

Ex post studies utilize historical data to analyze the effect of historical trade policies. In other words, these studies explain the effect of a trade policy after it has already been implemented. This analysis employs for the most part econometric models. The results are most useful when policymakers want to assess the implications of any future trade policy. Unfortunately, the *ex post* approach studies suffer from one major limitation: they cannot answer "what if" questions.

The gravity model is the most commonly-used *ex post* econometric technique to assess the economic impact of trade policy changes. In fact, this approach dominates the applied economic literature, and has been used extensively to assess the impact of different trade policy issues on trade flows between different countries. This may be a result of its proven efficiency when quantifying the implications of alternative trade policy scenarios (Piermartini & Teh, 2005). The

[6] Various studies analyze the impact of trade policy changes on household and industry-level, country or region level, multiple country or a single one, sectors or commodities, and *ex post* or *ex ante* implementations of the policy.

[7] Trade liberalization is the move towards less restricted trade across national borders through the reduction of tariffs, NTBs, and other barriers (Agénor & Aizenman, 1996).

applied economic literature has a long list of studies that utilize the basic or modified[8] gravity model (e.g., Binh, *et al.*, 2011; Martinez-Zarzoso, 2003; Martinez-Zarzoso & Nowak-Lehmann, 2003; Serlenga & Shin, 2007; Paulo *et al.*, 2015; and Martin & Pham, 2015). These studies demonstrate the ability of the gravity models to explain trade flow patterns between countries. However, a word of caution: there are a few cases that show evidence of contradictions between the theory and historical data. Piermartini and Teh (2005) have ascribed this to the weaknesses in the theoretical foundation of the gravity model.

Gravity models are based on the concept that the trade volume between two geographical regions depends on the economic size of the two geographical regions, which is usually measured by the countries' GDP and their distance apart from each other. This was first used by Tinbergen (1962) to analyze the impact of various trade-related policies, in particular, analyzing bilateral trade flows based on the economic size and the distance between the countries. Since then, it has become a popular empirical trade policy analysis approach. This popularity is basically due to the ability of the gravity model to explain trade flows and its apparent adaptability when testing out the role played by other variables in altering trade patterns (De Benedictis & Taglioni, 2011).

Gravity models have been extensively used to examine the effect of FTAs on agricultural and food trade. For instance, Jayasinghe and Sarker (2008) applied gravity model to analyze NAFTA impact on trade in six agricultural products: red meat, grains, vegetables, fruits, sugar and oilseeds. The results of this study suggested that trade under NAFTA was greater than what natural determinants can explain, and further displaced trade with non-NAFTA countries. Similarly, Susanto *et al*. (2007) and Ghazalian (2017) applied gravity model to examine NAFTA impact on agricultural trade. Susanto *et al.* (2007) analyzed US-Mexico agricultural trade, they found that the US agricultural imports from Mexico were higher under NAFTA due to the reduction in tariff rates. Ghazalian (2017) examined the effect of both NAFTA and the Canada-United States Free Trade Agreement (CUSFTA) on disaggregated agricultural products: trade between the US and

[8] The basic gravity model can be augmented with extra variables that can affect trade. These include: trade resistance, which measures the trade barriers between countries, country remoteness (the less remote a country the more sources of imports it has), and per capita income of the importer and exporter as a measure of country size (Ivus & Strong, 2005).

Canada. The author found indicators that agricultural products under examination were impacted differently due to NAFTA/CUSFTA.

Reviewing the theoretical foundation of the gravity model reveals that the model has high explanatory power, and is considered to be one of the most successful empirical models in economics; however, it was long criticized for lacking a strong theoretical foundation (Piermartini & Teh, 2005; Anderson, 2010). Moreover, Bergstrand (1985) criticized the basic gravity model for omitting price variables, resulting in misspecifying outcomes(s)[9]. Due to the nature of analysis, an *ex post* approach analysis will not be able to fulfill the objectives of this study.

2.3 *Ex Ante* Approach

The *ex ante* approach involves projection of the possible future effect of a policy change, and provides a tool to examine its possible impacts before implementation. This approach can simulate the impacts of a proposed policy change, and can answer "what if"-type questions. In other words, the *ex ante* approach provides a framework for projecting the impact of policy changes, and has been widely applied for such situations. Input-output (I-O), partial, and CGE models are the most frequently-used *ex ante* approaches by the applied economic studies. I-O models are the standard to analyze regional impacts of policy changes. Although they are known for their good performance for small area economic impact analysis, they have been criticized for their bias toward overestimating the impact of a policy at a regional level. Such situations arise naturally due to the model's inability to take explicit economic structure into account (Rickman, 1992; Gillespie *et al.*, 2001; West, 1995).

CGE models are more detailed than I-O models, and account for all the links among various sectors of an economy, including cross-sector effects. For example, if the price of manufactured goods increases, the demand of consumers would lead to changes throughout the economy. Consumers would buy fewer manufactured goods, and the changes in consumer demand and industry output would affect employment and other related variables (Burfisher, 2016). CGE

[9] The basic gravity model assumes identical prices across the countries. Failure to allow for differing prices results in misspecification of the gravity model, as differing prices are important due to trade barriers between the countries (Feenstra, 2004). Anderson (1979) derived the first gravity model that allows for price effect. Since this study, price index and other approaches have been used in the development of gravity models.

models have been used in the applied economic literature to assess the *ex ante* impacts of policy changes, particularly trade policies, providing a framework for assessing economical changes or shocks (Seung *et al.*, 1999; Alavapati *et al.*, 1996; Shoven & Whalley, 1992; Madden & Giesecke, 2013). These CGE models are very sophisticated[10], as they have the ability to identify sectors/groups that would be affected positively or negatively, along with the magnitude of the change after altering some parameters, and then quantifying the impact against a benchmark status. This is one of the major reasons behind the popularity of CGE models (Bandara, 1991).

CGE models are commonly developed at the country level; however, modified versions of CGE can be used at subnational levels to reflect the impact of the national policy on a specific region (e.g., a provincial economy). These modified versions are designated regional CGE, and can be used and applied to analyze the same issues as the national CGE (Madden & Giesecke, 2013). Good examples of CGE models applications in trade policy assessment can be found in Cox and Harris (1992), Hinojosa-Ojeda (2000), and Lloyd and MacLaren (2002). Although these applications have shown that such models have the ability to capture trade policy impacts, some authors criticized their high level of aggregation, their overestimation of economic impacts, and their huge data requirements (Flores, 2008).

Based on the above points, and given the time period and regional focus, the *ex post* approach[11] was incapable of fulling the research objectives, whereas reviewing the *ex ante* approach revealed the following facts:

i. I-O models are considered to be the standard models to analyze the impacts of policy changes, whose main advantage is ease of use. However, the use of fixed coefficient[12] in I-O models and the lack of supply side constraints are their major limitations.

[10] A less sophisticated model is the partial equilibrium analysis. Partial models focus on only one sector, assuming that the impact of one sector on the other sectors of an economy does not exist, or is very small. Thus, the major shortcomings of the partial equilibrium approach is that it does not provide a complete picture of the interrelation between various economy sectors.

[11] As mentioned in section 2.2, *ex post* approaches, such as econometrics models, are more appropriate to estimate the impacts of past policies. Thus, they are inappropriate for fulfilling the objectives of this research. Moreover, econometric models lack sufficient structure for complex policy analysis.

[12] Using fixed coefficients implies that the marginal response due to policy changes is equivalent to the average relationship observed in the based year (Rose, 1995).

ii. Unlike partial equilibrium approaches, which miss the intermarket relationships, CGE models can trace the impacts of a policy shock through various economic sectors, and therefore, their outcomes in trade policy analysis are more comprehensive.

iii. CGE models can provide a comprehensive insight into policy, capable of highlighting the importance of linkages between sectors, and thus providing unique quantitative insights into the possible impact of policy changes.

Although CGE models are considered to be the most sophisticated among the three above-mentioned models, researchers discovered that the insights provided by CGE models provided a significant advantage over other *ex ante* approaches. The ability of CGE models to capture the impacts of policy changes throughout various economic sectors was sufficient to justify their use (Whalley, 1985; Clarete & Roumasset, 1986).

2.4 CGE Models for Trade Policy Analysis

CGE models are very popular for analyzing a wide range of policy issues. These applications vary from estimating the welfare impact of tax reform on alternative energy resources to the effect of foreign trade reforms on labour markets, and employment (de Melo, 1988). The wide interest in using CGE modeling to analyze the impact of trade policy can be explained by the following five principles (Piermartini & Teh, 2005; Borges, 1986; Kehoe & Kehoe, 1994):

i. It can capture the direct and indirect impacts associated with shocks related to implementation of trade policy reform;

ii. It is theoretically consistent: CGE models are based on the economic theory and have a microeconomic foundation whereby the production and demand functions for all agents in the economy are explicitly calculated and taken into account, thus ensuring that the analysis is based on a correct theoretically sound understanding of how economies work;

iii. CGE models were built on an equilibrium system where income and expenditures have to match, therefore any shock (e.g., trade policy changes) can be quantitatively measured;

iv. It can measure changes in aggregate sectorial welfare, which is particularly important when policymakers are concerned about understanding the impact of a policy on a specific sector. As a result, this framework can help to answer questions such as "who are the winners and losers?" brought about by changes in trade policy; and

v. CGE models are not restricted to perfect competition markets; imperfect or other market structure can be factored into the analysis.

Although the CGE model is a powerful tool, with any other method, it also has a number of drawbacks when used for analyzing trade policy. Firstly, CGE may fail to capture some of the benefits and costs of the transition. For instance, it cannot capture all the resource reallocation costs associated with the transition (Piermartini & Teh, 2005). Secondly, it is a simple tool for economic impact analysis, and does not take the political impetus for such changes into account. Schiff and Winters (2003) argue that security and political concerns[13] have been a strong impetus behind many modern-day trade agreements.

Despite the above-mentioned limitations, CGE analysis is considered to be "a comprehensive *ex ante* simulation" method (Bohringer *et al.*, 2003, p.32), and one of the most powerful tools for analyzing the impact of trade policy changes.

2.5 Structure of CGE Models for Trade

A CGE model is a system of equations that describes an economy as a whole (Burfisher, 2012). It includes complete specifications of the demand and supply sides of all markets in the economy, whereby numerical magnitudes are used to mimic the internal or external policy shocks and their impact on the economy. CGE models, in general, consist of three major components:

i. Economic agents, such as households, firms, and government;

ii. Rules of the economic agents in the economy, and how they interact; and

iii. Intraregional and international trade flows.

[13] More details on the political economy of trade policy are available in Baldwin (1989).

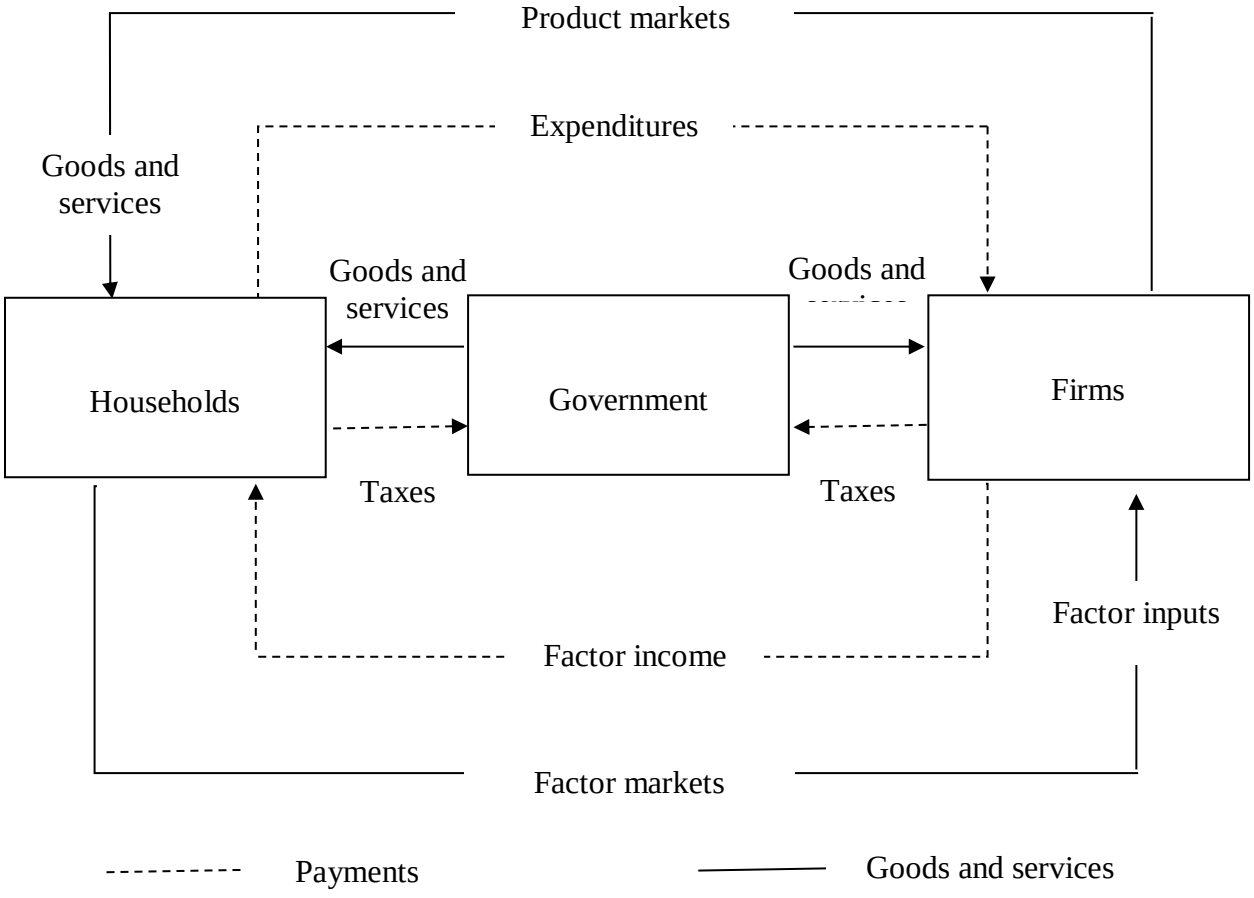
The circular flow of income in the economy is CGE's major milestone. Households own the factors of production, and are also the consumers of the final products. They maximize their utility by choosing a bundle of goods and services that are subject to budget constraints. Firms rent the production factors from the households for use in producing goods and services. The production side consists of the output, inputs of production, and technology ((divided into intermediate and final levels). The intermediate-level goods are used as inputs to produce a composite range of intermediate goods. Similarly, the primary production factors, i.e., land, labour, and capital, are used to produce value-added items. At the aggregate level, value-added goods, along with the composite intermediate goods, are used to produce the final output. The government's role in this circular economic system is to collect taxes, and to distribute a portion of those taxes to households and firms in the form of subsidies and transfers. The international sector provides imports to the domestic market, as well as exports to the international markets - the flow is explained by inward and outward payments (Piermartini & Teh, 2005). Figure 2.1 shows the circular flow of income in a simple CGE model (Wing, 2004, p.29). The solid line represents the flow of goods and services, while the broken line depicts the flow of payments in an economy.

As shown in Figure 2.1, equilibrium in the economy must be attained in order to achieve the condition of market clearance. Equilibrium is reflected by the balanced budget of the activities in the economy where total expenditure is in balance with total income. At the value equilibrium point, the revenues from production are allocated as receipts for the households, rentals for primary factors, payments for intermediate inputs, and taxes for the government. The sum of the total value of the outputs equals the cost of the inputs of intermediate goods and the payments to the primary factors used in production (Wing, 2004).

CGE models can be categorized into two broad categories: static and dynamic CGE models. The static model provides a before-and-after shock comparison of an economy. The static model can be utilized to determine the ultimate winners and losers of economic shocks. Static models are simpler in nature compared to dynamic ones, but their major drawback is that they do not define the adjustment process resulting from the shock (e.g., temporary unemployment). On the other hand, dynamic CGE models capture the adjustment throughout the shock rather than merely its final outcome. The major drawback of dynamic models is their level of complexity,

whereby the dynamic properties of the shock need to be modeled. Regardless whether CGE is a static or dynamic model, it can be a single or multi-country model. The single-country model contains one country or region, whereas a multi-country model contains two or more regions or countries, and describes these regions' economies in detail (Burfisher, 2012; Shantayanan & Delfin, 1998).

CGE models were built for the stated objectives of the research, which is known as the special-purpose CGE model. There is no single standard model that can answer all research questions. However, researchers can combine various components of different models to address most of their research questions.



Source: Wing (2004).

Figure 2.1: Circular flow of the economy

In the applied CGE, the circular flow in the economy is represented by a Social Accounting Matrix (SAM), whereby each expenditure is matched to an income. The SAM represents a snapshot of an economy for a given year of monetary exchange in a square matrix format, where rows and columns correspond to the income and expenditure of different economic agents. It symbolizes the flow of income between firms and households within the presence of government and international sectors. In SAM, each line and its corresponding column is an account: the row shows the income of the account, while the column indicates the expenditure of the economic actor. The value of each cell corresponds to both an income for an account, and an expenditure for another, thereby leading to a balance between the sum of rows and columns (Monge *et al.*, 2014).

There are several major sources of economic data to be considered for building a SAM. These include: economy's I-O table, national accounts, government budgetary accounts, and balance of payments and trade statistics. These sources provide information on the production, inter-industry linkages in the economy, exports and imports, and public expenditures and revenues (Piermartini & Teh, 2005). The CGE model follows the SAM disaggregation of factors, activities, and institutions, and is expressed as equations defining the behaviour of different SAM agents[14]. For instance, the behaviour of firms and consumers is driven by profit and utility maximization, respectively (Lofgren *et al.*, 2002). On the trade side, the Armington assumption[15] is implied where the goods are assumed to be imperfect substitutes for each other. This specification allows cross-hauling of a large amount of commodities, where a country imports and exports the same products. This allows the consumers to have different degrees of substitutions among domestic and imported goods. The number of purchases of domestic and imported goods depends on the prices, as well as Armington elasticity (Kehoe & Kehoe, 1994). Finally, a CGE model also includes a set of savings/investments accounts. These constraints in the model have to be satisfied for the region (country) as a whole, but do not apply to any individual agent (Lofgren *et al.*, 2002).

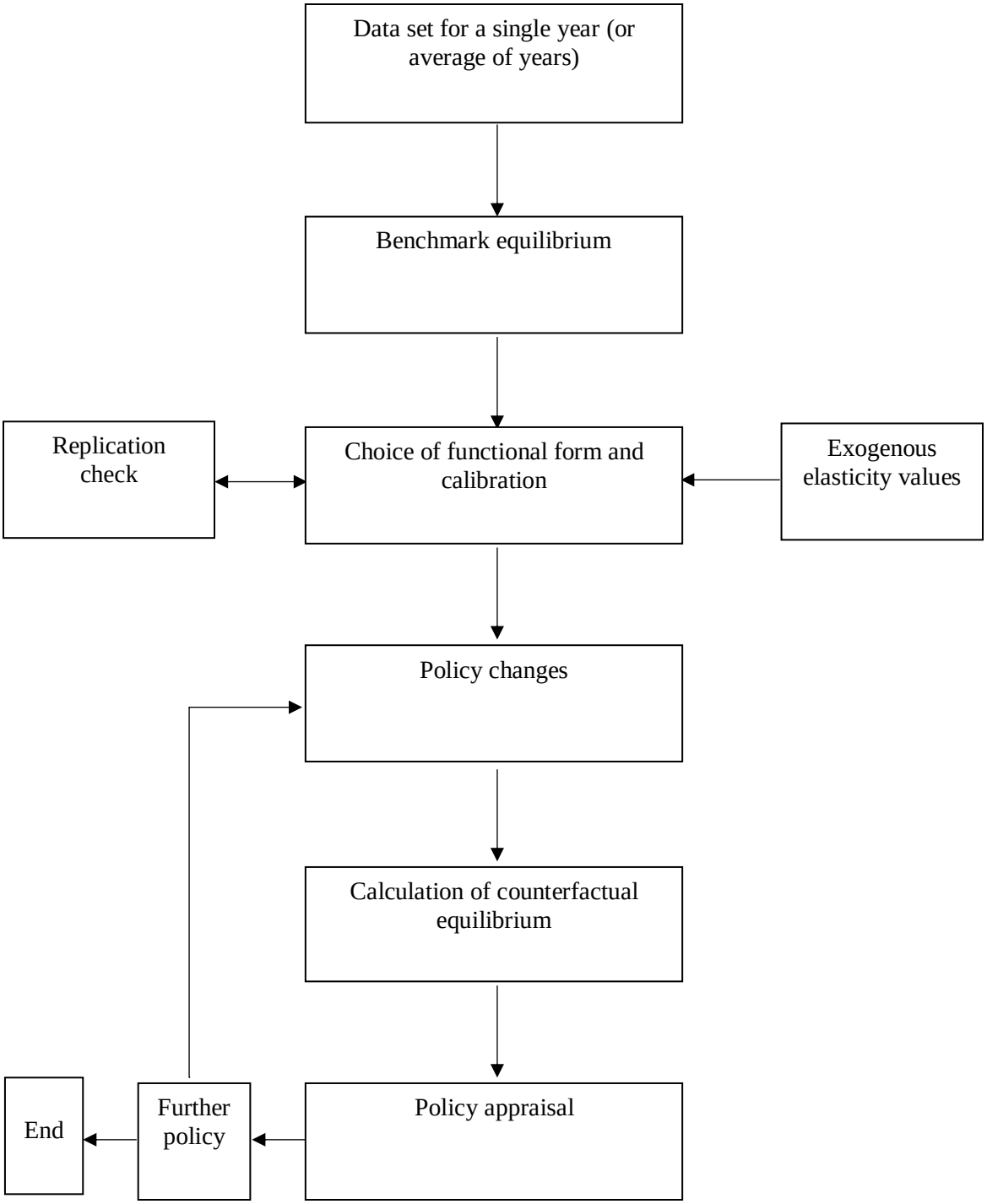
[14] In CGE model, the number of equations must equal the number of variables (such as GDP, employment, etc.) as a necessary condition for a unique solution.

[15] Armington elasticity is an economic parameter representing the elasticity of substitution between goods from different sources (e.g., domestic vs. imported). The Armington assumption is commonly used in international trade modeling. A country can import and export the same good, known as cross-hauling. This is inconsistent with the Heckscher-Ohlin trade theory under perfect competition, as it implies that goods are homogenous across countries. Armington (1969) solved this problem by assuming that the goods are imperfect substitutes for each other.

2.6 Technical Aspects of CGE Models

The CGE model starts by assuming that the economy is in equilibrium for the selected year. This is labelled as the benchmark equilibrium of the economy, and is used to calibrate the model. Once that is accomplished, the effects of any policy change (called a counterfactual equilibrium) are compared to this equilibrium. The model is then used to simulate the policy change by altering the relevant parameters, and calculating the new equilibrium. This approach is used to answer "what if" questions, which helps researchers and policymakers to predict what would happen should such a policy change take place in the economy (Petersen, 1997). Figure 2.2 outlines the flowchart of the calibration procedure for a typical CGE model. Once the data set is selected, an appropriate functional form must be used to reflect the nature of demand and supply in an economy. For instance, the households are represented by equations that depict its source of income and demand for goods, while each industry is represented by equations modeling its supply and input demands. The equilibrium then is determined by matching supply and demand with inputs and outputs (Rodriguez, 2007).

Choosing an appropriate functional form for households and firms is a challenging process for two reasons: (i) The functional forms must be consistent with economic theory, analytically tractable, and congruent with how the researcher introduces elasticities into the model. This explains why many researchers often use general functional forms such as Cobb-Douglas (C-D) and Constant Elasticity of Substitution (CES), where the key parameters values, such as income and price elasticities, can be accurately incorporated while allowing for tractability (Shoven & Whalley, 1984). (ii) Another important technical aspect and challenge of the CGE is exogenous or behavioral parameters: those that model behavior of producers and consumers in an economy. The number of behavioral parameters in the model depends on the objectives of the research. Three three unique types are required: Elasticity of substitution between the primary factors of productions, substitutability of domestic and imported products (i.e., Armington elasticities, and household demand and income elasticities (Piermartini & Teh, 2005).



Source: Shoven and Whalley (1984).

Figure 2.2: Flowchart of the calibration procedure in typical applied Computable General Equilibrium model

Once an economy is assumed to be in benchmark equilibrium, the modeler must then calibrate the parameters of the model so that it can reproduce the data set as an equilibrium solution. Once the calibration process is completed, the model can be used to evaluate the impact of the policy changes by calculating the counterfactual equilibrium. The results can then be used for policy appraisal by comparing the benchmark to counterfactual equilibrium (Shoven & Whalley, 1984; Bohringer *et al.*, 2003). Calculating welfare changes is one of the major functions of a CGE model. Once the counterfactual equilibrium is calculated, statics can be used to compare welfare before and after the policy change. The most commonly used welfare measures are Equivalent Variation (EV) and Compensating Variation (CV)[16]. The CGE is useful not only for estimating EV and CV, but can also be used to evaluate several other factors: distributional effects, changes in relative prices, use of factors of production across industries, and in the context of international trade, changes in terms of trade for each country (Shoven & Whalley, 1984).

2.7 Regional CGE Models

Regional CGE models are modified versions of the standard CGE that can be used at subnational or any regional level to reflect the impact of a policy on a specific region, state, or province. These modified versions can be used and applied to analyze the same issues as the standard CGE. Regional CGE models can be useful for local governments in two ways (Rodriguez, 2007):

i. To identify the regional impacts of national policy on a specific state, region, or province, which helps local government to participate efficiently in national debates and discussions on different policy proposals; and

ii. To evaluate the impacts of proposed polices at the local level, which allows the local authorities to make local policies based on a well-defined analytical framework.

A regional CGE can be used to disaggregate an economy based on the objective of the study. For instance, an economy can be disaggregated into a rural and an urban region, or to

[16] The EV is "the amount of compensation, paid or received, that will leave the consumer in his initial welfare position following the change in price if he is free to buy any quantity of the commodity at the new price". The CV is "the amount of compensation paid or received, that will leave the consumer in his subsequent welfare position in the absence of the price change if he is free to buy any quantity of the commodity at the old price" (Currie *et al.*, 1971, p.746).

identify a specific state, province, city, town, or even a village within a country. According to Rodriguez (2007), the existing regional CGE can be categorized into three categories: region-specific, bottom up, and partial regional CGE models.

The region-specific models are designed for an area within a country (e.g., state, province, or city). These models have a structure similar to a model of a country, whereby the behavior of agents in these models is identified in the same way as in the national standard model. The major difference between a standard and region-specific CGE is the treatment of the foreign sector. In the standard national CGE, the foreign sector is considered as the rest of the world, whereas in the region-specific model, the external sector is represented by the rest of the country and other countries in the world combined. The main idea behind these models is to examine specific local concerns such as a policy impact on a specific region of the country, to evaluate local concerns that are not relevant at the national level, or to assess the impact of a national policy on a particular region. Although region-specific CGE models are very useful for local authorities in terms of evaluating the impact of different policies on a specific region within a country, the major constraints in constructing these models are the data availability, and the inability of these models to capture the effects of a policy on other regions or on the country as a whole, unless all the regions are connected via a multi-region model.

The second category of regional CGE is bottom-up models, which divide the country into two or more regions, whereby each region is composed of economic agents, (i.e., households, firms, and government). The main feature distinguishing these models from the others is the treatment of the foreign sector and government. The foreign sector in these models is composed of the rest of the country and RoW, and the government is composed of regional and national governments. The advantages of these models over the region-specific ones are two-fold: their ability to capture the impact of a regional policy on other regions in the country (i.e., the spill-over effect on the other regions), and their ability to capture both the direct effect on a particular region, as well as the responses of other regions in the country. However, the main constraint of the bottom-up models is data availability, since they require comprehensive data for all regions in the model, including the intraregional trade within the country.

The third category of regional CGE is partial regional models. Any regional CGE model that cannot be classified as region-specific or bottom-up models fits into this category. Partial regional CGE can be classified into different categories based on the level of disaggregation. Some of them contain a regional disaggregation on the production side, some focus only on households, while others provide a disaggregation of production and households. These models are generally used when there is a weak, or no feedback effect, from the regional to the national level. Partial regional CGE models are very flexible, and can be used in various innovative ways depending on the objectives of the study. For instance, Kuiper and van Tongeren (2004) generated macro level impacts and fed these into the village-level model. The main advantage of partial regional CGE models is that they are less demanding in terms of data, as they are based mainly on secondary data. Furthermore, they do not require information on intraregional flows among different regions within the country. The major disadvantage of these models is that when they are compared to the bottom-up models, they are unable to capture intraregional flows and feedback from the region to the national level.

Regional CGE models have been used in the applied economic literature to examine various types of policies on different regional disaggregation. In the following subsection, the basic components of a typical regional CGE are presented. The differences between regional and national CGE models, as well as the major challenges facing regional CGE, are discussed in subsection 2.7.1. Subsection 2.7.2 includes a survey of the applied literature on regional CGE models, and the manner in which these have been used by modelers to evaluate certain policies' impact on a regional level.

2.7.1 Salient Features of Regional CGE Models

As mentioned in the previous sections, a regional CGE model is a modified version of the national model, as they have similar components and technical aspects, with some minor differences. The main difference between regional and national CGE is the foreign sector. In these models, trade is not only with the foreign countries, but also with other regions in the country. In addition, the level of openness with other regions is greater in these models than with other countries, as labour is more likely to be mobile between regions within a country than between countries. The production specifications aspect of regional CGE is generally guided by the neoclassical theory; therefore, factor demands in regional CGE models depend on output and

factor prices. The C-D and CES are the most commonly-used functional forms on the production side in the regional CGE studies (e.g., Buckley, 1992; Gazel, 1996). However, different forms have been employed in other research, such as the Generalized Leontief functional form (Li & Rose, 1995). Regional CGE models require special treatment of intermediate goods, as they can be purchased either within the region or imported from the foreign sector; these include goods from other regions or other countries, and are usually specified by the Armington assumption (Armington, 1969).

Regional household demand is a composite of both local and imported goods (either from other regions within a country or from abroad). The functions such as C-D and CES are often used to represent the regional utility, where income elasticities of demand are equal to unity. Some studies employ the Stone-Geary utility function, which leads to a Liner Expenditure System; this is a generalization of C-D with an advantage that additional income does not necessarily increase consumption (e.g., Kilkenny, 1998; Li & Rose, 1995). Regional CGE models employ a multiple-level consumption structure to allow for different elasticities of substitution between different sets of goods. The Armington CES function is typically used to represent the choices between local and imported goods. The same function was also employed to represent the export demand (Morgan *et al.*, 1996). The government sector requires special treatment in regional CGE, as the government sector includes the regional and federal governments. In general, most modelers tend to lump the regional government together with the federal government, depending on the research objectives (Partridge & Rickman, 1998). Other studies treated the regional government in a more complex way, especially those with more fiscal focus, where the regional and federal governments were separated into two different accounts, which ultimately depended on the objectives of the study (e.g. Rickman, 1992).

The points above show that the construction of a regional CGE model is similar to the national standard CGE model. However, the openness of a regional economy with other regions of a county suggests that there is more complexity in a regional model. This complexity, as well as the degree of disaggregation, often depends on the objectives of the study. The degree of complexity and the extensive amount of data required for each region to run these models (which is not always fully or partially available at the regional level) are considered to be the major constraints and challenges of regional CGE models.

2.7.2 Regional CGE Applications in Applied Economic Literature

Regional CGE models have been used to examine different type of policies, such as estimating the effect of tax reform, transportation, alternative energy structure, trade reforms, labour markets, and employment. The focus of these studies was to assess and evaluate the impact of national or local policies on a particular region within a country. Although the trade application of regional CGE models is still not very popular, it is growing in popularity over time, especially in federal countries (e.g., US, Canada and Australia), where local governments of different states or provinces use regional studies to understand the impact on the local economy. In this subsection, some published applications of regional CGE models are reviewed with an emphasis on the relevant contribution of regional CGE models in the trade field; however, they are not common in the CGE-based analysis literature.

Numerous studies have used regional CGE models for different novel applications to estimate the regional effects of various policies (see Table 2.1). Bahan *et al.* (2003) constructed a 1996 detailed bi-regional SAM for the regional CGE model for the Quebec Ministry of Finance. Data for this model were obtained from national accounts and I-O tables. The bi-regional SAM in this study was very detailed, as it included 56 sectors, 121 and 48 categories of goods and services and personal consumption expenditures, respectively. The bi-regional structure described the economies of both Quebec and the Rest of Canada (RoC), as well as the interaction between the two regions. The SAM structure was adapted on the basis of the needs of Quebec's Ministry of Finance. However, one of the unique features of this research was using supra-regional accounts in the SAM, which made no distinctions between the two regions, i.e., Quebec and the RoC. Supra-regional accounts include: accumulation account to allow for high mobility of capital in Canada, investment income accounts to consider the integration of financial markets, federal government account, and RoW account, with a special distinction between interprovincial and international trade. Although the authors did not estimate an actual regional CGE model in their study, they actually compiled all the statistical bases of the bottom-up regional CGE model by constructing a detailed bi-regional SAM.

Table 2.1: Selected regional CGE-based studies

Study	Region	Model type	Application
Bahan *et al.* (2003)	Quebec, Canada	Bottom-up	Bi-regional SAM for the regional CGE model for Ministry of Finance in Quebec
Liew (1984)	Multi regions, Australia	Bottom-up	Tariff removal impact on different regions in Australia
Berck *et al.* (1991)	San Joaquin Valley, California, US	Region-specific	Regional effects of reduced agricultural use of water
de Miguel and Manresa (2004)	Extremadura, Spain	Region-specific	Regional impact of agricultural subsidies
Holden *et al.* (2005)	Highlands, Ethiopia	Region-specific	Regional impact of fertilizer subsidy removal
Canning and Tsigas (2000)	US (10 distinct economic regions)	Bottom-up	Federal and State tax policy
Kuiper and van Tongeren (2004)	Village in Jianxi province, China	Region-specific	Trade reforms
Domingues and Lemos (2004)	Brazil (2 regions, Sao Paolo and the rest of the country)	Bottom-up	Trade reforms
Jean and Laborde (2004)	EU (divided into 119 regions)	Bottom-up	Trade reforms
Bautista and Thomas (2000)	Zimbabwe (9 household groups)	Partial regional	Trade reforms
Cury *et al.* (2004)	Brazil (7 household groups)	Partial regional	Trade reforms
Filho and Horridge (2005)	Brazil (27 regions, with production and household disaggregation	Partial regional	Trade reforms
Bosello *et al.* (2014)	Italy (3 sub-regions: North, Centre, and South)	Partial regional	Subnational SAM for Italy. Test application, factor productivity loss
Bosello and Standardi (2018**)**	Italy, France, Spain, Greece and Portugal (70 sub-regions)	Partial regional	Climate changes
Ciuriak *et al.* (2015)	Canada (2 regions: Ontario and RoC)	Partial regional	Trade reforms
Lysenko *et al.* (2015)	Canada (12 regions)	Partial regional	Trade reforms

Liew (1984) evaluated the tariff removal in Australia by comparing the prediction of a bottom-up multiregional CGE model with the predictions of top-down ORANI[17] model. The author found that the bottom-down model had a better prediction on the regional level compared to the top-down models.

Berck *et al.* (1991) used a regional CGE model to examine the regional effects of reduced agricultural use of water in San Joaquin Valley in California. They estimated that the GDP in San Joaquin Valley would be reduced by a small percentage, as the resources released from the agricultural sector would be absorbed by other economic sectors.

de Miguel and Manresa (2004) estimated the regional impact of agricultural subsidies and social contributions of employers for the Extremadura region in Spain. In their study, they obtained the model parameters from a regional SAM built for the aforementioned economy. For the regional model, they disaggregated households according to location, rural/urban living, income, and age. This disaggregation was consistent with the national CGE models. The results showed a negative effect of agricultural subsidies on some micro and macro-economic variables such as prices, household welfare, and unemployment rates. One potential drawback of this study is its inability to capture the intraregional effects of the policy.

Holden *et al.* (2005) simulated the fertilizer subsidies impact on the Ethiopian Highlands region. Using a region-specific CGE model, the authors found that the fertilizer subsidy removal had a negative environmental externality, as it increased land degradation in the region.

Canning and Tsigas (2000) applied the bottom-up CGE to model the federal, state, and local tax impacts. They divided the US economy into ten distinct economics regions, which were engaged in intraregional and international trade. For each region in the model, their respective set of unique composition of industries, capital, and trade patterns were included. The research outcome showed that farms are a favored industry in terms of taxation at the federal level.

Kuiper and van Tongeren (2004) used a regional CGE model to estimate the impact of removing tariffs and import barriers imposed by the OECD countries on a specific village in Jianxi

[17] ORANI is an applied CGE model of Australian economy. The model has been used in Australia as a tool for policy analysis by academics and the economists in governmental and private sectors (Horridge, 2000).

province of China. The authors built a novel model to account for household production and consumption response of agricultural trade liberalization. The model was based on two steps: quantify the impact of the policy on the national Chinese economy by using Global Trade Analysis Project (GTAP)[18] model simulations, and simulate the outcome on prices and labour demand, which were then used as inputs in the village-specific CGE model. The results showed that the changes in agricultural input and output prices increased the aforementioned village supply of rice and livestock, as the cash constraint was lifted following the liberalization. The results further showed that the trade liberalization increased off-farm employment opportunities.

In their study, Domingues and Lemos (2004) divided Brazil into two regions: Sao Paolo, and the rest of the country. The authors examined the long-run regional impact of a proposed Free Trade Area of America in Brazil by applying intraregional CGE model. The outcomes of the study showed that the trade reforms had a positive impact on the Brazilian economy. They further concluded that the benefits were due mostly to the gains in a specific region of Brazil, i.e., Sao Paolo rather than all regions.

Jean and Laborde (2004) divided 25 countries in Europe into 119 distinct regions to assess the possible impact of trade policies at the regional level. The authors used a two-tiered approach -- the first tier involved assessing the trade shock on EU as a whole by using the Modeling International Relationships in Applied General Equilibrium (MIRAGE)[19] model. The results obtained from MIRAGE model were then used as input for the regional CGE model, where each of the 119 regions were considered separately. The goal of their study was to bridge the gap between national and local concerns about trade policy impact. They suggested that although their approach was costly in terms of time, data, and computational resources, assessing the impact of trade policy at regional levels is very useful as it gives a better idea of the nature of adjustments needed at the regional level.

Bautista and Thomas (2000) used an agricultural-focused regional CGE model to examine the income and equity effects of trade liberalization in Zimbabwe. Their model was a household

[18] This project was developed in the Centre for Global Trade Analysis at Purdue University, Department of Agricultural Economics. The project produced a global economic database covering many sectors and different parts of the world.

[19] MIRAGE is a multi-region multi-sector CGE model developed to assess the impact of trade policy in the EU.

focused model, where the households were divided into multiple groups: Urban (high and low income) and rural (large scale commercial owners, managers, large scale commercial farm labourer, and small holder). The authors concluded that the trade policy reform had a great role in promoting growth in Zimbabwe and improving income equity among the different household groups. Similar to this study, Cury *et al.* (2004) used a household-focused regional CGE model to simulate the impact of trade policy reforms on income distribution in Brazil. They divided Brazilian households into seven groups: Urban: poor family headed by an active individual, poor family headed by a non-active individual, and average income; Rural: poor and average income; and Others: high average income, high income. The results of the study showed that trade policy reform resulted in a modest welfare reduction for most groups.

Filho and Horridge (2005) used a highly disaggregated multi-regional single country CGE for Brazil, whereby the country was divided into 27 regions. The production side in the model was disaggregated according to the ORANI model, whereby the households were highly disaggregated into ten different labour types and 270 various household expenditure patterns. The simulation showed that trade reform was found to reduce inequality and poverty among farmers in Brazil due to the fact that poor farmers gained proportionally more compared to wealthy farmers. The outcomes further showed that although the trade policy shocks had a positive poverty and income distribution effects, they did not generate a drastic change.

Bosello *et al.* (2014) developed a regional CGE model for Italy, where they split the Italian economic system into ten sectors and three regions: North Centre, and South. The authors utilized GTAP standard database to build a sub-regional SAM for Italy that corresponds to the research regional disaggregation and accounts for sectoral interaction within sub regions in Italy and each of them with Europe and RoW. The functional structure of the standard GTAP model was modified to allow for different degree of factors and goods mobility within the country as goods and factors move easier within the country that between countries. The bilateral trade flow across regions within the country was estimated using two sources of information: transport data and economic production data. The authors tested their model by introducing a simple 20% unified productivity loss in all primary factors across Italian territory. The test confirmed that the change in the factor mobility across Italian regions increases the diverging patterns both at the sectoral and GDP level.

Similar to their Italy model, Bosello and Standardi (2018) built a multi-regional CGE model for Euro-Mediterranean region: Italy, France, Spain, Greece and Portugal. In this study, the

authors constructed a detailed database based on GTAP. The database characterizing 70-subnatioanl entities and 57 sectors. The data used in constructing the database and determining the bilateral trade flows across sub-regions was obtained from Eurostat and the National Statistical Offices. The purpose of this research was to use this detailed model and database to perform more informative economic assessment of climate change compared to that offered by standard CGE models. The authors concluded that highly disaggregated CGE models provides insightful detailed information that can support decision making. These two studies i.e. Bosello *et al.* (2014) and Bosello and Standardi (2018) based on the regionalized model developed by Standardi (2013) which has been applied in several other studies (e.g. Carrera *et al.*, 2015; Koks *et al.*, 2015; Standardi & Eboli, 2015; Pérez-Blanco *et al.*, 2016).

Few regional studies have been conducted to evaluate trade reform economic impact at provincial level in Canada. Among these Ciuriak *et al. (*2015) and Lysenko *et al.* (2015). In the first study the authors introduced a hybrid approach to estimate province-level impact starting from GTAP database. In their study, they split Canada into Ontario and RoC and utilized dynamic CGE model to analyses the Canada-Korea Free Trade Agreement (CKFTA) on the province of Ontario. In the later study the authors modified GTAP database and replaced Canada with its provinces separately to perform province-level analysis of international trade impact. In their study, they aggregated the world into 16 regions: Korea, US, EU, RoW and 12 Canadian regions to analysis the Canada-EU Free Trade Agreement (CETA) utilizing GTAP static model. These two studies showed that major trade agreements have different impacts on regions within a country based on region's comparative advantage and geographic location. This conclusion is important for federal countries like Canada where provinces/regions have different comparative advantages and their international trade relations.

The literature review shows that regional CGE models can provide richer insights than national models for local decision and policymakers, and that the applications of regional CGE are flexible and can be modified and used in innovative ways based on research need. Intensive need for data is the major challenge in building these models. Regional CGE models can be used for quite different types of applications, although they have been used more extensively in tax reform, agricultural, and transport policies.

2.8 CGE Based-Analysis of TPP

There were a limited number of CGE models that were built to examine the effect of the TPP on member countries and none to date on the CPTPP impact. This may be due to many factors: recent signing of the agreement, difficulties of using CGE models to analysis the NTBs impact, and the expectation that the TPP/CPTPP would have had a relatively small effect on most members' GDP or welfare (Burfisher *et al.*, 2014). A more in-depth investigation showed that to date there is no literature on the economic impact of either the CPTPP or the TPP on a specific region, state or province. Most of the CGE-based analysis of economic impact of the TPP had been based on the GTAP model (refer to Table 2.2). The features of GTAP, which describes the countries' supply, demand, and trade flow, as well as their bilateral tariff rates, makes it one of the preferred CGE models to analyze trade shocks. The available studies differ in their assumption about the time frame (dynamic vs. static), the degree of liberalization, and the baseline scenarios.

Table 2.2: Selected CGE-based analysis studies of TPP

Study	CGE type	Focus	Scenario	Study outcomes
Burfisher *et al.* (2014)	National study, using static GTAP V8	Agriculture	Tariff elimination	Positive change in the real GDP of the TPP countries vary from 0% to 0.1%.
Todsadee *et al.*, (2012)	National study, using static GTAP V7	Agriculture	Tariff elimination	Positive change for most of the TPP countries, but some countries would face a reduction in their real GDP.
Kawasaki (2016)	National study, using static GTAP	Not specified	Tariff and NTBs elimination	Positive change in real GDP of all TPP countries.
Petri and Plummer (2016)	National study, using static GTAPV8	Not specified	Tariff and NTBs elimination	Positive change in the real GDP of the TPP countries range from 0.38% to 13.57%.
Petri *et al.* (2012)	National study, using static GTAP V7	Not specified	Tariff elimination	Positive change in real GDP of all TPP countries.
Cheong (2013)	National study, using dynamic GTAP V8	Not specified	Tariff elimination	Limited but positive change in the real GDP of most of the TPP countries.
Lee and Itakura (2014)	National study, using dynamic GTAP V7	Agriculture	Tariff and NTBs elimination	Positive welfare gains for all TPP countries.

Burfisher *et al.* (2014) utilized a static GTAP model[20] using Version 8 (GTAP V.8) database to analysis to impact of TPP on the US and other TPP members. The model used in this study was focused on food and agriculture, which compromised 25 of a total of 29 sectors. In their study, they ran two simulations to quantify the economic effect of TPP on agriculture. In the baseline scenario, the authors simulated the trade and production trends between the TPP members between 2014 and 2025 without the TPP. The goal of this simulation was to simulate the natural growth of trade and production among the members of the agreement based on the natural growth of population, consumptions, and preferences. Under the baseline scenario, the value of intraregional agricultural trade was projected to increase by 9.2% between 2014 and 2025. They further discovered that the middle-income TPP economies[21] would be the fastest growing markets for of the TPP's agricultural products, while Chile, New Zealand, Vietnam, and Singapore would be the fastest growing agricultural exporters to other TPP member countries. They also found that agricultural output levels in all TPP countries, except Japan and Singapore, would increase between 2014 and 2025 under the TPP scenario, relative to the baseline scenario results.

Under the hypothetical scenario, Burfisher *et al*. (2014) eliminated all the intra-TPP countries' agricultural and non-agricultural tariffs and Tariff Rate Quotas (TRQs), and compared the results with the baseline scenario. The results showed that the TPP would have a minimal impact on the members real GDP with 0% or a small positive effect, except for Vietnam, Japan, New Zealand, and Mexico, whose real GDP in 2015 was projected to be 0.1%, 0.02%, 0.01%, and 0.01% higher, respectively. While the impact on real GDP was minimal, the study showed that the TPP would have had important implications for agricultural trade among the agreement members, as it included a projected net increase of 6% in agricultural trade compared to the baseline scenario. These included US and Japan, which would have been the major players under this trade expansion, with US supplying one-third of the expansion in intraregional agricultural exports, and Japan accounting for about 70% of the expansion in intraregional agricultural imports. The authors further analyzed the impact of the TPP in terms of the agricultural trade between TPP members and the RoW. They found that the expansion of the agricultural trade among the TPP countries

[20] Chapter 4 provides a full description of GTAP model and its database.

[21] According to the World Bank (2016c) four of the CPTPP countries (Mexico, Malaysia, Peru, Vietnam) are classified as middle-income economies, while the rest of the CPTPP countries are classified as high-income economies.

was expected to increase the diversion of the agreement members' agricultural imports and exports from and to the RoW toward the TPP countries.

The study conducted by Todsadee *et al.* (2012) was one of the first to simulate the potential implications of trade liberalization on TPP countries' livestock production sector. The authors employed the GTAP CGE model using the GTAP V.7 database to address their research question of the how the TPP would have impacted the livestock sectors among the agreement member countries. The simulations of this agriculturally-focused model showed that TPP could have resulted in both winners and losers among the member countries. The results indicated that eight TPP countries (Japan, Canada, Vietnam, New Zealand, Malaysia, Australia, Singapore, and Peru) would have experienced an increase in their real GDP by less than 1%, while US and Chile would experience a reduction in their real GDP due to the changes associated with the TPP agreement. The results further showed that the rate of export growth would have been positive among most TPP countries, and the imports in all TPP countries would have increased more than exports. Under this simulation, the livestock sector output would have increased in most of the TPP countries except for Peru, Vietnam, Japan, and Malaysia, which would experience a decline in both livestock and meat production.

Kawasaki (2014) traced out the potential macroeconomic implications of the TPP on the agreement members and non-members by using the GTAP CGE model and comparing the results with the baseline scenario, which includes pre-trade existing agreements among member countries (Table 3.1). The author found that the TPP had the potential to increase the GDP of member countries by 0.4% - 10%, and to expand their trade by 11% by 2013. Furthermore, it would have limited positive spillover benefits for non-member countries.

Petri and Plummer (2016) updated the results reported in Petri *et al.* (2012) on the economic effects of the TPP using the GTAP V8 database. Unlike other studies, this study simulates a partial cut in tariffs and NTBs. This US-focused study showed that US would have been one of the largest beneficiaries from the TPP. The simulation suggested that by 2030, the TPP would have increased real GDP in US and Canada by 0.5% and 1.3%, respectively, and would have increased annual exports by 9.1% and 7%, respectively. The estimates in their study were higher than those reported

in Petri *et al.* (2012) due to the fact that the NTBs were higher, and the effect on non-preferential provision of the TPP were taken into account.

Unlike the aforementioned studies, Cheong (2013), as well as Lee and Itakura (2014) used a dynamic GTAP CGE solved between 2013 and 2027, and between 2014 and 2030, respectively, using V.8 and V.7 databases of GTAP to trace the TPP's potential economic impacts. Cheong (2013) found that TPP would have had a limited impact on the real GDP of the members of the agreement; however, this impact would be positive on most members. Lee and Itakura (2014) basically used GTAP CGE model to estimate the impact of different FTAs using a Japan-focused model. Under the TPP scenario, they found that the TPP reform would have resulted in a 1% productivity increase in the agricultural sector and that Japan's overall welfare gains could have been increased by 0.4%.

From the limited number of the available studies of CGE-based analysis of the TPP, it appears that the agreement would have a positive economic impact on the member countries in terms of real GDP, welfare, trade, and production. However, there is a general agreement among all of these studies that the economic impact would be limited because the twelve current TPP members already have multiple RTAs (Table 3.1).

2.9 Concluding Remarks

The aforementioned information indicates that the national and regional CGE models are similar in structure, with some minor differences related to the trade flow and some other intraregional aspects. It also explains that the applications of regional CGE are quite variable and flexible, with a new type of application to be developed based on future study needs. Although, the regional CGE models are complex and data-demanding, they are becoming widely used since they provide unique insights in comparison to other types of regional models. In spite of the fact that use of regional CGE models to simulate the trade reforms impact has become very common in the applied economic literature, there is no standard structure for these models. This has resulted in some novelty in using them, as researchers can modify these models to fit their study's objectives.

To date, CGE-based analysis literature of the TPP is limited. At the time of writing there was no study examined the economic impact of CPTPP on member countries, or the impact of

either agreement on a specific sub-region within a country except those conducted by governments (e.g. Government of Canada, 2018b). The flexibility of CGE model makes it possible to split a country into sub-regions, and subsequently analyze the economic changes at provincial, state, or sub-region levels.

Chapter 3
Description of Comprehensive and Progressive Agreement for Trans-Pacific Partnership

3.1 Background

The provisions of CPTPP are varied and wide-ranging, covering trade and trade-related issues such as customs, trade facilitation, technical barriers, trade remedies, and investments. The CPTPP incorporates the provisions of the previous TPP, except for the 22 provisions that are related to trade and investment with US and a number of provisions pertaining mainly to intellectual property and investor-state dispute settlement (Government of New Zealand, 2018b).The provisions of CPTPP can be divided into two categories: Market Access, which includes tariff, nontariff barriers, and trade in goods, services and agriculture; and Rule, which covers the procedures, standards, and regulations of international trade such as intellectual property rights. This study is focused on the trade component -market access- of CPTPP. However, when analyzing trade, other provisions are also of importance since these are helpful in understanding the full context of the agreement, and distinguishing between trade and non-trade provisions, which are not always clear and often overlap with other provisions.

In this chapter, the tariff elimination and commitment schedule among the CPTPP member countries are highlighted, and for the purposes of comparison and analysis, the US commitments under the former TPP are also discussed. Understanding the trade provision is important, given the large number of FTAs between CPTPP parties (see Table 3.1)[22]. In addition, this description is useful in order to understand the nature of the CPTPP and its likely impact on trade. Basically, the focus of the following sections is on the current trade barriers among CPTPP member countries, the main features of the CPTPP as a trade agreement, the trade provisions of the CPTPP, and tariff elimination and reduction schedules based on product categories and sectors on both sides (i.e., Canada and other CPTPP member countries).

[22] Table 3.1 lists the current regional and bilateral FTAs among CPTPP member countries and the US as part of the former TPP. Some of these agreements have been fully implemented (e.g., NAFTA between the U.S., Canada, and Mexico), while others have been signed and have entered into force, but are not fully implemented to date (e.g., Canada-Peru Agreement). As shown in this table, the trade between CPTPP member countries is liberalized to a high extent due to the large number of FTAs in place. For instance, Canada already has trade agreements with several CPTPP countries (Mexico, Chile, and Peru).

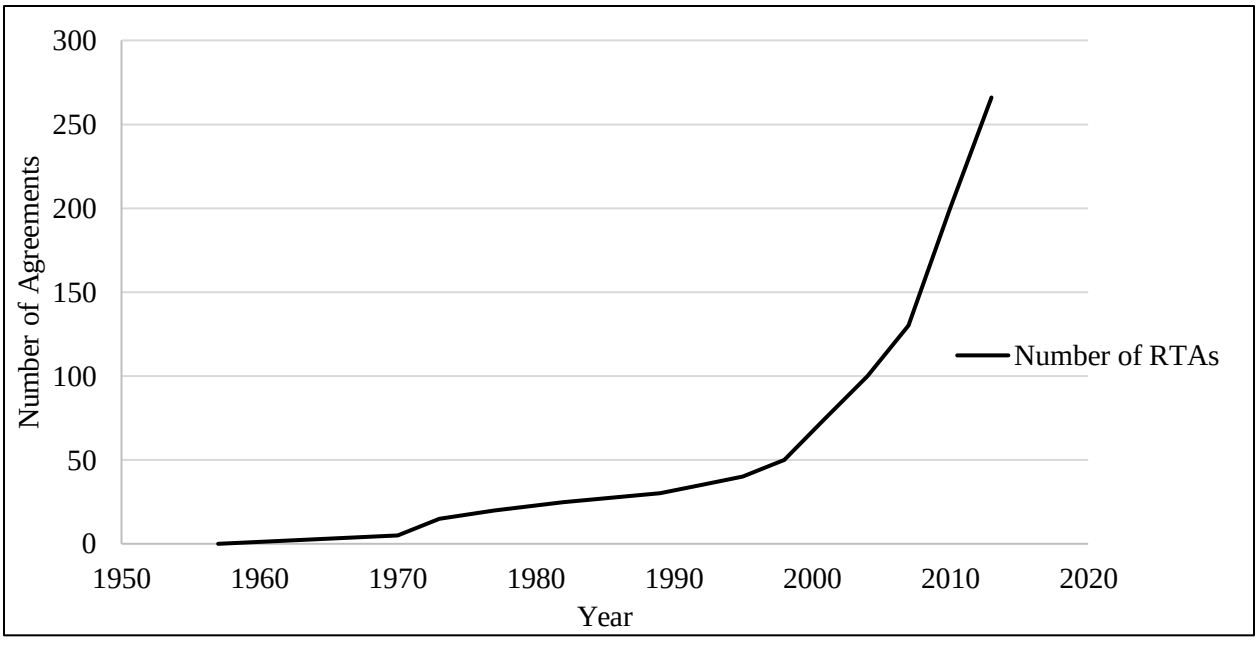
Table 3.1: Existing trade agreements among CPTPP member countries and the US

Agreement	TPP Members	Agreement type
ASEAN	Brunei Darussalam, Malaysia, Singapore, Vietnam	Regional
ASEAN-AUSTRALIA-NZ	Australia, Brunei Darussalam, Malaysia, New Zealand, Singapore, Vietnam	Regional
ASEAN-JAPAN	Brunei Darussalam, Japan, Malaysia, Singapore, Vietnam	Regional
P-4	Brunei Darussalam, Chile, New Zealand, Singapore	Regional
NAFTA/USMCA	US, Canada, Mexico	Regional
Canada-Chile	Canada, Chile	Bilateral
Canada-Peru	Canada, Peru	Bilateral
US-Australia	US, Australia	Bilateral
US-Chile	US, Chile	Bilateral
US-Peru	US, Peru	Bilateral
US-Singapore	US, Singapore	Bilateral
Australia-Chile	Australia, Chile	Bilateral
Australia-New Zealand	Australia, New Zealand	Bilateral
New Zealand-Malaysia	New Zealand, Malaysia	Bilateral
New Zealand-Singapore	New Zealand, Singapore	Bilateral
Chile-Japan	Chile, Japan	Bilateral
Chile-Malaysia	Chile, Malaysia	Bilateral
Chile-Mexico	Chile, Mexico	Bilateral
Chile-Vietnam	Chile, Vietnam	Bilateral
Japan-Australia	Japan, Australia	Bilateral
Japan-Mexico	Japan, Mexico	Bilateral
Japan-Peru	Japan, Peru	Bilateral
Japan-Singapore	Japan, Singapore	Bilateral
Japan, Vietnam	Japan, Vietnam	Bilateral
Japan-Malaysia	Japan, Malaysia	Bilateral
Singapore-Australia	Singapore, Australia	Bilateral
Brunei Darussalam-Japan	Brunei Darussalam, Japan	Bilateral
Peru-Chile	Peru, Chile	Bilateral
Peru-Mexico	Peru, Mexico	Bilateral
Peru-Singapore	Peru, Singapore	Bilateral
Malaysia-Australia	Malaysia, Australia	Bilateral

Source: World Trade Organization (2016).

3.2 The New Generation of FTAs

The number of bilateral FTAs, Regional Trade Agreements (RTAs), and Mega-Regional Trade Agreements (MRTAs)[23] has increased dramatically after 2000 (see Figure 3.1). The total number of RTAs reached 274 by 2015. To date, the EU single market and NAFTA are the largest agreements in terms of GDP and trade volume. The growing number of FTAs reflects the increasing trade openness worldwide, which has been significantly correlated the GDP per capita (World Bank, 2016b). There is a continued debate on the benefits of FTAs, RTAs, and MRTAs. On one hand, FTAs have opened markets between trade partners leading to productivity growth, and many other gains in terms of more technology spillover, efficient division of labour, and in some cases, fostering the domestic reforms in developing countries (Hoekman & Javorick, 2006; Baccini & Urpelainen, 2014). On the other hand, some researchers argue that FTAs, in general, have drawbacks. These include diverting trade away from more efficient non-members, which is known as trade diversion effect. In the same context, FTAs can cause erosion in the preferences given to least developed countries in terms of trade, since trade would be concentrated within specific trade blocs (Baldwin & Wyplosz, 2006).



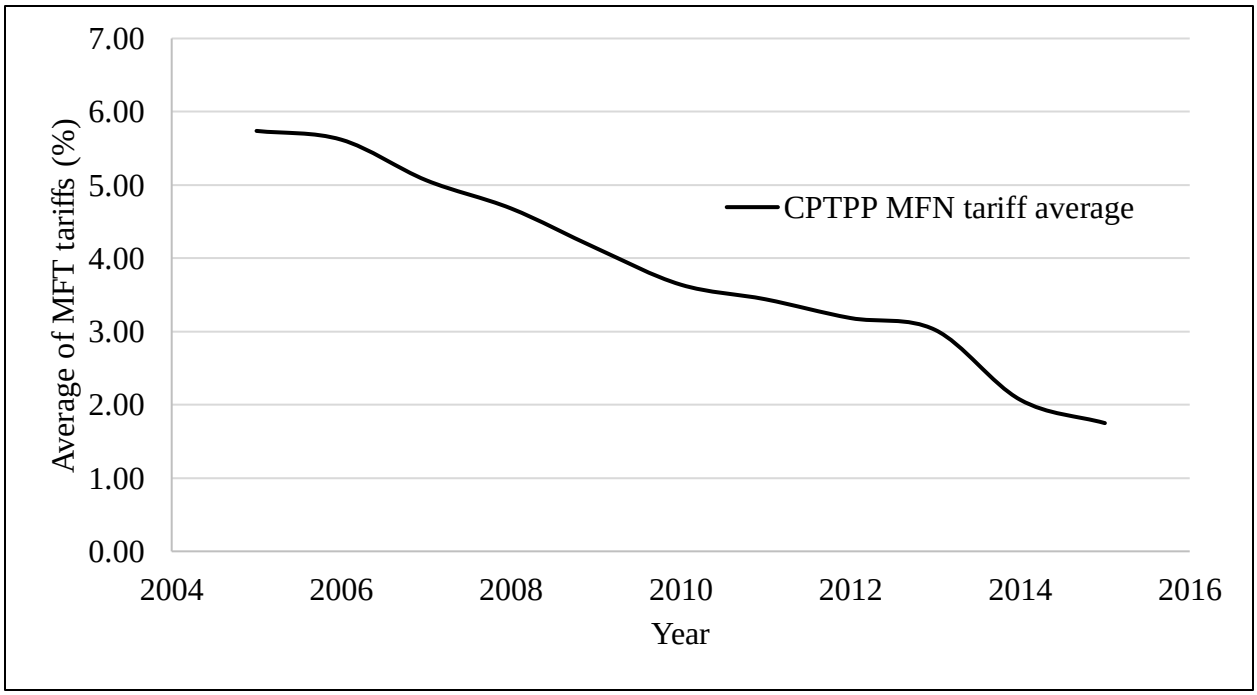
Source: World Trade Organization (2016).

Figure 3.1: Number of the World Regional Trade Agreements

[23] This concept is used to describe a deep integration partnership beyond simply increasing trade links between countries, with a major share of world trade and foreign direct investment; in other words, NRTs are RTAs that have a global impact beyond their area of application. The EU single market, NAFTA, and most recently the CPTPP, are well known examples of MRTs (World Economic Forum, 2014).

3.2.1 Main Features of CPTPP

Similar to other new generation FTAs, the CPTPP focuses more on reducing NTBs, than than on tariffs, relative to the earlier generation of similar agreements. The tariffs imposed by the CPTPP member countries and the US have continued to decrease over the years. Figure 3.2 illustrates the decrease in the average Most Favored Nation (MFN) tariffs[24] of the CPTPP countries over the years. In Figure 3.3, the average MFN tariffs in the CPTPP countries and the US in 2014 are outlined. Lowering tariffs is a major part of the CPTPP's provisions; however, both tariffs and NTBs[25] are already low between many CPTPP countries as a result of other trade agreements, such as ASEAN and P4 (Oliver, 2015). The CPTPP is not all about eliminating or lowering tariffs and NTBs; the comprehensive approach of this agreements includes provisions about investment among member countries, in addition to making provisions to many social and environmental issues.

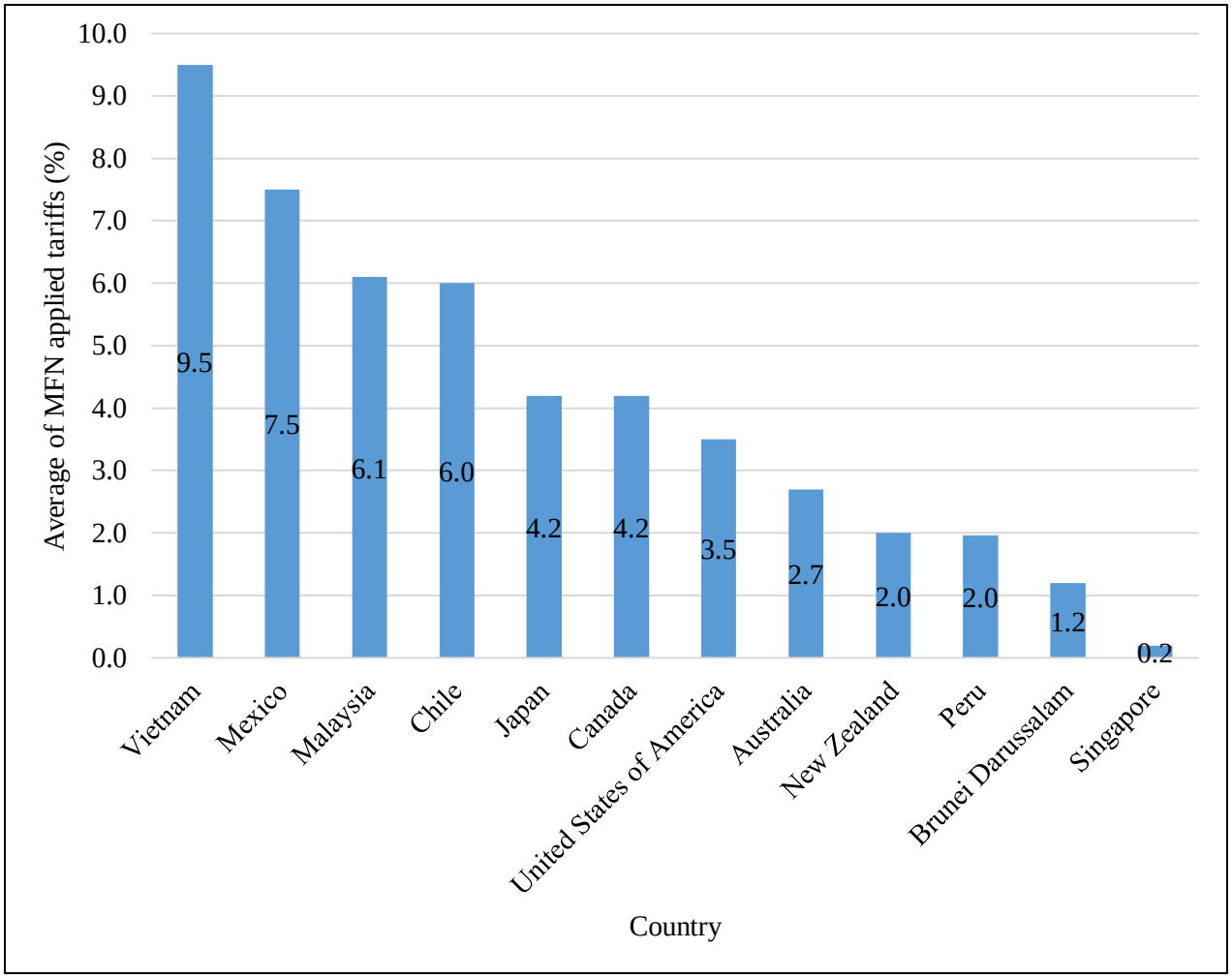


Source: International Trade Centre (2016).

Figure 3.2: CPTPP member countries Average MFN tariffs over years

[24] Tariffs applied by WTO to goods imported from other WTO countries (International Trade Centre, 2016).

[25] The NTBs cover a long list of barriers that can be obstacles to trade, such as import licensing requirements, discriminatory standards, and rules of origin. Those NTBs are recognized as the major challenge to trade policy (UNCTAD, 2010).



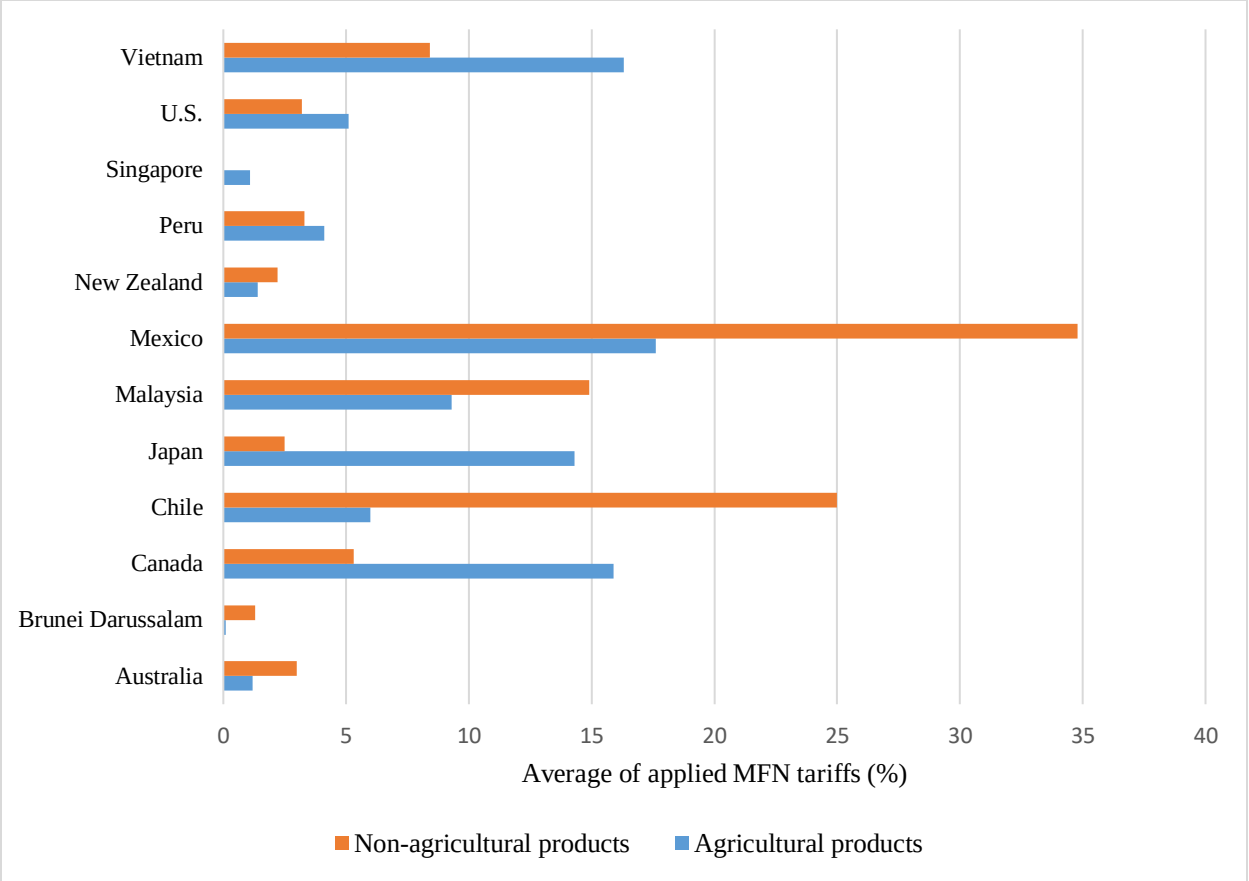
Source: World Trade Organization (2016).

Figure 3.3: Simple average of applied Most Favoured Nation tariffs in CPTPP countries and the US, 2014

3.2.2 Current Trade Barriers and the Proposed Reduction Under CPTPP

The trade barriers imposed by Canada on its imports, and barriers imposed by CPTPP countries on Canadian exports[26], are varied depending on the product, sector, and trade partner. On average, Canada imposes higher tariffs on agricultural products, and lower tariffs on non-agricultural products, compared to other CPTPP countries. Figure 3.4 displays the average tariff level on agricultural and non-agricultural products among the CPTPP member countries and the US.

[26] These barriers are not applicable on many Canadian exports or imports to or from some CPTPP countries and the US, as Canada and many other CPTPP countries already have FTAs in place, such as NAFTA/USMCA and other agreements.

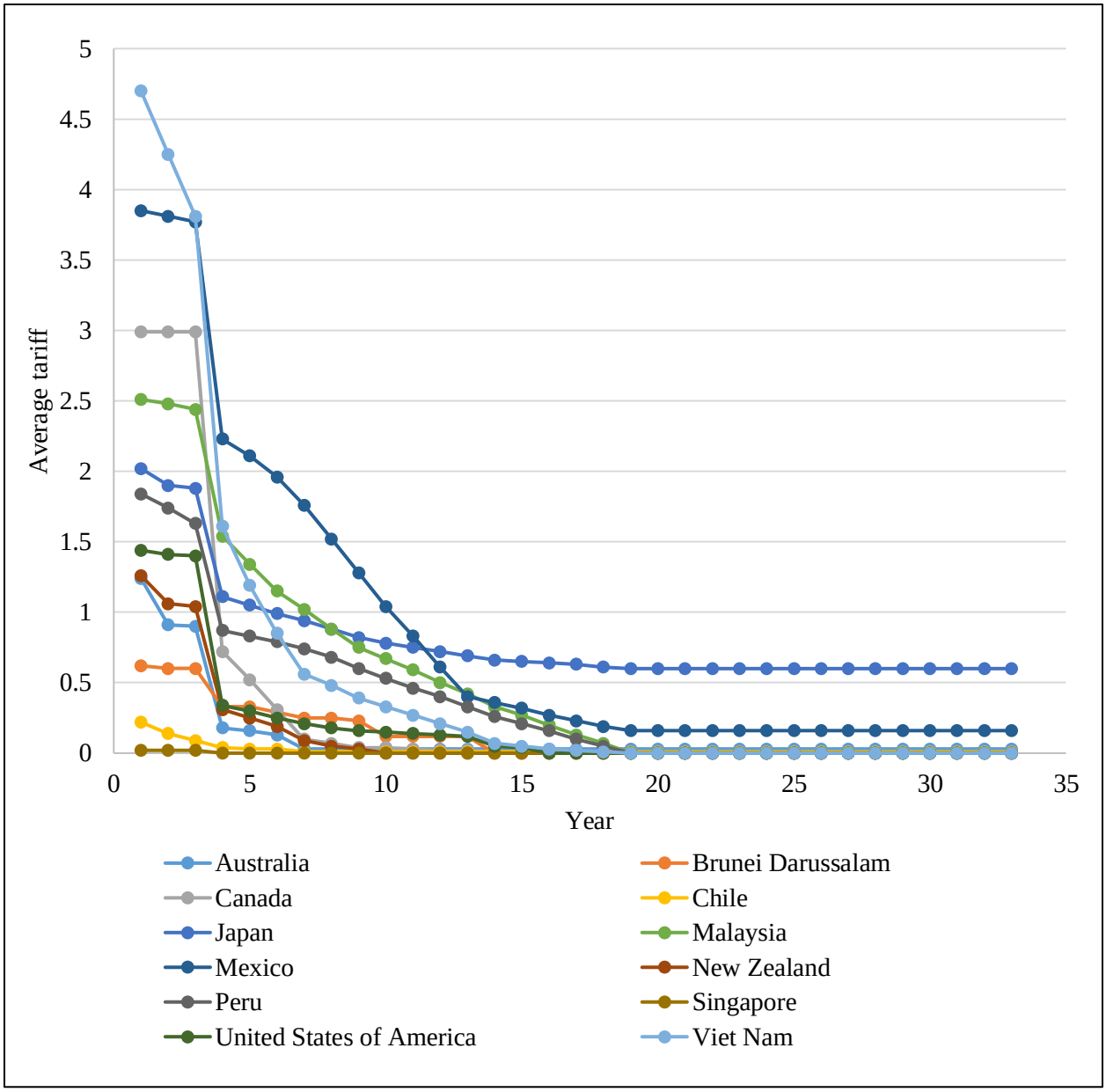


Source: World Trade Organization (2016).

Figure 3.4: Average tariff level on agricultural and non-agricultural products among the CPTPP countries and the US

The proposed reduction of tariffs among CPTPP countries is projected to happen over a maximum period of 21-years; however, the tariff elimination timeframe differs from one country to another (see Figure 3.5 and Section 3.3). The CPTPP would grant immediate elimination of tariffs on most of tariff lines[27]. The percentage of tariff lines, which would be guaranteed immediate duty-free entry, varies from one CPTPP country to another, but on average, roughly 90% of the total number of tariff lines would be duty-free immediately upon enactment of the CPTPP.

[27] The product code beyond the six digits of the Harmonized System (HS) is used at the national level. It was introduced in 1988 and revised in 1996, 2002, 2007, 2012, and 2016. The HS is organized into 21 sections, 96 chapters, and more than 5,000 headings and subheadings. It is used to classify traded goods on a common basis for customs purposes. The first two digits (HS-2) of any HS code refer to the chapter in which the goods are classified; the second two digits (HS-4) identify the group of the good within that chapter, and the last two digits (HS-6) are used as a subheading for more specifications (United Nations International Trade Statistics, 2016). For example, 1006.40 HS is broken rice where 10 refers to the cereals, 06 refers to the rice, and 40 indicates that the rice is broken.



Source: International Trade Centre (2016)

Figure 3.5: Average tariff reduction over time among the CPTPP countries and US commitment under the former TPP

Figure 3.5 shows the tariffs reduction among the CPTPP countries under the proposed CPTPP agreement and the US commitment under the former TPP over time. It is important to note that the CPTPP countries would not uniformly grant duty free-entry to all CPTPP countries. Canada, Mexico, Japan and Chile have tariff reduction or elimination schedules that treat countries differently, while Australia, Brunei Darussalam, Malaysia, New Zealand, Peru, Singapore, and Vietnam have uniformed tariff reduction schedules (Gryga, 2015).

3.3 Tariff Concessions in CPTPP Agreement

The CPTPP includes a progressive liberalization of trade over a transitional period up to 21-years[28] for some members. It incorporates a precise schedule of tariff elimination or reduction, either when the agreement enters into force or within a 21-year period. In Canada, the elimination or reduction of tariffs on many products would happen gradually over a 12-year period. The liberalization schedules show that a large percentage of products would be liberalized once the agreement comes into force or quite rapidly, while tariff rates for a smaller percentage of products would decrease gradually over a 20-year period. However, even small drops in tariff rates can be significant if there is a high volume of trade.

The elimination schedules are complex in the CPTPP, as every member country would have its own format. Different complex codes and notations would be applied in the tariff elimination schedules[29] to reflect how each tariff line would be treated. For many CPTPP countries, the level of tariff reduction is impressive. For instance, Singapore would remove all tariffs once the agreement comes into force[30], whereas Mexico and Vietnam would drop the tariff on some categories currently set at 20% or higher to 0% when the agreement becomes effective. On the other side, there will be more tariffs on relatively more protectionist countries such as Canada and Japan, who have embedded complications within their schedules. For instance, both countries use tariff rate quotas to protect their domestic products. For example, a country could set a certain quantity of a product that could be sold at a lower tariff, and any quantity above that quantity would be charged a higher duty. Although these complications are used to protect domestic products, these countries would still need to lower their rates gradually over a longer period of time until the full trade liberalization is reached. Table 3.2 shows the proposed period of tariff elimination among the CPTPP's members countries under CPTPP and highlights the US committed under the former TPP agreement.

[28] The time period of tariff eliminations or reductions varies from one country to another. Japan will remove tariffs gradually over a 21-year period, while Singapore will remove all custom duties on the date that the agreement comes into force.

[29] Every CPTPP member country has its own tariff elimination notation notes. For Canadian codes and notation, see Table 3.3 in this chapter.

[30] Another confusing part of the CPTPP is that there is no specific date when the agreement will come into effect. CPTPP member countries must first finish the domestic ratification of the agreement. Article 30.5 in Chapter 30 in the agreement discusses the entry into force rules.

Table 3.2: Tariff elimination schedules of the CPTPP countries

Country	Tariff elimination schedule (years)
Australia	4
Brunei-Darussalam	11
Canada	12
Chile	8
Japan	21
Malaysia	16
Mexico	16
New Zealand	7
Peru	16
Singapore	On the date of entry into force
Vietnam	21
US*	30

Source: Government of New Zealand (2018b).
* As the US committed under TPP before its withdrawal in 2017.

3.3.1 Tariff Concessions on the Canadian Side

On the Canadian side, the trade liberalization would be scheduled over a 12-year period. Although there are currently some non-dutiable tariff lines in Canada, the Canadian CPTPP schedule would ensure that the majority of the dutiable tariff lines except some agricultural ones would be fully liberalized either immediately, or progressively over a 12-year period. Tariff eliminations on trade between Canada and the rest of CPTPP's countries would possibly ensure a broader access of the Canadian products into the CPTPP's countries markets. The tariff elimination schedule of Canada is 257 pages, and is coded according to the HS2012 code system[31]. Similar to other CPTPP countries, Canada has its own notation on how different tariff lines would be treated (see Table 3.3). This notation code of staging categories would be used to reflect how long it would take to liberalize each tariff line. For instance, goods under staging category EIF would be duty-free on the date when the agreement would become effective for Canada, while custom duty rates on products under staging category CA3 would be reduced to 5.5% on the date that the agreement would come into force in Year 1, 5% on January 1 of Year 2, 2.5% on January 1 of Year 3, 2% on January 1 of Year 4, and be duty-free effective January 1 of Year 5. Each CPTPP individual

[31] For more details about HS2012, refer to Japan International Cooperation Agency (2012).

member has different notation codes. In fact, in are a total of 224 different notation codes in the tariff elimination schedules of various CPTPP's countries. This adds further complexity for readers and researchers, in addition to the lengthy agreement and the unspecified dates of when the agreement would come into force., Table 3.4 lists the categories of goods in terms of tariff eliminations.

Table 3.3: Canada tariff elimination code

Staging	Description
EIF	Entry into force. Customs duties on goods in this staging category shall be eliminated entirely, and be duty-free on the date of entry into force for Canada.
B4	Customs duties on goods in this staging category shall be eliminated in four annual stages, and be duty-free effective January 1 of year 4.
B6	Customs duties on goods in this staging category shall be eliminated in six annual stages, and be duty-free effective January 1 of Year 6.
B7	Customs duties on goods in this staging category shall be eliminated in seven annual stages, and be duty-free effective January 1 of Year 7.
B11	Customs duties on goods in this staging category shall be eliminated in 11 annual stages, and be duty-free effective January 1 of Year 11.
CA1	Customs duties on goods in this staging category shall be maintained at the base rate during Year 1 through Year 8, and shall be eliminated in four annual stages beginning in Year 9, and be duty-free effective January 1 of Year 12.
CA2	Customs duties on goods in this staging category shall be reduced to one-quarter of the base rate of the date of entry into force in Year 1, and shall be maintained at that rate through Year 11, and be duty-free effective January 1 of Year 12.
CA3	Customs duties on goods in this staging category shall be reduced to rate of duty of 5.5% on the date of entry into force in Year 1, 5% on January 1 of Year 2, 2.5% on January1 of Year 3, 2% on January 1 of Year 4, and be duty-free effective January 1 of Year 5.
TRQs	Tariff Rate Quotas of Canada. Customs duties on goods in this staging category shall be governed by the terms of the TRQ as outlined in Appendix A of Canada's schedule in Annex 2-D.

Source: Government of New Zealand (2018b).

The next sub-sections briefly discuss how different goods categories are treated according the Canadian tariff elimination schedule. The products would be categorized into general groups, and Saskatchewan's major exports and imports to and from the TPP countries would be specifically addressed.

.

Table 3.4: Canada's tariff concession schedule

Product category	Tariff lines	Tariff concession
Agricultural products	0101.21.00 – 2403.99.90	The elimination of tariffs will be achieved over a transitional period, more than 80% of the agricultural tariff lines which were dutiable will be fully liberalized on the date of entry into force, and the remaining will be liberalized over a maximum 11-year period or governed by the TRQ term (see Table 3.3).
Industrial, mineral, plastic, and chemical, and metal products	2501.00.10 - 4911.99.00 and 6801.00.00 - 8311.90.00	The removal of the customs duties on the majority of these tariff lines will be immediate on the date of entry into force of the agreement, except for a few tariff lines, which will be liberalized in a maximum 6-year period.
Textile products	5001.00.00 - 6704.90.00	The tariffs will be removed completely on more than 96% of these tariff lines on the date of entry into force with the remaining to be removed in a maximum 6-year period.
Machinery, electrical equipment, and other miscellaneous manufactured products	8401.10.00 - 9619.00.99	The vast majority of customs duties on these tariff lines will be removed immediately on the date on entry into force, while the tariffs on vehicles and vehicle parts will be removed over an 11-year period; the remaining will be removed in 6- or 11-year time period or governed by the term CA3 (see Table 3-2)

Source: Government of New Zealand (2018b).

3.3.1.1 Agricultural Products

For agricultural products[32] including processed foods, animal, and vegetable products, the Canadian schedule of tariff reduction or elimination is not straight forward. Although the general rule is that the elimination of tariffs would be achieved over a transitional period, more than 80% of the dutiable agricultural tariff lines would be fully liberalized on the date when the agreement comes into force.

The majority of live animals, fish and aquatic products, and products of animal origin (except the dairy products, as classified in Chapters 1, 2, 3, and 5 in HS2012), are already non-dutiable in Canada; however, the majority of the small percentage of the dutiable tariff lines in this category would be duty-free when the agreement comes into force, or progressively over an 11-year period. Approximately 52% of dairy[33], eggs, and natural honey products would be duty-free upon entry into force, 47% of the aforementioned products would be governed by the term TRQ; the remainder would be liberalized progressively over a maximum 6-year period.

All vegetables, fruits, nuts, coffee, spices, and cereals would be duty-free on the date that the agreement comes into force; these include wheat, barley, and oats. These products are important for Saskatchewan, as it claims over 46% and 38% of the total Canadian wheat and barley production, respectively. About 72% of milling industry products' tariff lines would be duty-free on the date when the agreement comes into force, and 28% would be liberalized over an 11-year period. All seeds oil, industrial or medicinal plants, vegetable saps, and planting materials tariff lines would be duty-free of the date that the agreement comes into force, although the vast majority of these products are already non-dutiable. Canada-imposed tariffs vary between 2.5% and 11% on most vegetable and animal oils, including canola, soybean, and sunflower oils. However, once the agreement comes into force, Canada would remove all tariffs on more than 90% of these tariff lines, with the remaining to be removed over 11 years. The rest of agricultural products, including

[32] Under the World Trade Organization's agreement on Agriculture, which was signed by Canada in December 1993, imports are subjects to low "within access commitment" tariff rates until the import access quantity has been reached; any imports over the limit are subject to higher "over access commitment" rates of duty (Government of Canada, 2013).

[33] Canadian dairy farmers have largely criticized both the CPTPP and TPP agreements and announced their stand against any additional liberalization in the Canadian dairy sector, as this industry could face a "big hit" due to the potential competition from foreign products (Dairy Farmers of Canada, 2018).

prepared foodstuffs, beverages, spirits and vinegar, and tobacco, would be treated differently. Where the majority of these products would be duty-free on the date that the agreement comes into force, some would be liberalized over a maximum 11-year period, with few to be governed by TRQs. Table 3.5 summarizes Canadian agricultural products tariffs concessions in the CPTPP.

Table 3.5: Canada tariff concessions schedule for agricultural products

Agricultural product	Tariff lines	Tariff concession
Live animals, animal products, fish and aquatic products, and products of animal origin, except dairy products.	0101.21.00 – 0308.90.90 and 0501.00.00 - 0511.99.90	The vast majority of these tariff lines are non-dutiable; the majority of the small percentage of the dutiable tariff lines in this category will be duty-free upon entry into force, or progressively over 11 years.
Dairy, eggs, and natural honey products	0401.10.10 - 0410.00.00	52% of these tariff lines will be duty-free upon entry into force, 47% will be governed by the term TRQ, and the remainder will be liberalized progressively over a maximum 6-year period.
Vegetables, fruits, nuts, coffee, spices, and cereals	0601.10.11 - 1008.90.00	All of these tariff lines will be duty-free upon the date of entry into force.
Milling industry products	1101.00.10 - 1109.00.20	Approximately 72% of these tariff lines will be duty-free on the date of entry into force, and 28% will be liberalized over 11-years.
Seeds oil, industrial or medicinal plants, vegetable saps, and planting materials	1201.10.00 - 2403.99.90	Tariffs on more than 90% of these tariff lines will be removed on the date of entry into force, with the remaining to be removed over an 11-year period.

Source: Government of New Zealand (2018b).

3.3.1.2 Industrial, Mineral, Plastic, Chemical, and Metal Products

The customs duties on imports into Canada of the majority of industrial, mineral, chemical, plastic, rubber, leather, wood, article of stones, glass and glassware, and metal products originating in other CPTPP countries would be removed immediately and would be duty-free on the date when the agreement comes into force, except for a few rubber products, which would be liberalized over a maximum 6-year period. All mineral products would be duty-free when the agreement comes into force, including major mineral products in Saskatchewan. The majority of imported mineral and wood products into Canada are non-dutiable; consequently, the CPTPP agreement is not

expected to have a significant impact on their imports into Canada. On the other hand, more than 60% of chemical plastic, leather, stone, and metal products are dutiable, and therefore, the CPTPP agreement is expected to impact these industries.

3.3.1.3 Textile Products

Canada imposes tariffs vary between 6.5 and 18% on more than 70% of textile products. These tariffs would be removed completely on more than 96% of these products on the date when the agreement comes into force, with the remaining to be removed over a maximum 6-year period.

3.3.1.4 Machinery, Electrical Equipment, and other Miscellaneous Manufactured products

Machinery and electrical equipment have special treatment in the tariffs elimination schedule of Canada. Currently, more than 35% of this equipment is dutiable; the vast majority of customs duties on these products would be removed immediately on the date when the CPTPP agreement comes into force, while tariffs on vehicles and vehicle parts[34] would be removed over an 11-year period. The tariffs on the remaining tariff lines within this category would be removed in a 6 or 11-year period, as governed by the term CA3 (see Table 3.3). Medical or surgical instruments, optical photographic, and all other instrumental or miscellaneous manufactured products would be duty-free on the date that the agreement comes into force.

3.3.1.5 Tariff Rate Quotas

In total, 98 tariff lines are expected to be liberalized within a tariff quota and governed under the TRQs term. Agricultural and food products, such as certain animals, poultry, meat and frozen meat, dairy, butter, oils, and honey products, are well-represented among these. These tariff lines categorized under TRQs staging category in the tariff schedule of Canada would be administered through an import licensing system. Most of these quotas are expected to be increased progressively each quota year, until years 11, 14, or 19, with the quantity remaining at the level of the last quota year. Under CPTPP, Canada and other member countries TRQs commitments are not counted toward the in-quota quantity of any TRQs provided under any other trade agreement.

[34] CPTPP text includes a special appendix on motor vehicles trade between Japan and Canada, and is attached to the agreement (Government of New Zealand 2018b).

The level of imports under quotas varies across products. For instance, 56,905 Metric Ton (MT) of milk, 11,014 MT of skim milk powder, 2,587 MT of concentrated milk, 7,762 MT of yogurt and buttermilk, 5,121 MT of butter, 26,745 MT of chicken, 3,983 MT of turkey, and approximately 19 million dozen eggs could be imported duty-free on Year 19 after the agreement comes into effect. The quota ceilings are increased gradually every year, except for the second year after the agreement comes into force, when most of the product annual aggregate quotas would be doubled. while Table 3.6 below provides a snapshot of the products that should be governed under TRQs in Canada.

Table 3.6: Canada TRQs allocated to CPTPP member countries under CPTPP commitments

Product	**Current quantity (MT)**	**Quantity upon full implementation quantity (MT)**
Milk	8,333	56,905
Cream	500	734
Skim milk Powders	1,250	11,014
Milk powders	1000	1,138
Cream powders	100	114
Concentrated milk	333	2,587
Yogurt and buttermilk	1,000	7,762
Powdered buttermilk	750	970
Whey powder	1,000	Unlimited
Products consisting of natural milk constituents	667	4,552
Butter	750	5,121
Industrial cheese	1,329	9,076
Mozzarella and prepared cheese	483	3,300
Cheeses of all types	604	4,126
Ice Cream and Mixes	1,000	1,138
Other dairy	1,000	1,138
Broiler hatching eggs and Chicks	166,667	1,138,093
Chicken	3,917	26,745
Turkey	583	3,983
Eggs	2,783,333	19,006,158

Source: Government of New Zealand (2018b).

3.3.2 Tariff Concessions on the other CPTPP Member Countries Side

On the other side of the agreement, 10 countries would have different trade liberalization schedules, varying from immediately to a 21-year schedule. Canada already has bilateral and regional FTAs with some of the CPTPP member countries including Mexico, Chile and Peru (see Table 3.1). Therefore, the CPTPP agreement would not significantly impact trade between Canada and these countries, as most tariff concessions are already included in these FTAs. All CPTPP member countries would be obligated to eliminate or reduce the tariffs on their imports from other CPTPP countries. Each country would have its own notation on how different tariff lines would be treated. These notations would be used to reflect how long it would take to liberalize different tariff lines, and whether or not the tariff line would be governed under tariff quota. Japan, Chile, and Vietnam would have the most complex elimination schedules, including multi-notations and staging categories. The next subsections discuss how CPTPP would open new markets for Canadian exports. Various goods are categorized similar to those in Section 3.2.1.

3.3.2.1 Agricultural Products

All CPTPP countries would open their markets to Canadian agricultural products either immediately, or over different liberalization time schedules. The relatively protectionist countries would have sophisticated treatment for agricultural products, where the liberalization would take place over a period of up to 16 years. At the same time, many agricultural products would be governed by tariff quotas. For example, Chile, Japan, and Mexico would have different treatment for each partner country, while Malaysia, Vietnam, and Peru would open their markets over a transitional period of 16 years. Other countries such as New Zealand, Australia, Brunei-Darussalam, and Singapore, would be more open and would make more than 95 of the agricultural products duty-free on the date of entry into force.

Japan is an important market for Canada's agricultural products for two reasons: (i) Japan's market is a large market relative to other CPTPP members' markets. (ii) under the CPTPP, Japan will reduce or eliminate tariffs and other trade barriers on many agricultural products imports. Table 3.7 below summarizes Japan's agricultural products tariffs concessions under CPTPP.

Table 3.7: Canada tariff concessions schedule for agricultural products

Agricultural product	Tariff lines	Tariff concession
Live animals, animal products, fish and aquatic products, and products of animal origin, except dairy products.	0101.21.00 – 0308.90.90 and 0501.00.00 - 0511.99.90	Tariff lines (01,03 and 05) will be duty-free upon entry into force, or progressively over the agreement implementation. Tariff on meat products (tariff lines starting by 02) will be reduced drastically (from 38.5% to 9%) and/or governed by TRQs upon full implementation of the agreement.
Dairy, eggs, and natural honey products	0401.10.10 - 0410.00.00	Tariffs on the majority of products in this category will be reduced progressively to reach on average 10% upon full implementation of the CPTPP. The reminder of these tariff lines will be governed by TRQs and few of them will be fully liberalized over the implementation.
Vegetables, fruits, nuts, coffee, spices, and cereals	0601.10.11 - 1008.90.00	The vast majority of these tariff lines will be duty-free upon entry into force, or progressively over the first few years of implementation. Cereals (tariff lines starting by 10) will be governed by TRQ.
Milling industry products	1101.00.10 - 1109.00.20	Half of tariff lines in this category will be governed by TRQ. Tariffs on the reminder products will be guaranteed MFN treatment upon entry into force.
Seeds oil, industrial or medicinal plants, vegetable saps, and planting materials	1201.10.00 - 2403.99.90	Tariffs on more than 80% of these tariff lines will be removed on the date of entry into force, or progressively over the first few years of implementation. The reminder products will be governed by TRQs or guaranteed MFN treatment upon entry into force.

Source: Government of New Zealand (2018b).

3.3.2.2 Industrial, Mineral, Plastic, Chemical, and Metal Products

The majority of these categories of products are already duty-free as they are initial inputs for different industries and sectors. The general treatment of these product categories among all CPTPP countries is significantly harmonized, where the few dutiable tariff lines among these products are expected to be liberalized immediately upon entry into force, or over a period of up to 16 years. Some countries such as Japan and Mexico will have different treatment for different countries among the agreement members for these product categories.

3.3.2.3 Textile Products

Most textile products are dutiable. The review of different CPTPP member countries tariff elimination schedules showed that all CPTPP members, except Singapore, impose high customs duties on the vast majority of textile products. Vietnam imposes up to 100% and 37.5% duty, respectively, on textile products' tariff lines, while Malaysia, Mexico and Japan impose up to 30% duty on these tariff lines. The rest of the CPTPP member countries impose tariffs varying between 6% and 17% on these product categories. Although these products are highly dutiable among CPTPP members, almost 90% of these products categories would be duty-free immediately on the date when the agreement comes into force.

3.3.2.4 Machinery, Electrical Equipment, and other Miscellaneous Manufactured Products

There would be significant differences among CPTPP members with regards to the liberalization of machinery and electrical equipment products. For these products, generally speaking the CPTPP members can be classified into two categories: (i) protective countries, where most machinery and electrical equipment would be dutiable (includes Australia, New Zealand, Brunei-Darussalam, Chile, Malaysia, Mexico, Peru, US, and Vietnam, where the duties on these products would vary between 5% and 30%, on average). These countries would liberalize their markets gradually over 4, 10, or 16 years. (ii) less-protective countries, where the vast majority of these products are non-dutiable (includes Japan and Singapore).

3.3.2.5 Tariff Rate Quotas

Each CPTPP member country has its own tariff quotas for different products. Some countries such as Chile and Malaysia have special treatment for each CPTPP member based on other bilateral or regional FTAs (such as NAFTA/USMCA). Generally speaking, agricultural products are well represented among the TRQs, but most of these quotas would be progressively increased each year. TRQs are still unclear in terms of how they would be divided among CPTPP members. However, some CPTPP members have provided additional details in terms of the special treatment of different members (i.e., Japan has a long list of appendices with regards to the tariff quotas, in particular to be used to safeguard mainly agricultural products). Table 3.8 highlights some important special treatments of the different Canadian products, where they exist.

Table 3.8: Tariff Rates Quotas and special treatments of selected Canadian products

Country	Details
Chile	- Custom-duties on some wheat and sugar products shall be treated as in Canada-Chile Free Trade Agreement, 1996.
Japan	- A special appendix highlights the TRQs (see Table 3.7). - A special appendix on the trade of motor vehicles between Japan and Canada is attached to the CPTPP agreement.
Malaysia	- A special appendix highlights the TRQs. Malaysia will increase its in-quota quantity for CPTPP countries upon entry into force for the following products: live animals, meat products, and milk.
Mexico	- A special appendix highlights the TRQs. Mexico will increase its in-quota quantity for CPTPP member countries progressively over implementation for the following products: milk and cream quantity to be increase to 375,000 litres, milk powder to 42,000 MT, condensed milk to 1,500 MT, butter to 2,000 MT, cheese to 6,500 MT, and palm oil to 12,000 MT.
Vietnam	- A special appendix highlights the TRQs, Vietnam TRQs schedule is for manufacturing products, in particular for used vehicles

Source: Government of New Zealand (2018b).

3.4 Concluding Remarks

The CPTPP agreement includes very long and sophisticated tariff commitments of different member countries. These sophistications vary from the undefined date when the agreement would come into force among members. Furthermore, each of the CPTPP member has different notation codes, with many of them already possessing existing bilateral or regional FTAs; further, each country has different levels of protection on different categories of products. As the agreement enters into force, tariffs would fall dramatically. As noted above, about 75% of the non-zero tariff lines shall be eliminated immediately (as the CPTPP enters into force), and many others shall be eliminated progressively over years.

Canada currently has three different bilateral and regional FTAs with four of the large CPTPP members (Table 3.1). This in fact places Canada in a very special situation, and leads to further questions about whether this agreement would impact the existing Canadian FTAs, such as NAFTA/USMCA and the trade flow between Canada and other countries that already have FTAs in place, as well as the RoW. This phenomenon is known as trade diversion, which basically describes the trade flow changing from more efficient non-member exporters toward less efficient ones as a consequence of FTAs, RTAs, and MRTAs (Balassa, 1967; Baldwin & Wyplosz, 2006).

Chapter 4
Research Methodology

4.1 Introduction

This chapter provides details and a description of the models, databases, and scenarios for analysis used in this thesis. To fulfill the study's objectives, two types of analysis were required: (i) national, to assess CPTPP impact on Canada and other CPTPP member countries' economies and compare it to the impact of the former TPP, if it had been implemented; and (ii) subnational, to evaluate the economic impact of CPTPP on Saskatchewan's provincial economy and compare it to the impact of the former TPP, if it was implemented. Due to the international nature of this study's analysis, a global CGE model and database were needed to fulfill this study's objectives. Therefore, the GTAP model and its version nine (V.9) database was chosen for the analysis, as it covers the entire world[35].

This chapter is divided into sections: Section 4.2, provides a general overview of GTAP model and its database. Section 4.3 and Section 4.4 describe the conceptual and structural design of the standard GTAP model and model equations. The model's sectoral and regional disaggregation is described in Section 4.5. A detailed description of the modified subnational GTAP model is discussed in Section 4.6. Finally, Section 4.7 provides an overview of the simulation scenarios which are designed to fulfill the study's objectives.

4.2 General Description of Standard GTAP Model

The standard GTAP is a comparative static, global general equilibrium model, based on an I-O accounting framework generally used alongside its database for a wide range of policy analysis, and can be extended and modified to support particular types of policy analysis. The GTAP model was built based on other robust general equilibrium models, including the Sectoral Analysis of Liberalizing Trade in the East Asian Region (SALTER) model, developed at the Australian Productivity Commission (Jomini *et al.*, 1991). In addition, the World Agricultural LibeRAlisation Study (WALRAS) model was developed to analyze the agricultural trade policy in the OECD countries (Shoven & Whalley, 1984). The GTAP model was also influenced by the

[35] As the standard GTAP model can only be disaggregated at national level, a modified version of GTAP model was developed in this study for the purposes of subnational analysis.

work of Peter Dixon (Dixon *et al.*, 1982) and Leif Johansen (Johansen, 1960). GTAP is implemented using General Equilibrium Modeling Package (GEMPACK)[36] or General Algebraic Modeling Software (GAMS) environment in order to run the large and complicated structure of its equations.

4.2.1 GTAP Database

This research utilized GTAP Database current edition V.9, which is very popular and has been utilized in analyzing international economic issues in an economy-wide framework, such as global trade liberalization, and regional trade agreements. It has been used in thousands of applied economic research studies since the original version was released, mainly in trade policy analysis. It represents the world economy and consists of different country level databases to simulate trade flow quantitatively. The GTAP database consists of different accounts to measure the value of annual flows of goods and services. It includes data on bilateral trade goods and services, intermediate inputs among sectors, and taxes and subsidies for different countries. Its comprehensiveness and flexibility, to be aggregated or disaggregated based on research needs and objectives, has made it one of the most popular databases in CGE analysis (Aguiar *et al.*, 2016; Hertel *et al.*, 2013). Version 1 of the GTAP database was released in 1993, and included 15 regions and 37 sectors. It was followed by several releases of updates, with more comprehensive, sector-expanded databases, including more regions and countries, higher disaggregation, and updated tariff data. A summary of historical development of GTAP database is provided in Appendix A. Due to the increasing popularity of GTAP database applications, it has also undergone several extensions to make the database more relevant to different policy issues. For instance, GTAP-E, GTAP-AEZ, and GMig were developed for analyzing climate, energy, and migration polices. The GTAP database could not be disaggregated at a lower level than a national level; thus, this study splits GTAP (Canada's national database) into two separate databases[37] (Saskatchewan and RoC) in order to track TPP economic shocks on Saskatchewan's economy.

[36] GEMPACK is a modeling software suitable for CGE models, and is appropriate for solving large systems of non-linear equations to handle a wide range of economic behaviours.

[37] Splitting GTAP database to account for subnational regions requires detailed data about each region's internal and foreign trade. The process of splitting Canada's national database is explained later in this chapter.

4.2.1.1 Structure of GTAP Database V.9

GTAP Database V.9 was released in 2015, and includes 140 regions[38] and 57 sectors, representing the world economy for three benchmark years: 2004, 2007, and 2011. The method and data sources for these benchmark years are consistent to allow for meaningful comparison of development over time, if needed by researchers.

The database classifies economic activities into 57 sectors (products and services) based on United Nations Central Product Classification, and International Standard Industrial Classification (Aguiar *et al.*, 2016). The sectoral classification consists of 26 agricultural and food sectors, 16 manufacturing sectors, and 15 service and other sectors. It includes three factor endowments: capital, land, and natural resources, as well as five labour categories: officials and managers, technicians, clerks, service/shop workers, and agricultural and unskilled workers[39]. On the technical side, the database contains five files: sets, parameters, core data, energy data, and CO_2 emission data. The arrays in the sets files are designed to allow the database to parameterize the standard GTAP model with any level of aggregation.

The behavioural parameters include the Armington elasticities, factor substitution elasticities, factor transformation elasticities, and demand elasticities. The main data files include data on the input-output flows for each region and bilateral international trade[40]. These files also include protection data on both the exports and imports duties and subsidies. In addition to the aforementioned data, the database files include income tax, capital stock, depreciation, population, energy volume, and CO_2 emission (Harrison & Pearson, 1998). Table 4.1 summarizes the sources of data in GTAP Database V.9, whereas Figure 4.1 shows its construction methodology. All the data files are in a Binary Header Array (HAR) to keep the size of the files small. This type of file is compatible to work with GEMPACK. Further description of file sets of GTAP Database V.9, and it arrays and parameters, are provided in Appendix B.

[38] These included 120 individual countries, along with 20 composite regions.

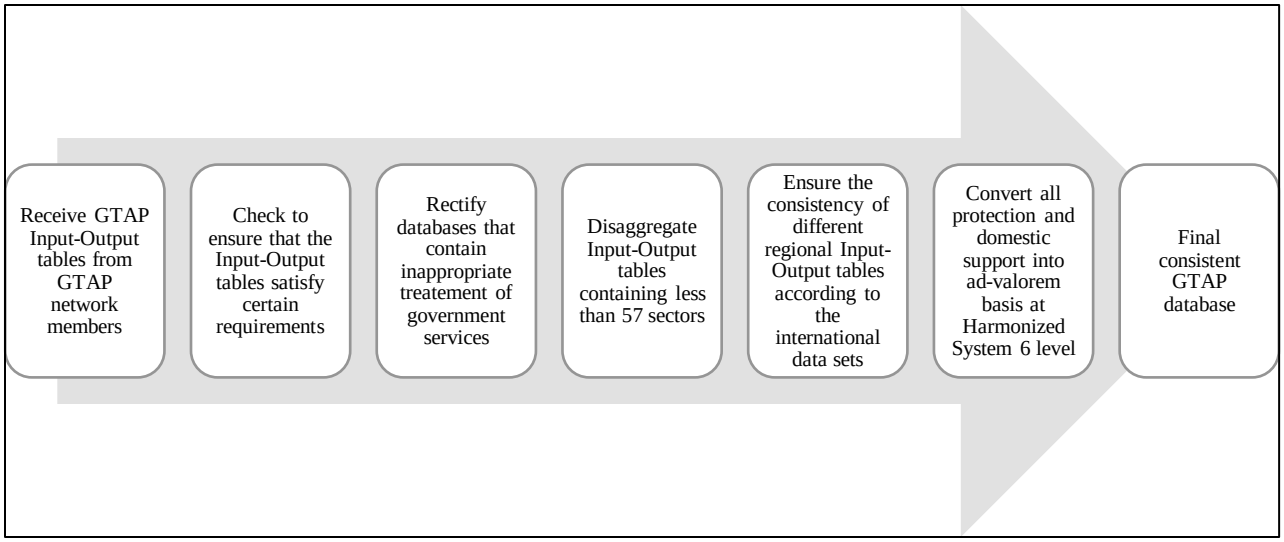
[39] The labour classification and disaggregation is based on the International Labour Organization classification.

[40] Taxes are implicitly included in these data.

Table 4.1: GTAP Database V.9 data sources

Element	Data source/description
Input-Output tables	GTAP network members across the world and international databases by several international organizations.
Agricultural production targets	The Organization for Economic Cooperation and Development (OECD), and Institute for Prospective Technological Studies (IPTS).
Labour categories	Classified using the International Labour Organization system.
Disaggregation of agricultural and food sectors	United Nations Food and Agriculture Organization (FAO).
Protection and domestic support data	The International Trade Centre (ITC), the Organization for Economic Cooperation and Development (OECD), World Trade Organization (WTO), Food and Agriculture Organization (FAO), International Food Policy Research Institute (IFPRI), Market Access Map (MAcMap), the Financial Report on the European Agricultural Guidance and Guarantee Fund (EAGGF), Francois, Worz, & Narayanan (2013), and Centre d'Études Prospectives et d'Information Internationales (CEPII).
Macroeconomic data	World Bank Development Indicators.
Trade flow	United Nations Commodity Trade Statistics Data (COMTRADE), International Monetary Fund (IMF), and Netherland Ventral Plan Bureau (CPB).
Energy data	International Energy Agency (IEA).
CO_2 Omission	United Nations Food and Agriculture Organization (FAO), and Emission Database for Global Atmospheric Research (EDGAR).

Source: Aguiar *et al.* (2016).



Source: Aguiar *et al.* (2016).

Figure 4.1: GTAP database construction processes

4.2.1.2 Input-Output Data in GTAP Database

The I-O tables represent the interindustry flow of goods and services within an economy, first introduced by Leontief (1937). They can be constructed at any level of aggregation, i.e., at national regional or subnational level, but it is more common to have I-O tables constructed at a national level. The basis for their construction is a transitions table for the country, which represents the interdependencies among economic agents (producers of goods and services, owners or production factors, and final users of goods and services). All similar goods are grouped into one sector. The final demand represents the ultimate final use of sectors' commodities. Some goods re-enter the production process for further value-added, and are called intermediate inputs which, together with primary inputs (land, labour, and capital), are used in producing the final commodities (Kulshreshtha & Thompson, 2005).

These I-O tables are the core of SAM, which is technically a CGE model database. The SAM reports the value of all transactions in the economy over a specific period of time, which is usually a calendar or financial year. It includes more comprehensive data than the I-O tables, as it represents economic and social information of an economy by bringing together the structure of production, income generation by factors of production, income distribution, and the saving and investment patterns in the economy. These can be used in more applications than the I-O tables, such as the effect caused by income generation (Dwyer *et al.*, 2012).

The GTAP database is basically constructed using different countries' I-O and SAM tables, which vary from one country/region to another in terms of the level of disaggregation of economic sectors. One of the major challenges of constructing a multi-country/region[41] database for the CGE models is to unify the disaggregation level among all regions. This results in matching the sectoral disaggregation of the GTAP database, which includes 57 sectors (twelve sectors within agriculture, eight within food and beverage[42], and the remaining within resource, manufacturing, and services sectors). The 57 sectors in GTAP Database V.9 are listed in Appendix C.

4.2.2 Behavioral Parameters in the Model

Behavioural parameters are key factors in evaluating the impact of a given economic shock. The elasticity values in the model directly impact the analysis results. Thus, accurate values of different elasticities are essential in the analysis. The GTAP database contains five types of elasticities: source substitution (Armington), factor substitution, factor transformation, investment flexibility, and consumer demand elasticities. The model elasticities were extracted from different sources in the economic literature and other reliable sources[43] as shown in Table 4.2.

Table 4.2: Sources of model elasticities

Elasticity	**Source**
Source substitution elasticities	Hertel *et al.* (2004)
Factor substitution elasticities	Jomini *et al.* (1991)
Factor transformation elasticities	Generated by GTAP from a standard aggregation
Investment flexibility parameters	Generated by GTAP from a standard aggregation
Consumer demand elasticities	Reimer and Hertel (2004)

Source: Aguiar *et al.* (2016).

[41] Regional composition of GTAP Database V.9 is available in Narayanan (2016).

[42] Agricultural and food products are well classified in GTAP database compared to other sectors, which is considered one of the main features of GTAP database. Data processing of food and agricultural products in GTAP database is available in Peterson (2016).

[43] All the numerical values of the elasticities in the GTAP model are available in Aguiar *et al.* (2016).

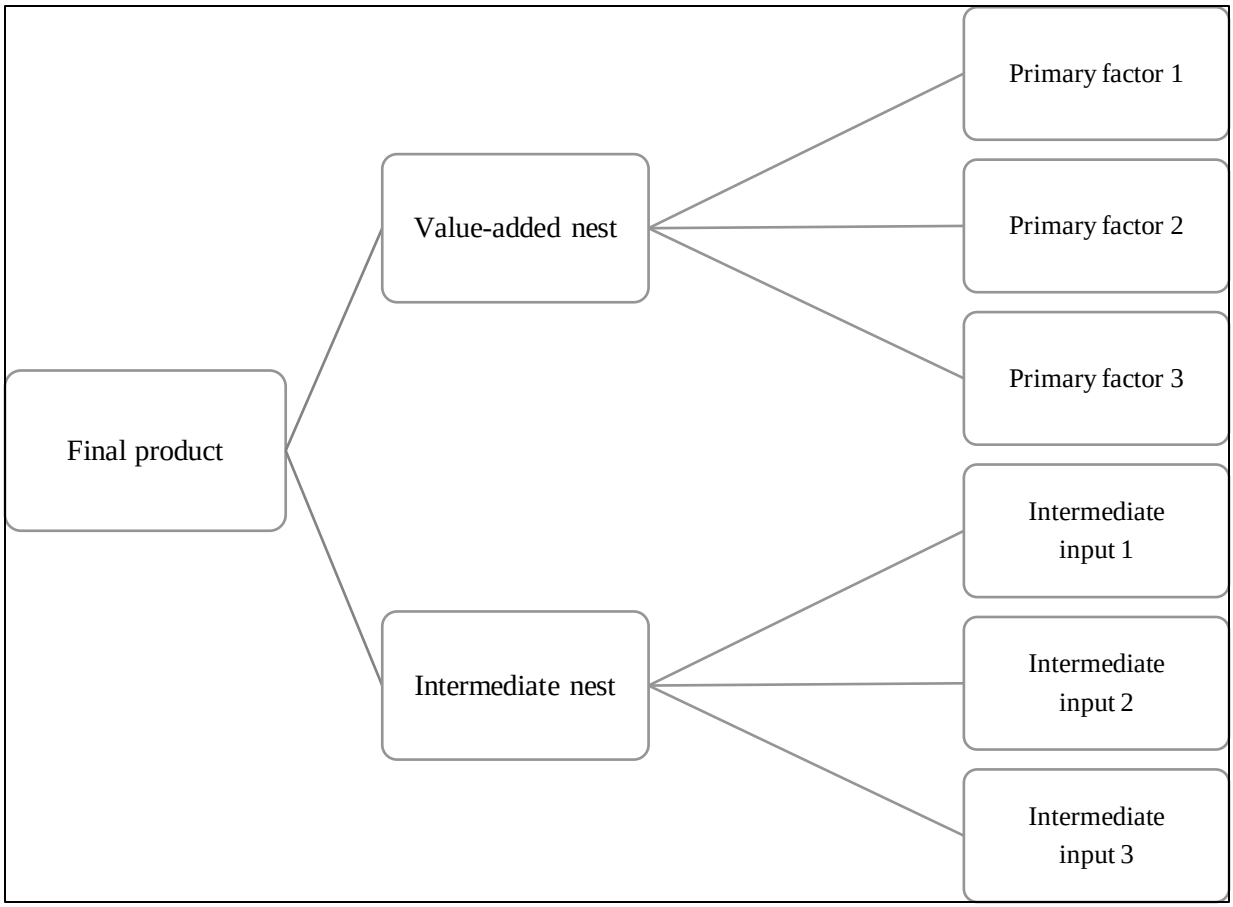
Source substitution elasticities describe the substitution between domestic products and imports within a country, and imports from different regions. In the GTAP model, the substitution elasticities are defined separately for each region, commodity, and sector (i.e., for each commodity within each region, the demand mix is determined separately for each industry, final demand category, and sourcing of imports for intermediate commodities). Unlike other models, GTAP treats each region separately from others in terms of elasticity of substitution, which gives this model an advantage in analyzing trade reforms over other models (Aguiar *et al.*, 2016; Hertel *et al.*, 2013).

Factor substitution elasticities describe the substitutability between factor of production in the production function. Nested CES production function is used in the GTAP model (Figure 4.2), where the production function has two levels: First, a producer combines the primary factor of production to produce a value-added nest, and combines intermediate products (domestic and imported) to produce an intermediate nest[44]. Second, a producer combines value-added and intermediate nests to produce the final product. Each combination has its own elasticity of substitution, which gives it a high degree of flexibility in the analysis by allowing the modeler to describe the different ways that subsets of inputs could be combined in the production process, and by separating each nest from the others at all levels of production (Burfisher, 2012).

Factor transformation elasticities describe the degree of primary factors mobility between sectors in each country/region. The model distinguishes between two types of production factors: mobile and sluggish[45]. All labour and capital are considered as mobile factors across the sectors, while land is treated as sluggish factors or partially mobile (less mobile) across the sectors. The elasticity of transformation in the factors' mobility case reflects the degree of mobility across the sectors. The smaller the value of this parameter, the greater is the mobility of the factor. For instance, the elasticity of transformation of agricultural land, which is used for a specific activity, is close to one; this means that the factor of production is sluggish. While labour elasticity if transformation is closer to the middle; this means that labour is partially mobile across the sectors.

[44] Combining primary factors in the production process produces a value-added product, and the combining intermediate inputs produces an intermediate product.

[45] Sluggish factors are defined as the factors with less mobility across different production sectors. The level of sluggishness is based on the factor itself.



Source: Aguiar *et al.* (2016).

Figure 4.2: Visualization of nested production function

The consumer demand elasticities are one of the most important parameters in the model. The model employs C-D CES (Hanoch, 1975). The functional form can be classified somewhere between non-homothetic[46] CES and the more flexible functional form. Consumer demand elasticities in GTAP model were obtained from Reimer and Hertel (2004), who estimated the demand system in different regions using cross-country data on consumer expenditures. The GTAP model includes more than 500 different elasticities taken from the economic literature, other databases, or calculated using econometrics techniques.

[46] Utility functional form depends on the application and assumptions of the study. Most of the CGE models assume homothetic utility function, where income elasticity of demand is equal to one. However, it is common in applied economic analysis to assume non-homothetic utility function (depending on the application of the analysis) where income elasticity of demand differs from one. It is also possible, but less common, for some modelers to assume quasi-homothetic utility function, such as Stone-Geary utility function (e.g. Jensen *et al.*, 2015).

4.2.3 Protection Data

Protection data, i.e., tariffs and subsidies, are the core of trade policy research, which requires consistent and reliable information about border protection. Building a comprehensive and consistent protection database is a major challenge for two reasons: the increasing numbers of trade agreements, which creates a variability to the protection across trading partners, and consequently the increasing complexity of protection patterns using a variety of protection instruments.

Protection data are one of the key components of a GTAP database[47], taken from different sources and are presented in two forms: (i) implicitly where the rate of the protection instrument can be calculated from the different valuations of the same economic flow; and (ii) explicitly where the database includes arrays summarizing the value of revenue generated from tariff and expenditure associated with subsidies. The GTAP database arrays are available in Appendix B.

Data on tariffs come in different types, such as specific tariff, *ad valorem* equivalent[48] (AVE), compound tariff, and mixed tariff. All of these different types of tariffs are converted into an *ad valorem* basis at HS6 level, and is then aggregated[49] to 57 sectors corresponding to GTAP economic sectors. The tariffs in the model can be altered to estimate the impact of such change on trade, production, and other aspects. The domestic payments and subsidies for the agricultural sector are taken mainly from OECD, country notification to the WTO, and other sources (see Table 4.1) and converted into subsidy rates at a sector level. The database includes only the transfers that do not affect the market price for agricultural commodities, i.e., transfers to producers.

[47] The methodology of building GTAP tariffs database is provided by Guimbard *et al.* (2012).

[48] Duties are levied on a traded item on the basis of its value, i.e., not on the basis of quantity, quality, weight, or other factors. The duties are calculated as a percentage of the value of the product. For instance, if the value of a product increases, the custom duty in the product increases (Asakura, 2003).

[49] All the tariffs data is available at HS6 disaggregation in the form of a tool called Tariff Analysis and Simulation Tool for Economists (TASTE). This tool allows modelers to construct their own aggregated/disaggregated tariff shock starting from HS6. This is important to make the database suited for analytical purposes to make it possible to aggregate the information up from the product level (Horridge & Loborde, 2008).

4.2.4 Bilateral Trade Data

The GTAP model contains bilateral trade data on the products and services for each region. Since it is common to have large discrepancies in reported imports and exports by trade partners, further processing is done to produce a consistent set of bilateral trade flows. In the GTAP database, trading partners are linked through trade flow, where the value of imports at cost, insurance and freight (CIF) price, minus the value of transportation services, equals the value of exports at Free on Board (FoB) prices.

The primary source of merchandise trade data for the GTAP database is United Nation COMTRADE database, where different sources are used for comparison to ensure the reliability of the bilateral trade data[50]. The statistics' sources provide merchandise totals by individual country for different sectors and commodities. The data from different sources are processed and compared to have the best reliable figures, although generally speaking, there are some discrepancies in imports and exports reports for different reasons, including transport margin, misclassifying of commodities, and misidentifying of partners. The quality of trade data in GTAP database, which is essential in trade analysis policies, is determined with the reliability indices developed by Gehlhar (1996)[51]. Similar to merchandise trade data, the reliability of services trade data is also determined using indices developed by Gehlhar (1996). Bilateral trade services data are basically collected from the United Nations trade in services database and EUROSTATA's international trade in services database.

The available data on international trade in services database from these aforementioned sources is highly reliable, which is crucial because trading in services has become more important in FTAs negotiations. In addition, the service sectors represent a large and ever-growing percentage of international trade. In 2016, trade in services constituted about one-fourth of world trade in 2016 (van Leeuwen & McDougall, 2016).

[50] The methodology of processing the trade data, ensuring its reliability, is available in Gehlhar (1996).

[51] The goal of this method is to deal with any discrepancy of data reported by trading partners. According to this method, the data is reliable if the deviation in the value of two reports by imports and exports is less than 20%. The indices are constructed based on the reliable reported data per region per good (the higher the index, the more reliable the reporter). If the importer has a higher index than the exporter, the reported data from the importer is considered more reliable.

4.3 Conceptual Description of Standard GTAP Model

This section describes the GTAP standard model structure and its core elements. This includes demand and supply sides, endogenous and exogenous parameters, behavioural and identity equations, and model closure. All CGE models have nearly identical structure in terms of modeling the demand, supply and trade, with some slight differences in incorporating different market structures[52], i.e., perfect and imperfect competition. The model and model behavioural equations that determine how the economic agents respond to the changes in the relative prices of goods and services are modified accordingly.

4.3.1 Endogenous and Endogenous Variables, Exogenous Parameters, and Model Closure

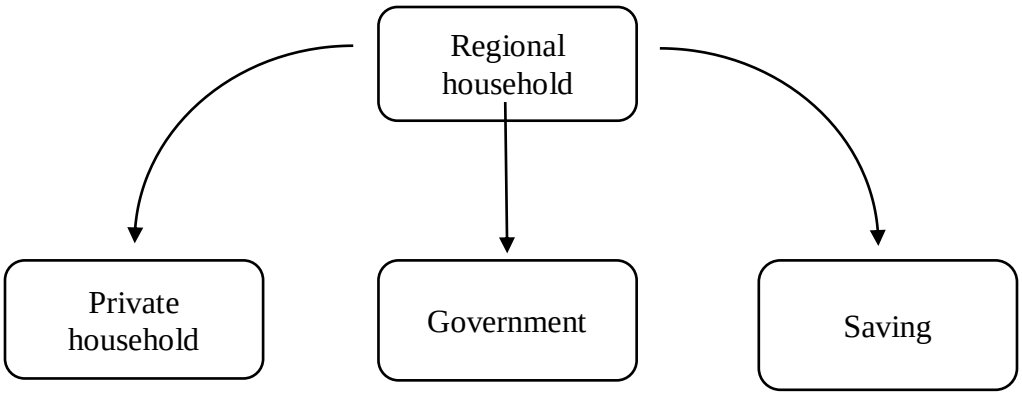
In CGE models, any variable determined within the model is considered to be an endogenous variable. These variables in the study model include all prices and quantities of goods, imports and exports, tax revenue, and saving. On the other hand, the exogenous variables in a model represent all the variables that have fixed values, and do not change by solving the model. Similarly, exogenous parameters such as taxes represent all parameters that have a constant value (Burfisher, 2012). In this study, tax, tariff rates, and elasticities are the most important exogenous variables. In order to evaluate the impact of the trade reform on Canada and Saskatchewan, the tariff rates were shocked among CPTPP/TPP countries. Model elasticities describe the responsiveness of demand and supply to changes in prices and income. Similar to the tariff rates, elasticities have a very significant impact on the model results; in fact, the model solutions are directly related to the size of elasticities used in the model. Numerical values of the all elasticities in the study model were obtained from Aguiar et al. (2016). Appendix B includes, among other parameters, a list of the model elasticity types that are used in the GTAP standard model. The decision on the selection of a variable to be endogenous or exogenous is represented by the model closure. This decision is very important, as it directly reflects model results in significant ways[53].

[52] Market structure assumption in modeling tariffs is very important. Under a perfect competition assumption, any tariff cuts or increases are fully-passed on to consumers, while under imperfect competition assumption, changes will intensify the competition (Roson, 2006).

[53] To illustrate the importance of the model closure, assume that a modeler tries to evaluate the impact of a decline in demand in the manufacturing products sector. This causes the manufacturing sector demand for labour to fall. If the modeler assumes that the labour supply is exogenous, then wages in an economy will fall until all the laid off manufacturing sector workers are reemployed in other sectors. In contrast, if the modeler assumes that the wages in the economy is exogenous, then the loss of jobs in the manufacturing sector will cause national unemployment.

4.3.2 Final Demand

The final demand side of the model represents the demand by regional household, domestic agents (private households, government, and investors) and the export market. Each demand is specified by a different functional form in order to ensure best representation of each economic agent's behaviour and preferences. Regional household is a macroeconomic account similar to the GDP, except that it does not account for depreciation. In the study model, this basically collects all income generated in the economy such as trade tax, sales tax, income tax, and factor income. All of these collections are then distributed to the private households, government, and saving. Figure 4.3 shows the regional household expenditure, which is specified as C-D functional form[54] (where the increase in the regional income causes changes in private expenditure, government expenditure, and saving) (Brockmeier, 2001).

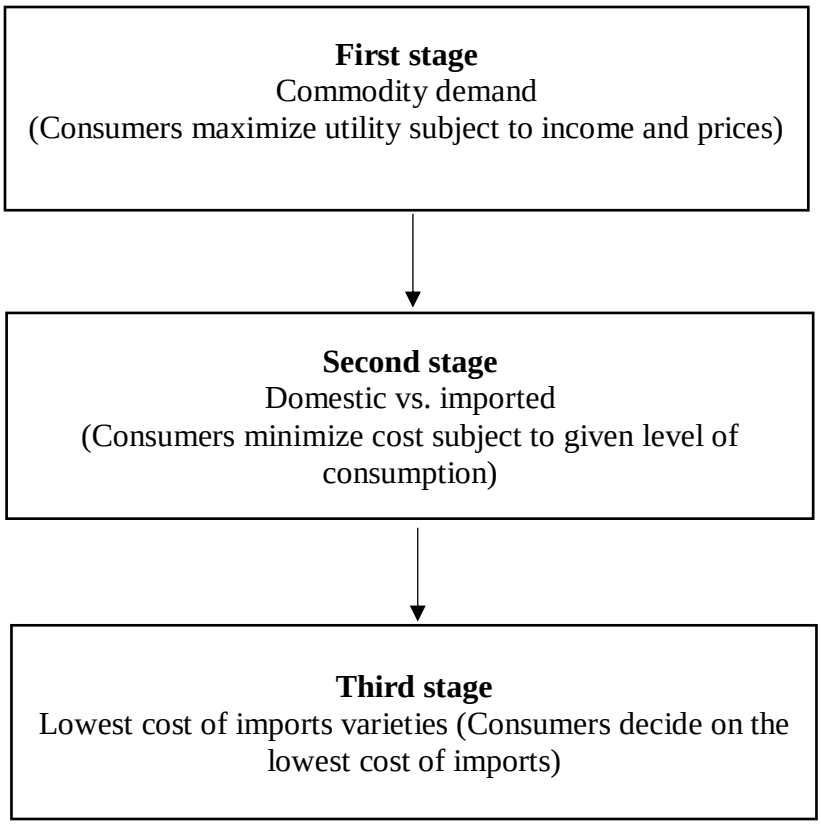


Source: Burfisher (2012).

Figure 4.3: Regional household expenditure

Private households make their consumption decision in three stages: in the first stage, the consumers decide on the quantity of each commodity; in the second stage consumers minimize their cost of the given level of consumption by deciding on the share of domestic and imported commodities subject to Armington Import aggregation function (Armington,1969); and in the third stage, consumers decide on the lowest cost sourcing of imports, which is indeed identical to the second stage in consumer decision (see Figure 4.4).

[54] Full details on the regional household account in the GTAP model is available in McDougall, (2002).



Source: Burfisher (2012).

Figure 4.4: Stages of final demand of private household

Depending on consumer behaviour, different functional forms can be used to describe the final demand in CGE models. There are four functions that are widely used in CGE models: C-D, Stone-Geary/Linear Expenditure System (LES), CES, and CDE[55]. The standard GTAP model utilizes nested CES functional form to describe the expenditure. This demand system has several features that make it more flexible in terms of applications. It is non-homothetic in nature; thus, as income changes, consumers can proportionally spend a larger share of their income on luxury goods and a smaller share on necessity goods. This behaviour depends on the income elasticity. It can also be transferred to other functional forms by choosing the income and substitution parameter values (for instance, by choosing constant values for income and substitution). The CES is considered less general than the flexible functional form, such as translog function (Hanoch, 1975).

[55] For full discussion on the characteristics of different functional forms that describe the consumer behaviour, see Burfisher (2012) and Hertel (1997).

As noted above, at the second stage of the decision-making, the consumers determine the sourcing of each commodity -- domestic vs. imports. In the study model, domestic and imported varieties were assumed to be imperfect substitutes. Therefore, these preferences were modeled using the Armington import aggregation function. This function describes how the domestic and imported varieties are combined to produce the composite commodity, which is demanded by the final consumer. The Armington import substitution elasticities size are important in analyzing the trade reforms such as tariff elimination or reduction. The third stage of decision-making is a replication of the second stage, where the consumer decides on the lowest cost sourcing of imports using the Armington import aggregation function. In multi-regions trade models, this is an important stage, where a bi-lateral or multi-lateral trade agreement can shift the demand from one country or region to another in response to a range of changes such as altered polices, trade agreements, population, and other factors and shifters.

The export demand in the study model represents all the demand by foreign consumers. In a multi-regional model, for instance, the demand for Canadian exports to the US is equivalent to the demand for imports by the US from Canada. The export demand elasticity in the model is determined by foreign Armington elasticity parameters. Each traded commodity in the model has its own foreign elasticity of substitution. The government demand in the model is treated in a simple fashion, using the C-D functional form; i.e., the initial budget share in the government consumption basket remains fixed. For instance, if the government spends 10% of its budget on manufacturing commodities, it would continue to spend 10% of any sized budget on these commodities, whether their prices rise or fall. Finally, the investment demand is also treated in a simple fashion in the study model. Here, the static approach does not account for the intertemporal calculations about the future that influence investment decisions. Investment demand replicates the demand for capital goods observed in the base year of the model reported in the model's database. This basically means that the study model is a saving-driven[56] model, meaning that the saving rate is exogenous and constant, and investment spending changes in response of the changes in the supply of saving.

[56] It is common in CGE models to have investment-driven models. In such models, the aggregate value of investment is fixed at its initial level and, as the income increases, the consumption will increase; however, the saving will remain constant (Burfisher, 2012).

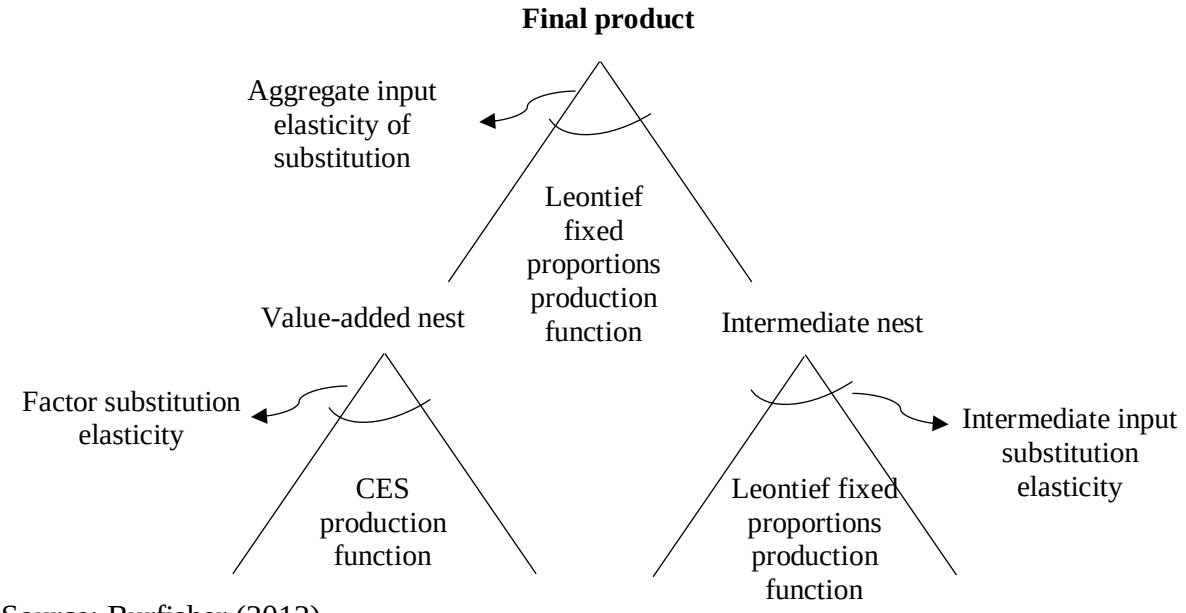
4.3.3 Supply Side in the Model

This subsection discusses the supply side in the GTAP model, including production, intermediate, and export supply. On the production side, the model is governed by the nested technology of production, where a different production functional form can be used in each nest, which provides more flexibility in modeling. For instance, a modeler can assume a functional form, which allows for some substitutability between factor of production in the value-added nest, and a functional form that allows for fixed ratios in the intermediate nest.

The intermediate input nest has a simple technology of production, as intermediate inputs are assumed to be used in fixed proportion. In other words, the elasticity of substitution between intermediate inputs is zero. Thus, the producer cannot substitute one intermediate input for another to produce the same bundle of intermediate good. In the study model, the GTAP standard functional form (i.e., Leontief fixed proportions production function) was used to describe the intermediate production activity (Simola, 2013).

In the value-added nest, producers assemble their bundle of primary factors of production (Gohin & Hertel, 2003). Due to the flexibility of composing the value-added bundle (i.e., the mix of primary factors in the most cases is variable), the CES production function was used to describe the production technology in this nest. This functional form allows for substitutability between primary production factors through the elasticity of factor substitution, where the larger the elasticity parameter value, the larger the substitutability between the primary factors of production. Examples of CES production function with two factors and more can be found in Arrow *et al.* (1961).

At the top level of the production process, the producer combines the intermediate inputs and the value-added bundles to produce the final output. Similar to the intermediate inputs nest, this stage of production in the study model is described by the Leontief fixed proportions production function, where a fixed ratio of intermediate inputs and value-added bundles are needed to produce any level of output. In other words, the aggregate input elasticity of substitution is zero. Figure 4.5 simplifies the representation of production in a CGE model.



Source: Burfisher (2012).

Figure 4.5: Nested production technology

The last part of supply in the study model is the export supply. It is directly related to the domestic supply. If the price in the export market increases relative to the price in the domestic market, the supply would shift toward export market. The functional form used to describe the export supply was the export transformation functional form, which describes the flexibility of produces to transform their products between export and domestic markets (Powell & Gruen, 1968).

4.3.4 Factors of Production

In the study model, the factors of production were disaggregated into three categories: capital, land and labour. It was assumed that factors of production were in fixed supply. Furthermore, the land was assumed to be sluggish, and labour and capital were assumed to be fully employed and mobile across different sectors, but immobile internationally. The mobility of labour and capital is governed by the Constant Elasticity of Transformation function (CET)[57] factor supply function (Hertel & Tsigas, 1988) and they are both partially mobile across the sectors. Factor elasticities describe, for instance, how labour force can be transformed into different types of workers from one sector to another.

[57] CET is identical to export transformation function.

4.3.5 Trade and Taxes in the Model

The trade and taxes (including trade taxes) values represent the shocks used for the simulation in the study model. In the database, import data appear as an expenditure of each commodity column account, where the spending on import tariffs, trade margin cost, and the actual cost of imports in FoB price were reported separately for each trading partner. On the exports side, the database reports the exports data as spending on export tax, the value of export trade margin services, and the value of all other types of exported goods and services. The separation in reported figures, i.e., imports or exports values and imports or export taxes, is important in order to track the impact of trade reforms.

The exchange rate is an important variable when it comes to the multi-country/region CGE models. There are two approaches for treating the exchange rate in CGE models: some models utilize the nominal exchange rate where the appreciation or depreciation in a particular country currency is accounted for in the trade volume via this variable. Other models use the real exchange rate, which is basically the relative price of traded to non-traded goods (Robinson, 2006). In the model, used in this thesis an explicit nominal exchange rate was not used, but the mechanism of real exchange rate was embedded through the *pfactor*[58] variable. For instance, a change in factor price across countries reflects the changes in the relative prices of goods, which is similar to the change in the real exchange rate (Burfisher, 2012).

Trade and domestic[59] taxes are an important component in this study model, as they directly influence consumer and producer behaviours, as well as trade in an economy. The focus of this study is on trade taxes (taxes imposed on imports and exports), and the study model includes five types of taxes: trade, production, sales, factor use, and income taxes. The database in the model was organized in a traceable way; in other words, one can trace the amount of revenues generated (direct burden) by each tax in the model and quantify their efficiency effect[60].

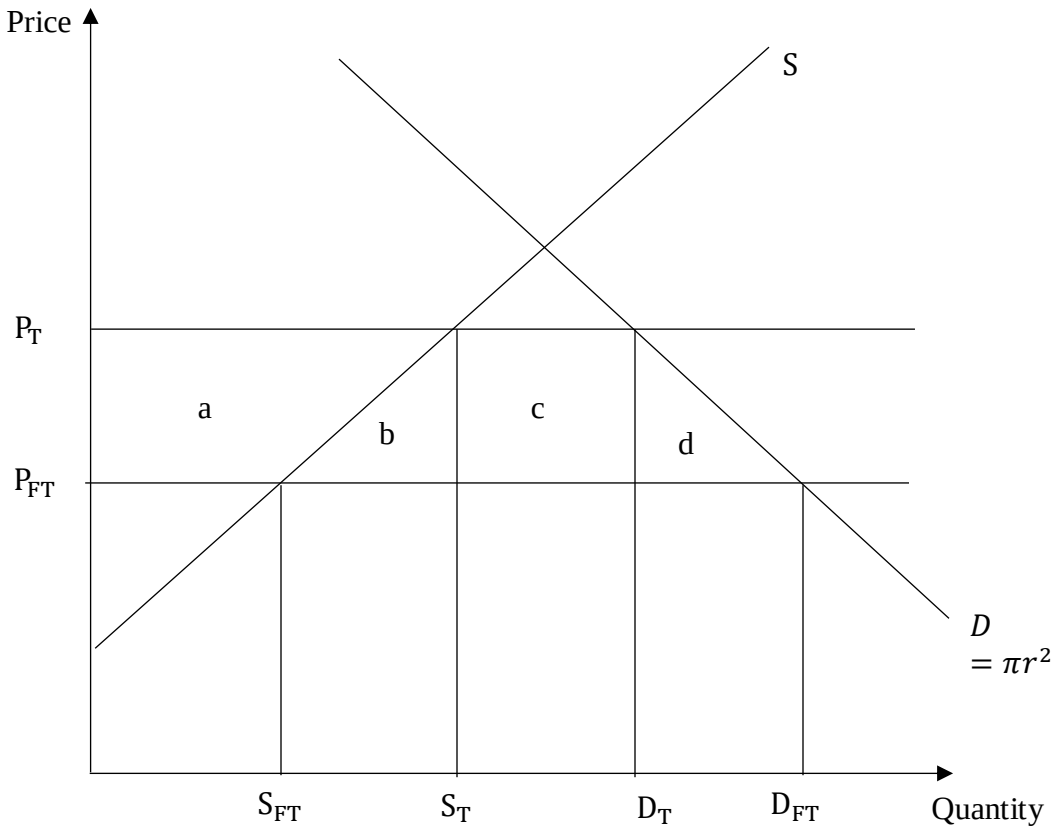
[58] *pfactor* factor "describe the Percentage change in an index of a country's factor prices relative to the world's average factor prices" (Burfisher, 2012).

[59] Domestic taxes include taxes on outputs and factor use of production, sales of intermediate and retail goods, and income tax.

[60] The efficiency effect of a tax is basically referring to the dead weight loss, where the forgone opportunities are not transferred elsewhere in the economy.

Trade taxes include both import and export taxes. Import taxes or tariffs are levied on the quantity or value of imports (goods or services) either directly (specific tariff), or as a percentage of the CIF value (which is also known as ad-valorem tariff - see subsection 4.2.4). In the study model database, import tariffs are paid by the imported commodity column to the import tariff RoW account. The import tariffs are passed to the final users and intermediate imported goods users as an increase in their cost. Each imported commodity from each destination has a different *ad valorem* tariff rate, which is based on the trade agreements in place between different countries. These data facilitate the analysis of the CPTPP and TPP trade reform.

The welfare effects of tariffs are summarized in Suranovic (2012). Import tariffs are usually imposed as trade barrier to protect domestic industry from cheap imports. For an import country, import tariffs raise the price for consumers, and lead to a decline in imports. This is depicted in Figure 4.6 below.

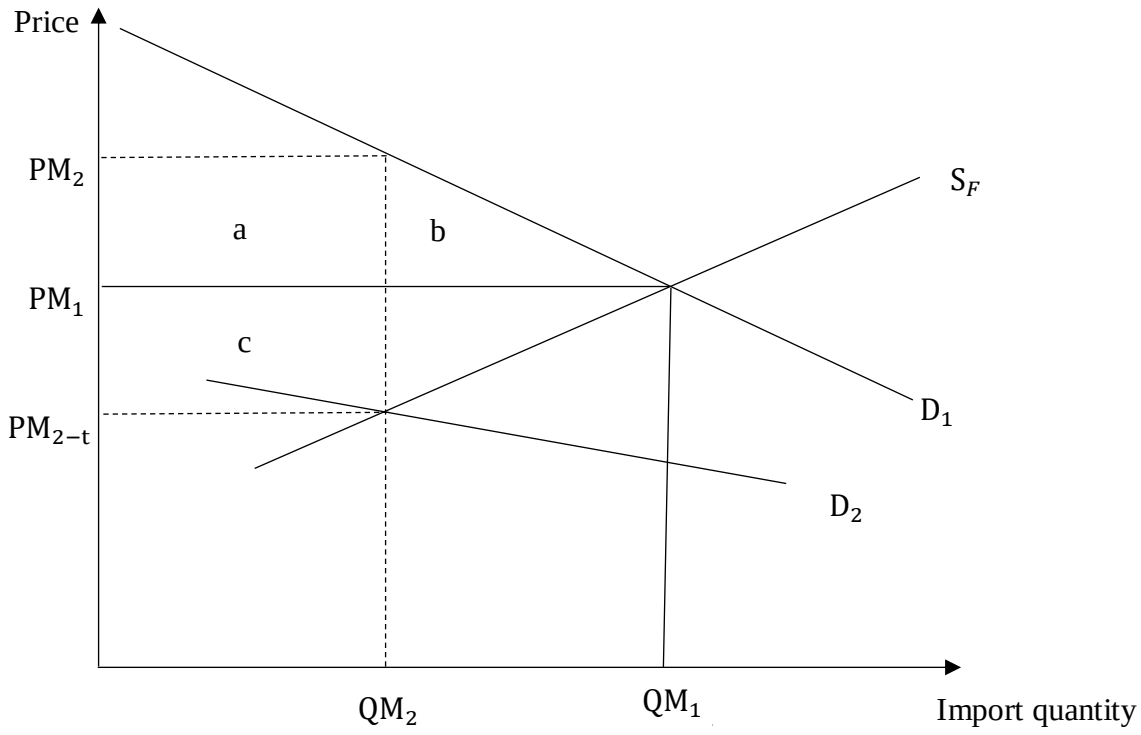


Source: Suranovic (2012).

Figure 4.6: Theoretical welfare effect of tariff, small country case on an importing

For simplicity, consider a market in a small importing country. In Figure 4.6, *D*, S, P_{FT}, D_{FT} represent the domestic demand and supply, international free trade price and domestic quantity demanded at this price, respectively. At P_{FT} the domestic supply is S_{FT}, the difference between D_{FT} and S_{FT} represents the imports. Imposing import tariff will raise the price by the full value of the tariff (small country assumption) to P_T. The tariff rate is the difference between P_T and P_{FT}, and the imports after tariff is the difference between D_T and S_T. The impact of tariff can be summarized as follows: the consumer surplus falls by the area (*a* + *b* + *c* + *d*), domestic producer surplus increase by area *a*, government tariff revenue is represented by area *c*, and the national welfare loss is represented by area (*b* + *d*).

Analyzing import tariff under GTAP model is based on the Armington assumption that goods are differentiated by country of origin. There is no domestic production of the imported goods, and thus there are slight differences from the theoretical model represented in Figure 4.6. GTAP model accounted for the direct and indirect burdens of the import tariff. This is explained in Figure 4.7 below.



Source: Burfisher (2012).

Figure 4.7: Effect of *ad valorem* tariff (import tax) on an importing economy

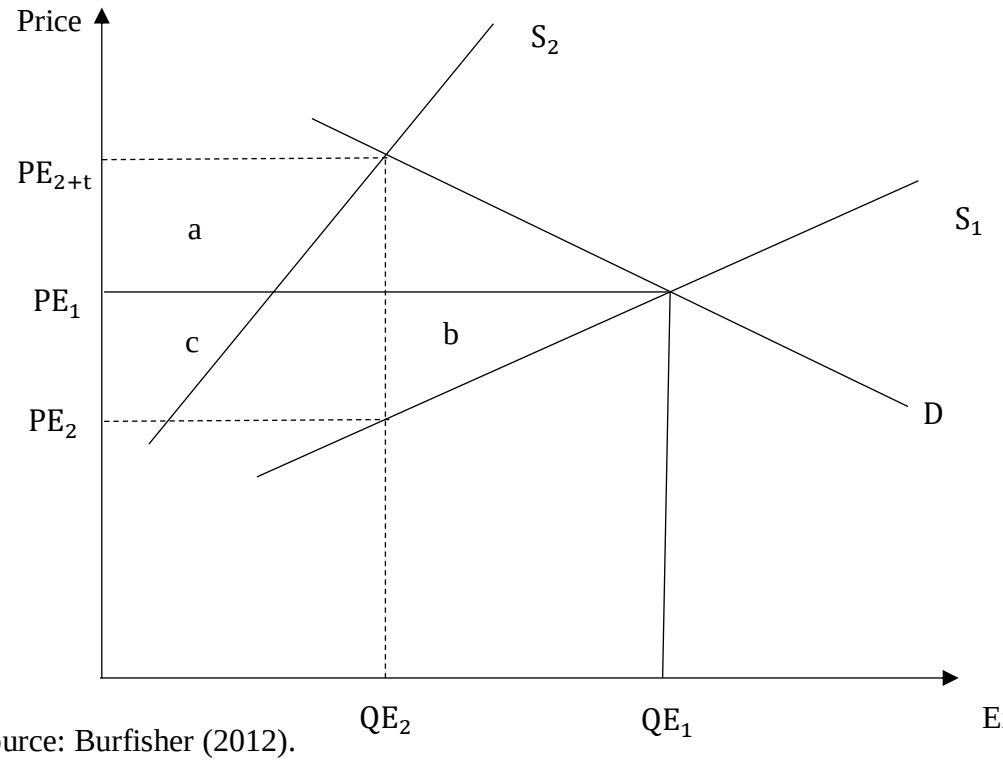
Figure 4.7 shows how the *ad-valorem* tariff affects an importing economy, which is captured in the study model. The foreign supply of the imported good is represented by S_F curve, the duty-free demand for imports is D_1, the CIF price and quantity of imports (no tariff in place) are PM_1 and QM_1 , respectively. Import tariff (t) would shift the demand curve downward, where consumers would pay higher price PM_2 (CIF world price plus the tariff) for the imported quantity QM_2, while the import price net of tariff is PM_{2-t}. The effect of the tariff is summarized by the areas *a*, *b* and *c* in Figure 4.7. The effect of tariff can be categorized into two categories: the direct burden of tariff, represented by the area *a* plus *c*, and the excess burden, represented by the area *b*[61]. Area *a* plus *c* is the tariff revenue paid by consumers to the government on imports of QM_2. Area *b* is consumption inefficiency; consumers who would have been willing to purchase QM_1 - QM_2 no longer can do. Area *a* plus *b* represents the consumer surplus that is lost when consumer reduce their import consumption to QM_2 . Area *b* is the lost in consumer surplus that is not recouped in the economy. Area *c* represents the terms of trade[62] effect. The terms-of-trade is similar to a direct burden in redistributing purchasing power. The purchasing power is redistributed from foreigners to domestic consumers as foreigners accept lower price. This compensates domestic consumers for area *c* (tariff payment to the government); thus, the domestic price increase by less than the full amount of the tariff. The gains in terms of trade to importers (area *c*) is a loss of import purchasing power by the exporting country. These tariff effects (including efficiency effects), have been quantified in this study, as represented in Figure 4.7.

The second type of trade taxes is the *ad valorem* export taxes. This type of trade taxes plays the opposite role of the import tariffs since it technically lowers the price producers receive from selling their products to the international market. It is common to introduce *ad valorem* export tax on vital goods such as food and agricultural products, to ensure that there is adequate supply of these goods available for the domestic market, as well as to encourage producers to shift their sales from export market to domestic market. The *ad valorem* export tax is reported in the model database as an expenditure from the domestic commodity column account to the export tax row.

[61] The direct burden of the tariff is the amount of revenue paid by consumers to the government, the excess burden is the consumption inefficiency due to the tariff.

[62] The terms of trade measure the import purchasing power of a country's exports, which is the ratio of the price of a country's export goods to the price of its imports (Burfisher, 2012).

Figure 4.7 illustrates the potential effect of the ad-valorem export tax, and the difference between this type of trade tax and the taxes on imports.



Source: Burfisher (2012).

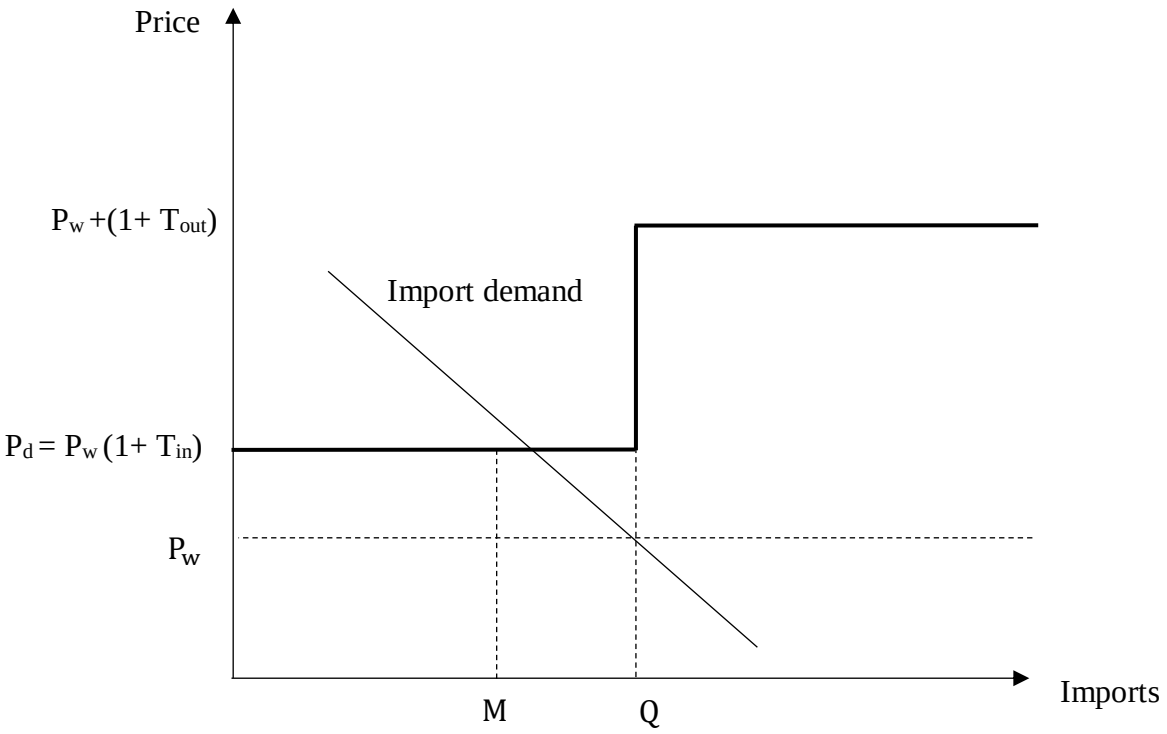
Figure 4.8: Effect of *ad valorem* export tax on an exporting country

Figure 4.8 represents the effects of an *ad valorem* export tax on the exporter. S_1 represents the home country's supply of exports to the world without export tax. Under Armington assumption, the products are differentiated by country of destination, therefore there is no domestic demand for export variety. D in Figure 4.8 is the foreign demand for the home country's exports. In the initial equilibrium the exporting country exports QE_1 to the importing country at FoB export price PE_1. Export tax (*t*) shifts the supply upward to S_2, lowering the producer price to PE_2, increasing the export price to PE_{2+t}, and lowering the export quantity to QE_2. The export tariff effects can be summarized by the areas *a*, *b*, and *c* in Figure 4.8. Area *a* plus *c* is the export tax revenue transferred from producer to the government (direct burden), area *b* is the efficiency effect (excess burden), area *a* plus *b* is the loss in producer surplus, area *a* is transferred to the government as tax revenue, area *b* is the dead weight loss, and area *c* is the terms-of-trade gains, which measures the changes in purchasing power from foreign producer to domestic producers because the export price rises from PE_1 to PE_{2+t}.

Other types of taxes in the model are the domestic taxes, which include production, sales, intermediate, factor use, and income taxes, which would not change in a simulation of the CPTPP trade reform.

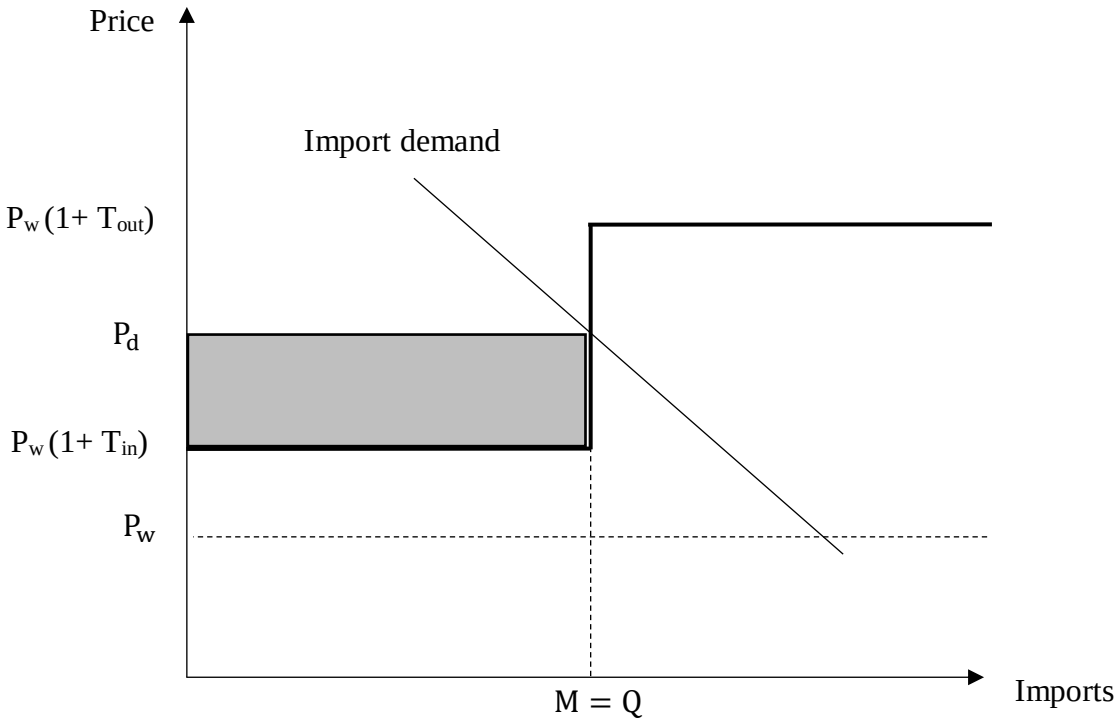
4.3.6 Tariff Rate Quotas

The TRQs system is a mechanism that ensures both tariff and market access. This system has emerged from the Uruguay Round Agreement on Agriculture (URAA). Most of the new generation of FTAs include TRQs, which generally guarantee some new quantities to be charged new duty rates. TRQs are commonly used to control imports of agricultural commodities. In some trade agreements, TRQs represent important component that impact the quantitative analysis of the trade reform policy, thus modeling TRQs can provide a more comprehensive representation of multilateral trade agreements (Skully, 1999). In trade agreements, products under TRQs are subject to a low tariff (or none) as far as they do not exceed a fixed quantity (in-quota-tariff), while imports above that quantity are charged a higher tariff (out- of quota tariff). Graphically, TRQs can be represented in Figures 4.9, Figure 4.10, and Figure 4.11.



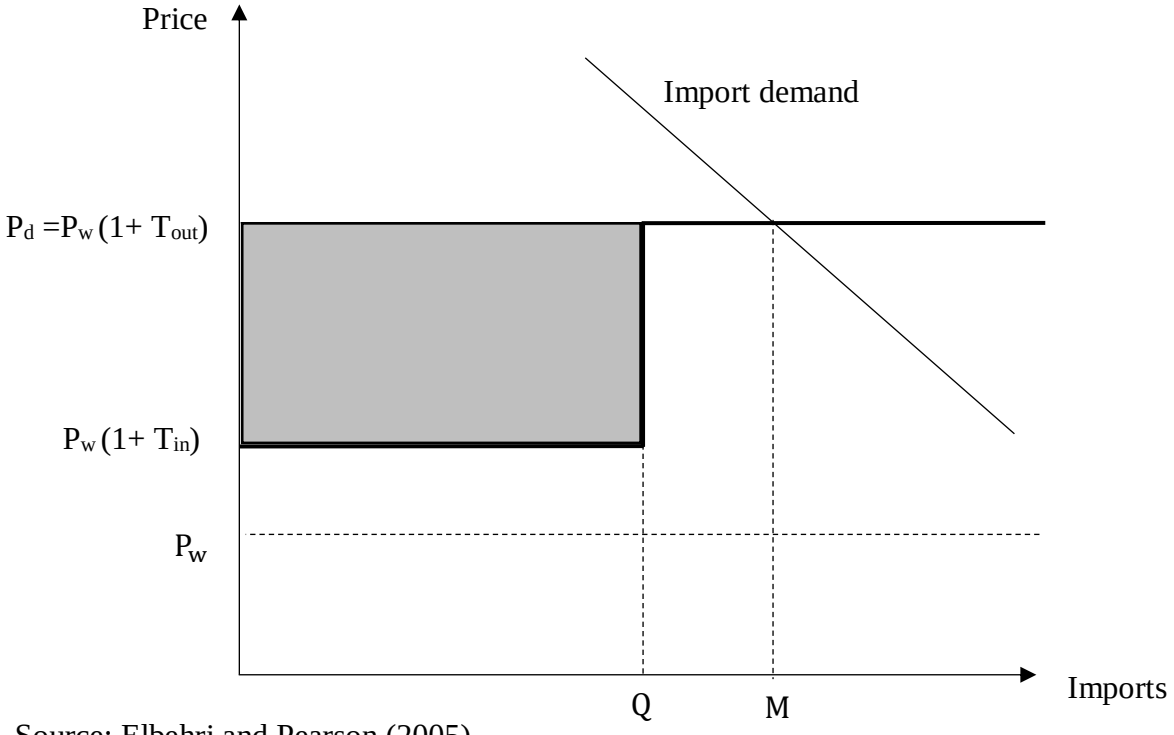
Source: Elbehri and Pearson (2005).

Figure 4.9: Tariff Rate Quota, in-quota case



Source: Elbehri and Pearson (2005).

Figure 4.10: Tariff Rate Quota, at-quota case



Source: Elbehri and Pearson (2005).

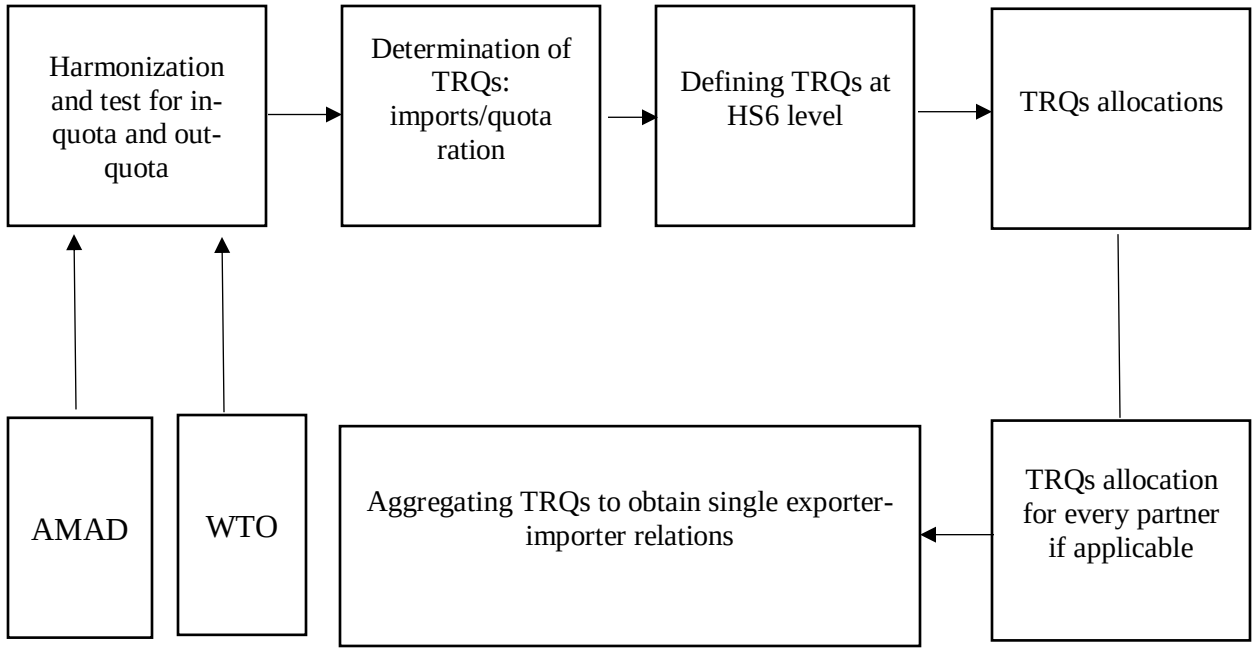
Figure 4.11: Tariff Rate Quota, out-of-quota case

In Figure 4.9, Figure 4.10 and Figure 4.11 Q represents quota, M represents imports, TRQ regime is represented by two horizontal lines. The lower line represents the in-quota imports, the upper line represents the import supply of over-quota imports, the vertical line connects the in-quota and out-of-quota segments. T_{in} and is T_{out} are in-quota and out-quota tariffs, respectively. P_w and P_d represent world price and domestic price, respectively, where domestic price is determined by the world price plus tariff. Under TRQ there are three cases: (i) imports are below quota Q (Figure 4.9) in-quota tariff will be applicable. (ii) imports are at quota Q (Figure 4.10) making the quota effective. (iii) imports above quota Q (Figure 4.11) making out-quota tariff rate effective. In at-quota and over-quota cases there are quota rents which shown by shaded areas in Figure 4.10 and 4.11 (Elbehri & Pearson, 2005).

Figure 4.9 represents the in-quota case where the imports demand is in-quota, the domestic price equals the world price plus the tariff rate. In this case, no quota rent occurs. In the second case (i.e. at-quota case) represented in Figure 4.10, the import demand intersects with import supply at its vertical portion where Q=M. In this case the domestic price (P_d)exceeds the price in the first case (i.e. in-quota case), the difference between P_d and P_w (1+ T_{in}) represents the quota rent per unit. Figure 4.11 represents the out-of-quota case where the import demand exceeds the quota. The domestic price equals the world price plus the out-of-quota tariff. The difference P_d and P_w (1+ T_{out}) represents the quota rent per unit.

Considering the wide use of TRQs in FTAs in particular for agricultural products, the analysis of the impact of a trade agreement can be biased if TRQs are neglected, specially when there is a particular interest in a sector governed by TRQs (Rae, 2001; Pelikan & Brockmeier, 2008). Thus, modeling TRQs can add a value and minimize any potential bias in the simulation. However, modeling TRQs poses significant data challenge, and many TRQs are defined beyond the HTS-6 digit that is used in GTAP model to define different tariff lines. Many studies that utilized GTAP model to simulate trade agreements, did not account for TRQs due to the aforementioned reasons and due to the fact the TRQs impact generally does not make a significant impact in overall results, unless there is a particular interest in a specific sector (e.g. Burfisher *et al.*, 2014; Lee & Itakura, 2014; Jacobs, 2016; Petri *et al.*, 2012; Cerdeiro, 2016).

The later versions of GTAP model (i.e. GTAP V.6 and newer) implicitly incorporated TRQs in the standard model. GTAP uses a consistent aggregation procedure to account for TRQs, based on combining in-quota and out-of-quota rates. Data on TRQs in GTAP model come from Agricultural Market Access Database (AMAD) (Bouët *et al*., 2006). TRQs treatment procedure in GTAP is illustrated in Figure 4.12 below.



Source: Bouët *et al*. (2006).

Figure 4.12: TRQs treatment in GTAP

As first step the fill rate is calculated which equals to the ration of imports to the quota. Based in the fill rate, the *ad valorem* rate is defined, where three market regimes are considered: (i) if the fill rate is less than 90%, quota is not binding but out-of-quota rate is prohibitive, in-quota *ad valorem* rate is chosen. (ii) if the fill rate is between 90%-99%, quota is binding, a simple average of in-quota and out-of-quota *ad valorem* rates is used. (iii) if the fill rate is higher than 99%, quota is binding, and out-of-quota rate is not prohibitive, out-of-quota *ad valorem rate* is used.

This study follows Strutt *et al.* (2015) approach in modeling TRQs, where a simplified approach to incorporate them in the analysis. Some TRQs and tariffs in the CPTPP region are high enough to be nearly prohibitive, therefore the second market regime (i.e. fill rate between 90%-99% is implemented in this study. These rates are illustrated in Appendix D.

4.3.7 Price Linkages

Prices for the same commodity all along the supply chain from producers to consumers were noted to track the effect of different economic shocks. There are seven types of prices in GTAP standard model. The model that was utilized in this study reports on bilateral export and import prices for every commodity traded between every two regions in the model. This detailed representation of prices in the multi-country CGE model allows for divergences of taxes, tariffs, and trade margin costs among different trade partners, simplifies tracking the policy shock's impact on all agents in the model, and further allows the modelers to analyze all forms of tariffs and taxes. Table 4.3 lists the prices alongside their description, and summarizes how these prices are linked in the standard GTAP model, which was utilized in this study.

Table 4.3: Prices in standard GTAP Model

Price type	Description
Producer price	Cost of production.
Consumer price	Producer price plus sales tax for domestic varieties or bilateral CIF import price plus import tariff and sales tax for import varieties.
Bilateral import price	Exporter's bilateral export price plus CIF trade margin (no tariff).
Bilateral export price	Exporter's domestic producer price plus export tax.
World import price	Trade-weighted sum of bilateral CIF import price in a specific country.
World export price	Trade-weighted sum of bilateral FoB export price in a specific country.
Global price	Trade-weighted sum of all countries' bilateral export price.

Source: Burfisher (2012).

In order to express prices in relative terms, the standard GTAP model uses an index of global wages and rents for labour, capital, and other factors as a numeraire. The numeraire in GTAP model serves as a benchmark of value against which the changes in other prices can be measured.

4.3.8 Model Closure Rules

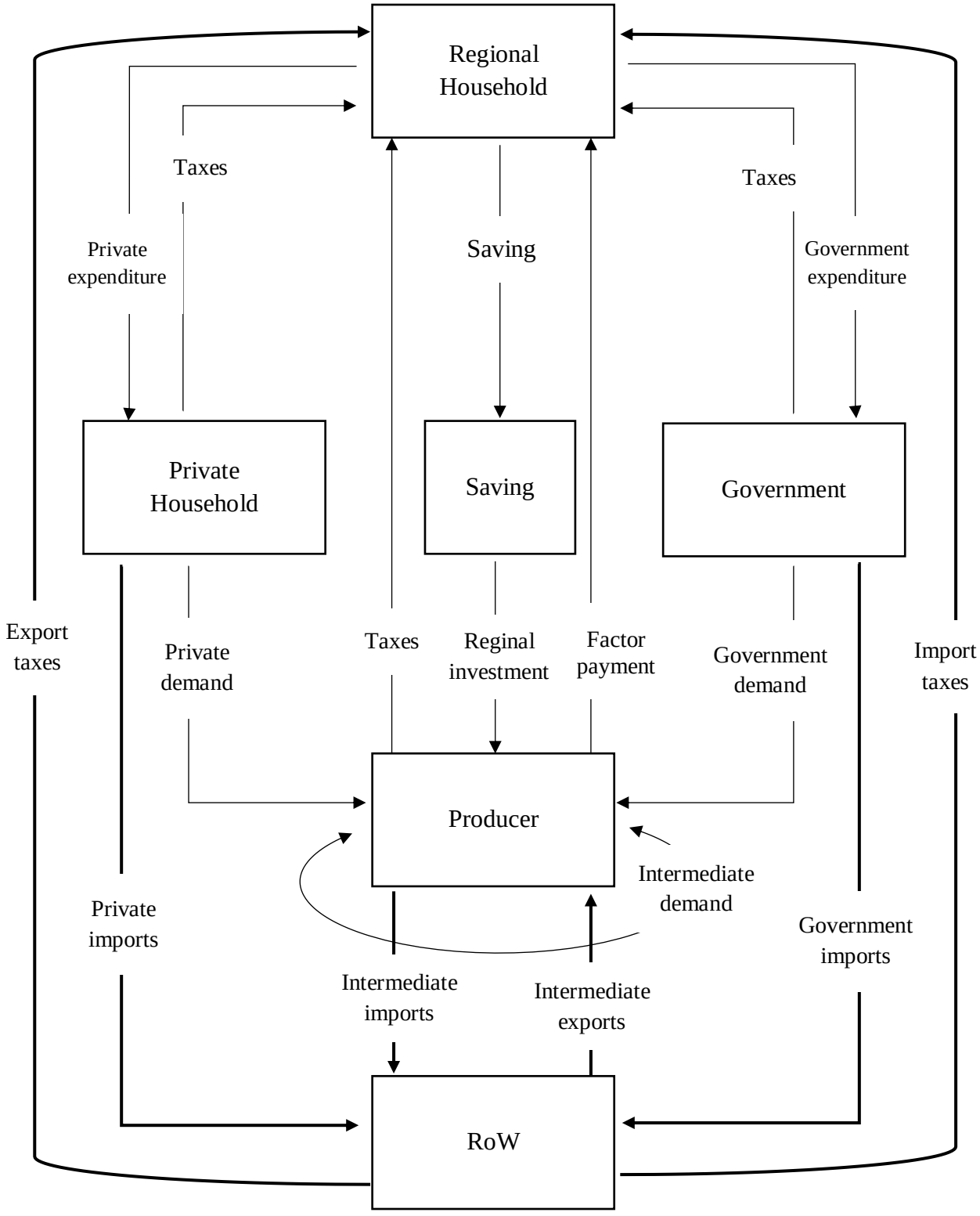
As highlighted, the choice of endogenous and exogenous variables in the model was required for model closure. This significantly impacted the results of the analysis[63]. For the study model, closures were classified as microeconomic and macroeconomic. For microeconomic closure, it was assumed that the total supply of labour, capital and land were fixed and fully-employed. Factor prices were adjusted to restore full employment in the post-shock equilibrium. In terms of macroeconomic closure, the current account was allowed to adjust to the trade reform. The changes in current account related to the changes in domestic investment, which was reflected in the final demand, and in turn affected production and trade.

4.4 Model Equations Description

The GTAP model depends on neoclassical theory where, for instance, consumers maximize their utility subject to a budget constraint and producers maximize their profit subject to a technology constraint. The model assumes a perfectly competitive market, constant returns to scale technology, and full employment. In addition, and most importantly, domestic and imported varieties are heterogeneous goods. In this subsection, economic agent behaviour under the standard GTAP model is described and provides a full description of the standard GTAP model equations. The discerption in this section was based on Burfisher (2012) and Corong *et al.* (2017).

The complicated multi-region GTAP model utilized in this study can be described graphically in Figure 4.13, using the circular flow of an economy before explaining the model equations. As shown in Figure 4.13, the starting point was the regional household account, which has a fixed endowment with primary factors of production: land, labour, and capital. Regional household collects all income through selling sales of endowment factors to producers, which yields factor payments, and in turn collects taxes from private households, domestic producers, government, and trade taxes. In turn, regional household exhausts all of this income on three sources of final demand: private expenditures, government spending and saving.

[63] In the study model, it was assumed that labour and capital are mobile across sectors, while land is immobile. Modelers can change these assumptions based on their research objectives. The implications of these assumptions have a significantly impact the results. For instance, the more inelastic the labour supply, the greater the gains achieved in terms of wage increases. Similarly, the more elastic labour supply, the greater gains achieved in terms of additional jobs.



Source: Corong *et al.* (2017).

Figure 4.13: Circular flow in the study model, based on GTAP standard model

Regional household expenditure is governed by C-D utility function. The Government in the model purchases domestic and imported commodities in order to produce public goods and government services; government behaviour is governed by C-D function. Private household purchases domestic products and imported products, is represented in the model by CDE. Finally, savings are completely exhausted on investment.

The producers combine primary and intermediate inputs to satisfy their final demand. Producers get their income from selling commodities to private households, government investment goods to the saving sector, intermediate inputs to other producers, and the RoW, where bilateral exports and imports are differentiated by destination and source region. Producers completely exhaust all their income on intermediate inputs, factor of production, taxes, and imported intermediate inputs. Finally, the RoW (which represent all trading partners in the model) sells their goods to private consumers, firms and government. The RoW account pays import and export taxes to the regional household account (Corong *et al.*, 2017).

The following subsections provide an explanation of GTAP model behavioural equations, as described by Lanz and Rutherford (2016). As mentioned, this model is static and multi-regional, tracking the production and distribution of goods in the global economy. This model is essentially based on optimizing behaviour, where consumers maximize utility subject to budget constraints, and producers' intermediate and primary inputs are subject to a given technology.

Table 4.4 summarizes the notation used in describing the model. The first panel defines the dimensions used to describe the model, such as the set of sectors, commodities, and regions. The second panel defines the primal variables used in the GTAP model. The third panel defines the price variables of goods, and factors them in the model. The last panel lists the taxes and subsidies notation.

The notation in Table 4.4 was used throughout the model equation's presentation and description in the following subsections, and thus all symbols in the equations correspond to the notation and variables in Table 4.4.

Table 4.4: Model notation and variables

Set of indices	
Index	**Description**
i,j	Sectors
r,s	Regions
f	Factors of production
Quantity variables	
Variable	**Description**
$\mathbf{C_r}$	Aggregate consumption demand
$\mathbf{G_r}$	Aggregate public demand
$\mathbf{Y_{ir}}$	Production
$\mathbf{M_{ir}}$	Aggregate imports
$\mathbf{FT_{fr}}$	Factor transformation
$\mathbf{YT_j}$	International transportation services
Prices	
Price	**Description**
$\mathbf{p_r^C}$	Consumer price index
$\mathbf{p_r^G}$	Public price index
$\mathbf{p_{ir}^Y}$	Supply price
$\mathbf{p_{ir}^M}$	Import price
$\mathbf{p_j^T}$	Marginal cost of transportation services
$\mathbf{p_{fr}^F}$	Factor price
$\mathbf{p_{fir}^S}$	Price of sector-specific primary factors
Taxes and subsidies	
Tax/subsidy	**Description**
$\mathbf{t_{ir}^O}$	Output taxes
$\mathbf{t_{fjr}^f}$	Factor taxes
$\mathbf{t_{ijr}^{fd}}$	Intermediate input taxes on domestic intermediates
$\mathbf{t_{ijr}^{fi}}$	Intermediate input taxes on imported intermediates
$\mathbf{t_{ir}^{pd}}$	Consumption taxes on domestic
$\mathbf{t_{ir}^{pi}}$	Consumption taxes on imports
$\mathbf{t_{ir}^{gd}}$	Public demand taxes (domestic)
$\mathbf{t_{ir}^{gi}}$	Public demand taxes (imports)
$\mathbf{t_{is}^{xs}}$	Export subsidies
$\mathbf{t_{isr}^{ms}}$	Import tariffs

4.4.1 Accounting Flows

This subsection describes the accounting flow in the model. For all sectors, commodities and markets supply equals demand and this is a flow to different agents. Starting with domestic production (vom_{ir}), this production is distributed to exports ($vxmd_{irs}$), international transportation services (vst_{ir}), intermediate demand ($vdfm_{ijr}$), household consumption ($vdpm_{ir}$), investment ($vdim_{ir}$), and government consumption ($vdgm_{ir}$). This flow can be described in the following equation:

$$vom_{ir} = \sum_{s} vxmd_{irs} + vst_{ir} + \sum_{j} vdfm_{ijr} + vdpm_{ir} + vdgm_{ir} + vdim_{ir} \qquad (4.1)$$

In the similar fashion, total imported goods (vim_{ir}), was used for intermediate demand ($vifm_{jir}$), private consumption ($vimp_{ir}$), and public consumption ($vigm_{ir}$). This flow can be described as:

$$vim_{ir} = \sum_{j} vifm_{jir} + vimp_{ir} + vigm_{ir} \qquad (4.2)$$

Inputs to produce Y_{ir} include intermediate inputs (both domestic and imported), factors of production (both mobile factors of production (vfm_{fir}), and sluggish factors of production (vfr_{fir}); the value of mobile factors were paid as factor income ($evom_{fr}$). This flow can be described as:

$$\sum_{i} vfm_{fir} = evom_{fr} \qquad (4.3)$$

For the international market, the clearing condition requires that region *r* exports of good *i* (vxm_{ir}) equals the total imports of this good in all trading partners' markets ($vxmd_{irs}$). This can be shown as:

$$vxm_{ir} = \sum_{s} vxmd_{irs} \tag{4.4}$$

In similar fashion to the international clearance, international transportation requires that the sum of all regions of service experts (vst_{ir}) equals the sum of all trade flows of service inputs ($vtwr_{jisr}$). This can be shown as:

$$\sum_{r} vst_{ir} = \sum_{isr} vtwr_{jisr} \tag{4.5}$$

With regards to the tax flow in the model, each region's taxes consists of indirect taxes: on production ($\mathcal{R}_{ir}^{Y}$), consumption tax ($\mathcal{R}_{r}^{C}$), public demand ($\mathcal{R}_{r}^{G}$), imports ($\mathcal{R}_{ir}^{M}$), and direct taxes on households ($\mathcal{R}_{r}^{HH}$). With this flow in mind, the regional budget then can be represented as:

$$vom_{Cr} + vom_{Gr} + vom_{Ir} = \sum_{f} evom_{fr} + \sum_{i} \mathcal{R}_{ir}^{Y} + \mathcal{R}_{r}^{C} + \mathcal{R}_{r}^{G} + \mathcal{R}_{r}^{HH} + \sum_{i} \mathcal{R}_{ir}^{M} + vb_{r} \tag{4.6}$$

In equation 4.6, ($evom_{fr}$) refers to factor income, and (vb_{r}) to the net transfer from abroad to region r. This equation shows that the total private consumption expenditure (vom_{Cr}), total public consumption expenditure (vom_{Gr}), and total investment (vom_{Ir}) equals the sum of factor income, taxes, and transfer from abroad.

Equations 4.1- 4.6 show the market clearance (supply = demand) and income balance (net income = net expenditure). The following set of equations shows the net operating profit of all sectors. Production is assumed to take place under perfect competition with constant return to scale technology, thus the cost of inputs equals the value of outputs. This can be represented in the following set of equations:

$$Y_{ir}: \sum_{f} vfm_{fir} + \sum_{j} \left(vdfm_{ijr} + vifm_{ijr}\right) + \mathcal{R}_{ir}^{Y} = vom_{ir} \tag{4.7}$$

$$M_{ir}: \sum_{s} \left[vxmd_{isr} + \sum_{j} vtwr_{jisr} \right] + \mathcal{R}_{ir}^{M} = vim_{ir} \tag{4.8}$$

$$C_r: \sum_{i} (vdfm_{iCr} + vifm_{iCr}) + \mathcal{R}_{ir}^{C} = vom_{Cr} \tag{4.9}$$

$$G_r: \sum_{i} (vdfm_{iGr} + vifm_{iGr}) + \mathcal{R}_{ir}^{G} = vom_{Gr} \tag{4.10}$$

$$I_r: \sum_{i} vdfm_{iIr} = vom_{Ir} \tag{4.11}$$

$$FT_{fr}: evom_{fr} = \sum_{i} vfm_{fir} \tag{4.12}$$

4.4.2 Agents Behavior

This subsection presents the equations that characterize the behaviour of agents in the model. The agents in the model optimize their behaviour based on the neoclassical economic theory. This subsection shows the optimization problems for each component in the model, which includes production, demand and trade.

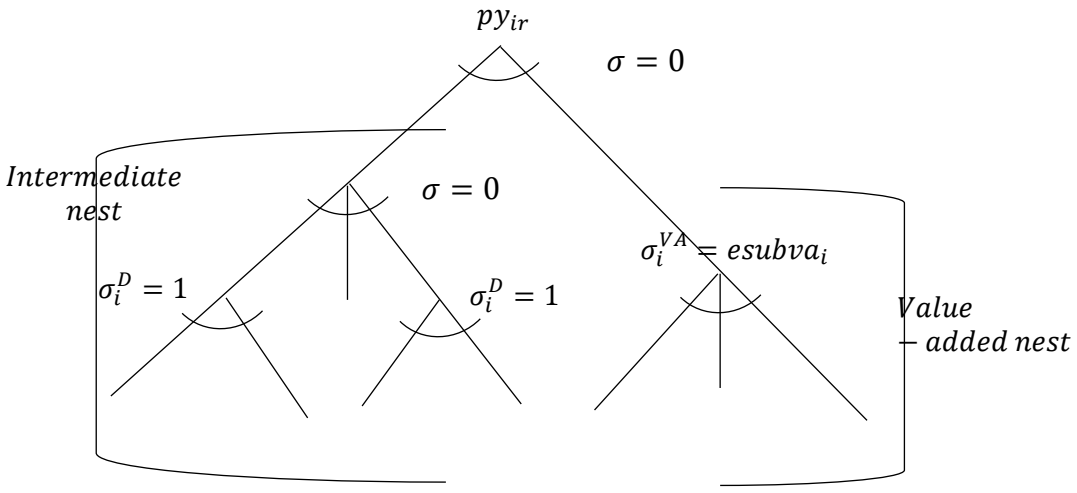
4.4.2.1 Production

Producers minimize cost subject to technical constraints. The producer's problem can then be presented as:

$$\begin{aligned} &\min_{difm,ddfm,dfm} C_{ir}^{D} + C_{ir}^{M} + C_{ir}^{F} \\ &\boldsymbol{s.t.} \quad C_{ir}^{D} = \textstyle\sum_j p_{jr}^{Y}\left(1 + t_{jir}^{fd}\right) ddfm_{jir} \\ &\qquad C_{ir}^{M} = \textstyle\sum_j p_{jr}^{M}\left(1 + t_{jir}^{fi}\right) difm_{jir} \\ &C_{ir}^{F} = \textstyle\sum_f \left(pf_{fr} + ps_{fir}\right)\left(1 + t_{jir}^{f}\right) dfm_{fir} \\ &\qquad Y_{ir} = F_{ir}(ddfm, difm, dfm) \end{aligned} \tag{4.13}$$

Where $F(.)$ is the production function described by nested CES form, (d) in all variables stands for decision. For instance, $(vdfm_{ijr})$ refers to benchmark data on intermediate demand for good j used in producing good i in region r, $(ddfm_{jir})$ in equation 4.14 represents the corresponding decision variable.

Figure 4.13 describes the CES for production, whereby σ represents the elasticity of substitution between intermediate and value-added nests, σ_i^D denotes the elasticity of substitution between domestic and imported intermediate inputs, and σ_i^{VA} relates to the elasticity of substitution in the value-added nest.



Source: Lanz and Rutherford (2016).

Figure 4.14: Nested structure for production

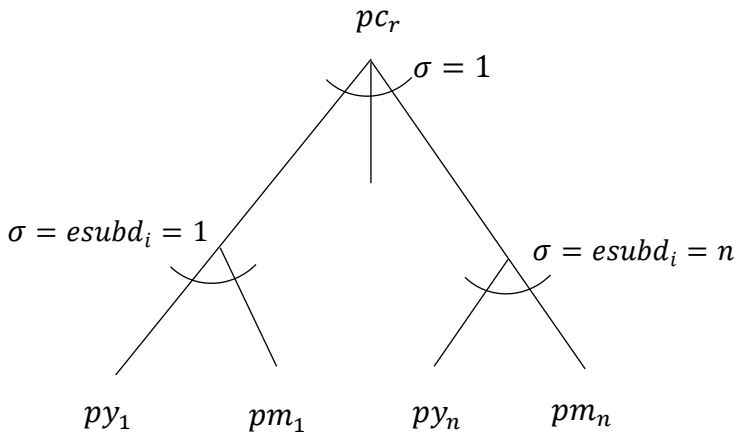
4.4.2.2 Private and Public Consumption

Private consumption in the model is modeled by minimization of the cost of the given level of consumption, such as:

$$\min_{ddpm,dipm} \sum_i py_{ir}\left(1 + t_{ir}^{pd}\right)ddpm_{ir} + pm_{ir}\left(1 + t_{ir}^{pi}\right)dipm_{ir} \qquad (4.14)$$

$$\boldsymbol{s.t.} \quad C_{ir} = H_r(ddpm, dipm)$$

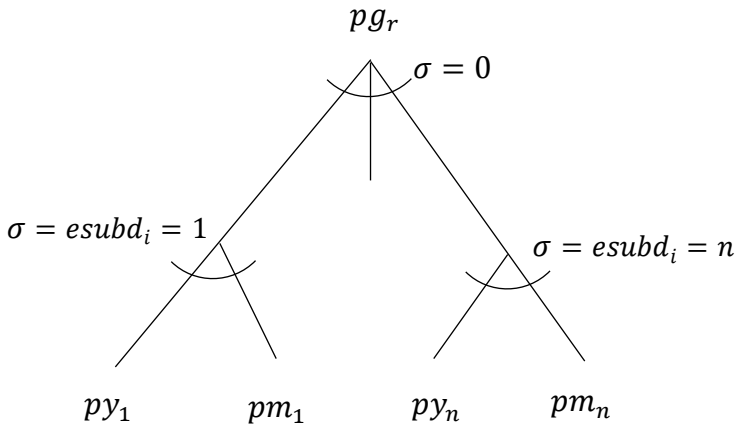
Where $H(.)$ represents the final demand which includes domestic and imported products for final use, and is described by C-D CES function shown in Figure 4.15, each product has different elasticity of substitution.



Source: Lanz and Rutherford (2016).

Figure 4.15: Nested private consumption

Public consumption is modeled as a fixed coefficient Leontief aggregation, where the substitution happens at the second level between domestic and imported goods, while the sectoral commodity aggregate is kept constant. Figure 4.16 illustrates this form.



Source: Lanz and Rutherford (2016).

Figure 4.16: Public consumption

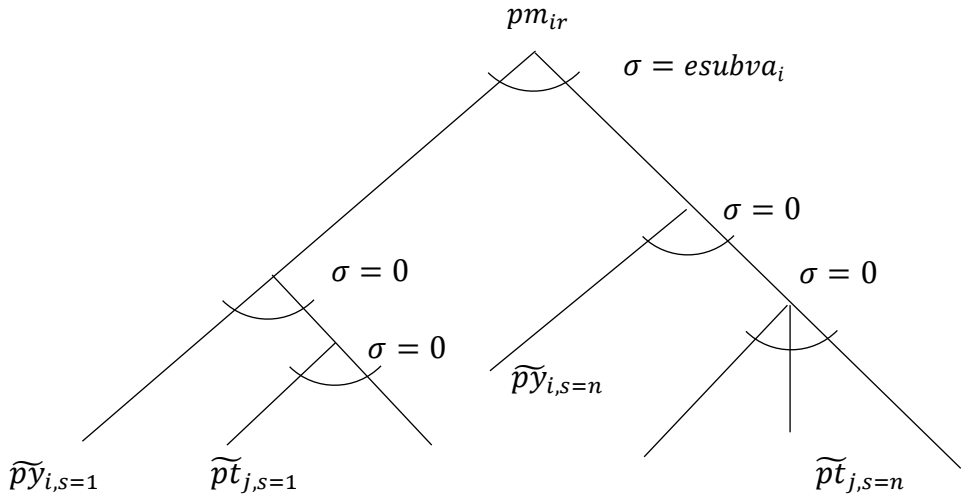
4.4.3 Trade

Imports from different sources is based on Armington regional differentiation. This can be represented by the following cost minimization problem:

$$\min_{dxmd,dtwr} \sum_{s} \left(1 + t_{jsr}^{ms}\right) \left[py_{is}(1 - t_{isr}^{xs}) dxmd_{isr} + \sum_{j} pt_j dtwr_{jisr} \right] \tag{4.15}$$

$$\boldsymbol{s.t.} \quad M_{ir} = A_{ir}(dxmd,\ dtwr)$$

Where $A(.)$ is the import aggregation function which can be described by CES-Leontief function, as shown in Figure 4.17. In this figure, $\widetilde{py}_{i,s} = py_{i,s}(1 - t_{isr}^{xs})(1 + t_{isr}^{ms})$ and $\widetilde{pt}_{j,s} = pt_{i,s}(1 - t_{isr}^{xs})$, which indicates that trade flow is subject to export subsidies and import tariffs.



Source: Lanz and Rutherford (2016).

Figure 4.17: Armington aggregation of traded goods

4.4.4 Sector-Specific Factors

In the standard GTAP model, land and natural resources are considered as sector-specific factors. These factors of production are supplied through the CET production function. The supply of sector-specific factors is modeled as the following profit-maximization problem:

$$\max_{dfm} \sum_{j} dfm_{sji} ps_{sji} \tag{4.16}$$

$$\boldsymbol{s.t.} \quad \Gamma_{sr}(dfm) = evom_{sr}$$

Where Γ_{sr} is the CET function.

4.5 Description of Study Models

The GTAP model is flexible in terms of level of disaggregation. This section describes the national and subnational model in terms of disaggregation and trade relationships. In the national model, Canada has trade partners that include the CPTPP countries, the US, and RoW. In terms of model focus, the model is an agricultural-focused model, where agricultural products are disaggregated into many subsectors. The factors of production are disaggregated into three factors: land, labour and capital. In addition, small country assumption is imposed on the model. The Subnational model is similar to the national one in terms of disaggregation, focus, and factor of production; however, trade partners for Saskatchewan include RoC in addition to the CPTPP countries, the US and RoW. Table 4.5 summarizes the main components of the national CGE models.

Table 4.5: Study CGE Models elements

Element	Description
Regional aggregation	13 regions[1]: Canada, Australia, Brunei-Darussalam, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the US, Vietnam, and RoW, and adding RoC in the sun-national model.
Production factors	Labour, land, and capital.
Sectors	15 sectors: Rice, Wheat, Other grains, Fruits/vegetables, Other oilseeds Other crops, Livestock, Meat products, Processed foods, Raw milk, Dairy products, Extractions, Labour-intensive manufacturing, Capital-intensive manufacturing, Services.
Agents	Household, producer, government, and regional household[2].
Exogenous variables	World price index for primary factors, Endowments distribution parameters for savings, government and private consumption and population, Slack variables for consumer goods, endowments, income, profits, savings price and tradable market clearing
Endogenous variables	Quantities of all domestic goods, Prices of all domestic goods, Quantities of all imports, Prices of all imported goods.

[1]: The national model includes 13 regions, while the subnational model includes 14 regions.
[2]: Regional household is a macroeconomic account similar to the GDP, except it does not account for depreciation. Regional household in the model basically collects all income generated in the economy such as trade tax, sales tax, income tax, and factor income. All of these collections go to the private household, government, and saving.

The national model accounts for two types of trade: That with the CPTPP countries and the US, and RoW, while the subnational model accounts for three types of trade: RoC, CPTPP countries and the US, and RoW trade. This unique structure of the model allows for better understanding of the CPTPP agreement impact on the Saskatchewan economy as separated from the RoC. The matrix in Table 4.6 shows the theoretical framework of trade interaction in the national and subnational models.

Table 4.6: Trade interactions in the national and subnational CGE models

	Canada	**CPTPP countries and US (11)**	**RoW**
Canada		Canada imports from CPTPP countries/US and exports to CPTPP counties/US	Canada imports from RoW and exports to RoW
CPTPP countries and US (11)	CPTPP countries/US import from Canada and export to Canada		CPTPP countries/US imports from Canada and exports to Canada
RoW	RoW imports from Canada and exports to Canada	RoW imports from TPP countries and exports to TPP countries	

	Saskatchewan	**RoC**	**TPP countries and US (11)**	**RoW**
Saskatchewan		RoC imports from Saskatchewan and exports to Saskatchewan	TPP countries/US imports from Saskatchewan and exports to Saskatchewan	RoW imports from Saskatchewan and exports to Saskatchewan
RoC	Saskatchewan imports from RoC and exports to RoC		CPTPP countries/US imports from RoC and exports to RoC	RoW imports from RoC and exports to RoC
CPTPP countries and US (11)	Saskatchewan imports from CPTPP countries/US and exports to CPTPP countries/US	RoC imports from CPTPP countries/US and exports to CPTPP counties/US		RoW imports from CPTPP countries/US and exports to CPTPP countries/US
RoW	Saskatchewan imports from RoW and exports to RoW	RoC imports from RoW and exports to RoW	CPTPP countries/US imports from RoW and exports to RoW	

For each trading partner, its database contains trade flow among regions. The model was designed to capture impacts of the CPTPP/TPP agreements on all CPTPP member countries and the US; however, it is a Canada-oriented model, where the focus is on Canada with a small focus on the economies of other trading partners.

4.5.1 Regional Aggregation

The national model simulation of the impact of trade reform under CPTPP was conducted with the global economy disaggregated into 13 regions. The regional disaggregation included the 11-CPTPP countries and the US individually, plus the RoW region, which included all other trading countries. Regions in the model are linked through bilateral trade flows. Trading flow in the model explicitly accounts for transportation and marketing costs. The subnational model had a higher level of disaggregation, where Saskatchewan and RoC were treated as separate regions.

4.5.2 Sectoral Disaggregation

The study model is agriculturally-focused. the agricultural and food sectors were disaggregated into 11 sectors, as shown in Table 4.7. The disaggregation was developed to reduce the aggregation bias in estimating trade impact focused on agricultural and food commodities. The non-agricultural, non-resources sectors were aggregated into extractions, labour-intensive manufacturing (which included textile, wearing apparel, transports, and machinery equipment), capital-intensive manufacturing (comprised of chemical, rubber, plastic products, mineral, and other products), and services sector (which included water, construction, trade, transport, sea and air transport, communication, financial services, insurance, business services, recreation and other services). Sectoral disaggregation is applicable to both national and subnational models. The details of sectoral disaggregation are illustrated in Table 4.7. Full disaggregation of GTAP Database V.9 is available in Appendix C.

4.6 Subnational Model Construction

This study refers to the provincial level analysis as a subnational analysis. In a federation such as Canada, understanding economic impact of trade reform for individual provinces has some merits since these changes may be different. This section describes Saskatchewan's CGE subnational model, including the methodology of building it, the subnational database construction, and the theoretical structure in the national GTAP model to adapt for subnational modeling. This model builds on and extends a regionalized model for Italy developed by Standardi (2013), which has been basically used to analyze the climate change's economic impact, and the environmental policies' shocks on more detailed geographical areas within a country.

Table 4.7: Sectoral disaggregation in the national and subnational models

Name	Description	Code in the model
Rice	Paddy and processed rice	prd pcr
Wheat	Wheat	wht
Other grains	Other grains not elsewhere classified	gro
Fruits/vegetables	Fruits and vegetables	f_v
Other oilseeds	Oilseeds	osd
Other crops	Sugar cane and sugar beet, plant-based fibers, and other crops not elsewhere classified	c_b pfp ocr
Livestock	Bovine animals, hogs, poultry and eggs, and other animals	ctl oap wol
Meat products	Bovine, pork, poultry, and other meat products	cmt omt
Processed foods	Raw and refined sugar, and vegetable oils and fats, other food, feed, and beverage products	sgr vol ofd b_t
Raw milk	Raw milk	rmk
Dairy products	Whey, non-fat and whole milk powders, butter, fats, oils and substitutes, cheese, and fluid milk and products	mil
Extractions	Forestry, fishing, coal, oil, gas, and minerals	frs fsh coa oil gas omn
Labour-intensive manufacturing	Textile, wearing apparel, leather products, wood products, metal products, motor vehicles and parts, transport equipment, electronic equipment, machinery and equipment, manufacturers not elsewhere classified	tex wap lea lum fmp mvh otn ele ome omf
Capital-intensive manufacturing	Paper products and publishing, petroleum and coal products, chemical, rubber, and plastic products, mineral products not elsewhere classified, ferrous metals, metals not elsewhere classified	ppp p_c crp nmm i_s nfm
Services	Electricity, gas manufacture distribution, water, construction, trade, transport not elsewhere classified, sea and air transport, communication, financial services, insurance, business services, recreation and other services, public administration, defence, health, education, dwellings	ely gdt wtr cns trd otp wtp atp cmn ofi isr obs ros osg dwe

4.6.1 Background

In principle, there are many different approaches to estimate the impact of a policy at the subnational level. These approaches vary from simple to more complicated. In applied regional economic analysis, there are three commonly-used approaches to assess economic impacts resulting from trade reform on a specific region within a large economy:

i. Disaggregation of the national model, where each commodity is disaggregated between regions based on their respective volume of production. In this approach, I-O tables and other sources of economic data are used. This is a direct approach, where the standard national model can be used to assess the economic impact on the subnational level, with a minimal data requirement. The major drawback of this approach is the inability to capture the internal trade flow. This approach has often been used to split different sectors at the national level to have deeper and more focused analyses (e.g. Burfisher *et al.*, 2014; Tariq *et al.*, 2012; Taheripour *et al.*, 2017). Other similar approaches have been suggested in the literature, such as the one developed by Winters (2002), Huang *et al.* (2003), and Qiao *et al.* (2003), to link macro results to a subnational level by translating national results derived from a national level to a regional level by using a price transmission coefficient, and employment expansion coefficient.

ii. The Leontief, Morgan, Polenske, Simpson and Tower method, developed by Leontief *et al.* (1965). This approach was originally developed to evaluate the effect of a hypothetical reduction in military compensation on non-military demand in industrial compensation, and regional distribution of employment in the continental US. However, it can also be used to disaggregate national model results to the provincial level, and generate results for commodities and other indicators. This approach is simple in principle, and can be described in two steps: (i) Using national I-O table and calculations to determine the direct and indirect effects of the given shock/policy reform at a national level; and (ii) the regional distribution of the impact is then determined by tracking all basic information in the I-O structure of each national industry at a regional level. The data requirement for this method is modest, but more demanding than the previous method. Similar to the previous method, the main limitation of this approach is its inability to capture the interregional trade flows, or to account for trade specialization of different regions within a country.

iii. Building a separate regional/subnational CGE model, where the country is split into multiple regions. Multiple approaches have been used for this approach: region-specific, bottom-up, or a partial or hybrid approach[64].

For the purposes of this study, a separate subnational CGE model for Saskatchewan was developed, in which Canada was divided into two regions: Saskatchewan, and RoC at the macro level. In other words, Saskatchewan was separated from the RoC and treated as a separate entity. The GTAP model was selected for subnational analysis to ensure consistency with the national analysis, and also because it is global and rich with data that can be utilized for such analysis. Since the structure of the GTAP database and model do not allow for regional aggregation at lower than national level, the model needed to be modified to meet the subnational analysis objectives. Treating Saskatchewan as a separate entity from Canada was complicated and data-demanding. However, this method provided more details including its ability to capture the internal (or interprovincial) trade flow.

4.6.2 Subnational Database Development

Subnational database-building depends on GTAP Database V.9. As noted, Canada was represented as one region in the GTAP model; the GTAP database was split into Saskatchewan, RoC, CPTPP countries and the US, and RoW. Splitting Canada database into Saskatchewan and RoC[65] required detailed data about the province's value-added, labour, resources, and trade. To this end, this study utilized Canada's national database as reported in the GTAP, and regionalized it to represent Saskatchewan and RoC. The data that was necessary for this study was collected from the following sources: (i) Sectoral outputs data adopted from Statistics Canada, Tables 381-0031 and 001-0017 (CANSIM database); and (ii) Saskatchewan trade data, available from Statistics Canada and Industry Trade Canada Online, provide information on Canada and Saskatchewan trade flow. The data was adopted from Table 386-0003 (CANSIM database).

4.6.2.1 Value-Added Side

The first step of regionalizing Canada's national database and splitting it into two regions consisted of dealing with Canada's national level in the original GTAP database. To this end, this

[64] See section 2.7 for full description on regional CGE models.
[65] For the purposes of this research, this study refers to the splitting of the data process as regionalizing the database.

study matched production data of the sectors available via Statistics Canada with the 15 sectors in the study model (see Table 4.7), and then divided each sector between Saskatchewan and RoC using the shares obtained from Statistics Canada CANSIM database (Tables 381-0031 and 001-0017). These proportional splits were then utilized as a proxy to regionalize the GTAP Canada database into Saskatchewan and RoC. Table 4.8 presents the percentage share of each sector in Saskatchewan and RoC.

Table 4.8: Sectoral split between Saskatchewan RoC (%)

Sector	RoC	Saskatchewan
Rice	100.00	0.00
Wheat	54.41	45.59
Other grains	79.00	21.00
Fruits/vegetables	96.94	3.06
Oilseeds	59.95	40.05
Other crops	79.69	20.31
Livestock	85.86	14.14
Meat products	84.92	15.08
Raw milk	97.78	2.22
Dairy products	97.24	2.76
Processed foods	96.01	3.99
Extraction	83.08	16.92
Labour-intensive manufacturing	97.27	2.73
Capital-intensive manufacturing	97.27	2.73
Services	96.86	3.14
Total	95.58	4.42

Source: Statistics Canada, CANSIM database, Table 381-0031 and Table 001-0017 (2017).

4.6.2.2 Interprovincial Trade Flow

The second major step of building a subnational database for Saskatchewan was determining the bilateral trade flow between Saskatchewan and RoC, and international countries. The detailed Canadian statistics helped in determining the interprovincial trade between provinces. It is common in regional economic research to use the gravity model approach to estimate the trade flow following the gravity equation as in physics (see Horridge & Wittwer, 2010; Dixon *et al.*, 2012); however, this approach does not always provide accurate outputs, as the there are many variables omitted that play an important role in determining trade across regions. The transportation data approach is another common method to depict the intranational trade in regional economic literature. For example, Chintrakarn and Millimet (2006) and Canning and

Tsigas (2000) utilized this approach to obtain trade flow across US states, and Dube and Lemelin (2005) used the transport data and integrated it with the economic data about exports and imports to estimate the trade flow of Quebec to estimate intranational trade flow. For the purposes of this study, the interprovincial trade data available via Statistics Canada[66] was utilized to depict the national trade flow. To ensure that the trade flow is consistent, this study utilized SplitReg and Splitadjust utilities developed by Horridge (2011).

The provincial production could be used domestically (within the province), exported nationally, or exported internationally. The approach of this study can be represented as follows: Assume that Y_{CAN} is the sectoral GTAP Canadian production that is used domestically, i.e., net of international trade, Π is a share matrix estimated using Statistics Canada data (each sector in the model is represented in a share matrix). Where the row in the matrix represents the origin subnational region, and the column corresponds to the destination subnational region, the shares π are used to split Y_{CAN} between domestic subnational demand and bilateral trade across the regions within the country, i.e., Saskatchewan and RoC. For example, assume that Table 4.9 represents share matrix of one sector in the model, and D is the subnational demand.

Table 4.9: Share matrix example

	Saskatchewan	RoC	Total
Saskatchewan	π_{11}	π_{12}	$\Pi_{1.}$
RoC	π_{21}	π_{22}	$\Pi_{2.}$
Total	$\Pi_{.1}$	$\Pi_{.2}$	1

IMP and EXP represent subnational imports and exports from and to other subnational region. The subnational figures for Saskatchewan were computed as follows:

$$(\pi_{11} + \pi_{21}).\mathrm{Y_{CAN}} = \mathrm{D_{Saskatchewan}} \tag{4.17}$$

$$\pi_{12}.\mathrm{Y_{CAN}} = \mathrm{EXP_{Saskatchewan}} \tag{4.18}$$

$$\pi_{21}.\mathrm{Y_{CAN}} = \mathrm{IMP_{Saskatchewan}} \tag{4.19}$$

Table 4.10 and Table 4.11 report on Saskatchewan's imports and exports based on the model calculations.

[66] Statistics Canada, CNSIM Database, Table 386-0003 (2017)

Table 4.10: Saskatchewan imports by region based on the model calculation (million USD)

	Country/region[2]												
Sector[1]	**AU[2]**	**BN**	**RoC**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.03
Wheat	0.00	0.00	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Other grains	0.00	0.00	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.82	0.03
Fruits/vegetables	0.01	0.00	5.80	0.85	0.00	0.01	10.29	0.04	0.64	0.00	0.14	57.25	6.05
Oilseeds	0.00	0.00	82.00	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.92	0.38
Other crops	0.03	0.00	31.56	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	3.07	1.03
Livestock	0.37	0.00	138.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	556.41	11.97
Meat products	0.00	0.00	52.56	0.01	0.00	0.00	0.00	0.00	0.13	0.00	0.00	71.38	0.07
Raw milk	0.00	0.00	2.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dairy products	0.00	0.00	4.62	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	2.35	0.02
Processed foods	37.87	0.00	215.87	21.15	0.46	8.80	14.95	1.00	0.15	0.01	0.99	2,700.00	225.51
Extraction	0.06	0.00	1,396.00	0.01	0.00	0.00	0.04	0.00	0.00	0.00	0.00	217.82	0.64
Labour-intensive manufacturing	0.87	0.00	5,107.00	0.17	50.35	10.06	122.31	1.03	0.55	0.68	3.03	3,240.50	583.06
Capital intensive manufacturing	2.93	0.00	1,506.00	0.19	10.64	0.53	11.63	0.71	0.04	2.49	0.57	3,224.80	234.55
Services	23.11	0.58	215.20	5.49	40.55	27.53	3.72	4.86	3.17	44.71	4.82	967.92	1,622.15

[1]: Saskatchewan subnational model data, based on GTAP V.9 database, 2011 reference year as calculated using share matrices.
[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

Table 4.11: Saskatchewan export by region based on the model calculation (Million USD)

	Country/region[2]												
Sector[1]	**AU**	**BN**	**RoC**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	125.95	2.30	33.45	0.99	13.19	0.01	10.05	0.85	0.26	34.83	253.53
Other grains	0.00	0.00	82.61	1.80	110.40	0.10	66.25	0.10	2.21	0.00	1.11	307.18	211.59
Fruits/vegetables	1.20	0.00	4.10	15.36	7.74	7.14	40.25	0.18	35.53	0.32	0.71	63.09	2,275.12
Oilseeds	1.01	0.00	176.46	0.53	761.86	0.09	482.77	0.05	1.68	0.77	6.67	305.57	1,285.07
Other crops	0.02	0.00	125.17	0.02	7.16	0.00	18.45	0.00	0.00	0.16	0.00	3.81	21.98
Livestock	0.00	0.00	1,030.43	2.49	6.45	0.00	0.23	0.00	0.68	0.00	3.39	281.19	63.46
Meat products	0.01	0.00	30.27	0.01	2.21	0.00	2.83	0.03	0.00	0.00	0.09	21.65	14.64
Raw milk	0.00	0.00	4.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
Dairy products	0.00	0.00	9.41	0.20	2.57	0.00	0.06	0.00	0.13	0.01	0.00	9.60	1.74
Processed foods	0.00	0.00	16.61	4.86	301.26	0.00	1.36	0.00	0.95	0.01	0.00	854.33	33.06
Extraction	0.17	0.00	2,631.00	0.00	1.21	0.00	0.18	0.00	0.00	0.00	0.00	6,136.40	3.42
Labour-intensive manufacturing	0.78	0.00	1,216.93	0.66	0.95	17.81	5.58	5.06	1.82	12.42	4.91	689.61	487.42
Capital intensive manufacturing	18.58	0.00	2,814.63	1.91	1.69	0.50	2.95	1.37	0.53	0.08	0.76	477.45	181.56
Services	23.01	0.95	469.65	6.73	60.41	21.03	4.09	1.74	2.62	121.66	5.06	870.77	1,295.41

[1]: Saskatchewan subnational model data, based on GTAP V.9 database, 2011 reference year as calculated using share matrices.
[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

4.6.2.3 International Trade Flow

The international trade flow with other regions in the model is less data-demanding. The trade was split based on the database available via Government of Canada, Innovation, Science and Economic Development Canada, adopted from Statistics Canada. This database included the international trade at the provincial level by product using HS code. A similar approach of splitting the interprovincial trade in subsection 4.6.2.2 was utilized to split the international trade of Saskatchewan and RoC.

4.6.3 Model Structure

The subnational model has some differences from the standard national GTAP model to account for the nature of the model. For example, in the national model (as most of CGE models) some factor endowments cannot move outside the region (country); however, this strong assumption is unlikely to happen in the subnational model, as labour and capital can allocate easily within a country, but not between different countries. In the same context, the value of trade Armington elasticities between regions in the model are basically set for international trade between countries; however, trade within a country requires different Armington elasticities to allow for more mobile trade between regions within a country than between countries. The empirical evidence found in the literature (e.g. McCallum, 1995) shows that what so-called border effects should be taken into the account in subnational analysis. All of these differences require modifying the functional structure in the subnational model to match the nature of the subnational analysis, and detailing the data originally available at the national level to the subnational scope.

To account for these differences between national and subnational models, this study introduces two main structural improvement. Firstly, through the CET function where labour and capital mobility within Canada was altered, thus labour and capital could move freely within Canada - unlike the national model structure, where labour and capital were modeled as immobile factors. Secondly, a new Armington nest for the subnational regions was added to account for the fact that products are closer substitutes within Canada compared to other regions in the model. It was easier to substitute domestic products with national product rather than with foreign products. However, these changes required altering the standard GTAP model equations and elasticities, as described in section 4.4.

4.6.3.1 Factors Mobility in Subnational Model

In the national Model, the value-added is a function of land, labour and capital. While land is a sluggish factor, labour and capital are perfectly mobile across the sectors, but are immobile across countries. In the subnational model, the assumption of the mobility among sectors was kept similar to the national model: the labour and capital mobility was altered inside Canada and was assumed to be imperfectly mobile within the country, but immobile for the other regions in the model.

To model this assumption, this study altered the original CET in the GTAP standard model (Standardi, 2013) in order to allow for the imperfect national mobility of land and capital within Canada. The first order conditions of the CET and the formula to determine Canada's price of endowment are given in the group of equations 4.52 to 4.55, where QL, QK, PL, and PK represents the quantity of labour and capital, and their associated prices, respectively. The variables CAN and SK are the Canadian aggregation index and Saskatchewan aggregation index, respectively. The parameters σ_L and σ_K are the elasticity of substitution of the endowment supply, which is technically the measure of mobility, where increasing the absolute value of these parameters would increase the factor mobility within Canada, represented by the elasticity of substitution parameter in the standard GTAP model.

$$QL_{SK} = QL_{CAN}\left(\frac{PL_{CAN}}{PL_{SK}}\right)^{\sigma_L}, \sigma_L < 1 \tag{4.20}$$

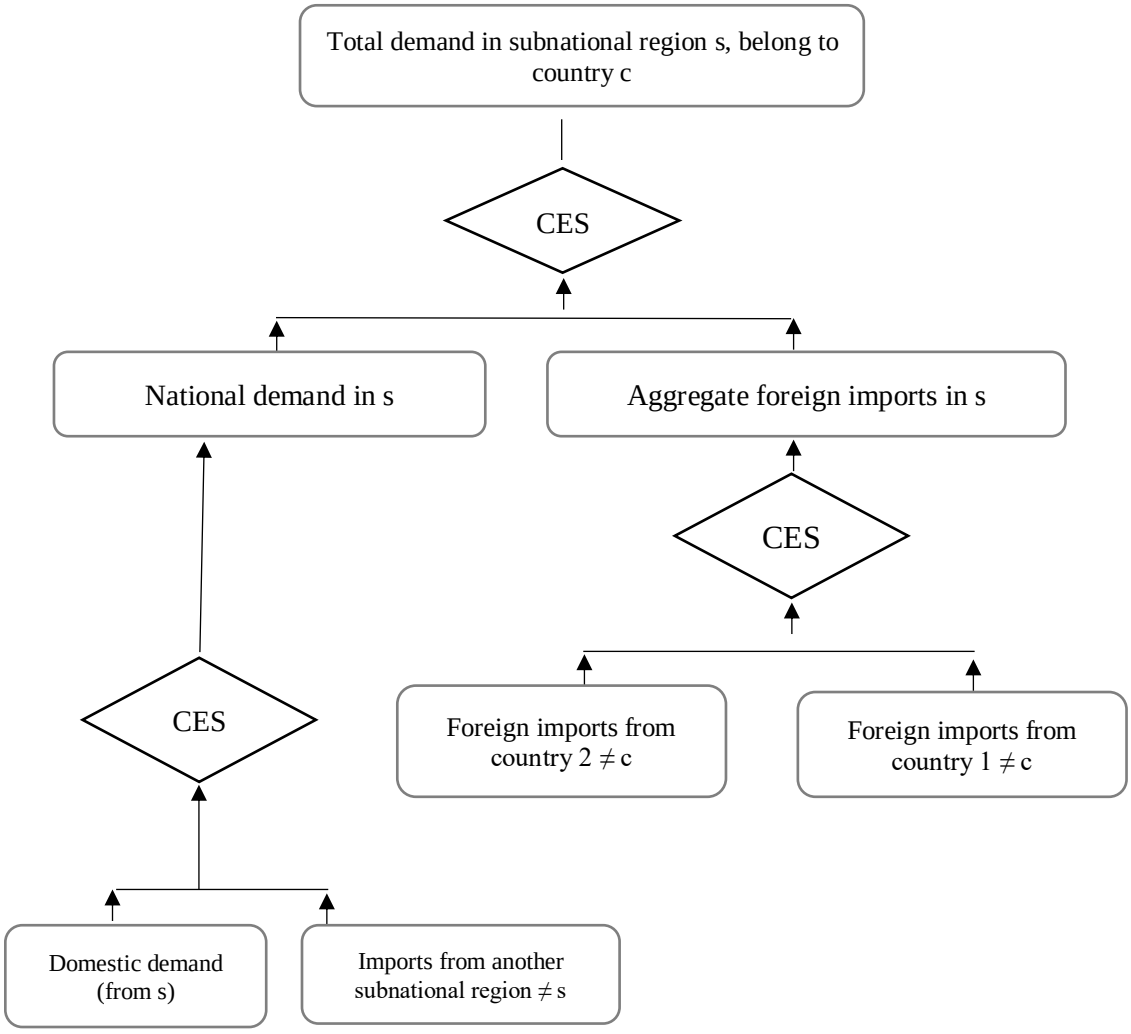
$$\sum_{SK} QL_{SK}PL_{SK} = QL_{CAN}PL_{CAN} \tag{4.21}$$

$$QK_{SK} = QK_{CAN}\left(\frac{PK_{CAN}}{PK_{SK}}\right)^{\sigma_K}, \sigma_K < 1 \tag{4.22}$$

$$\sum_{SK} QK_{SK}PK_{SK} = QK_{CAN}PK_{CAN} \tag{4.23}$$

4.6.3.2 Trade Structure in Subnational Model

The demand side[67] in the national model is represented by a double nest, where the first nest is similar to the domestic and aggregated foreign demand, while the second nest differentiates between the sources of the foreign imports. In the subnational model, a third nest to account for the demand within the country was added, where the subnational are products that are closer substitutes relevant to the national ones, while keeping the demand from foreign countries unchanged. Figure 4.18 summarizes the demand in our subnational model.



Source: Standardi (2013).

Figure 4.18: Commodity demand structure in regional model

[67] The demand side consists of private consumption, government spending, and intermediate goods demand, and government spending.

As shown in Figure 4.13, each subnational region in the model (i.e., Saskatchewan and RoC) has total demand, which is broken into two parts: national and international imports. To model the international and national bundles in a subnational region, the CES function was used, and new Armington elasticities were imposed. Taking the private demand in a subnational region as an example, QC_s, QCN_s, and QCM_s are respectively the total national and internationally-imported quantities in sub-region *s*. under the international bundle. $QCM1_s$ and $QCM2_s$ represent the imports from country 1 and country 2, respectively, under the national bundle $QCNS_s$ and $QCMS_s$, which represent the domestic and imported goods from the rest of the country in the subnational region. PC_s, PCN_s, PCM_s, $PCM1_s$, $PCM2_s$ $PCNS_s$, and $PCNM_s$ are the associated prices of the quantities, respectively. This relationship can be depicted as follows:

$$QCN_s = QC_s \left(\frac{PC_s}{PCN_s}\right)^{\sigma_{ARM}}, \sigma_{ARM} > -1 \quad (4.24)$$

$$QCM_s = QC_s \left(\frac{PC_s}{PCM_s}\right)^{\sigma_{ARM}}, \sigma_{ARM} > -1 \quad (4.25)$$

$$QCM1_s = QCM_s \left(\frac{PCM_s}{PCM1_s}\right)^{\sigma_{ARM1}}, \sigma_{ARM1} > -1 \quad (4.26)$$

$$QCM2_s = QCM_s \left(\frac{PCM_s}{PCM2_s}\right)^{\sigma_{ARM1}}, \sigma_{ARM1} > -1 \quad (4.27)$$

$$QCNS_s = QCN_s \left(\frac{PCN_s}{PCNS_s}\right)^{\sigma_{ARM2}}, \sigma_{ARM2} > -1 \quad (4.28)$$

$$QCNM_s = QCN_s \left(\frac{PCN_s}{PCNM_s}\right)^{\sigma_{ARM2}}, \sigma_{ARM2} > -1 \quad (4.29)$$

Where, σ_{ARM}, σ_{ARM1}, and σ_{ARM2} are the Armington elasticities between the national and international choices, the different international sources of demand, and the elasticity of domestic and demand from the rest of country, respectively. The modeling under the assumption that $\sigma_{ARM} = \sigma_{ARM1} < \sigma_{ARM2}$ (McCallum, 1995). A similar principle is applicable on the other sources of demand, i.e., government demand and intermediate goods demand. The total government demand in subnational region *s* is therefore the sum of the two demand components, and the intermediate demand is also the sum of the two sources, i.e., national and international. Elasticity of substitution for national demand is higher than that for international for all demands in the model, as it is easier to substitute among national relative to foreign products (McCallum, 1995).

4.7 Analysis Scenarios

This section describes three simulation scenarios. The growth in trade between countries is a natural trend due to population and factor of production growth. To avoid any possible bias in the simulation and to isolate the potential impact of the CPTPP on the members countries, three different scenarios were applied, which were applicable on both national and subnational study models.

i. Baseline growth scenario, where CPTPP was not incorporated in the analysis. This scenario was intended to simulate the impact of natural growth and other FTAs among CPTPP countries and the US which will take place over the coming decade.

ii. CPTPP scenario, where trade barriers as listed in Annex 2-D (see Appendix D) of the CPTPP agreement were eliminated. The goal of this analysis was to capture CPTPP impact on Canada/Saskatchewan and other CPTPP member countries by the expected average date of full CPTPP implementation (i.e., 2030).

iii. TPP scenario. For sake of comparison, this scenario was intended to analyses the economic impact of the former TPP, if it had been implemented, and compare it with the impact of CPTPP.

Figure 4.19 describes the study policy simulation scenarios.

In the following subsections, a full discussion on these scenarios is presented, along with its rationale and supporting information and data.

4.7.1 Baseline Scenario

The baseline growth scenario simulates the projection of growth among CPTPP countries and the US without CPTPP or TPP agreements. The projection takes into account capital accumulation, labour and population growth. Appendix E summarizes the key statistics on GDP, population, and agricultural trade among the CPTPP countries and the US. The natural growth of population and economic activities in the CPTPP countries is expected to be positive for most countries, with an average annual growth rate in the GDP varying from 0.79% to 6.15%, and

average population annual growth rate varying between -0.33% and 1.58% between 2011 and 2030 (see Table 4.12) (United States Census Bureau, 2018; PwC, 2017).

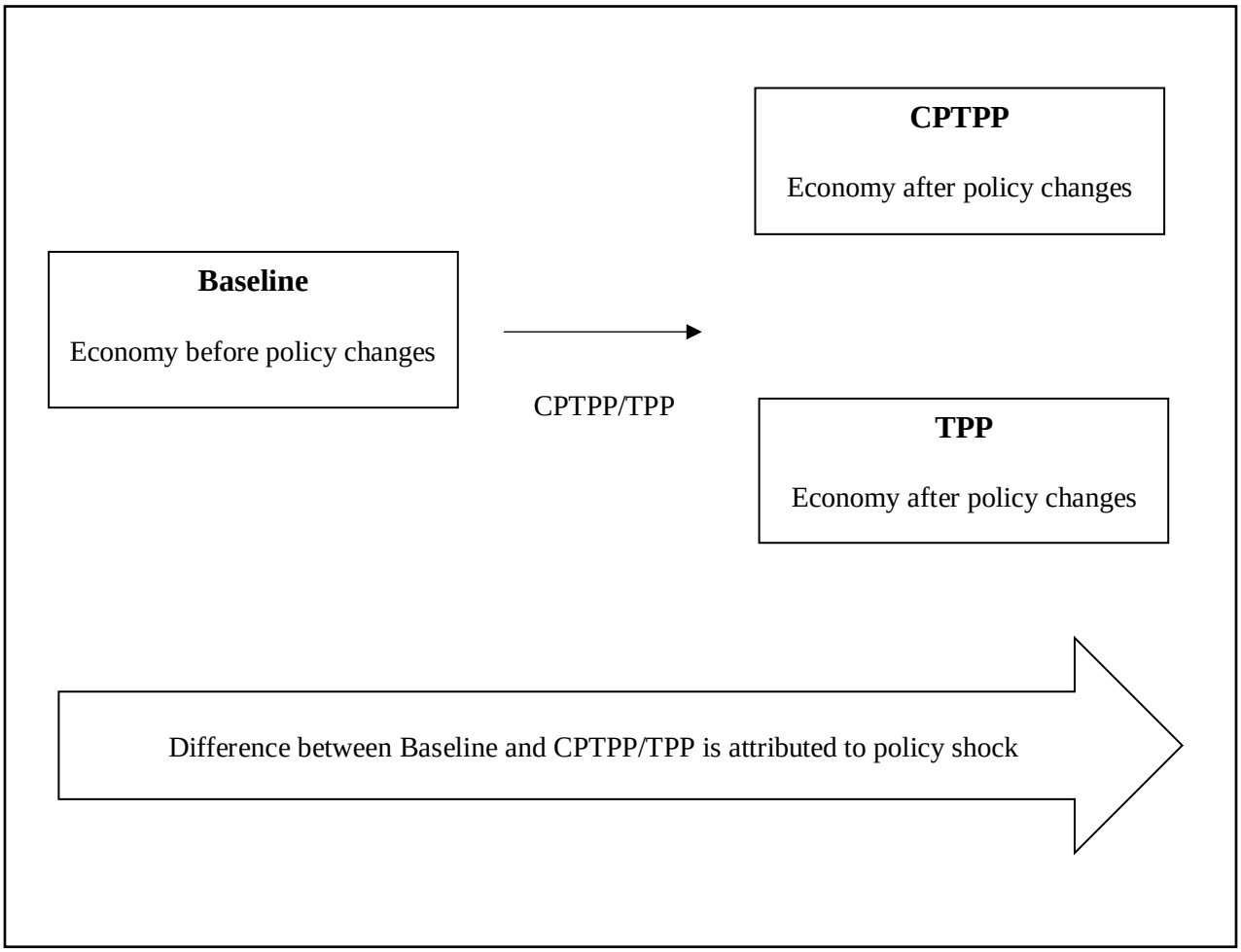


Figure 4.19: Study policy simulation scenarios

The demand for particular types of food among CPTPP countries and the US is also projected to grow over the coming years as a response to the economic and population growth; however, the total quantity of consumption per capita in CPTPP countries and the US would not increase dramatically (on account of substitution in consumption). The consumption trends in the CPTPP countries and the US show a high to moderate increase in the per capita consumption for meat, fruits and vegetables, and dairy products, a decrease in per capita direct consumption of cereals, and a large increase in non-food and services consumption per capita in all CPTPP countries (USDA 2017; Cook, 2011).

Table 4.12: Projected economic and population growth in CPTPP countries and the US, 2011-2030

TPP country	Average annual GDP growth (%)	Average annual population growth rate (%)
Australia	2.54	0.89
Brunei Darussalam	2.35	1.41
Canada	2.06	0.62
Chile	3.26	0.60
Japan	0.79	-0.34
Malaysia	4.60	1.20
Mexico	2.93	0.92
New Zealand	2.32	0.67
Peru	3.75	0.81
Singapore	2.92	1.60
Vietnam	6.15	0.72
United States	2.12	0.73
RoW	2.90	1.16

Source: United States Census Bureau (2018) and PwC (2017).

Another consideration that is being modeled in the baseline scenario is that other FTAs, in which CPTPP countries and the US are currently engaged among each other, would be in effect over the upcoming years[68] (see Table 3.1). To capture the impact of other trade agreements that will be implemented over the period of simulation between CPTPP member countries as well as the US, all the tariff cuts of these agreements were incorporated in the baseline growth scenario of the analysis. Data for these variables was collected from WTO's Regional Trade Agreements Database (WTO, 2017) in order to separate the potential impact of other trade agreements from the impact of the CPTPP. To deal with other bilateral or regional trade agreements tariffs, the study used simple averaging to aggregate the tariff data from tariff lines to the sectors defined in the study model. The average tariff cuts between were calculated and applied in all analysis scenarios. Table 4.13 shows a matrix of the relevant FTAs which would take place as 2030 approaches. A complete list of FTAs between CPTPP countries as well as the US is shown in Appendix F.

[68] Most of the bilateral and regional FTAs between CPTPP countries were already implemented in 2014; however, there are still some agreements to be implemented over the coming years.

Table 4.13: Scheduled trade agreement between CPTPP countries/the US - date of final implementation

Country[1]	AU	BN	CA	CL	JP	MY	MX	NZ	PE	SG	VN	US	Total
AU		2025			2034	2025		2025		2025	2025	2023	7
BN	2025			2017	2026	2025		2025		2025	2025		7
CA									2025				1
CL		2017			2022		2033	2017	2033	2017	2029		7
JP	2034	2026		2022		2026			2027	2025	2026		7
MY	2025	2025			2026			2025		2025	2025		6
MX				2033					2033				2
NZ	2025	2025		2017		2025				2025	2025		6
PE			2025	2033	2027		2033			2025		2025	6
SG	2025	2025		2017	2026	2025		2025	2025		2025		8
VN	2025	2025		2029	2026	2025		2025		2025	2025		8
US	2023								2025				2
Total	7	7	1	7	7	6	2	6	6	8	8	2	67

Source: World Trade Organization (2016).

[1]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

Elasticities are key parameters in the model as the simulation results and the conclusion of the model depend to a large extent on the size of these elasticities; in particular, the substitution elasticities between factors of productions, intermediate inputs, and trade elasticities (elasticities of substitution between domestic and imports, and elasticities of substitution between different sources of imports). High/low elasticities bring under/over estimation of the impact of the policy, trade patterns, welfare, and factor returns.

Trade elasticities are very important in evaluating trade policies; they measure the response of traded quantities to shocks. Export elasticities reflect the resilience of an exporter in the face of their competitors, while import elasticities reflect the level of resilience of the domestic products in the face of foreign products. According to Feenstra (1994) and Broda and Weinstein (2006), elasticities are critical for evaluating welfare gains from price changes, and for determining the real welfare consequences of FTAs. They also assess whether these agreements create additional trade between the parties, or divert trade away from countries outside of the agreement toward the agreements' trade partners. Based on these facts, this model adopted the default-provided elasticities in GTAP model. Table 4.14 illustrates the elasticities of substitution between domestic and imports, and Table 4.15 shows the elasticities of substitution between different sources of imports (i.e., from regions in the model) of each sector in the model.

It is worth noting that the Armington elasticities between alternative sources of imports are always higher than the elasticities of substitution between domestic and imported goods. This is because it is always harder to substitute domestic with imported good due to the regulations, tariffs, and other rules, while most of the imported goods from different sources are subject to the same rules. That same principle is applicable on the elasticity of substitution between national and domestic products in subnational modeling. Substituting domestic products within a particular region with a national product from other regions in a country is easier than substituting them with imported products. Inside a country, products can move freely between provinces or states as they are not subject to tariffs or other barriers; therefore, the elasticity of substitution between products within a country is always higher than the elasticity of substitution between domestic/national and imported goods.

Table 4.14: Armington elasticities[1] for Canada between domestic and imported products

	Countries/region[2]												
Sector	**AU[2]**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	3.03	2.61	2.82	3.57	3.52	3.1	3.47	2.78	3.57	2.64	3.89	3.18	3.82
Wheat	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45
Other grains	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Fruits/vegetables	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Oilseeds	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45
Other crops	3.05	3.22	3.13	2.9	3.23	3.09	2.95	3.13	3.13	3.23	2.8	3.17	3.02
Livestock	2.29	1.47	1.6	1.46	1.67	1.34	1.45	2.25	1.72	1.4	1.47	1.65	1.78
Meat products	4.08	4.14	4.06	4.09	4.18	4.18	4.16	4.02	4.21	4.21	4.13	4.09	4.15
Raw milk	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65
Dairy products	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65
Processed foods	1.78	1.83	1.72	1.87	1.75	2.68	1.87	1.87	1.96	1.76	1.88	1.81	1.92
Extraction	3.75	10.7	5.35	2.89	5.63	5.1	5.02	4.9	3.07	5.19	2.58	5.12	4.86
Labour-intensive manufacturing	3.75	3.85	3.63	3.75	3.74	3.95	3.69	3.79	3.74	4.12	3.88	3.79	3.8
Capital-intensive manufacturing	2.96	2.62	2.95	2.86	2.91	3.03	2.96	2.85	3	2.8	2.98	2.93	2.95
Services	1.93	1.96	1.92	1.94	1.93	1.94	1.93	1.93	1.94	1.93	2.05	1.93	1.94

[1]: Armington elasticities based on the GTAP model.
[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

Table 4.15: Armington elasticities[1] of Canada imported products from alternative sources of imports

	Countries/region[2]												
Sector	**AU**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	5.26	5.2	5.83	5.3	5.25	5.23	8.74	5.39	5.21	5.28	9.61	5.73	5.74
Wheat	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Other grains	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Fruits/vegetables	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Oilseeds	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Other crops	6.47	6.45	6.49	6.48	6.42	6.26	5.79	6.48	5.23	6.47	5.56	6.49	6.13
Livestock	3.76	3.53	2.95	3	3.13	3.5	2.96	3.82	3.01	2.75	2.83	3.39	4.26
Meat products	8.7	8.27	8.45	8.03	8.51	8.02	8.29	8.59	8.14	8.52	8.01	8.11	8.36
Raw milk	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Dairy products	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Processed foods	3.59	3.67	3.51	4.56	3.9	4.83	4.14	4.28	5.16	3.58	4.45	3.83	4.25
Extraction	10.2	2.14	10.9	11.5	12.5	10.9	21	9.68	8.78	10.4	3.18	11.2	11.2
Labour-intensive manufacturing	7.5	7.72	7.27	7.48	7.91	8.15	7.55	7.65	7.51	8.21	7.76	7.66	7.64
Capital-intensive manufacturing	6.14	5.71	6.36	5.49	6.07	6.28	6.02	5.94	5.98	5.71	6.01	6.24	6.19
Services	3.84	3.8	3.83	3.82	3.81	3.81	3.82	3.8	3.8	3.86	3.84	3.82	3.86

[1]: Armington elasticities based on the GTAP model.
[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

The percentage of *ad volorem* rate of tariffs Canada levied on products, and percentage of *ad volorem* rate of tariffs that are levied on Canadian products based on 2011 rates (as appear in the GTAP model) are reported in Table 4.16 and Table 4.17, respectively. The protection data, i.e., tariffs, reported in the model were updated in the simulation scenarios to incorporate the tariff concessions, which would be implemented during the coming decades. Similar to the elasticities, the size of trade impact is determined to a large extent by the size of the gap between domestic and imports prices created by protection. The protection data, as provided in the GTAP database, shows that Canada imposes generally high tariffs on both CPTPP countries and the RoW in few product categories, namely dairy products, other foods, and labour-intensive products. These products account for 49% of total Canadian imports, where dairy products and other foods accounts for roughly 10% of this total. The remaining Canadian imports from the CPTPP countries generally face low duties, ranging between 0% and 13.1%, while tariffs on products imported from the RoW are higher in most cases than similar products imported from the CPTPP countries and the US.

Japan, Malaysia, Peru, and Vietnam have the highest level of protection compared to other CPTPP countries. Table 4.16 and Table 4.17 report, respectively, the percentage of *ad volorem* rate of tariffs that Canada levied on products from a different source, and percentage of *ad volorem* rate of tariffs that are levied on Canadian products. As shown in these tables, Canadian exports to Japan, Malaysia, and Vietnam face tariffs ranging between 0.1% and 196%. It is worth noting that the average tariffs rates on Canadian merchandise to the CPTPP countries and the US is less than the average tariff levied by RoW on Canadian products. The main Canadian exports facing high tariff rates are: fruits and vegetables (tariff rate are: 196%, 16%%, and 17% levied by Japan, Vietnam and RoW respectively) dairy products (tariff rates are 132% and 18.9% levied by Japan and RoW respectively), meat products (tariff rates are: 60.6, 19.7%, and 26. %6 levied by Japan, Vietnam, and RoW respectively), and wheat (tariff rates are: 33.2%, 1.25%, and 10.4% levied by Japan, Vietnam, and RoW respectively). Most tariffs levied by CPTPP countries, the US and RoW on Canadian exports are in categories where Canada has a comparative advantage -- agricultural and food products, for instance. A closer look at Table 4.16 and Table 4.17 shows that on average, Canada seems to be more protective compared to other CPTPP countries, given the generally higher tariffs levied by Canada on CPTPP countries products. Also, given Japan's and Vietnam's high level of protection, particularly in the agricultural sector, Canadian exports to Japan and Vietnam would also be expected to face major changes when CPTPP is fully implemented.

Table 4.16: Percentage of *ad volorem* rate[1] of tariffs Canada levied on products by source

	Country/region[2]												
Sector	**AU**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0.596	0	0	0	0	0	0	0.58	0	0	0	0	0.101
Other grains	0.002	0	0	0	0.006	0	0	0	0	0	0	0	0.006
Fruits/vegetables	0.581	0	0	0	0.483	0.002	0	2.51	0	0	0.027	0	0.728
Oilseeds	0	0	0	0	0	0	0	0	0	0	0	0	0
Other crops	0.238	0	0	0	1.63	0.03	0	1.16	0.036	0	0.001	0	0.974
Livestock	0.001	0	0	0	0	2.02	0	0.008	0	0	0	14.6	1.79
Meat products	0.129	0	0	80.1	4.66	0	0.022	0.408	0	0	3.34	35.7	63.8
Raw milk	0	0	0	0	0	0	0	0	0	0	0	0	0
Dairy products	112.0	0	0	298	79.7	23.6	170.0	232.0	143.0	183.0	236.0	178.0	196.0
Processed foods	0.858	0	0	0.353	6.42	8.32	7.23	2.33	0.815	1.27	0.865	10.1	6.28
Extraction	0	0	0	0	0.152	0.166	0	0.134	0	0	0.091	0	0.004
Labour-intensive manufacturing	0.642	14.2	0	0	2.86	0.958	0	0.692	0.01	0	9.77	0	3.19
Capital-intensive manufacturing	0.184	0.062	0	0	1.83	2.7	0	1.18	0	0	1.27	0	0.631
Services	0	0	0	0	0	0	0	0	0	0	0	0	0

[1]:Percentage of *ad volorem* rate of tariffs by source based on 2011 rates, as appeared in the GTAP model.
[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

Table 4.17:Percentage of *ad volorem* rate[1] of tariffs levied on Canadian products by importers

	Country/region[2]												
Sector	**AU**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	0	0	0	0	0	0	0	0	0	0	0	0	8.93
Wheat	0	0	0	4.97	33.2	0	0	0	1.52	0	1.25	0	10.4
Other grains	0	0	0	0	21.3	0	0	0	2.69	0	0.226	0	2.73
Fruits/vegetables	0.088	0	0	0	196	0.452	0	0	3.27	0	16	0	17.6
Oilseeds	0	0	0	0	0	0.005	0	0	1.16	0	0.584	0	3.97
Other crops	0	0	0	0.236	0.017	0.009	0	0	0.049	0	0.268	0	4.17
Livestock	0.602	0	0	1.48	9.36	0.008	0.433	0.002	0.806	0	0.22	0	4.59
Meat products	0	0	0	0	60.6	0.451	8.16	0.019	5.58	0	19.7	0	26.6
Raw milk	0	0	0	0	0	0	0	0	0	0	0	0	0
Dairy products	4.27	0	0	6	132	3.27	40.3	0.006	0	0	1.61	14.3	18.9
Processed foods	2.77	1.22	0	5.18	8.62	2.64	2.32	0.22	5.18	0.583	9.82	1.87	12
Extraction	0	0	0	0	0.069	0.242	0	0	0.428	0	0.521	0	0.508
Labour-intensive manufacturing	2.51	5.6	0	0.004	1.23	2.5	0	0.085	1.01	0	4.59	0	4.09
Capital-intensive manufacturing	1.45	0.826	0	0	0.533	1.63	0	0.021	2.03	0	1.5	0	1.63
Services	0	0	0	0	0	0	0	0	0	0	0	0	0

[1]: Percentage of *ad volorem* rate of tariffs by source based on 2011 rates as appeared in the GTAP model.
[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

For the purpose of simulating the baseline growth scenario where this study assumes that the CPTPP would not be implemented, the protection rates in Table 4.16 and Table 4.17 were updated to incorporate the bilateral trade agreements and tariff reduction between CPTPP countries as well as the US, which would take place in parallel with the CPTPP. This step is important to capture CPTPP impact, as the rates used in constructing the GTAP Database V.9 benchmark are from 2011, and did not incorporate the bilateral and regional trade agreement after that year. Table 4.18 and Table 4.19, report on the updated tariff rates that Canada levied on products from different sources, and the tariff levied by other countries on Canadian products entering their markets.

Unlike most CPTPP countries, Canada does not have many trade agreements. This is due to the fact that all Canada's bilateral and regional FTAs have already been fully or partially implemented[69]. This would potentially leverage the impact of the CPTPP agreement on Canada compared to other CPTPP members that have multiple bilateral and regional FTAs that will be implemented over the coming decade.

The implementation of the CPTPP would not be shadowed by multiple bilateral FTAs for Canada, but NAFTA/USMCA has freed the trade with US and Mexico, who are major trade partners for Canada. This would potentially offset any differences compared to other TPP countries, particularly in the agriculture and agri-food category, which exceeded 47 billion in 2015. Canada is the second largest supplier of agricultural products to US. On the other hand, Canada is the leading importer of US agricultural products, perhaps as a result of NAFTA; in fact, Canada-US agricultural trade has tripled since NAFTA entered into force (AAFC, 2016).

The goal of the baseline growth scenario simulation is to account for nature growth in CPTPP countries and the US and to segregate the impact of the CPTPP agreement from other bilateral and regional trade agreements that will be implemented over the coming years. This is a necessary step to avoid any over or under estimation of the CPTPP in terms of economic impact, as the natural growth is taken into account before estimating the agreement impact on member countries.

[69] Canada has FTAs with Chile, Japan, U.S., Mexico, Singapore, and Peru. These agreements have been implemented except for the agreement with Peru, which will gradually be implemented over the coming years, as well as the Canada-Japan Economic Partnership Agreement, which is still under negotiation.

Table 4.18: Updated percentage of *ad volorem* rate[1] of tariffs Canada levied on products by source

	Country/region[2]												
Sector	**AU**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0.596	0	0	0	0	0	0	0.58	0	0	0	0	0.101
Other grains	0.002	0	0	0	0.006	0	0	0	0	0	0	0	0.006
Fruits/vegetables	0.581	0	0	0	0.483	0.002	0	2.51	0	0	0	0.027	0.728
Oilseeds	0	0	0	0	0	0	0	0	0	0	0	0	0
Other crops	0.238	0	0	0	1.63	0.03	0	1.16	0.0072	0	0	0.001	0.974
Livestock	0.001	0	0	0	0	2.02	0	0.008	0	0	14.6	0	1.79
Meat products	0.129	0	0	80.1	4.66	0	0.022	0.408	0	0	35.7	3.34	63.8
Raw milk	0	0	0	0	0	0	0	0	0	0	0	0	0
Dairy products	112.0	0	0	298.0	79.7	23.6	170.0	232.0	28.6	183.0	178.0	236.0	196.0
Processed foods	0.858	0	0	0.353	6.42	8.32	7.23	2.33	0.163	1.27	10.1	0.865	6.28
Extraction	0	0	0	0	0.152	0.166	0	0.134	0	0	0	0.091	0.004
Labour-intensive manufacturing	0.642	14.2	0	0	2.86	0.958	0	0.692	0.002	0	0	9.77	3.19
Capital-intensive manufacturing	0.184	0.062	0	0	1.83	2.7	0	1.18	0	0	0	1.27	0.631
Services	0	0	0	0	0	0	0	0	0	0	0	0	0

[1]: Percentage of *ad volorem* rate of tariffs by source was updated based on TPP member countries tariff commitments.
[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

Table 4.19: Updated percentage of *ad volorem* rate[1] of tariffs levied on Canadian products by importers

	Countries/region[2]												
Sector	**AU**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**	**RoW**
Rice	0	0	0	0	0	0	0	0	0	0	0	0	8.93
Wheat	0	0	0	4.97	33.2	0	0	0	0.304	0	1.25	0	10.4
Other grains	0	0	0	0	21.3	0	0	0	0.538	0	0.226	0	2.73
Fruits/vegetables	0.088	0	0	0	196	0.452	0	0	0.654	0	16	0	17.6
Oilseeds	0	0	0	0	0	0.005	0	0	0.232	0	0.584	0	3.97
Other crops	0	0	0	0.236	0.017	0.009	0	0	0.0098	0	0.268	0	4.17
Livestock	0.602	0	0	1.48	9.36	0.008	0.433	0.002	0.1612	0	0.22	0	4.59
Meat products	0	0	0	0	60.6	0.451	8.16	0.019	1.116	0	19.7	0	26.6
Raw milk	0	0	0	0	0	0	0	0	0	0	0	0	0
Dairy products	4.27	0	0	6	132	3.27	40.3	0.006	0	0	1.61	14.3	18.9
Processed foods	2.77	1.22	0	5.18	8.62	2.64	2.32	0.22	1.036	0.583	9.82	1.87	12
Extraction	0	0	0	0	0.069	0.242	0	0	0.0856	0	0.521	0	0.508
Labour-intensive manufacturing	2.51	5.6	0	0.004	1.23	2.5	0	0.085	0.202	0	4.59	0	4.09
Capital-intensive manufacturing	1.45	0.826	0	0	0.533	1.63	0	0.021	0.406	0	1.5	0	1.63
Services	0	0	0	0	0	0	0	0	0	0	0	0	0

[1:] Percentage of *ad volorem* rate of tariffs by source was updated based on TPP member countries tariff commitments.

[2]: AU: Australia, BN: Brunei-Darussalam, RoC: Rest of Canada, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

4.7.2 CPTPP Scenario

Many tariff cuts that are planned by other trade agreement between CPTPP member countries, this may improve market access between these countries over the coming years. Under the CPTPP scenario, tariffs as listed in Annex 2-D (see Appendix D) of the CPTPP agreement were incorporated to capture the impact of the CPTPP agreement. The intra-CPTPP tariffs on agricultural and non-agricultural products as listed in the CPTPP, were included to allow for comparison of the results of the baseline growth scenario.

4.7.3 TPP Scenario

Under TPP scenario, the former TPP which included the US was simulated to analyse and assess its impact if it was implemented. This analysis was intended to compare the economic impact of the TPP relative to the CPTPP on the TPP countries, particularly on Canada and Saskatchewan (in both the national and subnational models). This comparison is important as the US represents the largest trade partner for Canada and Canada and the US have highly integrated economies, thus US being part of a trade agreement or not may have impact on Canada at least through diverting trade flows.

4.8 Concluding Remarks

Analyzing the economic impact of the CPTPP agreement on its member countries, and then at the subnational level in Canada, was a very extensive and demanding exercise in terms of data and computational process. In this study, the GTAP model was chosen because it provided a comprehensive template for multi-sector, multi-region analysis. With regards to developing a resource- and agricultural-focused model, the study models identified 11 agricultural sectors and four non-agricultural sectors including extractions, manufacturing, and services; this sectoral dissertation is meant to minimize the bias of high aggregation with a stronger focus on agricultural sectors. For subnational analysis, the study developed a region-specific model whereby Saskatchewan was treated as a separate trade entity in a manner consistent with the national model structure.

In the next two chapters, the study reports the results of the analysis, where national and subnational models' results are reported in Chapter 5 and Chapter 6, respectively.

Chapter 5

National Model Simulation and Results

5.1 Introduction

This chapter reports on the impact of the CPTPP and its economic implications for the member countries, based on the national model. Results are reported for all CPTPP countries in summary form -- but detailed results are reported for the Canadian economy. The national model simulations were undertaken for three scenarios: (i) Baseline scenario (no CPTPP in effect) (ii) CPTPP scenario, where the trade barriers were reduced or eliminated among the members according to the agreement tariff schedules. (iii) TPP scenario (where the former TPP agreement was simulated to evaluate its economic impact on the member countries and compare it with the CPTPP impact.

5.2 Description of CPTPP Countries and the US -- Statistics, Economies, and Background

The trend of changes in population, GDP, supplies for factors of production, and the multiple bilateral agreements between the TPP members[70] made tracking the potential impact of the TPP a more complicated process. These changes are important consideration in the model as they are needed to separate the changes associated with the CPTPP from those associated with other bilateral trade agreements or their natural growth.

According to FAO and World Health Organization (WHO) statistics (2003), food consumption per capita growth in CPTPP countries and the US (particularly within high-income economies) is expected to be very modest between 2015 and 2030. Although the consumption of food per capita would not increase, the total consumption would increase by 10.4% due to the increase in population (WHO, 2003). In addition, the income growth and the social changes would lead to changes in the consumer food basket in the CPTPP countries that tend to increase in the consumption of high-value, frozen, and prepared processed foods (Burfisher *et al.*, 2014; Muhammad *et al.*, 2011). Background on CPTPP countries and the US economies is presented in Table 5.1.

[70] Details on projected economic and population growth, and bilateral trade agreements between TPP countries can be found in Chapter 4, Table 4.10, and Table 4.11, respectively.

Table 5.1: Summary statistics for the CPTPP countries and the US

	Country[1]											
Economic indicator	**AU**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US**
GDP per capita (USD, 2017)	54,256	27,560	44,412	13,196	40,408	10,426	9,102	40,596	6,051	55,252	2,306	59,407
Population (Millions)	25	0	37	18	126	32	124	5	32	6	94	326
Exports share of GDP (%, 2015)	20	52	32	30	18	71	35	28	21	177	90	13
Imports share of GDP (%, 2015)	21	33	34	30	18	63	38	27	24	150	89	15
Agriculture value added (% GDP, 2015)	3	1	2	4	1	9	4	6	8	0	17	1
Manufacturing value-added (% GDP, 2015)	7	14	11	12	18	23	18	12	15	20	14	12
Services value-added (% GDP, 2015)	72	38	69	63	73	55	64	71	59	74	40	78
Simple average of applied MFN tariffs in the TPP countries, 2014	3	1	4	6	4	6	8	2	2	0	10	4
Average GDP growth rate (2017-30) (%)	3	2	2	3	1	5	3	2	4	3	6	2

Source: Data for GDP and population obtained from International Monetary Fund Economic Outlook (2016). Data for trade and value-added obtained from World Bank database. (2016c). Data for tariffs obtained from World Trade Organization (2016).

1 : AU: Australia, BN: Brunei-Darussalam, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

As shown in Table 5.1, all countries are classified as high-income economies, except for Mexico, Malaysia, Peru, and Vietnam, which are middle-income economies (World Bank, 2016b). In terms of openness, all countries can be classified as high and middle open economies, having low level trade protection (World Trade Organization, 2017). On average, the CPTPP agricultural sector is small (0% - 17% of a country's GDP) compared to manufacturing (7-20% of a country's GDP), and services (more than 37% of a country's GDP). Figures in Table 4.12 show that the economic growth in all CPTPP countries and the US would be positive over the coming decade, with an average growth of 2.9% in the GDP among these countries, and a higher growth in middle-income members compared to high-income country members. This indicates that at least the short and medium prospects for the CPTPP economies are positive, which is an indirect indicator that there is a good potential for trade growth, both among both the members and other countries in the world. The bilateral trade flow of merchandise between Canada and other countries is concentrated with three major trade partners: US, Mexico and Japan. Trade with these three countries together represent high percentage of Canada's total imports and exports. The US stands to be the major trade partner for Canada representing roughly two third of Canada's trade. (United Nations, 2016).

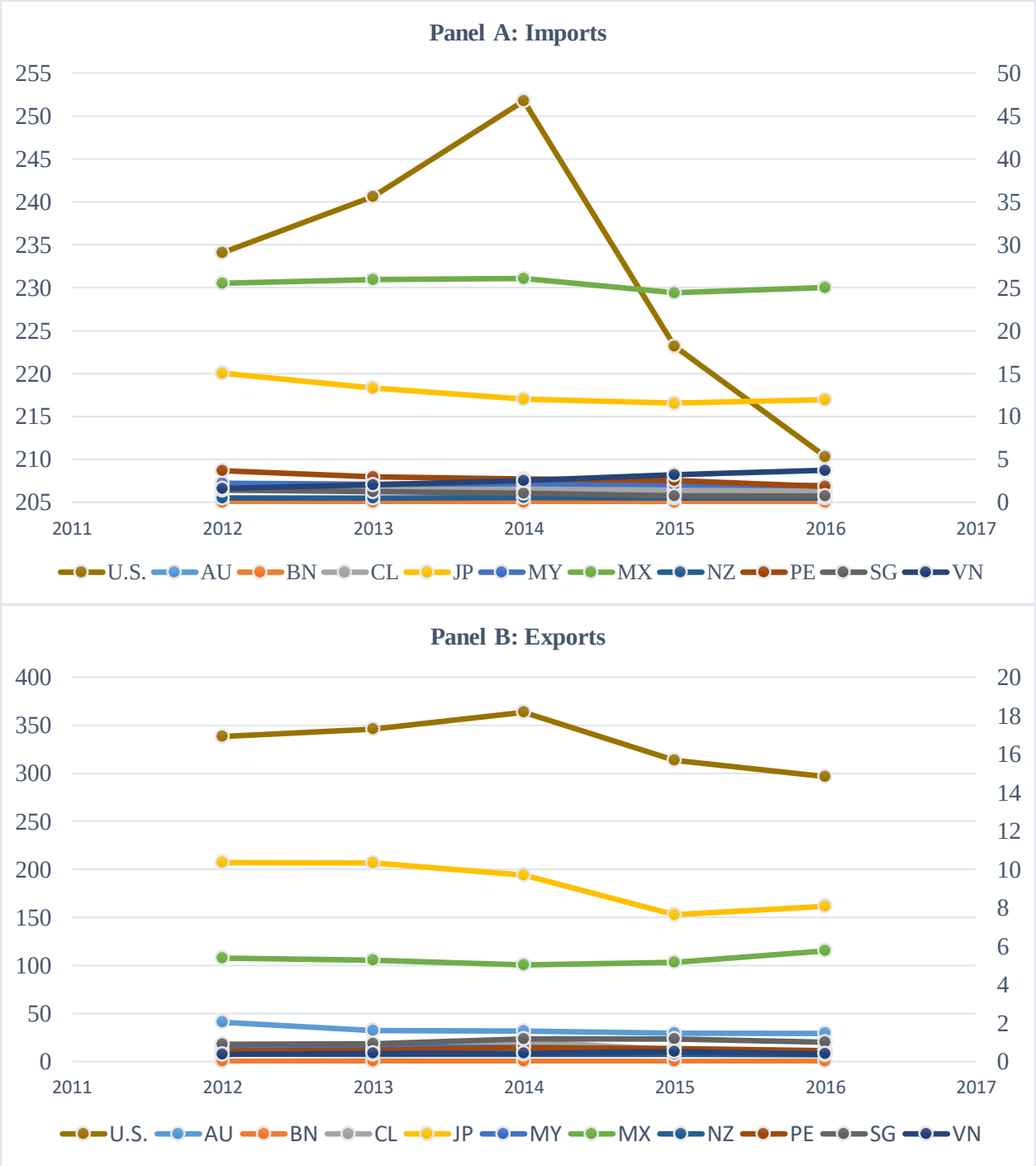
Table 5.2: Canada- merchandise trade with CPTPP countries and the US, 2016 (billion USD)

	Trade flow		
Country	**Imports**	**Exports**	**Re-exports**
Australia	1.510	1.460	0.189
Brunei Darussalam	0.001	0.009	0.001
Chile	1.280	0.547	0.033
Japan	11.940	8.090	0.109
Malaysia	1.960	0.532	0.023
Mexico	25.040	5.760	0.283
New Zealand	0.501	0.346	0.021
Peru	1.860	0.577	0.020
Singapore	0.741	1.000	0.301
Vietnam	3.744	0.396	0.020
United States	210.34	296.570	30.55
Total	257.407	315.287	31.550

Source: United Nations, Comtrade Database (2016).

The trend of Canada trade (imports and exports) from and to CPTPP countries and the US has not decreased, nor increased sharply, over the last five years (see Figure 5.1). In addition, trade with US, Mexico and Japan, as a share of total Canadian trade, has dominated over this period. However, Canada did witness a slight decline in its trade with the US in 2016 compared to the

previous year. This indicates that no drastic economic changes have been happening in terms of trade for Canada over the past five years.



Source: United Nation, Comtrade Database (2016).

Figure 5.1: Canada imports and exports from and to CPTPP countries and the US, 2012-2016, billion USD

5.3 National Baseline Scenario Simulation: Results and Discussion

In this section, the simulation of trade among model' countries/regions is reported, assuming the absence of the CPTPP agreement[71]. This scenario describes and discusses the trade growth among the countries due to tariff elimination and growth among the members. The simulation and discussion is focused on agricultural and food products; however, non-agricultural products are included at high level or aggregation (see Table 4.9)**.** The simulation under this scenario involves growth and elimination of trade protection under other agreements, as shown in Table 4.11.

5.3.1 Sectoral Distribution of Canadian Trade

Table 5.3 shows Canadian imports and exports from and to CPTPP countries, the US and RoW for each model sector. Total Canadian imports in 2011 were 483 billion USD, of which those from the CPTPP countries accounted for 9% (about 43 billion USD) and those from the US accounted for 54% (about 261 billion USD). Canada's imports of agricultural and agri-food products from CPTPP countries represented 7.42% of its total imports from CPTPP countries. The main agricultural import products from CPTPP countries are fruits and vegetables, processed foods, dairy products, and meat products, these amount together to about 3 billion USD. On the exports side, all figures have been evaluated by the trade partner's CIF import values. Canada's total exports in 2011 exceeded 503 billion USD. Manufacturing products dominated Canada's exports. The non-agricultural Canadian exports represented about 90% of total Canadian exports. With regards to exports to the CPTPP countries, Canada's exports accounted for 7% (about 35 billion USD) while its exports to the US accounted for 65% (about 316 billion USD) of Canada total exports. As shown in Table 4.16 and Table 4.17, Canada imposes different tariffs on different sectors. High tariffs are imposed on products such as dairy products and labour-intensive products, and zero or low tariffs on products such as rice, oilseeds, and raw milk. Tariffs levied on Canadian products entering into CPTPP countries vary, depending on the products and the trade partner; for instance, Japan levies tariffs in excess of 60.6% on Canadian meat products, while Chile and Australia levy 0% on these same product that cross its borders.

[71] Canada database developed for the national analysis is based on the disaggregation discussed in Chapter 4 can be accessed via: https://app.box.com/s/efbixep25re4xqgfy69xonmkuxwse1ed.

Table 5.3: Canada imports and exports by model sector, 2011 (million USD)

Sector	Imports from CPTPP	Imports from US	Imports from RoW	Total Imports	Exports to CPTPP	Exports to US	Exports to RoW	Total Exports
Rice	5	178	186	369	0	5	2	7
Wheat	0	24	7	31	1,324	684	4875	6,883
Other grains	2	389	19	410	322	733	515	1,570
Fruits/vegetables	1,210	4,622	1,064	6,897	231	1,932	2784	4,948
Oilseeds	24	385	70	479	3,075	849	3394	7,318
Other crops	131	375	1,140	1,646	152	571	184	907
Livestock	16	469	177	661	108	1,713	859	2,679
Meat products	419	3,503	386	4,308	2,342	2,397	1989	6,729
Raw milk	0	1	5	6	0	0	0	1
Dairy products	178	624	911	1,712	66	132	229	427
Processed foods	1,250	13,498	7,596	22,344	1,484	14,838	4344	20,665
Extraction	2,016	7,276	12,602	21,894	4,737	65,379	19684	89,799
Labour-intensive manufacturing	2,3961	12,3116	68,721	215,797	8,683	108,590	27311	144,583
Capital-intensive manufacturing	9,664	77,801	36,775	124,240	5,248	92,920	46363	144,530
Services	4,734	28,903	48,439	82,074	7,384	26,002	38682	72,070
Total	43,609	261,161	178,098	482,868	35,155	316,743	151218	503,115

Source: Aguiar *et al*. (2016).

5.3.2 Main Assumptions

In the baseline scenario, several assumptions have been imposed to simulate the growth and trade among model countries, assuming no implementation of the CPTPP or TPP. These assumptions include:

i. Reduction in tariffs due to non-CPTPP bilateral and regional trade agreements among model countries were simulated. These reductions would take place over the coming decade. The updates of tariff rates were based on the outline in Appendix F, Table 4.16, Table 4.17, and Table 5.4;

ii. The simulation did not include any reductions/changes in non-tariff barriers for the services trade, as there is no tariff data reported in the GTAP database; in addition, this is an agricultural-focused model;

iii. Comparative static GTAP was applied, where it was assumed that: (a) the time has no explicit treatment, (b) there are constant returns to scale production technology, and (c) markets are perfect competitive markets;

iv. Land was assumed to be in fixed supply, while capital and labour growth were incorporated in the simulation;

v. Primary factors are not allowed to move across borders, whereas the movement of goods and services are allowed; and

vi. The CPTPP would not come into effect over the coming decade.

5.3.3 National Baseline Scenario simulation

This section presents the results of the simulation of the national baseline Scenario between 2017 and 2030 without the CPTPP or TPP. The baseline Scenario solution aims to quantify the economic impact of natural growth and bilateral and regional trade agreements that have been concluded among model countries, but are not yet fully implemented.

Before performing the simulation, the database needed to be updated to reflect the *status quo* of 2017; this was necessary, as the reference year of our GTAP database was 2011[72]. To these effects, the GTAP Database V.9 was reproduced and updated to reflect the growth in the world economy after 2011 (i.e., from 2011 to 2017, and then from 2017 to 2030). The methodology followed is highlighted in Gehlhar (1997)[73]. Regions in the study model have grown at different rates, hence the future growth level would also be different from one country to another. The shocks for each region in the model between 2011 and 2017, and then between 2017 and 2030, are shown in Table 5.4. Three variables were updated: population, labour and physical capital[74]. The data on these variables were collected from external sources, which include: International Monetary Fund (IMF) (2016) and the Federal Reserve Bank of St. Louis Economic Data (FRED) (2016). These variables were updated for all regions in the model by their corresponding endowment changes. It is worth noting that the tariff levels between the regions in the model were left unchanged in the first update (i.e., 2011 to 2017) as there were no significant changes over this period, but they were updated for the period between 2017 and 2030. Land, on the other hand, was assumed to be fixed in supply.

Except for the population, projections of other variables, i.e., physical capital, and labour force, were not available for the upcoming decade; therefore, Autoregressive and Moving Average time series analysis was utilized to forecast the capital and labour force in each region in the model until 2030. The period chosen for both time series models extends from 1970 to 2014. The date used in this analysis is annual data obtained from the aforementioned sources. Details of the models are available in Appendix G. Once the database was updated to reflect 2017, the database was updated again to reflect the growth over the period between 2017 and 2030. Table 5.4 shows the growth values used to update the GTAP database to reflect 2017, and then 2030. In baseline scenario simulation, all the bilateral and regional trade agreements that would be implemented over the coming decade were included.

[72] GTAP model is not a growth model, therefore it cannot determine the changes and growth in the factors of production, nor the population and GDP over time; therefore, the changes of the aforementioned variables must be incorporated.

[73] In the study model, the GDP was treated as an endogenous variable to be affected by other shocks; however, there are some studies in the field (see Burfisher *et al.*, 2014) that treat the GDP as an exogenous variable.

[74] Physical capital in this study refers to goods that are fixed, tangible, and reproducible.

Table 5.4: Percentage growth in population, capital stock, and labour force used to update GTAP database to reflect growth over the simulation period

	Update to reflect 2017 Percent increase relative to 2011 figures			Update to reflect 2030 Percent increase relative to 2017 figures		
Region	**Population**	**Capital stock**	**Labour force**	**population**	**Capital stock**	**Labour force**
Australia	10.50	6.76	11.00	15.58	17.08	21.48
Brunei Darussalam	6.74	7.87	7.70	14.13	22.76	7.44
Canada	6.78	10.44	8.89	10.28	16.01	15.93
Chile	5.86	16.91	12.99	10.57	24.35	16.95
Japan	-1.53	10.39	2.54	-4.70	22.49	4.99
Malaysia	8.21	18.53	13.03	15.86	28.06	21.28
Mexico	9.43	19.45	11.73	13.75	26.26	19.60
New Zealand	4.42	11.61	10.72	10.82	16.80	21.42
Peru	8.67	17.08	14.58	14.58	26.59	22.68
Singapore	11.67	18.98	16.72	10.96	22.19	26.28
Vietnam	8.67	19.91	9.83	10.28	27.27	19.32
United States	4.64	7.17	7.81	8.97	10.16	12.24
RoW	8.39	16.61	9.85	13.68	28.62	17.67

Source: Data for population obtained from International Monetary Fund Economic Outlook (2016). Date for capital stock and labour force growth based on ARMA model in Appendix G. Data for ARMA econometric models obtained from the Federal Reserve Bank of St. Louis Economic Data (2016).

5.3.3.1 Updating Database to Reflect 2017

The update first involved updating the model database, and then examining to which extent these updates could predict the changes in trade by comparing them with the actual figures. To examine the strength of the model in predicting the changes in trade, the predicted and actual figures were compared. Overall results showed good performance of the model in predicting the trade patterns, although the results varied across countries/region; nevertheless, the model performed well in trade prediction.

5.3.3.2 Trade under National Baseline Scenario

As a result of partial tariff eliminations and natural growth, the trade between CPTPP countries, the US and RoW is expected to grow in both agricultural and non-agricultural products. The results show that trade among the CPTPP countries would grow, but most of this growth would be due to increases in population, labour force, and capital stock.

Under the baseline scenario, Canada's total trade would be expected to grow at a moderate level. The total value of Canadian imports globally (including CPTPP countries and the US) would be estimated to increase by 14.62%, an increase worth nearly 79.2 billion USD. The total exports would be projected to increase by about 32.2% (179.7 billion USD). Canadian imports and exports from CPTPP countries, would increase by 40.6% (nearly 21.1 billion USD) and 40.4% (16.6 billion USD), respectively. Trade with the US and RoW would also increase, total imports from the US are projected to increase by 11.3% (30.6 billion USD), while total exports to the US are projected to increase by 30% (107.1 billion USD). Total imports from the RoW are projected to increase by 12.55% (27.5 billion USD), while total exports to the RoW are projected to increase by 33.2% (55.9 billion USD). On the agricultural side, Canada's total agricultural imports and exports would increase by 11.3% (4.9 billion USD) and 36% (23.3 billion USD), respectively. The agricultural imports and exports to CPTPP countries would increase by 14.2% (500 million USD) and 38.2% (4.3 billion USD), respectively, to the US by 11.6% (3.1 billion USD) 33% (9.4 billion USD), respectively. Canada agricultural imports from RoW would also increase by 9.97% (1.3 billion USD) and to increase by 38.5% (9.6 billion USD), respectively. Table 5.5 summarizes the general changes in trade between 2017 and 2030.

Table 5.5: Canadian trade under the national baseline scenario (million USD)

	All imports			All exports		
Region	**2017 (USD)**	**2030 (USD)**	**Change (%)**	**2017 (USD)**	**2030 (USD)**	**Change (%)**
CPTPP	51,916	73,011	40.63	41,288	57,976	40.42
US	270,401	300,978	11.31	348,105	455,162	30.75
RoW	219,330	246,850	12.55	168,769	224,748	33.17
Total	541,647	620,839	14.62	558,162	737,886	32.20
	Agricultural imports			**Agricultural exports**		
Region	**2017 (USD)**	**2030 (USD)**	**Change (%)**	**2017 (USD)**	**2030 (USD)**	**Change (%)**
CPTPP	3,518	4,018	14.21	11,260	15,564	38.22
US	26,396	29,471	11.65	28,416	37,796	33.01
RoW	13,268	14,591	9.97	25,074	34,739	38.55
Total	43,182	48,080	11.34	64,750	88,099	36.06
	Non-agricultural imports			**Non-agricultural exports**		
Region	**2017 (USD)**	**2030 (USD)**	**Change (%)**	**2017 (USD)**	**2030 (USD)**	**Change (%)**
CPTPP	48,398	68,992	42.55	30,030	42,411	41.23
US	244,005	271,506	11.27	319,689	417,364	30.55
RoW	206,063	232,258	12.71	143,694	190,008	32.23
Total	498,466	572,756	14.90	493,413	649,783	31.69

Further details on the simulation show that the main source of the projected change would be natural growth. Bilateral and regional trade agreements would have limited impact on Canada. The projected increase in the population and factor of production would account for nearly all growth changes in agricultural and non-agricultural Canadian trade. This reflects the fact that Canada has only a few trade agreements to be implemented with the CPTPP countries over the coming decade, as almost all major Canada trade agreements have already been fully or partially implemented.

Trade between Canada and each of the CPTPP countries under the baseline scenario would grow with all CPTPP countries and the US. As shown in Table 5.6 and Table 5.7, the Canadian trade with all regions would increase. In terms of absolute value, the Canadian imports of agricultural products from US would lead the change by about 3.1 billion USD. With regards to the agricultural imports from CPTPP countries, they are projected to witness noticeable increase from Australia (147 million USD), Mexico (125 million USD) New Zealand and Chile (83 million USD each). Similar to the imports, on the exports side, US would continue to be the largest export destination for Canadian agricultural products with a projected increase exceeding 9.3 billion USD. On the CPTPP countries side, the major increase in Canadian agricultural exports to Japan, Mexico and Peru are projected to increase by 2.1, 1.2 billion and 303 million USD, respectively. It is interesting to note that although Peru is not one of the major export destination for Canada, it is the only country that has signed a bilateral trade agreement that would come into force over the simulation period. This may explain, to some extent, the high increase in Canadian exports to Peru. Under the baseline scenario, although some import sources or export destinations would change to a higher rate, the absolute dollar value of change for many sources may be considered insignificant, depending on the size of the economy.

A closer and more disaggregated look at the simulation results shows that agricultural sectors would be affected differently in terms of trade. Table 5.8 shows that imports of all Canadian agricultural sectors would increase at a moderate level except for dairy products sector, which would decrease slightly on import side. This can be attributed to the current protection policy on this sector. Increases are also expected for non-agricultural sectors, with a major increase in extractions imports. On the exports front, Canadian agricultural exports would increase at higher levels, including dairy and meat products, relative to the imports. Wheat, other grains, oilseeds, and meat product exports would also be projected to increase at larger rates compared to other sectors. Most of the growth would be attributed to the natural growth, not to FTAs. This conclusion is expected because Canada's trade agreements have already been fully or partially implemented, and therefore, they would not have a major impact on Canadian trade. These results align with the study conducted by Burfisher *et al.* (2014), which showed similar results to those concluded in this study.

Table 5.6: Canadian imports by region under national baseline scenario, 2030 (million USD)

	Agricultural imports			Non-agricultural imports			Total imports		
Region/ scenario	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
Australia	482	629	147	2,421	3,488	1,067	2,903	4,117	1,214
Brunei Darussalam	0	0	0	23	41	18	23	41	18
Chile	449	532	83	1,525	2,315	790	1,974	2,847	873
Japan	93	129	36	13,025	19,867	6,842	13,118	19,996	6,878
Malaysia	58	57	-1	3,234	4,418	1,184	3,292	4,475	1,183
Mexico	1,408	1,533	125	16,695	22,964	6,269	18,103	24,497	6,394
New Zealand	543	626	83	366	451	85	909	1,077	168
Peru	185	168	-17	5,433	7,591	2,158	5,618	7,759	2,141
Singapore	29	39	10	4,131	5,595	1,464	4,160	5,634	1,474
Vietnam	270	305	35	1,545	2,262	717	1,815	2,567	752
United States	26,396	29,471	3,075	244,005	271,506	27,501	270,401	300,977	30,576
RoW	13,268	14,591	1,323	206,063	232,258	26,195	219,331	246,849	27,518

Table 5.7: Canadian exports by region under national baseline scenario, 2030 (million USD)

	Agricultural exports			Non-agricultural exports			Total exports		
Region/ scenario	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
Australia	305	440	135	2,759	3,683	924	3,064	4,123	1,059
Brunei Darussalam	1	1	0	36	45	9	37	46	9
Chile	195	306	111	1,211	1,866	655	1,406	2,172	766
Japan	6,861	9,047	2,186	11,203	14,843	3,640	18,064	23,890	5,826
Malaysia	285	421	136	1,561	2,151	590	1,846	2,572	726
Mexico	2,833	4,126	1,293	6,921	10,528	3,607	9,754	14,654	4,900
New Zealand	105	145	40	426	584	158	531	729	198
Peru	447	750	303	492	760	268	939	1,510	571
Singapore	77	116	39	4,996	7,373	2,377	5,073	7,489	2,416
Vietnam	151	213	62	425	578	153	576	791	215
United States	28,416	37,796	9,380	319,689	417,364	97,675	348,105	455,160	107,055
RoW	25,075	34,739	9,664	143,695	190,008	46,313	168,770	224,747	55,977

Table 5.8: Canadian total imports and exports by sector under national baseline scenario, 2030 (million USD)

	Imports			Exports		
Sector	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
Rice	431	555	124	8	10	2
Wheat	35	40	5	9,506	13,515	4,009
Other grains	474	593	119	1,907	2,380	473
Fruits/vegetables	7,926	9,353	1,427	6,619	8,817	2,198
Oilseeds	547	666	119	9,531	12,621	3,090
Other crops	1,867	2,241	374	1,323	1,919	596
Livestock	751	909	158	3,415	4,479	1,064
Meat products	4,594	4,602	8	8,388	12,547	4,159
Raw milk	5	5	0	1	2	1
Dairy products	1,869	1,820	-49	500	762	262
Processed foods	24,680	27,295	2,615	23,550	31,049	7,499
Extraction	26,985	38,683	11,698	106,088	122,435	16,347
Labour-intensive manufacturing	240,927	268,298	27,371	154,125	215,878	61,753
Capital-intensive manufacturing	139,065	166,846	27,781	156,044	209,741	53,697
Services	91,490	98,933	7,443	77,155	101,729	24,574

Besides Canada, all other CPTPP countries as well as the US would also witness a growth in their agricultural and non-agriculture imports and exports relative to 2017 figures, except for Japan, which would witness a slight decrease in its imports, but a substantial increase in its exports[75]. Similar to Canada, the natural growth would be the major driver of the growth; however, the FTAs would play a more significant role, especially in the trade of those countries engaged in multiple bilateral and regional trade agreements, such as Australia, Japan and Mexico.

The growth in both imports and exports of agricultural and non-agricultural products in Canada and other countries in the model would be accompanied by growth in production to meet the projected growth in the domestic and trade demand. This would be basically a result of changes in the population, factors of production, and in some cases, a reduction in tariffs due to the bilateral and regional trade agreements. In the next subsection, the study summarizes the projected changes in production by model sector in Canada, other CPTPP countries and the US under the baseline scenario simulation.

5.3.3.3 Value of Output under National Baseline Scenario

The GTAP model identifies the value of output for each sector in the model. Sectoral value of output[76] is an endogenous variable that is determined within the model and responds to changes in exogenous valuables, for instance, policy shocks. The output responds to both the demand and supply of factor of production. Under the baseline scenario, the value of agricultural output would increase in all CPTPP countries. Table 5.9 summarizes the projected increase in Canada's output between 2017 and 2030. The total agricultural output is projected to grow by approximately 24% (49.7 billion USD) in 2030. However, different agricultural sector output would grow at different levels, and the major increase in absolute value could be attributed to specific sectors in the model, (i.e., wheat, oilseeds, meat products, and processed foods), which would increase by 4.1, 3.8, 9.9, and 18 billion USD, respectively.

[75] Unlike all CPTPP countries, Japan's population will decrease over the simulation period, which would be the major reason for the projected decrease in its imports.

[76] This refers to the production value of economic sectors in USD.

Table 5.9: Canadian value of output by sector under national baseline scenario (million USD)

Sector	2017 (USD)	2030 (USD)	Change (USD)
Rice	422	501	79
Wheat	10,437	14,614	4,177
Other grains	5,232	6,626	1,394
Fruits/vegetables	7,436	9,706	2,270
Oilseeds	12,092	15,911	3,819
Other crops	4,566	6,041	1,475
Livestock	13,919	17,935	4,016
Meat products	37,659	47,652	9,993
Raw milk	6,614	7,976	1,362
Dairy products	18,982	22,176	3,194
Processed food	87,343	105,355	18,012
Extraction	194,267	245,349	51,082
Labour-intensive manufacturing	363,579	478,200	114,621
Capital-intensive manufacturing	426,785	552,577	125,792
Services	2,351,284	2,650,075	298,791
Total agricultural	204,702	254493	49,791
Total non-agricultural	3,335,915	3,926,201	590,286
Total	3,540,617	4,180,694	640,077

Agricultural output in all other CPTPP countries and the US would grow at moderate levels. These increases would be a normal response to the natural growth in the factors of production, and the increased demand in both the domestic and international markets. US would continue to be the largest agricultural producer among all countries in the model with an increase in its value of production over the simulation period - exceeding 198 billion USD (13.6%). Japan's agricultural production would be projected to grow by about 5.5%; however, this small increase is equivalent to 31 billion USD in value. Table 5.10 summarizes the projected changes in the value of different sectors' output among TPP member counties under the baseline scenario.

Table 5.10: Value of Output in CPTPP countries and the US under national baseline scenario (million USD)

	Agricultural			Non-agricultural			Total		
Country	**2017 (USD)**	**2030 (USD)**	**Change (%)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
Australia	163,411	205,238	25.60	2,867,083	3,473,318	21.14	3,030,494	3,678,556	21.38
Brunei Darussalam	129	171	32.56	27,429	36,251	36,251	27,558	36,422	32.16
Chile	52,423	65,913	25.73	532,417	730,210	730,210	584,840	796,123	36.13
Japan	560,186	591,216	5.54	11,821,823	13,226,697	13,226,697	12,382,009	13,817,913	11.60
Malaysia	101,019	116,748	15.57	893,093	1,159,131	1,159,131	994,112	1,275,879	28.34
Mexico	215,754	264,701	22.69	2,101,075	2,699,201	2,699,201	2,316,829	2,963,902	27.93
New Zealand	53,402	64,868	21.47	315,594	374,686	374,686	368,996	439,554	19.12
Peru	73,023	93,023	27.39	364,616	478,928	478,928	437,639	571,951	30.69
Singapore	6,916	9,673	39.86	858,629	1,160,431	1,160,431	865,545	1,170,104	35.19
Vietnam	71,611	85,362	19.20	298,215	383,449	383,449	369,826	468,811	26.77
United States	1,453,179	1,651,755	13.66	29,892,602	33,532,629	33,532,629	31,345,781	35,184,384	12.25

5.3.3.4 GDP under National Baseline Scenario

Table 5.11 shows the simulation results of the baseline scenario on real GDP[77] for Canada and other countries in the model. Impact on the real GDP is calculated in percentage change, as well as in dollar value. For Canada, the simulation shows that its GDP would increase by 147% due to changes under the baseline scenario, which would be worth about 290 billion USD. The natural growth component of the simulation is the driving force generating gains in Canada's GDP. All other CPTPP countries would also witness an increase in their GDP over the simulation period under the baseline scenario. These impacts vary from a small increase, such as in the case of Japan, to a high positive impact up to more than 25% for Chile, Peru, and Singapore[78]. The GDP for US would be projected to grow by 12.6%. Similar to Canada, but at different rates, the GDP growth in CPTPP countries would be driven by the natural growth rather than the FTAs. This result would be expected as the trade barriers among CPTPP countries are already at low rates, thus the projected cuts in the tariffs between these countries would have a minimum impact on the CPTPP countries' GDP.

Table 5.11: GDP growth in CPTPP countries and the US under national baseline scenario, 2030 (billion USD)

Country	GDP-2017 (USD)	GDP-2030 (USD)	Change (%)
Australia	1,609	1,930	19.95
Brunei Darussalam	20	25	25.00
Canada	1,980	2,271	14.70
Chile	309	412	33.33
Japan	6,261	6,678	6.66
Malaysia	342	423	23.68
Mexico	1,368	1,721	25.80
New Zealand	186	220	18.28
Peru	207	269	29.95
Singapore	319	413	29.47
Vietnam	156	181	16.03
United States	17,310	19,415	12.16

[77] GDP was estimated as follows: $GDP = C + I + G + X - M$, where C: consumption, I: investment, G: government spending. X: exports, and M: imports. Real GDP is adjusted for price changes (inflation or deflation).

[78] It is important to note that some countries in the model have a small GDP compared to large economies like U.S. and Japan, and thus the gain in GDP values is much smaller when measured in dollars.

5.3.3.5 National Bassline Scenario Summary

The baseline scenario simulation results show a projected economic growth among the CPTPP countries and the US. These indicate that nearly all the changes in the region would be driven by the growth in factors of production and population, rather than by projected partial elimination of trade barriers proposed under non-CPTPP agreements between 2017 2030, which is a reflection of the fact that tariff rates between CPTPP members are already very low in most of trading sectors.

The Canadian economy would grow over the simulation period; nearly all the growth can be attributed to the natural growth (i.e., growth in population and factors of production). Canada has multiple trade agreements with many of the CPTPP countries; in fact, all of these agreements have already been implemented (for instance, NAFTA). Canada has a trade agreement with only one CPTPP member (Peru), which is scheduled to be implemented by 2025. By 2030, Canada's GDP is projected to grow by about 14.7% compared to 2017, the agricultural value of production would increase by about 49.8 billion USD, and agricultural products imports and exports would grow by 4.8 and 23 billion USD, respectively. Canada trade with CPTPP member countries, the US and RoW would increase, regardless of the minimum changes in the tariff rates between Canada and other regions in the model.

The next section presents the simulation results of the impacts of implementing the CPTPP trade clauses, and comparing them with the baseline scenario results. The baseline scenario is the starting point of the CPTPP scenario simulation, where all the natural growth and other FTA among model's countries were incorporated to segregated CPTPP impact from all other changes and avoid any potential double-counting.

5.4 National CPTPP Scenario Simulation: Results and Discussion

Under the CPTPP scenario, tariff trade barriers on the agricultural and non-agricultural sectors between CPTPP member countries, as listed in Annex 2-D of the agreement were reduced/eliminated. This would result in some impact on the members' economies. The results were compared with the baseline scenario results to separate the impact of the CPTPP from other FTAs and natural growth. In this simulation, the US was not aggregated in RoW, as it represents a major trade partner for all CPTPP member countries.

5.4.1 Simulation Design and Assumptions

The CPTPP experimental design involved reduction or removal of the tariffs on imports from any of the CPTPP member countries. The CPTPP scenario experiment was conducted based on the post-baseline scenario experiment, which was explained in section 5.3. In addition to the baseline scenario assumptions listed in subsection 3.5.2, three other assumptions were imposed to fulfill the purposes of this simulation:

i. The baseline scenario was the starting point of the CPTPP scenario, any economic changes due to the CPTPP agreement will be added to the top of the changes simulated under the baseline scenario simulation;

ii. This scenario assumes that the CPTPP would be fully implemented by 2030; and

iii. The US was treated as a separate region in the model as it represents a major trade partner for all CPTPP member countries.

5.4.2 Trade under National CPTPP Scenario

The simulation showed that the CPTPP would have some implications on the trade between CPTPP countries, the US and with RoW. The total value of Canadian imports is projected to increase by 0.26%, while its total exports are estimated to increase by 0.28%, relative to the baseline scenario without CPTPP. This increase is worth nearly 1.61 billion USD in imports, and 2.04 billion USD in exports. Separating Canadian trade with CPTPP member countries from that with the US and RoW shows that Canadian imports from CPTPP countries are projected to increase by 3.79% or 2.77 billion USD, and decrease by 0.17% (502 million USD) and 0.26% (651 million USD) from the US and RoW, respectively. In terms of exports, Canadian total exports to CPTPP countries is projected to increase by 8.50% (nearly 4.98 billion USD) and to decrease by 0.42% (about 1.9 billion USD) and 0.46% (nearly 1.05 billion USD) to the US and RoW, respectively.

The impact of the CPTPP would be more noticeable in agricultural trade. The total Canadian agricultural imports are projected to increase by 1.22% (587 million USD), and total agricultural exports are projected to increase by 4.78% (4.21 billion USD). The agricultural trade with CPTPP countries would also experience growth: agricultural imports from the CPTPP

member countries would increase by 17.12% (688 million USD) relative to the baseline scenario. Table 5.12 below illustrates the general changes in Canadian imports and exports under national CPTPP scenario.

Table 5.12: Canadian trade under national CPTPP scenario, 2030 (million USD)

	All imports			All exports		
Region	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**
CPTPP	73,011	75,778	3.79	57,976	62,963	8.60
US	300,978	300,476	-0.17	455,162	453,263	-0.42
RoW	246,850	246,199	-0.26	224,748	223,703	-0.46
Total	620,839	622,453	0.26	737,886	739,929	0.28
	Agricultural imports			**Agricultural exports**		
Region	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**
CPTPP	4,018	4,706	17.12	15,564	20,175	29.63
US	29,471	29,527	0.19	37,796	37,652	-0.38
RoW	14,591	14,434	-1.08	34,739	34,485	-0.73
Total	48,080	48,667	1.22	88,099	92,312	4.78
	Non-agricultural imports			**Non-agricultural exports**		
Region	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**
CPTPP	68,992	71,070	3.01	42,411	42,789	0.89
US	271,506	270,951	-0.20	417,364	415,612	-0.42
RoW	232,258	231,764	-0.21	190,008	189,218	-0.42
Total	572,756	573,785	0.18	649,783	647,619	-0.33

Analyzing the simulation at more disaggregated level shows that major increase in Canadian imports in absolute value would basically come from Japan (1.63 billion USD) with substantial increases in imports from Vietnam and New Zealand (increases worth 513 and 467 million USD, respectively). Canadian agricultural exports to the CPTPP member countries are projected to increase by 4.60 billion USD, the major increase contributed by Japan and Mexico, with an increase of 4.36 billion and 179 million USD, respectively. Canadian agricultural exports to the US and RoW are projected to decrease slightly by 0.38% (144 million USD) and 0.73 (254 million USD), respectively. This trade diversion is an expected result due to the tariff cuts between CPTPP members. Table 5.13 and Table 5.14 show the detailed changes of Canadian imports and exports under by region under CPTPP scenario.

All CPTPP member countries are expected to experience growth in their agricultural and non-agricultural trade with their CPTPP trade partners. Japan would experience a large expansion in its trade[79]. Its total imports from the CPTPP member countries are projected to be 9.96 billion USD higher than the baseline scenario in 2030, representing the majority of total imports expansion in the interregional CPTPP trade. On the exports side, CPTPP member countries exports to other members of the agreement are projected to increase at moderate levels. Australia and New Zealand would experience a noticeable growth in their exports to other CPTPP, nearly 2.70 and 1.5 billion USD, respectively, relative to the baseline scenario analysis.

CPTPP countries trade is also projected to divert from the US and RoW toward the CPTPP member countries. This would result in reductions of the US trade with CPTPP member countries. The total CPTPP countries imports from the US and RoW are projected to decrease by 0.67% (nearly 5.47 billion USD) and 0.31% (nearly 5.93 billion USD), respectively, while their total exports to the US and RoW are projected to decrease by 0.26% (nearly 5.47 billion USD) and 0.29% (nearly 5.93 billion USD), respectively relative to the baseline scenario. Table 5.15 and Table 5.16 summarize CPTPP member countries and the US trade under CPTPP scenario, relative to their trade under the baseline scenario.

[79] Japan imposes high tariffs on most of its agricultural imports, and thus CPTPP agreement has important consequences on Japan's agricultural trade.

Table 5.13: Canadian imports by country/region under national CPTPP scenario, 2030 (million USD)

	Agricultural imports			Non-agricultural imports			Total imports		
Region/ scenario	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Australia	629	643	14	3,488	3,486	-2	4,117	4,129	12
Brunei Darussalam	0	0	0	41	41	0	41	41	0
Chile	532	637	105	2,315	2,303	-12	2,847	2,940	93
Japan	129	141	12	19,867	21,482	1,615	19,996	21,623	1,627
Malaysia	57	69	12	4,418	4,520	102	4,475	4,589	114
Mexico	1,533	1,583	50	22,964	22,843	-121	24,497	24,426	-71
New Zealand	626	1,089	463	451	455	4	1,077	1,544	467
Peru	168	168	0	7,591	7,581	-10	7,759	7,749	-10
Singapore	39	68	29	5,595	5,588	-7	5,634	5,656	22
Vietnam	305	308	3	2,262	2,772	510	2,567	3,080	513
United States	29,471	29,527	56	271,506	270,951	-555	300,977	300,478	-499
RoW	14,591	14,434	-157	232,258	231,764	-494	246,849	246,198	-651

Table 5.14: Canadian exports by country/region under national CPTPP scenario, 2030 (million USD)

	Agricultural exports			Non-agricultural exports			Total exports		
Region/ scenario	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Australia	440	451	11	3,683	3,903	220	4,123	4,354	231
Brunei Darussalam	1	1	0	45	46	1	46	47	1
Chile	306	331	25	1,866	1,859	-7	2,172	2,190	18
Japan	9,047	13,410	4,363	14,843	15,056	213	23,890	28,466	4576
Malaysia	421	428	7	2,151	2,224	73	2,572	2,652	80
Mexico	4,126	4,305	179	10,528	10,404	-124	14,654	14,709	55
New Zealand	145	146	1	584	579	-5	729	725	-4
Peru	750	748	-2	760	759	-1	1,510	1,507	-3
Singapore	116	116	0	7,373	7,351	-22	7,489	7,467	-22
Vietnam	213	238	25	578	608	30	791	846	55
United States	37,796	37,652	-144	417,364	415,612	-1752	455,160	453,264	-1896
RoW	34,739	34,485	-254	190,008	189,218	-790	224,747	223,703	-1044

Table 5.15: CPTPP countries and the US imports under national CPTPP scenario, 2030 (million USD)

	Total imports from CPTPP			Total imports from US			Total imports from RoW		
Region/ scenario	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**
Australia	112,537	112,943	0.36	37,247	37,426	0.48	217,843	218,269	0.20
Brunei Darussalam	3,082	3,185	3.34	497	482	-3.02	3,496	3,405	-2.60
Canada	73,011	75,778	3.79	300,978	300,476	-0.17	246,850	246,199	-0.26
Chile	19,742	19,893	0.76	25,179	25,195	0.06	88,496	88,537	0.05
Japan	234,924	244,891	4.24	111,340	107,882	-3.11	827,337	823,881	-0.42
Malaysia	124,648	124,918	0.22	23,227	23,297	0.30	191,047	191,033	-0.01
Mexico	56,326	60,408	7.25	250,790	249,010	-0.71	178,608	177,100	-0.84
New Zealand	25,239	25,777	2.13	5,667	5,648	-0.34	30,568	30,466	-0.33
Peru	10,691	10,996	2.85	11,327	11,296	-0.27	41,962	41,793	-0.40
Singapore	110,236	110,023	-0.19	41,254	41,366	0.27	279,702	280,053	0.13
Vietnam	44,709	46,414	3.81	7,371	7,327	-0.60	132,897	132,139	-0.57
Total CPTPP	815,145	835,226	2.46	814,877	809,405	-0.67	2,238,806	2,232,875	-0.26
United States	1,304,460	1,300,444	-0.31	**	**	**	2,413,000	2,413,002	0.00

Table 5.16: CPTPP countries and the US exports under national CPTPP scenario, 2030 (million USD)

	Total exports to CPTPP			Total exports to US			Total exports to RoW		
Region/ scenario	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**
Australia	123,214	125,918	2.19	25,486	25,300	-0.73	328,446	326,812	-0.50
Brunei Darussalam	8,524	8,525	0.01	400	400	0.00	7,498	7,493	-0.07
Canada	57,976	62,963	8.60	455,162	453,263	-0.42	224,748	223,703	-0.46
Chile	45,499	46,418	2.02	16,431	16,357	-0.45	136,461	135,909	-0.40
Japan	217,721	223,201	2.52	245,761	244,936	-0.34	1,108,016	1,104,665	-0.30
Malaysia	109,893	110,558	0.61	53,919	53,817	-0.19	262,174	261,792	-0.15
Mexico	41,092	42,841	4.26	401,288	400,830	-0.11	115,556	115,401	-0.13
New Zealand	22,734	24,228	6.57	6,490	6,381	-1.68	41,015	40,239	-1.89
Peru	21,081	21,187	0.50	9,315	9,307	-0.09	66,463	66,431	-0.05
Singapore	127,283	127,939	0.52	49,755	49,674	-0.16	313,818	313,465	-0.11
Vietnam	40,127	41,448	3.29	40,453	40,179	-0.68	110,785	109,966	-0.74
Total CPTPP	815,144	835,226	2.46	1,304,460	1,300,444	-0.31	2,714,980	2,705,876	-0.34
United States	814,877	809,405	-0.67	**	**	**	1,297,097	1,299,903	0.22

In terms of sectors, the increase in the value of Canada agricultural imports from CPTPP countries as a whole is projected to be the largest for dairy products, meat products, and processed foods, with an increase of 511, 102, and 74 million USD, respectively. Most of the expansion in Canada's agricultural imports from CPTPP member countries would be due to the trade with Japan and New Zealand. In terms of exports, most of expansion in the Canadian agricultural exports to other CPTPP countries would occur in meat products and wheat, with an increase of 3.59 billion, and 552 million USD, respectively. These represent nearly 90% of Canada's agricultural exports growth to the CPTPP member countries. The dairy products sector would be significantly impacted from the CPTPP agreement, as this sector is particularly protected sector in Canada. Japan and Canada would account for the largest increase in dairy products imports, while Australia and New Zealand would account for the most expansion of exports of this sector among CPTPP member countries.

Canadian growth in its agricultural exports to CPTPP member countries, would also be accompanied with a slight decrease in its exports to the US and RoW. Canadian exports of meat products and wheat to the US are projected to decrease by 23 and 14 million USD, respectively, and by 30 and 156 million USD to the RoW, respectively. This diversion in trade is one of trade agreements impact. The economic literature show that trade agreements, divert FTA member imports away from non-member countries, where the increase openness among trade agreement members allow for more efficient allocation of their resources (Dai *et al*., 2014). Table 5.17 and Table 5.18 show a detailed summary of Canada's imports and exports by sector under the CPTPP simulation scenario, relative to the baseline scenario.

In summary, the CPTPP scenario simulation results show that Canada would experience a change in terms of its trade relative to the baseline scenario. The results further show that Canada and other CPTPP member countries would experience a slight reduction of their trade with the US and RoW, however these reductions are not projected to be significant in terms of absolute values. This result can be attributed to the to the large trade volume between CPTPP member countries and the US which is a major trade partner for all CPTPP member countries.

Table 5.17: Canadian imports by sector under national CPTPP scenario, 2030 (million USD)

	Imports from CPTPP			Imports from US			Imports from RoW		
Sector	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Rice	6	6	0	301	302	1	248	248	0
Wheat	0	0	0	30	31	1	9	10	1
Other grains	2	2	0	563	566	3	28	28	0
Fruits/vegetables	1,320	1,321	1	6,642	6,652	10	1,391	1,392	1
Oilseeds	28	28	0	544	547	3	94	94	0
Other crops	91	91	0	543	545	2	1,607	1,611	4
Livestock	22	22	0	661	682	21	226	233	7
Meat products	534	636	102	3,629	3,743	114	439	450	11
Raw milk	0	0	0	1	1	0	4	4	0
Dairy products	207	718	511	570	444	-126	1,042	855	-187
Processed foods	1,807	1,881	74	15,987	16,014	27	9,503	9,509	6
Extraction	4,154	4,142	-12	13,192	13,198	6	21,336	21,305	-31
Labour-intensive manufacturing	41,469	43,433	1,964	131,186	130,445	-741	95,643	95,051	-592
Capital-intensive manufacturing	16,128	16,255	127	96,549	96,584	35	54,167	54,123	-44
Services	7,241	7,240	-1	30,579	30,724	145	61,112	61,285	173
Total ag.	4,018	4,706	688	29,471	29,527	56	14,591	14,434	-157
Total non-ag	68,992	71,070	2,078	271,506	270,951	-555	232,258	231,764	-494
Total	73,011	75,778	2,767	300,978	300,476	-502	246,850	246,199	-651

Table 5.18: Canadian exports by sector under national CPTPP scenario, 2030 (million USD)

	Exports to CPTPP			Exports to US			Exports to RoW		
Sector	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Rice	0	0	0	7	7	0	3	3	0
Wheat	2,763	3,315	552	1,157	1,143	-14	9,594	9,438	-156
Other grains	512	555	43	1,063	1,060	-3	805	803	-2
Fruits/vegetables	396	570	174	3,477	3,471	-6	4,944	4,929	-15
Oilseeds	4,984	4,969	-15	1,371	1,369	-2	6,266	6,248	-18
Other crops	325	323	-2	1,203	1,198	-5	390	388	-2
Livestock	186	201	15	2,725	2,703	-22	1,568	1,558	-10
Meat products	4,152	7,742	3,590	4,410	4,387	-23	3,984	3,954	-30
Raw milk	0	0	0	1	1	0	1	1	0
Dairy products	109	200	91	245	245	0	408	408	0
Processed foods	2,136	2,299	163	22,137	22,068	-69	6,776	6,755	-21
Extraction	9,035	9,055	20	82,977	82,812	-165	30,423	30,379	-44
Labour-intensive manufacturing	13,812	14,121	309	162,862	162,002	-860	39,204	38,997	-207
Capital-intensive manufacturing	8,536	8,615	79	134,088	133,539	-549	67,117	66,824	-293
Services	11,029	10,998	-31	37,437	37,259	-178	53,264	53,018	-246
Total ag.	15,564	20,175	4,611	37,796	37,652	-144	34,739	34,485	-254
Total non-ag	42,411	42,789	378	417,364	415,612	-1,752	190,008	189,218	-790
Total	57,976	62,963	4,987	455,162	453,263	-1,899	224,748	223,703	-1,045

5.4.3 Trade Diversion

As a rule of thumb, a trade agreement can be considered beneficial for a country if the total diversion from trade with non-member countries is less than the total trade creation. The simulation results show that Canada total imports from CPTPP countries would grow by 2.77 billion USD, while its imports from the US and RoW would drop by 1.15 billion USD. Canadian exports to CPTPP countries would grow by about 5 billion USD while it would decrease by 2.94 billion USD to the US and RoW relative to the baseline scenario (see Table 5.13 and Table 5.14 for details). The trade creation is higher than the trade diversion, and therefore, CPTPP is beneficial for Canada.

5.4.4 Value of Output under CPTPP scenario

This subsection compares the production in the CPTPP countries by 2030, relative to the baseline scenario. As shown in the previous subsections trade in agricultural and non-agricultural communities is projected to grow with the reduction/elimination of tariffs between the CPTPP countries, the change would be accompanied with changes in production. Under the CPTPP scenario, the total Canadian agricultural value output is projected to increase by 1.91% (nearly 4.86 billion USD). At the sector level, meat products, wheat and livestock value of output are projected to increase by 7.11%, 2.39% and 4.56, respectively, relative to the baseline scenario, representing the largest absolute change (3.39 billion, 349, and 780 million USD, respectively). The output value of dairy products sector is projected to decease by 1.04% (223 million USD). The decrease in dairy products sectors is a result of removal of the high protection on this sector[80]; where Canada would depend more on imported dairy products. It is worth noting that the moderate impact of CPTPP on Canada also reflects the fact that majority of Canada agricultural trade is with US, which is already liberalized under the NAFTA/USMCA agreement. Table 5.19 provides a detailed list of sectoral output values changes under the CPTPP scenario, relative to the baseline scenario.

The agricultural value of output would slightly change in all CPTPP counties. Japan would witness a noticeable decline in many of its agricultural sectors output, with a total decline of 1.06% (about 6.26 billion USD) relative to the baseline scenario. In contrast, Australia, New Zealand and

[80] Canada has announced that it will support the producers in the supply managed value chain sectors such as the dairy products sector as the CPTPP is implemented.

Mexico would witness an increase in most of their agricultural sectors. By sector, the largest increase in the agricultural output in the region would be in meat products in Australia (1.46 billion USD and in dairy products (524 million USD) in New Zealand. Table 5.20 summarizes the agricultural and non-agricultural sectors value of output for CPTPP countries and the US under the CPTPP scenario relative to the baseline scenario. It is important to note that part of the FTA's effects is improving comparative advantages of members, consequently factors of production move from less efficient to more efficient sectors. For example, the simulation results show a decline in Japan agricultural output and an increase in its manufacturing sectors.

Table 5.19: Canadian value of output by sector under national CPTPP scenario, 2030 (million USD)

Sector	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Change (%)**
Rice	501	502	1	0.20
Wheat	14,614	14,963	349	2.39
Other grains	6,626	6,741	115	1.74
Fruits/vegetables	9,706	9,767	61	0.63
Oilseeds	15,911	15,892	-19	-0.12
Other crops	6,041	6,076	35	0.58
Livestock	17,935	18,715	780	4.35
Meat products	47,652	51,038	3,386	7.11
Raw milk	7,976	7,930	-46	-0.58
Dairy products	22,176	21,953	-223	-1.01
Processed foods	105,355	105,780	425	0.40
Extraction	245,349	244,917	-432	-0.18
Labour-intensive manufacturing	478,200	476,510	-1,690	-0.35
Capital-intensive manufacturing	552,577	551,572	-1,005	-0.18
Services	2,650,075	2,654,481	4,406	0.17
Total agricultural	254493	259,357	4,864	1.91
Total non-agricultural	3,926,201	3,927,480	1,279	0.03
Total	4,180,694	4,186,836	6,142	0.15

Table 5.20: Value of output in CPTPP countries and the US under national CPTPP scenario, 2030 (million USD)

	Agricultural			Non-agricultural			Total		
Country	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (%)**
Australia	205,238	208,759	1.72	3,473,318	3,476,659	0.10	3,678,556	3,685,418	0.19
Brunei Darussalam	171	170	-0.58	36,251	36,263	0.03	36,422	36,433	0.03
Chile	65,913	67,175	1.91	730,210	730,026	-0.03	796,123	797,201	0.14
Japan	591,216	584,953	-1.06	13,226,697	13,239,675	0.10	13,817,913	13,824,628	0.05
Malaysia	116,748	116,586	-0.14	1,159,131	1,159,723	0.05	1,275,879	1,276,309	0.03
Mexico	264,701	265,812	0.42	2,699,201	2,699,264	0.00	2,963,902	2,965,076	0.04
New Zealand	64,868	66,025	1.78	374,686	375,324	0.17	439,554	441,349	0.41
Peru	93,023	93,071	0.05	478,928	478,936	0.00	571,951	572,007	0.01
Singapore	9,673	9,685	0.12	1,160,431	1,160,833	0.03	1,170,104	1,170,518	0.04
Vietnam	85,362	85,358	0.00	383,449	384,660	0.32	468,811	470,018	0.26
United States	1,651,755	1,647,409	-0.26	33,532,629	33,518,798	-0.04	35,184,384	35,166,207	-0.05

5.4.5 Gross Domestic Product under the National CPTPP Scenario

The simulation results show that the CPTPP agreement would have a positive effect on all CPTPP member countries. Canada's GDP in 2030 is projected to be 0.28% (3.9 billion USD) higher than the baseline scenario. New Zealand and Vietnam would experience the largest gain in relative terms of their GDPs (0.82% and 0.67 relative to the baseline scenario, respectively). Along with that, US's GDP would drop by 0.11% (11.29 billion USD) relative to the baseline scenario.

5.4.6 National CPTPP Scenario Summary

The CPTPP scenario simulation results have shown that if the CPTPP agreement is to be fully implemented, it would have a positive impact on the member countries in terms of trade abd other economic indicators. As expected, the trade of the CPTPP countries would divert from the US and RoW toward the agreement countries. The CPTPP countries' agricultural output would increase, where the major agricultural sector to be affected in terms of trade would be those highly protected, such as the dairy and meat products sectors. In summary, although the tariff rates between CPTPP member countries are already low, and many tariffs would be reduced or eliminated due to other bilateral or regional trade agreements other than the CPTPP, the CPTPP agreement has room to positively impact its members. however, the overall impact would be be high for most of the agreement members. Canada's agricultural trade in terms of total value with Japan would remarkably change. Although part Canada trade would divert away from the US, the US would continue to be Canada's largest trade partner. In terms of sectors, Canadian dairy and meat products would witness major changes in trade and output. At the time of writing there was no comprehensive CGE-based analysis literature on the CPTPP agreement economic impact to verify the outcomes of this study. However, the results of this study are in line with the Government of Canada analysis of CPTPP economic impact (e.g. Government of Canada, 2018b).

In the next section, this study summarizes the TPP scenario results. As previously noted, the TPP scenario simulates the economic impact of the former TPP, if it had been implemented, on Canada and other CPTPP member countries. Emphasis is place on how this change would be reflected on the Canadian economy relative to the CPTPP scenario.

5.5 National TPP Scenario Simulation: Results and Discussion

The US represents a major trading partner for all CPTPP member countries and it accounts for 60% of the combined GDP of the 12-member countries of the former TPP (World Bank, 2016b). US is Canada's largest trade partner, representing more than 52%, and 76% of Canada's trade, respectively. Given that, Canada as well as other CPTPP members may experience important changes in their trade if the US is part of the trade pact or not[81]. Canada had already endorsed a trade agreement with the US (i.e., NAFTA/USMCA). Consequently, whether the US is part of the trade pact or not, the economic impact on Canada might be insignificant, however, this would impact its trade flows with the CPTPP member countries, in particular, large countries such as Japan. This hypothetical analysis assesses the impact of the former TPP if it had been fully implemented, on Canada and other CPTPP member countries.

5.5.1 Simulation Design and Assumptions

The TPP simulation design involved keeping trade commitments between all member countries of the CPTPP, and add those that the US agreed on under the former TPP agreement. Similar to baseline and CPTPP scenarios, several assumptions were imposed to achieve the objectives of this simulation. In addition to the CPTPP scenario assumptions listed in subsections 5.4.1., three other assumptions were imposed to ensure fulfilling the goals and objectives of this simulation:

i. The CPTPP scenario is the starting point of the TPP scenario; therefore, any economic changes will be assessed relative to the CPTPP scenario;
ii. The former TPP is assumed to be fully implemented as per the US previous commitment under the former agreement; and
iii. US is assumed to keep all its trade agreements with TPP member countries, including NAFTA with Canada which was assumed to remain in place

[81] Due to the recent uncertainty in trade with the US, many countries have started alternative trade plans. For instance, sixteen Asian countries plan to form a so-called Regional Comprehensive Economic Partnership (RCEP). This agreement will include China, and will be easier to join with fewer environmental and labour standards required (Association of Southeast Asian Nations, 2016).

5.5.2 Trade under National TPP Scenario

The simulation showed that including the US in the trade pact would have implications for Canada international trade flows and the total value of Canadian trade would be affected. As anticipated, the overall impact on Canada trade would not be significant, however a significant diversion in trade is projected. Under TPP scenario, total Canadian imports and exports are projected to be 0.15% and 0.29% higher relative to CPTPP scenario, this includes trade diversion from the CPTPP countries and the RoW toward the US. On the agricultural side, Canada's total agricultural imports would decrease by 13.56% from the CPTPP countries (638 million USD) and 14% from the RoW (about 1.7billion USD) relative to the CPTPP scenario. This reduction would be accompanied with an increase in Canada's agricultural imports from the US by 16.61% (4.9 billion USD). The decrease in in the agricultural imports from CPTPP countries would be minor in absolute value, majority of this decrease is projected to happen in trade with Australian and New Zealand (a decrease worth 140 and 293 million USD, respectively, relative to CPTPP scenario), with no noticeable change in the agricultural imports from other CPTPP member countries. The increase of imports from US, which represent a large amount in the absolute value, would leave Canada with 4.61% (2.25 billion USD) increase in its total agricultural imports from the whole world, compared to the CPTPP scenario. In terms of exports, total Canadian agricultural exports would also decrease to CPTPP member countries under the TPP scenario relative to the CPTPP scenario. However, the decrease would not be significant except for agricultural exports to Japan which is projected to be 8.13% (about 1.09 billion USD) lower than exports under CPTPP scenario. Total agricultural exports to the entire world would increase slightly by 0.51% (nearly 474 million USD) relative to the CPTPP scenario.

Under the TPP scenario, Canadian trade with RoW would also change. Agricultural imports from RoW are projected to decrease by 2.02 billion USD (14% lower than CPTPP scenario), while its agricultural exports to the RoW are estimated to increase slightly by 361 million USD (1.05%) relative to the CPTPP scenario. The diversion in trade is a natural consequence of trade agreements, therefore having the US as part of the agreement would promote trade with the US and divert part of Canada trade away from CPTPP countries. Table 5.21 provides a general summary of the total Canadian agricultural and non-agricultural imports and exports under the TPP scenario relative to the CPTPP scenario, whereas Table 5.22 and Table 5.23 provide

a detailed list of changes in Canada trade with all regions in the model relative to the CPTPP scenario.

Table 5.21: Canadian trade under national TPP scenario, 2030 (million USD)

	All imports			All exports		
Region	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**
CPTPP	75,778	75,101	-0.89	62,963	62,060	-1.43
US	300,476	303,784	1.10	453,263	455,226	0.43
RoW	246,199	244,491	-0.69	223,703	224,758	0.47
Total	622,453	623,376	0.15	739,929	742,044	0.29
	Agricultural imports			**Agricultural exports**		
Region	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**
CPTPP	4,706	4,068	-13.56	20,175	19,134	-5.16
US	29,527	34,431	16.61	37,652	38,806	3.06
RoW	14,434	12,413	-14.00	34,485	34,846	1.05
Total	48,667	50,912	4.61	92,312	92,786	0.51
	Non-agricultural imports			**Non-agricultural exports**		
Region	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**
CPTPP	71,070	71,031	-0.05	42,789	42,924	0.32
US	270,951	269,353	-0.59	415,612	416,421	0.19
RoW	231,764	232,078	0.14	189,218	189,913	0.37
Total	573,785	572,462	-0.23	647,619	649,258	0.25

Other CPTPP members would also be impacted if the US is part of the agreement because it is one of the major trade partners for all CPTPP members. On the imports side, all CPTPP members would experience a decrease in their trade with other CPTPP countries and RoW, and an increase in their imports from US relative to the CPTPP scenario. Similar on the exports side, CPTPP countries would experience an increase in their exports to US and RoW, and a decrease in their exports to the CPTPP member countries. It is worth noting that trade flows changes would not be significant (in terms of absolute value) except for those large economies i.e. Japan, Canada, Vietnam, Mexico, New Zealand and Australia. Table 5.24 and Table 5.25 summarize the CPTPP members' trade under the TPP scenario.

Table 5.22: Canadian imports by country/region under national TPP scenario, 2030 (million USD)

	Agricultural imports			Non-agricultural imports			Total imports		
Region/ scenario	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
Australia	643	503	-140	3,486	3,504	18	4,129	4,007	-122
Brunei Darussalam	0	0	0	41	41	0	41	41	0
Chile	637	571	-66	2,303	2,308	5	2,940	2,879	-61
Japan	141	132	-9	21,482	21,411	-71	21,623	21,543	-80
Malaysia	69	60	-9	4,520	4,509	-11	4,589	4,569	-20
Mexico	1,583	1,547	-36	22,843	22,938	95	24,426	24,485	59
New Zealand	1,089	796	-293	455	457	2	1,544	1,253	-291
Peru	168	126	-42	7,581	7,604	23	7,749	7,730	-19
Singapore	68	59	-9	5,588	5,589	1	5,656	5,648	-8
Vietnam	308	273	-35	2,772	2,671	-101	3,080	2,944	-136
United States	29,527	34,431	4904	270,951	269,353	-1598	300,478	303,784	3,306
RoW	14,434	12,413	-2021	231,764	232,078	314	246,198	244,491	-1,707

Table 5.23: Canadian exports by country/region under national TPP scenario, 2030 (million USD)

	Agricultural exports			Non-agricultural exports			Total exports		
Region/ scenario	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
Australia	451	461	10	3,903	3,902	-1	4,354	4,363	9
Brunei Darussalam	1	1	0	46	46	0	47	47	0
Chile	331	327	-4	1,859	1,865	6	2,190	2,192	2
Japan	13,410	12,319	-1,091	15,056	15,094	38	28,466	27,413	-1,053
Malaysia	428	428	0	2,224	2,226	2	2,652	2,654	2
Mexico	4,305	4,349	44	10,404	10,447	43	14,709	14,796	87
New Zealand	146	148	2	579	578	-1	725	726	1
Peru	748	743	-5	759	760	1	1,507	1,503	-4
Singapore	116	117	1	7,351	7,379	28	7,467	7,496	29
Vietnam	238	240	2	608	627	19	846	867	21
United States	37,652	38,806	1,154	415,612	416,421	809	453,264	455,227	1,963
RoW	34,485	34,846	361	189,218	189,913	695	223,703	224,759	1,056

Table 5.24: CPTPP countries and the US imports under national TPP scenario, 2030 (million USD)

	Total imports from CPTPP			Total imports from US			Total imports from RoW		
Region/ scenario	CPTPP (USD)	TPP (USD)	Change (%)	CPTPP (USD)	TPP (USD)	Change (%)	CPTPP (USD)	TPP (USD)	Change (%)
Australia	112,943	112,243	-0.62	37,426	38,457	2.75	218,269	217,159	-0.51
Brunei Darussalam	3,185	3,148	-1.16	482	583	20.95	3,405	3,337	-2.00
Canada	75,778	75,101	-0.89	300,476	303,784	1.10	246,199	244,491	-0.69
Chile	19,893	19,878	-0.08	25,195	25,098	-0.38	88,537	88,549	0.01
Japan	244,891	239,582	-2.17	107,882	123,495	14.47	823,881	818,462	-0.66
Malaysia	124,918	123,976	-0.75	23,297	26,309	12.93	191,033	189,722	-0.69
Mexico	60,408	60,298	-0.18	249,010	248,382	-0.25	177,100	177,173	0.04
New Zealand	25,777	25,629	-0.57	5,648	5,961	5.54	30,466	30,232	-0.77
Peru	10,996	10,951	-0.41	11,296	11,450	1.36	41,793	41,668	-0.30
Singapore	110,023	109,690	-0.30	41,366	41,122	-0.59	280,053	280,335	0.10
Vietnam	46,414	46,946	1.15	7,327	8,917	21.70	132,139	134,835	2.04
Total CPTPP	835,226	827,442	-0.93	809,405	833,558	2.98	2,232,875	2,225,963	-0.31
United States	1,300,444	1,319,681	1.48	**	**	**	2,413,002	2,408,995	-0.17

Table 5.25: CPTPP countries and the US exports under national TPP scenario, 2030 (million USD)

	Total exports to CPTPP			Total exports to US			Total exports to RoW		
Region/ scenario	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**
Australia	125,918	123,732	-1.74	25,300	25,635	1.32	326,812	327,853	0.32
Brunei Darussalam	8,525	8,521	-0.05	400	407	1.75	7,493	7,486	-0.09
Canada	62,963	62,060	-1.43	453,263	455,226	0.43	223,703	224,758	0.47
Chile	46,418	46,052	-0.79	16,357	16,456	0.61	135,909	136,009	0.07
Japan	223,201	222,298	-0.40	244,936	252,974	3.28	1,104,665	1,099,553	-0.46
Malaysia	110,558	110,358	-0.18	53,817	55,033	2.26	261,792	261,192	-0.23
Mexico	42,841	42,525	-0.74	400,830	400,662	-0.04	115,401	115,636	0.20
New Zealand	24,228	23,556	-2.77	6,381	6,664	4.44	40,239	40,443	0.51
Peru	21,187	21,160	-0.13	9,307	9,322	0.16	66,431	66,497	0.10
Singapore	127,939	127,657	-0.22	49,674	49,607	-0.13	313,465	313,408	-0.02
Vietnam	41,448	39,522	-4.65	40,179	47,695	18.71	109,966	104,816	-4.68
Total CPTPP	835,226	827,441	-0.93	1,300,444	1,319,681	1.48	2,705,876	2,697,651	-0.30
United States	809,405	833,558	2.98	**	**	**	1,299,903	1,288,894	-0.85

A closer look at Canadian trade by sector shows that different agricultural sectors would react in different ways under TPP scenario simulation. On the imports side, the decrease in Canada's imports from the CPTPP countries would be noticeable (in terms of absolute value) for meat and dairy products (343 and 115 million USD, respectively) relative to the trade under the CPTPP scenario. Imports from US would grow mainly for meat products, dairy products, and processed foods by 2.08, 1.25, and 1.55 billion USD, respectively, and would decrease by 321 million, 595 million, and 1.06 billion USD, respectively, from RoW relative to CPTPP scenario. Canadian agricultural exports would experience a decrease to the CPTPP countries and increase to the US and RoW; however, this change would not be significant in terms of value expect for meat products. The summary of Canadian imports and exports by sector under the TPP scenario relative to CPTPP scenario is reported in Table 5.26 and Table 5.27.

It is worth noting that the US is relatively more important for Canada that other members of CPTPP due to the size of trade between these two countries. Canada depends largely on intermediate goods for production on the US, consequently it indirectly impacts Canada's competitiveness in international market. In summary, the TPP scenario simulation results show that Canada would experience a change in terms of its trade flows relative to the CPTPP scenario, however the net creation and diversion in trade are not significant in absolute value.

5.5.3 Value of Output under National TPP Scenario

As shown in the previous subsection, trade under the TPP scenario is subject to change relative to the CPTPP scenario, and so are the values of output. The simulation showed that Canada total agricultural output value would be about 5.94 billion USD (2.29%) lower than the CPTPP scenario, the increase is mainly attributed to the decrease in meat products and dairy. Other agricultural sectors would not experience any significant change in terms of output. This decrease in Canadian agricultural production is a natural result, since Canada would have more imports under TPP scenario, this it would reply less on domestic production. Table 5.28 reports Canada's sectoral value of production under the TPP scenario relative to the CPTPP scenario.

Table 5.26: Canadian imports by sector under national TPP scenario, 2030 (million USD)

	Imports from CPTPP			Imports from US			Imports from RoW		
Sector	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
Rice	6	6	0	302	299	-3	248	249	1
Wheat	0	0	0	31	31	0	10	10	0
Other grains	2	2	0	566	565	-1	28	28	0
Fruits/vegetables	1,321	1,326	5	6,652	6,641	-11	1,392	1,397	5
Oilseeds	28	28	0	547	544	-3	94	94	0
Other crops	91	91	0	545	539	-6	1,611	1,611	0
Livestock	22	18	-4	682	727	45	233	188	-45
Meat products	636	293	-343	3,743	5,825	2,082	450	129	-321
Raw milk	0	0	0	1	1	0	4	4	0
Dairy products	718	603	-115	444	1,696	1,252	855	260	-595
Processed foods	1,881	1,700	-181	16,014	17,563	1,549	9,509	8,443	-1,066
Extraction	4,142	4,157	15	13,198	13,126	-72	21,305	21,383	78
Labour-intensive manufacturing	43,433	43,386	-47	130,445	129,553	-892	95,051	95,294	243
Capital-intensive manufacturing	16,255	16,281	26	96,584	96,212	-372	54,123	54,233	110
Services	7,240	7,208	-32	30,724	30,462	-262	61,285	61,168	-117
Total ag.	4,706	4,068	-638	29,527	34,431	4,904	14,434	12,413	-2,021
Total non-ag	71,070	71,031	-39	270,951	269,353	-1,598	231,764	232,078	314
Total	622,453	623,376	923	300,476	303,784	3,308	246,199	244,491	-1,708

Table 5.27: Canadian exports by sector under national TPP scenario, 2030 (million USD)

	Exports to CPTPP			Exports to US			Exports to RoW		
Sector	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**
Rice	0	0	0	7	7	0	3	3	0
Wheat	3,315	3,218	-97	1,143	1,158	15	9,438	9,484	46
Other grains	555	546	-9	1,060	1,071	11	803	805	2
Fruits/vegetables	570	558	-12	3,471	3,486	15	4,929	4,933	4
Oilseeds	4,969	4,893	-76	1,369	1,375	6	6,248	6,268	20
Other crops	323	322	-1	1,198	1,206	8	388	390	2
Livestock	201	198	-3	2,703	2,767	64	1,558	1,569	11
Meat products	7,742	6,901	-841	4,387	4,550	163	3,954	4,142	188
Raw milk	0	0	0	1	1	0	1	1	0
Dairy products	200	194	-6	245	303	58	408	420	12
Processed foods	2,299	2,304	5	22,068	22,882	814	6,755	6,831	76
Extraction	9,055	9,046	-9	82,812	82,922	110	30,379	30,375	-4
Labour-intensive manufacturing	14,121	14,180	59	162,002	162,147	145	38,997	39,217	220
Capital-intensive manufacturing	8,615	8,636	21	133,539	133,849	310	66,824	67,085	261
Services	10,998	11,061	63	37,259	37,503	244	53,018	53,236	218
Total ag.	20,175	19,134	-1,041	37,652	38,806	1,154	20,175	19,134	-1,041
Total non-ag	42,789	42,924	135	415,612	416,421	809	189,218	189,913	695
Total	62,963	62,060	-903	453,263	455,226	1,963	223,703	224,758	1,055

Table 5.28: Canadian value of output by sector under TPP scenario, 2030 (million USD)

Sector	CPTPP (USD)	TPP (USD)	Change (USD)	Change (%)
Rice	502	501	-1	-0.20
Wheat	14,963	14,936	-27	-0.18
Other grains	6,741	6,685	-56	-0.83
Fruits/vegetables	9,767	9,774	7	0.07
Oilseeds	15,892	15,838	-54	-0.34
Other crops	6,076	6,031	-45	-0.74
Livestock	18,715	18,013	-702	-3.75
Meat products	51,038	47,742	-3,296	-6.46
Raw milk	7,930	7,656	-274	-3.46
Dairy products	21,953	21,041	-912	-4.15
Processed foods	105,780	105,200	-580	-0.55
Extraction	244,917	245,241	324	0.13
Labour-intensive manufacturing	476,510	477,448	938	0.20
Capital-intensive manufacturing	551,572	552,362	790	0.14
Services	2,654,481	2,648,928	-5,553	-0.21
Total agricultural	259,357	253,417	-5,940	-2.29
Total non-agricultural	3,927,480	3,923,979	-3,501	-0.09
Total	4,186,836	4,177,396	-9,440	-0.23

US would experience an increase in the value of agricultural and non-agricultural output, relative to CPTPP scenario. CPTPP member countries would also experience a decrease in the value of their output; however, it is worth noting that those countries with high level of trade with the US (i.e., Mexico and Canada) would experience more noticeable change. Table 5.29 reports the changes in agricultural and non-agricultural production under TPP scenario relative to CPTPP scenario.

Table 5.29: Value of output in CPTPP countries and the US under national TPP scenario, 2030 (million USD)

	Agricultural			Non-agricultural			Total		
Country	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**	**CPTPP (USD)**	**TPP (USD)**	**Change (%)**
Australia	208,759	206,573	-1.05	3,476,659	3,472,497	-0.12	3,685,418	3,679,070	-0.17
Brunei Darussalam	170	170	0.00	36,263	36,264	0.00	36,433	36,434	0.00
Chile	67,175	66,745	-0.64	730,026	729,928	-0.01	797,201	796,673	-0.07
Japan	584,953	572,983	-2.05	13,239,675	13,257,682	0.14	13,824,628	13,830,665	0.04
Malaysia	116,586	116,420	-0.14	1,159,723	1,160,646	0.08	1,276,309	1,277,066	0.06
Mexico	265,812	265,207	-0.23	2,699,264	2,697,397	-0.07	2,965,076	2,962,604	-0.08
New Zealand	66,025	65,606	-0.63	375,324	374,994	-0.09	441,349	440,600	-0.17
Peru	93,071	92,895	-0.19	478,936	478,747	-0.04	572,007	571,642	-0.06
Singapore	9,685	9,636	-0.51	1,160,833	1,160,302	-0.05	1,170,518	1,169,938	-0.05
Vietnam	85,358	85,193	-0.19	384,660	391,650	1.82	470,018	476,843	1.45
United States	1,647,409	1,671,089	1.44	33,518,798	33,540,415	0.06	35,166,207	35,211,504	0.13

5.5.3.1 Gross Domestic Product under National TPP Scenario

The TPP scenario simulation results show that Canadian GDP is projected to be 2.3 billion or 0.11% lower than its GDP under the CPTPP scenario analysis. This is a notable gain for Canadian economy, which would experience less benefits if former TPP had been implemented. This result is similar to the Government of Canada economic modeling of CPTPP and TPP agreements, which found that he expected economic benefits of CPTPP for Canada are greater than they were for the TPP (Government of Canada, 2018a).

5.5.3.2 National TPP Scenario Summary

US is the major trade partner for Canada, as it represents approximately 52%, of Canada's imports, and 76% of its exports, therefore, any change in US trade relationships would be reflected directly on Canada. The simulation results show that Canada would experience different trade flows under CPTPP and TPP scenarios. Canada's agricultural imports would decrease from CPTPP countries and RoW, while they would increase from US under TPP scenario relative to the CPTPP scenario. The change in agricultural trade would be noticeable for meat products, dairy products, and the processed foods sectors, while other agricultural sectors would not experience significant changes. On the other hand, the total agricultural sectoral value of output would be less relative to the CPTPP scenario, with a noticeable decrease projected in in meat products. The wheat, other grains, and other crops sectors would not experience a significant output change relative to the CPTPP scenario.

US would continue to be the largest agricultural trade partner for Canada under both CPTPP and TPP scenarios; however, US's total market share of Canadian agricultural imports would be less under TPP scenario (60.7% under CPTPP compared to 67.6% under the TPP scenario. Similar to imports, under both CPTPP and TPP scenarios, US would continue to be the largest agricultural export destination for Canada with about 41% and 42% under CPTPP and TPP of its total agricultural exports under the CPTPP and TPP scenarios, respectively. Canada would have higher GDP gains under CPTPP scenario relative to TPP scenario simulation.

5.6 Concluding Remarks and Comparison between the National Simulation Scenario

The simulation results of different scenarios in the previous sections show that the natural growth, which includes population, labour supply, and capital accumulation, would be the major driver of the growth in the CPTPP countries over the coming decade, as the tariff rates among CPTPP member countries are already low on most traded products. In spite of this, the CPTPP agreement would have room to impact the agreement members. Table 5.30 reports on selected economic indicators for the Canadian economy in 2030 under the three simulation scenarios. As shown, Canada's GDP would not be significantly different; however, it would be the highest under the CPTPP scenario (3.9 and 2.6 billion USD higher than baseline and the TPP scenarios, respectively). The total value of the agricultural output is projected to be the highest under the CPTPP scenario (6.4 and 9.4 billion USD higher than the baseline and the TPP scenarios, respectively).

Table 5.30: Selected economic indicators for Canada's economy under the national scenarios, 2030 (million USD)

Economic indicator	**Baseline (USD)**	**CPTPP (USD)**	**TPP (USD)**
Gross Domestic Product	2,271,110	2,275,002	2,272,453
Total value of output	4,180,694	4,186,836	4,177,396
Total value of agricultural output	254,493	259,357	253,417
Total value of non-agricultural output	3,926,201	3,927,480	3,923,979
Total imports	620,839	622,453	623,376
Total agricultural imports	48,080	48,667	50,912
Total non-agricultural merchandise imports	572,756	573,785	572,462
Total exports	737,886	739,929	742,044
Total agricultural exports	88,099	92,312	92,786
Total non-agricultural merchandise exports	649,783	647,619	649,258
Aggregated trade balance	117,047	117,476	118,668
Aggregated agricultural trade balance	40,019	43,645	41,874
Aggregated non-agricultural merchandise trade balance	77,027	73,834	76,796
Welfare	473,211	474,386	474,642

The trade indicators show that Canada would continue to be an agricultural net exporter (i.e., having trade surplus[82] under the three scenarios), and its trade exchange including agricultural products would be the largest under the TPP scenario, however Canadian agricultural trade balance would be higher under CPTPP scenario. Canadian aggregated agricultural trade balance is projected to be 40.02, 43.65, and 41.87 billion USD under baseline, CPTPP and TPP scenarios, respectively. This translates into an improved worth of 3.6 and 1.7 billion USD under CPTPP scenario relative to baseline and TPP scenarios, respectively.

In terms of agricultural trade balance with different countries/regions in the model, the simulation results show that under all scenarios, Canada would continue to have agricultural trade surplus with most of the regions in the model, except for Australia, Chile, New Zealand, and Vietnam. Table 5.31 reports on the agricultural trade balance between Canada and other countries under the three simulation scenarios.

Table 5.31: Canadian aggregated agricultural trade balance by country/region under the national simulation scenarios, 2030 (million USD)

Country/region	**Baseline (USD)**	**CPTPP (USD)**	**TPP (USD)**
Australia	-190	-192	-42
Brunei Darussalam	1	1	1
Chile	-227	-306	-245
Japan	8,918	13,269	12,187
Malaysia	365	360	368
Mexico	2,593	2,722	2,803
New Zealand	-481	-942	-648
Peru	582	580	617
Singapore	77	47	58
Vietnam	-92	-70	-33
United States	8,324	8,124	4,375
RoW	20,147	20,051	22,433

[82] When a country whose exports are more than its imports, it has a trade surplus; when a country's imports are more than its exports, it has a trade deficit.

Canada's economy would benefit from the CPTPP, also notable is that the expected economic benefits of CPTPP for Canada are greater than they were for the TPP. In terms of agriculture, which is the primary objective of this study under both CPTPP and TPP scenarios, Canadian imports and exports are projected to increase with improvement in trade balance. Primarily, through gaining access into protected markets (such as Japan and those countries where Canada does not currently have FTAs), Canada would experience a positive impact under the CPTPP agreement while enjoying privileged access to the US market through NAFTA/USMCA and have benefit in terms of its trade balance, with a possibility for Canada to take over part of US's hypothetical market share of other countries if the former TPP had been implemented. The change for Canada due to the CPTPP would contribute to a welfare gain. The simulations suggest that the Canadian economic welfare under CPTPP is projected to be 1.17 billion USD higher than the baseline scenario.

At the time of writing there was no CGE-based literature of the impact of CPTPP agreement on its member countries. Therefore, the outcomes of this analysis cannot be compared to other studies, however, the economic modeling done by the Government of Canada is consistent with the results of this study. The CPTPP agreement is important for Canada as it includes Japan which is considered as highly-protected markets. Many Canadian agricultural sectors, which are currently at a competitive disadvantage in some CPTPP countries due to other bilateral or regional trade agreements between some of the them, would be guaranteed preferential access to their markets. With regards to the TPP analysis, this study's simulation results are broadly consistent with the CGE-based literature on the TPP (e.g., Petri & Plummer, 2016, Burfisher *et al.*, 2014, Strutt *et al*, 2015, Petri *et al.*, 2012, Lee & Itakura, 2014, Broadbent *et al.*, 2016), with some minor differences, which are basically related to the simulation assumptions and the model type static versus dynamic

The next chapter simulates the impact of the CPTPP agreement at the subnational level, i.e., provincial level. The objective of this estimation is to assess the CPTPP impact on Saskatchewan's economy. As shown in the national simulation, Canada's agricultural trade and production would be subject to change due to the CPTPP agreement. Consequently, Saskatchewan's would also be subject to these changes as one of the major agricultural provinces in the country. The simulation applied the same assumptions as those for the national simulation.

Chapter 6
Subnational Model Simulation

6.1 Introduction

In this chapter, a subnational CGE model for Saskatchewan was developed, based on the GTAP database. The objective was to assess the economic impact of the CPTPP agreement on Saskatchewan's economy. The main constraint of the CGE models including GTAP, is their level of detail, which are generally at a country level. It worth noting that although the trade policies are generally assessed at the national level, different geographic regions within a country stand to be affected differently depending on the region's comparative advantage in trade Lysenko *et al.*, 2015).

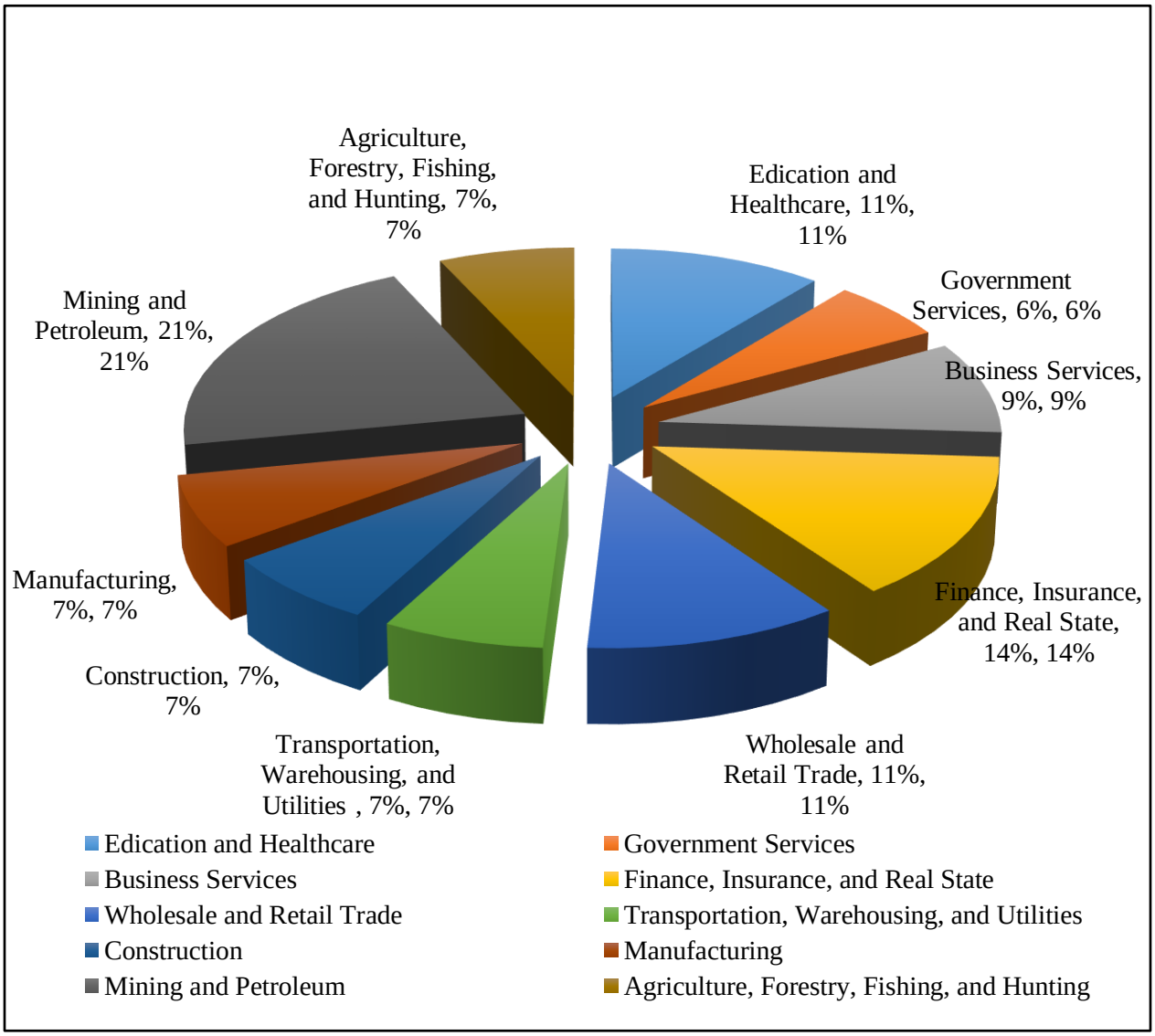
Policy changes may need special attention at the subnational level and may require different action by provincial or local decision-makers. For this reason, developing a more detailed geographical and disaggregated model would be an important in order to assess the economic consequences of an economic shock (for instance trade agreements) on a subnational level. Although the subnational analysis is important, it is surrounded with many challenges, including the difficulty of creating a consistent SAM for multiple sub-regions within a country. This study develops a subnational CGE model for Saskatchewan to assess the impact of the CPTPP on the province's economy. This model can also be used to assess other types of economic shocks, as it is based on the comprehensive GTAP V.9 database. Although few studies have used GTAP model for subnational economic analysis (e.g., Standardi, 2013; Peter *et al.*, 1996; Jean & Laborde, 2004; Canning & Tsigas, 2000; Carrera *et al.*, 2015; Koks *et al.*, 2015; Standardi & Eboli, 2015)[83], none have used it for estimating the CPTPP impact on a specific region in a country.

This chapter begins by providing a background on Saskatchewan's economy and its trade, then reports the results of the subnational model, and tests the model results against the standard national model. The last section of this chapter summarizes the output of the subnational model and compares the results with the national model results. This comparison was meant to test the consistency of these models.

[83] See Table 2.1 for more details about the available literature on subnational CGE models.

6.2 Saskatchewan Statistics, Economy, and Trade

Saskatchewan's economy is resource-based, where the natural resources, including agriculture, oil and gas, potash, and uranium, drive the provincial economy and trade. The resource sector, including agriculture, represents approximately 30% of its GDP in 2015 (see Figure 6.1). In 2016, Saskatchewan posted a real GDP of 58.8 billion CAD and 82.8 billion CAD actual GDP, equivalent to about 3% of Canada's total GDP (Government of Saskatchewan, 2015).



Source: Government of Saskatchewan, Saskatchewan Bureau of Statistics (2017)

Figure 6.1: Composition of Saskatchewan GDP by sector, 2015

In terms of production and trade, Saskatchewan is Canada's largest exporter of agricultural products, the second largest oil producing province in the country, and has the largest potash industry in the world. In addition, it accounts for 22% of the world's primary uranium production. The Saskatchewan economy and trade are led by its strong resource and agricultural sectors. Agriculture is one of the most important economic sectors in Saskatchewan, which accounts for more than 6% of the province's GDP. It is the most important grain-producing region in Canada, providing 37, 72, 48, 25, 24, and 31% of the world's total exported durum wheat, lentils, peas, mustard, canola, and flaxseed, respectively. In 2015, Saskatchewan agricultural exports were C$15.3 billion, representing 46% of the total provincial exports (C$33 billion). US is the top export market for Saskatchewan, accounting for 55% of total provincial exports, followed by China (10.3%), India (5.7%), and Japan (2.72%) (Government of Saskatchewan, 2015). In total, Saskatchewan exports to CPTPP countries account for about 9% of its total exports[84] (see Table 1.1 for details). Similar to Canada, Saskatchewan's bilateral trade flow with CPTPP countries is with two major trade partners: Mexico and Japan. Trade with two countries represents the majority of Saskatchewan trade with the CPTPP countries. In addition, this level of trade between Saskatchewan and these two countries has been consistent over the past five years.

Table 6.1 illustrates a snapshot of Saskatchewan's and Canada economies. The economic indicators for Saskatchewan are comparable to Canada's national economy. Saskatchewan's GDP per capita is, on average, higher than the national one. In 2015/16, Saskatchewan experienced a negative change it its real GDP, while the Canadian total national GDP experienced some growth. Saskatchewan's economy is more dependent on agriculture and resources compared to Canada's economy as whole, and in total, Saskatchewan relies more on exports relative to Canada (44.5 versus 31.5% share of the GDP of Saskatchewan and Canada, respectively). As the Saskatchewan economy is directly integrated in the Canadian economy, any economic trends in Canada are reflected on Saskatchewan. As shown in Chapter 5, the simulation suggests that there would be a potential positive impact of the CPTPP on Canada; it is therefore anticipated as well for the Saskatchewan's economy.

[84] A detailed summary of Saskatchewan's trade with CPTPP countries can be found in subsection 1.1.2.

Table 6.1: Saskatchewan and Canada general summary statistics

Indicator (year)	Saskatchewan	Canada (total)
Real GDP (million CAD chained 2007)	58,810	1,677,362
Real GDP per capita (CAD)	51,112	44,412
Real GDP change 2015/2016 (%)	-0.97	1.3
Average real GDP growth rate (2012-16) (%)	1.62	1.83
Population (millions)	1,15	36.29
Exports share of GDP – 2015 (%)	37.8	26.4
Imports share of GDP – 2015 (%)	20.9	28.5
Goods share of GDP – 2015 (%)	43.8	29
Services share of GDP – 2015 (%)	56.2	71
Simple average of applied MFN tariffs (Canada national rate) (%)	4.2	4.2

Source. Parliament of Canada (2017), Government of Saskatchewan, Saskatchewan Bureau of Statistics (2017), Statistics Canada (2017).

6.3 Subnational Baseline Scenario Simulation: Results and Discussion

This scenario simulates Saskatchewan's trade with TPP member countries between 2017 and 2030, assuming that no CPTPP or TPP is in place; it treats Saskatchewan as a separate region from the rest of Canada. For the sake of briefness, this section reports on only Saskatchewan and RoC results of simulation, however the model also captures the impact on other regions in the model[85]. Similar to the national model, the baseline scenario estimates the economic impact of growth and other trade agreement among CPTPP countries, and how this would impact Saskatchewan trade. Although this model treats Saskatchewan as a separate region, all Canadian trade agreements were incorporated in Saskatchewan's trade. The model assumes that there are no trade barriers between Canada and Saskatchewan, in spite of the fact that they are treated as separated regions in the model.

[85] The results of the simulation on other CPTPP countries are not reported in this chapter, as splitting Canada into two regions would have very minimum impact on other CPTPP countries. See Chapter 5 for the results of the national model.

6.3.1 Subnational Baseline Scenario Main Assumptions

The following assumptions were imposed on the subnational baseline model:

i. The simulation includes a reduction due to non-CPTPP bilateral and regional trade agreements among model countries, the simulation assumed that the CPTPP would not be implemented. Canada commitments under these agreements were imposed on Saskatchewan. The tariff rates Appendix F, Table 4.16, Table 4.17, and Table 5.4;

ii. Comparative static GTAP was applied, assuming: (a) time has no explicit treatment; (b) constant returns to scale production technology; and (c) markets are perfectly competitive;

iii. Land is assumed to be in fixed supply, while capital and labour growth were incorporated in the simulation; and

iv. Primary factors are not allowed to move across Canadian borders, but they are free to move between Saskatchewan and RoC.

6.3.2 Updating database to reflect 2017 and 2030

The database used for this simulation is GTAP V.9 database, which was updated to reflect the growth over the simulation period. A similar approach that was used in the national simulation was applied to the subnational simulation in order to update the database. That includes the economic growth in the period between 2017 and 2030 due to the growth in the population, labour force, and capital accumulation and trade[86].

6.3.3 Trade under Subnational Baseline Scenario

As a result of tariff reductions due to non-TPP trade agreements, and the natural growth which included population, labour force, and capital accumulation, Saskatchewan's interprovincial and international trade would be subject to change. Similar to the results of the national model, the simulation shows that almost all growth would occur due to the natural growth in Saskatchewan (i.e., not due to the trade agreements). Under the baseline scenario (as shown in Table 6.2),

[86] Full details on these updates can be found in subsection 5.3.4 Canadian levels of growth in labour, capital, and population were used as proxy of growth in Saskatchewan.

Saskatchewan's total imports from CPTPP member countries would increase by about 1.31 billion USD, and the agricultural imports would increase by 39 million USD. Imports from the US are projected to increase by about 1.7 billion USD. In terms of interprovincial imports (i.e., imports from RoC), Saskatchewan's total imports are projected to increase 3.1 billion USD by 2030, while the interprovincial agricultural imports are projected to increase by 256 million USD. More importantly, on the exports side, Saskatchewan's total exports to the CPTPP countries are estimated to increase by about 2.57 billion USD, with agricultural exports to increase by 1.67 billion USD. An increase is also projected in Saskatchewan exports to the US. Total Interprovincial exports are projected to increase by 3.27 billion USD, and the agricultural exports by 561 million USD. The simulation shows that the results of the subnational model are consistent with the national simulation. Saskatchewan's agricultural imports from RoW would also increase slightly by 101 million USD, while its agricultural exports to RoW would increase by about 2.9 billion USD. Table 6.2 provides a summary of Saskatchewan's trade under baseline scenario.

Table 6.2: Saskatchewan's trade under subnational baseline scenario (million USD)

	All imports			**All exports**		
Region	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
CPTPP	3,705	5,019	1,314	6,404	8,977	2,573
RoC	10,390	13,571	3,181	9,141	12,413	3,272
US	19,617	21,373	1,756	26,465	32,575	6,110
RoW	24,560	27,832	3,272	15,544	20,307	4,763
Total	58,272	67,795	9,523	57,554	74,272	16,718
	Agricultural imports			**Agricultural exports**		
Region	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
CPTPP	192	231	39	4,408	6,073	1,665
RoC	617	873	256	1,922	2,483	561
US	1,402	1,632	230	3,808	5,093	1,285
RoW	734	835	101	7,518	10,457	2,939
Total	2,945	3,571	626	17,656	24,106	6,450
	Non-agricultural imports			**Non-agricultural exports**		
Region	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
CPTPP	3,510	4,787	1,277	1,995	2,902	907
RoC	9,771	12,700	2,929	7,218	9,929	2,711
US	18,214	19,742	1,528	22,656	27,481	4,825
RoW	23,826	26,997	3,171	8,026	9,850	1,824
Total	55,321	64,226	8,905	39,895	50,162	10,267

Under baseline scenario, the major increase in Saskatchewan's agricultural trade would occur due to the increase in imports and exports from and to US, which is considered the major trade partner for Saskatchewan (increases worth 230 million and 1.28 billion USD in agricultural imports and exports, respectively are estimated). The agriculture trade with CPTPP countries would witness a modest increase (in absolute value) on import side, while more significant increase on the export side is projected in particular with Japan, Mexico and Peru (839, 546 and 132 million USD, respectively). On more segregated level, the major increase in Saskatchewan's agricultural exports to CPTPP countries is estimated to be for meat products, oilseeds, and wheat (increases worth 476, 606 and 451 million USD, respectively). Table 6.3 below summarizes Saskatchewan's imports and exports by model regions (total).

Table 6.3: Saskatchewan agricultural trade by regions under subnational baseline scenario (million USD)

	Agricultural imports			**Agricultural exports**		
Region	**2017 (USD)**	**2030 (USD)**	**Change (USD)**	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
Australia	27	37	10	75	110	35
Brunei Darussalam	0	0	0	0	0	0
Chile	22	26	4	54	90	36
Japan	4	6	2	2,755	3,594	839
Malaysia	3	3	0	77	118	41
Mexico	60	66	6	1,184	1,730	546
New Zealand	52	65	13	20	28	8
Peru	10	10	0	186	318	132
Singapore	3	4	1	25	38	13
Vietnam	12	13	1	33	48	15
United States	1,402	1,632	230	3,808	5,093	1,285
RoC	617	873	256	1,922	2,483	561
RoW	734	835	101	7,518	10,457	2,939

6.3.4 Value of Output under Subnational Baseline Scenario

Saskatchewan's sectoral value of output would respond to the increase in supply of factor of production, as well as to domestic, interprovincial, and international demands. Under the subnational baseline scenario, the value of Saskatchewan's agricultural output would increase by 7.65 billion USD. The output of all agricultural sectors would grow at different levels, with the major increase in absolute value estimated to be experienced for wheat, oilseeds and meat products, which would increase by 1.5, 1.1, and 2.6 billion USD, respectively. Table 6.4 summarizes the projected output changes in Saskatchewan's agricultural and non-agricultural sectors under the subnational baseline scenario.

Table 6.4: Saskatchewan sectoral value of output under subnational baseline scenario (million USD)

Sector	**2017 (USD)**	**2030 (USD)**	**Change (USD)**
Rice	0	0	0
Wheat	4,378	5,929	1,551
Other grains	1,085	1,321	236
Fruits/vegetables	217	263	46
Oilseeds	4,685	5,773	1,088
Other crops	948	1,259	311
Livestock	1,807	2,600	793
Meat products	5,114	7,783	2,669
Raw milk	206	263	57
Dairy products	550	676	126
Processed foods	3,562	4,333	771
Extraction	32,190	38,999	6,809
Labour-intensive manufacturing	9,607	11,579	1,972
Capital-intensive manufacturing	11,913	14,627	2,714
Services	78,576	84,999	6,423
Total agricultural	22,552	30,200	7,648
Total non.ag	132,286	150,204	17,918
Total	154,838	180,404	25,566

6.3.5 Saskatchewan's GDP under Subnational Baseline Scenario

Saskatchewan's GDP is projected to increase by about 15% by 2030 due to the growth simulation under the baseline scenario. The major increase can be attributed to the increase in exports, which is consistent with the national model results. Saskatchewan's GDP represents about 5% of Canada's national GDP. The analysis results of the subnational model show a high consistency with the national model results, where Saskatchewan's economy would grow at a by 2030. The GDP, value of output, and trade are projected to grow, driven by the natural growth in population and factor of production, rather than the projected elimination of trade barriers proposed over the simulation period.

The next section reports on results of the simulation in terms of the impact of implementing the CPTPP agreement on Saskatchewan. The baseline scenario is the starting point for this simulation, the results are compared accordingly.

6.4 Subnational CPTPP Scenario Simulation: Results and Discussion

Under the subnational CPTPP scenario, tariffs were reduced or removed on trade between among CPTPP member countries (including trade with Saskatchewan). The simulation results were compared with the subnational baseline scenario to capture the CPTPP agreement impact on Saskatchewan's economy. Assumptions similar to those of the CPTPP national model were imposed on the subnational CPTPP scenario. These assumptions are provided in in detains in subsection 5.4.1.

6.4.1 Trade under the Subnational CPTPP Scenario

Comparing the subnational baseline and CPTPP scenarios trade results reveals that CPTPP would have an impact on Saskatchewan's agricultural sector, but no noticeable impact on non-agricultural sectors. The total value of Saskatchewan's agricultural imports from the CPTPP region are projected to increase by 92 million USD, while the province agricultural exports to the same region are projected to increase by about 2 billion USD relative to the baseline scenario. These results are due to trade diversion in Saskatchewan's agricultural exports towards CPTTPP countries. As a result, net Saskatchewan agricultural imports and exports (interprovincial and international) are projected to increase by 215 million and 1.36 billion USD, respectively, relative

to the baseline scenario. Table 6.5 below summarizes the total changes in Saskatchewan's trade under CPTPP Scenario.

Table 6.5: Saskatchewan's trade under subnational CPTPP scenario (million USD)

	All imports			All exports		
Region	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
CPTPP	5,019	5,254	235	8,977	10,998	2,021
RoC	13,571	13,705	134	12,413	12,071	-342
US	21,373	21,802	429	32,575	32,028	-547
RoW	27,832	28,218	386	20,307	19,779	-528
Total	67,795	68,979	1,184	74,272	74,876	604
	Agricultural imports			**Agricultural exports**		
Region	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
CPTPP	231	323	92	6,073	8,104	2,031
RoC	873	922	49	2,483	2,454	-29
US	1,632	1,711	79	5,093	4,883	-210
RoW	835	830	-5	10,457	10,025	-432
Total	3,571	3,786	215	24,106	25,466	1,360
	Non-agricultural imports			**Non-agricultural exports**		
Region	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
CPTPP	4,787	4,929	142	2,902	2,895	-7
RoC	12,700	12,782	82	9,929	9,617	-312
US	19,742	20,090	348	27,481	27,143	-338
RoW	26,997	27,388	391	9,850	9,753	-97
Total	64,226	65,189	963	50,162	49,408	-754

Major Saskatchewan agricultural import increases are projected from New Zealand, while the major increase in agricultural exports are projected due to the increase in exports to Japan. It worth noting that significant amount of Saskatchewan agricultural exports would divert toward Japan due to the CPTPP. Slight decreases in Saskatchewan's agricultural exports to the US, RoC, and RoW are projected under CPTPP scenario analysis. Table 6.6 below summarises Saskatchewan trade by region under CPTPP scenario.

Table 6.6: Saskatchewan agricultural trade by regions under subnational CPTPP scenario (million USD)

	Agricultural imports			**Agricultural exports**		
Region	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Australia	37	41	4	110	104	-6
Brunei Darussalam	0	0	0	0	0	0
Chile	26	36	10	90	97	7
Japan	6	7	1	3,594	5,588	1994
Malaysia	3	4	1	118	116	-2
Mexico	66	69	3	1,730	1,773	43
New Zealand	65	133	68	28	26	-2
Peru	10	10	0	318	310	-8
Singapore	4	8	4	38	36	-2
Vietnam	13	15	2	48	54	6
United States	1,632	1,711	79	5,093	4,883	-210
RoC	873	922	49	2,483	2,454	-29
RoW	835	830	-5	10,457	10,025	-432

Saskatchewan agricultural imports from CPTPP countries would not be subject to any significant change. On the export side, the main sectors that would experience change due to CPTPP are meat products, wheat and oilseeds. Noticeably, Saskatchewan's oilseeds exports are projected to drop to the CPTPP countries, as other oilseeds producer (in particular Mexico) would dramatically increase their exports of this sector due to tariff reduction associated with the CPTPP agreement. Although Saskatchewan would experience trade diversion, its trade creation would be higher than the trade diversion in total (including whole trade sectors' interprovincial and international trade flows). Table 6.7 and Table 6.8 summarize Saskatchewan imports and exports by sector under CPTPP scenario relative to the baseline analysis.

Table 6.7: Saskatchewan imports by sector under subnational CPTPP scenario, 2030 (million USD)

	Imports from CPTPP			Imports from RoC			Imports from US			Imports from RoW		
Sector	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Rice	0	0	0	0	0	0	21	22	1	18	18	0
Wheat	0	0	0	25	26	1	2	2	0	1	1	0
Other grains	0	0	0	35	35	0	25	26	1	1	1	0
Fruits/vegetables	55	56	1	9	9	0	278	280	2	58	59	1
Oilseeds	2	2	0	34	35	1	36	36	0	6	6	0
Other crops	3	3	0	60	61	1	20	21	1	60	61	1
Livestock	2	2	0	224	254	30	48	57	9	16	20	4
Meat products	49	64	15	110	121	11	344	410	66	41	48	7
Raw milk	0	0	0	5	5	0	1	1	0	4	4	0
Dairy products	37	108	71	9	8	-1	108	89	-19	187	159	-28
Processed foods	83	88	5	361	368	7	748	768	20	443	454	11
Extraction	147	147	0	2,031	2,023	-8	470	470	0	764	763	-1
Labour-intensive manufacturing	1,664	1,771	107	7,859	7,930	71	5,127	5,228	101	3,799	3,848	49
Capital-intensive manufacturing	619	628	9	2,465	2,480	15	3,703	3,748	45	2,076	2,096	20
Services	2,357	2,383	26	345	349	4	10,442	10,644	202	20,358	20,681	323
Total ag.	231	323	92	872	922	50	1,632	1,711	79	835	830	-5
Total non-ag	4,787	4,929	142	12,700	12,782	82	19,742	20,090	348	26,997	27,388	391
Total	5,019	5,254	235	13,571	13,705	134	21,373	21,802	429	27,832	28,218	386

Table 6.8: Saskatchewan exports by sector under subnational CPTPP scenario, 2030 (million USD)

	Exports to CPTPP			Exports to RoC			Exports to US			Exports to RoW		
Sector	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Rice	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	1,360	1,628	268	178	175	-3	570	548	-22	4,624	4,400	-224
Other grains	227	244	17	126	125	-1	473	468	-5	356	351	-5
Fruits/vegetables	8	12	4	6	6	0	74	73	-1	104	102	-2
Oilseeds	2,528	2,485	-43	278	273	-5	700	689	-11	3,149	3,087	-62
Other crops	195	189	-6	210	204	-6	716	698	-18	230	224	-6
Livestock	26	28	2	1,481	1,477	-4	381	367	-14	221	214	-7
Meat products	1,697	3,484	1787	41	38	-3	1,856	1,726	-130	1,673	1,550	-123
Raw milk	0	0	0	128	125	-3	0	0	0	0	0	0
Dairy products	0	0	0	12	9	-3	0	0	0	0	0	0
Processed foods	31	33	2	23	22	-1	323	314	-9	99	97	-2
Extraction	2,752	2,749	-3	3,881	3,845	-36	25,760	25,525	-235	9,346	9,280	-66
Labour-intensive manufacturing	126	123	-3	1,545	1,439	-106	1,461	1,368	-93	346	322	-24
Capital-intensive manufacturing	15	15	0	3,950	3,803	-147	229	220	-9	114	109	-5
Services	9	9	0	553	530	-23	31	30	-1	44	42	-2
Total ag.	6,073	8,104	2,031	2,483	2,454	-29	5,093	4,883	-210	10,457	10,025	-432
Total non-ag	2,902	2,895	-7	9,929	9,617	-312	27,481	27,143	-338	9,850	9,753	-97
Total	8,977	10,998	2,021	12,413	12,071	-342	32,575	32,028	-547	20,306	19,779	-528

6.4.2 Value of Output under Subnational CPTPP Scenario

This subsection compares Saskatchewan's agricultural value of output under CPTPP relative to the baseline scenario. As the previous sections have shown, Saskatchewan's trade in agricultural committees is projected to change due to the tariff concessions with CPTPP countries, this would impact output. Under the CPTPP scenario, output value of Saskatchewan's agricultural sectors is projected to increase by 6.91% (about 2.08 billion USD) relative to the baseline scenario. The major projected increase is due to the increase in meat products, livestock, oilseed and wheat. Table 6.9 provides a detailed list of production output changes under subnational CPTPP scenario relative to the baseline scenario.

Table 6.9: Saskatchewan sectoral value of output under subnational CPTPP scenario (million USD)

Sector	**Baseline (USD)**	**CPTPP (USD)**	**Change (USD)**
Rice	0	0	0
Wheat	5,929	6,190	261
Other grains	1,321	1,414	93
Fruits/vegetables	263	281	18
Oilseeds	5,773	6,063	290
Other crops	1,259	1,326	67
Livestock	2,600	2,823	223
Meat products	7,783	8,676	893
Raw milk	263	267	4
Dairy products	676	673	-3
Processed foods	4,333	4,574	241
Extraction	38,999	39,627	628
Labour-intensive manufacturing	11,579	11,251	-328
Capital-intensive manufacturing	14,627	14,904	277
Services	84,999	93,206	8,207
Total agricultural	30,200	32,287	2,087
Total non.ag	150,204	158,988	8,784
Total	180,404	191,275	10,871

6.4.3 Saskatchewan GDP under Subnational CPTPP Scenario

The simulation results show that Saskatchewan's GDP would increase by 1.09% (about 1.2 billion USD) due to the implementation of the CPTPP agreement. It is worth noting that in the national simulation, Canada would experience a less significant impact on total GDP. This conclusion can be attributed to the nature of Saskatchewan's economy, which depends on agricultural sectors relatively more than the Canadian economy as whole.

A comparison of the results of the national and subnational models showed a high consistency in their results. Both models showed that the CPTPP 's impact on agricultural trade would be more noticeable than the impact on other sectors.

In the next section, this study simulates the economic impact on Saskatchewan if the former TPP (including the US) had been implemented. Similar to Canada, US is the largest trade partner for Saskatchewan. The goal of this simulation is to compare the TPP hypothetical impact relative to the CPTPP impact on Saskatchewan's economy. It is also worthy to note that the existence of NAFTA/USMCA ensure a preferential trade between Saskatchewan and the US.

6.5 Subnational TPP Scenario Simulation: Results and Discussion

As discussed, the US is Saskatchewan's largest trade partner. Trade with US accounts for about 83% and 48% of Saskatchewan's total imports and exports, respectively. Similar assumptions of the national TPP model were imposed on this simulation scenario (see subsection 5.5.1).

6.5.1 Trade under Subnational TPP Scenario

Trade simulation under the subnational TPP scenario showed that Saskatchewan's total imports and exports would be subject to a slight decrease relative to CPTPP scenario. Total Saskatchewan imports and exports are projected to be 174 and 146 million USD lower than its imports and exports under CPTPP simulation. The simulation further showed that part of Saskatchewan's trade would divert toward the US relative to CPTPP simulation. In fact, Saskatchewan's agricultural imports and exports from the US would be 428 and 146 million USD higher than the CPTPP, while its agricultural imports and exports from and to the CPTPP countries would be 51 and 531 million USD lower than the CPTPP scenario. The major change in

agricultural imports (in absolute value) would be with New Zealand (about 30 million USD lower than CPTPP scenario), while the major change in exports would be toward Japan (564 million USD lower than CPTPP scenario). Saskatchewan's trade with RoC and RoW would be lower under this scenario relative to the CPTPP scenario. Table 6.10 summarizes Saskatchewan's general trade simulation results under TPP scenario and Table 6.11 provides detailed information on Saskatchewan's imports and exports with each region of the model.

Table 6.10: Saskatchewan's trade under subnational CPTPP scenario (million USD)

	All imports			All exports		
Region	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
CPTPP	5,254	5,179	-75	10,998	10,469	-529
RoC	13,705	13,646	-59	12,071	12,033	-38
US	21,802	22,017	215	32,028	32,255	227
RoW	28,218	27,963	-255	19,779	19,973	194
Total	68,979	68,805	-174	74,876	74,730	-146
	Agricultural imports			**Agricultural exports**		
Region	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
CPTPP	323	272	-51	8,104	7,573	-531
RoC	922	848	-74	2,454	2,317	-137
US	1,711	2,139	428	4,883	5,029	146
RoW	830	663	-167	10,025	10,201	176
Total	3,786	3,922	136	25,466	25,120	-346
	Non-agricultural imports			**Non-agricultural exports**		
Region	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
CPTPP	4,929	4,906	-23	2,895	2,896	1
RoC	12,782	12,797	15	9,617	9,716	99
US	20,090	19,878	-212	27,143	27,229	86
RoW	27,388	27,299	-89	9,753	9,771	18
Total	65,189	64,880	-309	49,408	49,612	204

Table 6.11: Saskatchewan agricultural trade by regions under subnational TPP scenario (million USD)

	Agricultural imports			Agricultural exports		
Region	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
Australia	41	32	-9	104	110	6
Brunei Darussalam	0	0	0	0	0	0
Chile	36	32	-4	97	94	-3
Japan	7	6	-1	5,588	5,024	-564
Malaysia	4	3	-1	116	116	0
Mexico	69	68	-1	1,773	1,803	30
New Zealand	133	103	-30	26	27	1
Peru	10	8	-2	310	308	-2
Singapore	8	7	-1	36	37	1
Vietnam	15	13	-2	54	54	0
United States	1,711	2,139	428	4,883	5,029	146
RoC	922	848	-74	2,454	2,317	-137
RoW	830	663	-167	10,025	10,201	176

A closer look at Saskatchewan's trade by sector under TPP scenario shows that meat and dairy products imports would be subject to discernable changes, while no notable change is projected in all other sectors relative to CPTPP simulation. Meat and dairy products imports from CPTPP countries would be 24 and 20 million USD lower than the CPTPP scenario. Imports for these products would also drop from RoC and RoW while it would increase from the US. On the export side, Saskatchewan's wheat, oilseeds, and meat products exports would decrease to the CPTPP countries while these same exports would increase to US and RoW compared to CPTPP scenario analysis. Table 6.12 and Table 6.13 summarize Saskatchewan's imports and exports by sector with the CPTPP countries, US, RoC and RoW.

Table 6.12: Saskatchewan imports by sector under subnational TPP scenario, 2030 (million USD)

	Imports from CPTPP			Imports from RoC			Imports from US			Imports from RoW		
Sector	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
Rice	0	0	0	0	0	0	22	21	-1	18	18	0
Wheat	0	0	0	26	26	0	2	2	0	1	1	0
Other grains	0	0	0	35	35	0	26	26	0	1	1	0
Fruits/vegetables	56	56	0	9	9	0	280	279	-1	59	59	0
Oilseeds	2	2	0	35	34	-1	36	36	0	6	6	0
Other crops	3	3	0	61	61	0	21	20	-1	61	61	0
Livestock	2	2	0	254	241	-13	57	66	9	20	18	-2
Meat products	64	40	-24	121	87	-34	410	596	186	48	25	-23
Raw milk	0	0	0	5	5	0	1	1	0	4	4	0
Dairy products	108	88	-20	8	5	-3	89	250	161	159	57	-102
Processed foods	88	81	-7	368	345	-23	768	842	74	454	413	-41
Extraction	147	147	0	2,023	2,026	3	470	467	-3	763	764	1
Labour-intensive manufacturing	1,771	1,762	-9	7,930	7,938	8	5,228	5,145	-83	3,848	3,832	-16
Capital-intensive manufacturing	628	627	-1	2,480	2,484	4	3,748	3,718	-30	2,096	2,092	-4
Services	2,383	2,370	-13	349	349	0	10,644	10,548	-96	20,681	20,611	-70
Total ag.	323	272	-51	922	848	-74	1,711	2,139	428	830	663	-167
Total non-ag	4,929	4,906	-23	12,782	12,797	15	20,090	19,878	-212	27,388	27,299	-89
Total	5,254	5,179	-75	13,705	13,646	-59	21,802	22,017	215	28,218	27,963	-255

Table 6.13: Saskatchewan exports by sector under subnational TPP scenario, 2030 (million USD)

	Exports to CPTPP			Exports to RoC			Exports to US			Exports to RoW		
Sector	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**	**CPTPP (USD)**	**TPP (USD)**	**Change (USD)**
Rice	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	1,628	1,581	-47	175	175	0	548	559	11	4,400	4,449	49
Other grains	244	240	-4	125	126	1	468	473	5	351	352	1
Fruits/vegetables	12	12	0	6	6	0	73	73	0	102	102	0
Oilseeds	2,485	2,451	-34	273	275	2	689	695	6	3,087	3,107	20
Other crops	189	189	0	204	205	1	698	705	7	224	225	1
Livestock	28	27	-1	1,477	1,363	-114	367	378	11	214	216	2
Meat products	3,484	3,040	-444	38	16	-22	1,726	1,816	90	1,550	1,652	102
Raw milk	0	0	0	125	126	1	0	0	0	0	0	0
Dairy products	0	0	0	9	5	-4	0	0	0	0	0	0
Processed foods	33	33	0	22	20	-2	314	329	15	97	98	1
Extraction	2,749	2,748	-1	3,845	3,865	20	25,525	25,591	66	9,280	9,288	8
Labour-intensive manufacturing	123	125	2	1,439	1,467	28	1,368	1,385	17	322	329	7
Capital-intensive manufacturing	15	15	0	3,803	3,848	45	220	222	2	109	111	2
Services	9	9	0	530	536	6	30	31	1	42	43	1
Total ag.	8,104	7,573	-531	2,454	2,317	-137	4,883	5,029	146	10,025	10,201	176
Total non-ag	2,895	2,896	1	9,617	9,716	99	27,143	27,229	86	9,753	9,771	18
Total	10,998	10,469	-529	12,071	12,033	-38	32,028	32,255	227	19,779	19,973	194

6.5.2 Value of Output under Subnational TPP Scenario

Output value in Saskatchewan would be subject to change in response to trade and demand. Saskatchewan's value of total agricultural output would be 1.7% (555 million USD) lower than the CPTPP scenario, this can be attributed mainly to the lower output of meat and dairy products. Other sectors would not experience noticeable changes. Table 6.14 reports Canada sectoral value of output under TPP scenario relative to the CPTPP scenario.

Table 6.14: Saskatchewan sectoral value of output under subnational TPP scenario (million USD)

Sector	CPTPP (USD)	TPP (USD)	Change (USD)
Rice	0	0	0
Wheat	6,190	6,208	18
Other grains	1,414	1,412	-2
Fruits/vegetables	281	281	0
Oilseeds	6,063	6,052	-11
Other crops	1,326	1,328	2
Livestock	2,823	2,763	-60
Meat products	8,676	8,336	-340
Raw milk	267	245	-22
Dairy products	673	596	-77
Processed foods	4,574	4,511	-63
Extraction	39,627	39,700	73
Labour-intensive manufacturing	11,251	11,290	39
Capital-intensive manufacturing	14,904	14,901	-3
Services	93,206	92,857	-349
Total agricultural	32,287	31,732	-555
Total non.ag	158,988	158,748	-240
Total	191,275	190,480	-795

6.5.3 Saskatchewan GDP under Subnational TPP Scenario

The simulation results showed that Saskatchewan's GDP under the TPP simulation would be lower by 437 million USD relative to the CPTPP simulation, therefore TPP would generate less gains for Saskatchewan in terms of GDP. This result is consistent with the national economic simulation which showed that CPTPP would generate more gains for Canada than TPP.

6.6 Concluding Remarks and Comparison between the Subnational Simulation Scenarios

Subnational model simulation results showed high consistency with the national model analysis in terms of trade, trade diversion, gains, and losses. The analysis showed that the economic benefits of CPTPP agreement for Saskatchewan would be greater than they would be if the former TPP had been implemented. Table 6.15 outlines selected economic indicators of Saskatchewan's economy under baseline, CPTPP and TPP scenarios.

As reported, Saskatchewan's GDP gains would the highest under CPTPP scenario (1.1 billion and 437 million USD higher than the baseline and TPP scenarios, respectively). The total value of Saskatchewan's agricultural output is projected to be highest under the CPTPP simulation (10.8 billion and 795 million USD higher than the baseline and TPP scenarios, respectively). Trade indicators show that Saskatchewan's total interprovincial and international imports and exports of goods and services was projected to be highest under the CPTPP scenario. Its agricultural total trade position would be improved by 2030 under both the CPTPP and TPP scenarios, Saskatchewan total agricultural export would be largest under the CPTPP scenario (1.3 billion and 346 million USD relative to baseline and TPP scenarios, respectively). Historical data shows that Saskatchewan has been a net exporter province (Saskatchewan Trade and Export partnership, 2011), The simulation results under all scenarios showed that Saskatchewan would continue to be a net exporter by 2030. Saskatchewan is an agricultural net exporter province, Saskatchewan trade balance would be improved by 2030 under both CPTPP and TPP simulation, with a stronger position projected under CPTPP. Agricultural trade balance is projected to be 20.54, 21.68, and 21.2 billion USD under the baseline, CPTPP and TPP scenarios, respectively. This is an improvement worth 1.14 billion and 482 million USD under CPTPP and TPP, respectively, relative to the baseline scenario. Table 6.15 lists some selected economic indicators for

Saskatchewan in 2030 under the three simulation scenarios, and Table 6.16 summarizes Saskatchewan's agricultural trade balance with each country/region in the model.

Table 6.15: Selected economic indicators for Saskatchewan's economy under the subnational scenarios, 2030 (million USD)

Economic indicator	Baseline (USD)	CPTPP (USD)	TPP (USD)
Gross Domestic Product	90,930	92,046	91,609
Total value of output	180,404	191,275	190,480
Total value of agricultural output	30,200	32,287	31,732
Total imports	67,795	68,979	68,805
Total agricultural imports	3,571	3,786	3,922
Total non-agricultural imports	64,226	65,189	64,880
Total exports	74,272	74,876	74,730
Total agricultural exports	24,106	25,466	25,120
Total non-agricultural exports	50,162	49,408	49,612
Aggregated trade balance	6,477	5,897	5,925
Aggregated agricultural trade balance	20,535	21,680	21,198
Aggregated non-agricultural merchandise trade balance	-14,064	-15,781	-15,268
Welfare	30,261	30,710	30,652

Table 6.16: Saskatchewan aggregated agricultural trade balance by country/region under subnational scenarios, 2030 (million USD)

Country	Baseline (USD)	CPTPP (USD)	TPP (USD)
Australia	73	63	78
Brunei Darussalam	0.17	0.26	0.27
Chile	63	61	62
Japan	3,588	5,581	5,018
Malaysia	115	112	113
Mexico	1,664	1,704	1,735
New Zealand	-37	-107	-76
Peru	308	300	301
Singapore	33	28	30
Vietnam	34	39	41
United States	3,461	3,172	2,890
RoW	9,622	9,194	9,539

The CPTPP agreement would also contribute positively to Saskatchewan's welfare. The simulations suggest that Saskatchewan economic welfare would positively change due to the implementation of the CPTPP agreement, the change, however, would be small. Saskatchewan's economic welfare is projected to be 30.2, 30.7, and 30.6 billion USD under the baseline, CPTPP and TPP scenarios, respectively.

In conclusion, the CPTPP agreement would have a positive impact on Saskatchewan economy. Saskatchewan would enjoy greater economic benefit as the agreement is implemented without the US (i.e. CPTPP vs. TPP). The CPTPP agreement would help Saskatchewan in boosting its agricultural exports, by providing Saskatchewan with preferential access to large markets, including traditionally-protected markets such as Japan. CPTPP would support Saskatchewan Plan for Growth targets, as increasing its agricultural product is one of its main objectives. The subnational simulation shows high consistency with the national model results. Although the regional-based analysis of the CPTPP or TPP impact (i..e impact on a specific region within a country) has not yet been addressed in the applied economic literature, all the national -based analysis assessment of CPTPP and TPP have shown that the trade with Pacific-Rim countries would have a positive economic impact on Canada (e.g., Petri & Plummer, 2016, Burfisher *et al.*, 2014, Strutt *et al.*, 2015, Petri *et al.*, 2012, Lee & Itakura, 2014, Broadbent *et al.*, 2016; Government of Canada, 2018a).

Using subnational/regional CGE-based analysis to evaluate the impact of bilateral and regional trade agreements on a specific region within a country is still a developing field in applied economics. This study employed a methodology that allowed for analysis of provincial-level impacts of trade agreements. The GTAP national model was modified, and its database was utilized to evaluate the CPTPP's economic impact on Saskatchewan by splitting Canada into two regions: Saskatchewan and RoC. This study approach is transferable and can be applied to divide any country into more than two regions in order to analyze trade or non-trade economic shocks on a specific region within that country (subject to data availability).

Chapter 7
Conclusions

7.1 Introduction

This study filled a gap in the applied economic literature by developing an agricultural-focused CGE-based model to assess the economic impact of the CPTPP agreement on the Canadian and Saskatchewan economies. For this purpose, the GTAP database was used. The main objective of this study was to assess the likely economic impact of the CPTPP agreement and compare it to the impact of TPP, if it has been implemented, on Canada and Saskatchewan economies, including trade flows and impact on GDP.

Assessing the economic impact of trade agreements is usually done at country (national) level and can be achieved by utilizing trade-focused models, such as GTAP. Evaluating trade policy impact at subnational level is less common and more complex. This is because, a CGE-based analysis of a region is hard to undertake due to limited data availability, difficulty to obtain national and international trade date, difficulty in creating mutually-consistent SAMs in reconstructing bilateral trade flow for multiple subnational regions, and the lack of robust models that incorporate subnational regions. Although, building regional CGE models is complex, it is a growing and emerging topic, specifically in federal countries such as Canada, US or Australia. This is because trade policies may have a different impact on various regions within a country, and they can provide more detailed insight that can be of interest policy makers.

This study provides a comprehensive analysis of the economic impacts of the CPTPP agreement on two levels: (i) National level, where a CEG-base model was developed to estimate the economic impact of CPTPP agreement on Canada and other CPTPP members. (ii) Subnational level, where a subnational CGE-based model was developed that is capable of assessing the impact of the CPTPP on Saskatchewan's economy. Unlike other studies, which utilized hybrid approaches or partial CGE models to assess the impact at a subnational level (e.g., Ciuriak *et al.*, 2015; Kuiper & van Tongeren, 2004), a region-specific CGE model was built for Saskatchewan utilizing GTAP database, to assess CPTPP impact on the province's economy. The major features of this study models include extensive level of detail, incorporation of natural growth in the analysis, and

simulation of the economic impact of the CPTPP. All simulations in this study were run under the assumption that NAFTA remains in place.

Three scenarios applicable on both national and subnational analysis were developed to fulfill the objectives of the study:

i. Baseline scenario simulated trade among CPTPP countries, the US and RoW throughout the period of 2017 and 2030, assuming that no CPTPP agreement was in place. This scenario accounted for the natural growth, including the growth in population, labour force, and capital, and also accounted for other FTAs other than the CPTPP between CPTPP member countries that would be implemented over the coming decade;

ii. CPTPP scenario which simulated the CPTPP implementation, assuming that the CPTPP agreement would be fully implemented. Under this scenario, tariffs concessions as listed in Annex 2-D of the CPTPP agreement were incorporated to capture the impact of the CPTPP agreement to capture the impact of CPPP agreement on the members' economies in general, and on the Canadian and Saskatchewan economies in detail; and

iii. TPP scenario simulated the impact of the former TPP. The goal of this simulation was to capture the economic impact of TPP if it had been implemented, and to compare it with the CPTPP impact on Canada and Saskatchewan economies.

The reminder of this chapter is organized as follows: First, the conclusions of the national CGE-based model are summarized; secondly, findings of the subnational CGE-based model and a are presented; and lastly, the potential policy implications of this study are listed, along with a section on potential future research that has not been covered in this study.

7.2 National Model Conclusions

Both CPTPP and TPP simulation showed that these agreements would generate long-term economic gains for Canada. The economic benefits (including trade growth) of the CPTPP for Canada are projected to be greater than these of the TPP if it had been implemented. This can be attributed to the fact that Canada will continue to enjoy preferential access to the US market

through NAFTA/USMCA while gaining access into the CPTPP market. Canada's GDP gains would total 3.89 billion USD under CPTPP. Canada would also experience an increase in its trade, as well as an improvement in its trade balance in particular through agricultural trade. Under the CPTPP scenario, Canadian agricultural imports from CPTPP countries would increase by 688 million USD, and exports to the CPTPP countries to increase by 4.6 billion USD; hence, a trade diversion from the US and RoW toward the CPTPP member countries was also projected. By sector, the value of Canada's trade with CPTPP member countries is projected to be largest for meat products, dairy products and processed foods. The simulation also showed that all CPTPP member countries would experience economic gains due under the CPTPP. As expected, Japan would account for a major expansion in Canada's agricultural exports which would be driven primarily by newly-gained access for Canadian products int the traditionally protected Japanese market.

At the time of writing there was no CGE-based literature of the impact of CPTPP agreement on its member countries. Therefore, the outcomes of this analysis cannot be compared to other studies, however, the economic modeling of the CPTPP impact that done by the Government of Canada is consistent with the results of this study. The CGE-based modeling of the impact of the former TPP, share broad results claiming that TPP would have positive impact on its members including Canada (Petri & Plummer, 2016; Burfisher et al., 2014; Strutt et al., 2015; Petri et al., 2012; Lee & Itakura, 2014; Broadbent et al., 2016). The main differences between CGE-based studies that attempted to analyze the economic impact of the TPP including the type of CGE model (i.e. static or dynamic) and simulation assumptions, for instance degree for liberalization, accounting for only tariff removal, or including NTBs and TRQs. Although these differences may impact the value of the results, they do not change the ultimate conclusions.

7.3 Subnational Model Conclusions

Similar to the national model, three scenarios (baseline, CPTPP and TPP) were simulated to capture the economic impact of the CPTPP agreement on Saskatchewan. The same level of sectoral disaggregation and regional aggregation was used, with Canada split into two sub-regions -- Saskatchewan and RoC. The CPTPP would have a positive impact on Saskatchewan's economy. Saskatchewan's GDP gains would total 1.2 billion USD under CPTPP. Saskatchewan agricultural imports and exports from and to the CPTPP countries (excluding trade with the RoC, the US and

RoW) are projected to increase from 231 to 323 million USD and 6.07 to 8.10 billion USD, respectively, relative to the baseline scenario. Slight trade diversion from the US, RoC and RoW toward the CPTPP member countries was also projected. The significant growth in the province's agricultural export flow, which can be mainly attributed to the agricultural exports to Japan. Similar to the impact on Canada, the analysis showed that the economic gains for Saskatchewan under CPTPP are greater than TPP, which is a result of gaining access in key CPTPP markets such as Japan while keeping a strong liberalized trade relationship with the US.

Studies to assess the economic impact of CPTPP or TPP on specific regions of Canada are not currently available in the literature; therefore, comparing the presented results with other studies is not possible. However, the information available in the applied economic literature (Lysenko *et al.*, 2015; and Ciuriak *et al.*, 2015), as well as a thorough examination into the consistency of the subnational model with the national one, can be used as a benchmark for a validity test. The overall results appear to be reasonable, both in terms of scale and sectoral impacts. The results suggest that CPTPP is likely to benefit Saskatchewan, but less so for Canada as a whole; the CPTPP impact on Saskatchewan's GDP is more significant than its impact on Canada's GDP. Similar conclusion is applicable on analysing CPTPP relative to TPP impact on both the Canadian and Saskatchewan economies.

7.4 Policy Implications

Trade agreements have always had strategic geopolitical and economic implications. Geopolitically, trade agreements rely on the cooperation between countries beyond trade, which reflects the level of foreign policy integration and serves as a tool to forge stronger political and strategic ties among members. Economically, trade agreements are related to economic growth. Based on the principle of comparative advantage, increased trade leads to more competition, lower prices, and greater efficiency. Although, trade agreements have direct economic benefits through lowering trade barriers between member countries, there is a common perception that with the increasing number of trade agreements, these direct economic benefits have become limited, whereas the creation of strategic ties and boost investment flows between member countries have become the major strategic benefit of these agreements.

Despite the aforementioned perception, the economic modeling in this study showed that the CPTPP agreement has room to add direct economic benefits for its members. The results of this study showed that the economic benefits of the CPTPP for Canada and Saskatchewan are greater than they would be if the TPP had been implemented. This provides insight for policymakers and trade specialists on the potential impact of the CPTPP. The provincial insights are particularly important in the context CPTPP, as provincial governments in a federation such as Canada can better understand the direct economic impact and consequences of trade agreements, particularly on their economies. This further shed light on the importance of analyzing the impact of trade agreements, not only on a national level, but also on different geographic regions within a country. The policy implications of this study can be summarized into four main points:

i. CPTTP would generate long-term economic gains for Canada and Saskatchewan economies; therefore, the Canadian government would benefit from being part of CPTPP;

ii. The economic benefits of CPTPP for Canada and Saskatchewan are greater than the TPP benefits if it had been implemented. This is due to the fact that without the US in the agreement, Canada will gain access to the CPTPP market (including the traditionally protected large markets of Japan) while enjoying preferential access to the US market through NAFTA/USMCA;

iii. Implementing CPTPP without the US would allow Canada to gain a first mover advantage in key CPTPP market (such as Japan) and would take over part of the US's hypothetical market share in CPTPP market if the former TPP had been implemented;

iv. Under the current uncertainties surrounding Canadian trade relationship with the US, Canada should strengthen its trade relationships with other countries in order to gain access to new and growing markets; and

v. The Canadian dairy sector would specifically be under pressure, as it is a protected sector in Canada. Therefore, the government could consider providing income support programs in order to minimize the impact of CPTPP on this sector.

On a general level, the results of both models (i.e., national and subnational) from all scenarios are consistent. However, the detailed results of this study, especially those of a specific sector or trade within a specific region, are subject to greater uncertainty and should be treated with caution, with additional sensitivity analysis pursued and considered when it comes to policy decision-making.

7.5 Limitations

CGE models are complex and their results depends on the research assumptions, exogenous variables and economic parameters. Furthermore, simplifying assumptions and approximations are applied that may impact the simulation outcomes or the reseals magnitude. Therefore, CGE simulation results are not unconditional prediction of a policy change, the simulation is an experiment of policy change under assumed assumptions in a specific year.

This study utilized the well-known GTAP model and its database V.9, there are several limitations of this research:

i. Elasticity parameters. The selection of elasticity parameters critical and directly impact the analysis results which are very sensitive to the elasticity parameters levels assumed in the analysis. GTAP model includes Armington elasticities, factor substitution elasticities, factor transformation elasticities, and demand elasticities. All of these were selected carefully. However, the empirical results of this study are subject to the elasticity parameters and should be treated with caution.

ii. Regional and sectorial aggregations. The aggregation level is needed to run any simulation under GTAP model, hence there are evidences that the levels of sectoral and regional aggregation impact the results in trade analysis (see Ko & Britz, 2013).

iii. The subnational analysis in this study was done by splitting Canada national database in the GTAP model. This exercise required using data from external sources (i.e. Stats Canada) and imposing strong assumptions on the mobility of factor of productions across Canada and the interprovincial trade flows.

7.6 Future Research

This study is the first of its kind to assess the impact of the CPTPP, and certainly one of the first to introduce a model that allows for an assessment of the impact of trade agreements at a provincial level in Canada, within the context of the well-known GTAP multi-country CGE models. The subnational model allows for a breakdown of the GTAP national database so as to account for Saskatchewan as a separate entity, with the support of data collected from Statistics Canada. This is indeed the first attempt to apply the GTAP multi-country CGE model to analyze the impact of the CPTPP agreement at provincial level in Canada. For the purposes of this research, this study splits Canada into two regions. There is significant starting point towards understanding the regional impact of CPTPP agreement at provincial level in Canada. Further work is still necessary, including:

i. Building a CGE model to evaluate the impact of the recent replacement of NAFTA, and how this replacement may impact the magnitude of CPTPP on Canada and its provinces.

ii. A more detailed and comprehensive model similar to The Victoria University Regional model (VURM), The Enormous Regional Model (TERM) in Australia, and USAGE-R51 in US. Canada should be divided into 12 provinces/territories to capture the economic impact of CPTPP across Canada.

iii. Building a dynamic CGE provincial model to capture the intertemporal year-by-year economic impact of the CPTPP agreement on Canada and its provinces.

iv. Further disaggregation of sectors -- in particular, major sectors of the Canadian provincial economies, such as the canola sector for Saskatchewan.

References

Agénor, P.R. & Aizenman, J. (1996). Trade liberalization and unemployment. *The Journal of International Trade & Economic Development*, 5(3), 265-286.

Agriculture and Agri-Food Canada. (2016). United States-Canada Agriculture and Agri-Food Trade 2016. Retrieved from http://www.agr.gc.ca/eng/industry-markets-and-trade/statistics-and-market-information/agriculture-and-food-market-information-by-region/united-states-and-mexico/trade-data-and-analysis/united-states-canada-agriculture-and-agri-food-trade-2015/?id=1386857446891.

Aguiar, A., Narayanan, B., & McDougall, R. (2016). An overview of the GTAP 9 database. *Journal of Global Economic Analysis, 1*(1), 181-208.

Alavapati, J., White, B., Jagger, P., & Wellstead, A. (1996). Effects of land use restrictions on the economy of Alberta: A computable General Equilibrium Analysis. *Canadian Journal of Regional Science/ Revue Canadienne des* Sciences *Régionales*, *9*(3), 349-365.

Anderson, J. (1979). A theoretical foundation for the gravity equation. *American Economic Review, 69* (1), 106–116.

Anderson, J.E. (2010). The gravity model (Working Paper No. 16576). *National Bureau of Economic Research*. Retrieved from http://www.nber.org/papers/w16576.

Armington, P. S. (1969). A theory of demand for products distinguished by place of production. *International Monetary Fund*, *16*(1), 159-178.

Arrow, K.J., Chenery, H.B., Minhas, B.S., & Solow, R.M. (1961). Capital labor substitution and economic efficiency. *Review of Economics and Statistics*, *43*, 225-250.

Asakura, H. (2003). *World history of the customs and tariffs*. Brussels, Belgium: World Customs Organization.

Association of Southeast Asian Nations. (2016). Regional Comprehensive Economic Partnership (RCEP) Retrieved from https://asean.org/?static_post=rcep-regional-comprehensive-economic-partnership.

Baccini, L. & Urpelainen, J. (2014). Before ratification: Understanding the timing of international treaty effects on domestic policies. *International Studies Quarterly*, *58*(1), 29-43.

Bahan, D., Bilodeau, D., Lemelin, A., Robichaud, V., Courchesne, C., Girard, B., & Carel, G. (2003). A bi-regional social accounting matrix for the general equilibrium model of the ministère des Finances du Québec (GEMFQ) (Research paper 2003-003). Retrieved from http://www.finances.gouv.qc.ca/documents/Feuille/en/2003_003_eng.pdf.

Balassa, B. (1967). Trade creation and trade diversion in the European common market. *The Economic Journal, 77*(305), 1-21.

Baldwin, R.E. & Wyplosz, C. (2006). *The Economics of European Integration*. Vol. 2. London: McGraw-Hill.

Baldwin, R.E. (1989). The political economy of trade policy. *The Journal of Economic Perspectives, 3*(4), 119-135.

Bandara, J.S. (1991). Computable general equilibrium models for development policy analysis in LDCS. *Journal of Economic Surveys, 5*(1), 3-69.

Bautista, R. & Thomas, M. (2000). Trade and agricultural policy reforms in Zimbabwe: A CGE analysis, paper presented at the *3rd Conference on Global Economic Analysis,* Melbourne, Australia, 27-30 June.

Berck, P., Robinson, S., & Goldman, G. (1991). The use of computable general equilibrium models to assess water policies. In A. Dinar & D. Zilberman (Eds.), *Economics and Management of Water and Draining in Agriculture,* (pp. 489-511). Norwell, MA: Kluwer Academic Publishing.

Bergstrand, J. (1985). The gravity equation in international trade: some microeconomic foundations and empirical evidence. *The Review of Economics and Statistics, 67*, 474-81.

Binh, D.T.T., Duong, N. V., & Cuong, H. M. (2011). *Applying gravity model to analyze trade activities of Vietnam*. Retrieved from http://www.freit.org/WorkingPapers/Papers/TradePatterns/FREIT639.pdf.

Bohringer, C., Rutherford, T., & Wiegard, W. (2003). Computable general equilibrium analysis: Opening a black box. *Discussion Paper 03-56*. Mannheim, Germany: Center for European Economic Research.

Borges, A. (1986). Applied general equilibrium models: An assessment of their usefulness for policy analysis. *OECD Economic Studies, 7*, 7-43.

Bosello, F., & Standardi, G. (2018). A Sub-national CGE Model for the European Mediterranean Countries. In F. Perali & P. L. Scandizzo (Eds.), *The New Generation of Computable General Equilibrium Models* (pp. 279-308). Cham, Switzerland: Springer.

Bosello, F., Standardi, G. & Eboli, F. (2014). A Sub-National CGE Model for Italy (Working Paper No. 4.2014). *Social Science Research Network Electronic Journal*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2384591##.

Bouët, A., Decreux, Y., Fontagné, L., Jean, S., & Laborde, D. (2006). Tariff Data. In B. V. Dimaranan (Eds.), *Global Trade, Assistance, and Production: The GTAP 6 Data Base*. Center for Global Trade Analysis, Purdue University: USA.

Broadbent, M.M., Pinkert, A. D., Williamson, A.I., Johanson, S. D., Kieff, F. S., & Schmidtlein, K. R. (2016). *Trans-Pacific Partnership Agreement: Likely impact on the US economy and on specific industry sectors*. Washington, DC: United States International Trade Commission.

Brockmeier, M. (2001). *A Graphical Exposition of the GTAP Model* (GTAP Technical Paper No. 08). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=311.

Broda, C. & Weinstein, D. (2006). Globalization and the gains from variety. *Quarterly Journal of Economics*, *121*(2), 541585.

Buckley, P.H. (1992). A transportation-oriented interregional computable general equilibrium model of the United States. *The Annals of Regional Science*, *26*(4), 331-348.

Burfisher, M. (2012). *Introduction to Computable General Equilibrium Models*. New York, NY: Cambridge University Press.

Burfisher, M. (2016). *Introduction to Computable General Equilibrium Mode*ls (2nd ed.). New York, NY: Cambridge University Press.

Burfisher, M.E., Dyck, J., Meade, B., Mitchell, L., Wainio, J., Zahniser, S., Arita, S., & Beckman, J. (2014). *Agriculture in the Trans-Pacific Partnership*, ERR-176, US Department of Agriculture, Economic Research Service.

Burfisher, M.E., Robinson, S., & Thierfelder, K. (2001). The Impact of NAFTA on the United States. *The Journal of Economic Perspectives*, *15*(1), 125-144.

Canadian Broadcasting Corporation. (2015). Saskatchewan supports Trans-Pacific Partnership, some farmers nervous. Retrieved from http://www.cbc.ca/news/canada/saskatchewan/saskatchewan-trans-pacific-partnership-1.3250897.

Canning, P. & Tsigas, M. (2000). *Regionalism, federalism, and taxation: A food and farm perspective*. Technical Bulletin No. 1882, US Department of Agriculture, Economic Research Service.

Carrera, L., Standardi, G., Bosello, F., & Mysiak, Y. (2015). Assessing direct and indirect economic impacts of a flood event through the integration of spatial and computable general equilibrium modelling. *Environmental Modelling & Software*, *63*, 109-122.

Cerdeiro, D. A. (2016). Estimating the Effects of the Trans-Pacific Partnership (TPP) on Latin America and the Caribbean (LAC). *IMF Working Paper Series*. Retrieved from https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Estimating-the-Effects-of-the-Trans-Pacific-Partnership-TPP-on-Latin-America-and-the-43917.

Cheong, I. (2013). Negotiations for the Trans-Pacific Partnership agreement: Evaluation and implications for East Asian regionalism (Working Paper No. 428). *Social Science Research Network Electronic Journal*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2292899

Chintrakarn, P. & Millimet, D.L. (2006). The environmental consequences of trade: Evidence from subnational trade flows. *Journal of Environmental Economics and Management*, *52*(1), 430-453.

Ciuriak, D., Lysenko, D., & Xiao, J. (2015). Province-level impacts of Canada's trade agreements. *The International Trade Journal*, *29*(5), 397-426.

Clarete, R., L. & Roumasset J., A. (1986). CGE models and development policy analysis: Problems, pitfalls and challenges. *American Journal of Agricultural Economics, 68,* 1212-1216.

Cook, R. (2011). Tracking demographics and US fruit and vegetable consumption patterns. *Department of Agricultural and Resource Economics,* University of California, Davis. Retrieved from http://files.are.ucdavis.edu/uploads/filer_public/2014/05/19/blueprintseoeconsumptioncookfinaljan2012figures.pdf.

Corong, E., Hertel, T., McDougall, R., Tsigas, M., & van der Mensbrugghe, D. (2017). The Standard GTAP Model, Version 7. *Journal of Global Economic Analysis, 2*(1), 1-119.

Cox, D. & Harris, R.G. (1992). North American free trade and its implications for Canada: Results from a CGE model of North American trade. *World Economy, 15*(1), 31-44.

Currie, J.M., John A.M., & Schmitz, A. (1971). The concept of economic surplus and its use in economic analysis. *The Economic Journal, 81*(324), 741-799.

Cury, S., Coelho, A., & Corseuil, C. (2004). A computable general equilibrium model to analyze the distributive aspects in Brazil with a trade policy illustration, presented at the *Input-Output and General Equilibrium Data, Modeling and Policy Analysis,* Brussels, Belgium, 2-4 September.

Dai, M., Yotov, V.Y., & Zylkin, T. (2014). On the trade-diversion effects of free trade agreements. *Economics Letters,* 122(2), 321-325.

Dairy Farmers of Canada. (2018). Dairy Farmers of Canada reacts to reports regarding the revised CPTPP agreement. Retrieved from https://www.dairyfarmers.ca/news-centre/news/policy/dairy-farmers-of-canada-reacts-to-reports-regarding-the-revised-cptpp-agreement.

De Benedictis, L. & Taglioni, D. (2011). The gravity model in international trade. Retrieved from http://works.bepress.com/luca_de_benedictis/20.

de Melo, J. (1988). Computable general equilibrium models for trade policy analysis in developing countries: A survey. *Journal of Policy Modeling*, *10*(4), 469-503.

de Miguel, F. & Manresa, A. (2004). Suppression of agricultural subsidies in the Extremadura region: An applied general equilibrium analysis, paper presented at *the Input-Output and General Equilibrium Data, Modeling and Policy Analysis Conference,* Brussels, Belgium, 2-4 September.

Dixon, P., Rimmer, M., & Wittwer, G. (2012). USAGE-R51, a State-level Multi-regional CGE Model of the US Economy, presented at the *15th Annual Conference on Global Economic Analysis*, Geneva, Switzerland, 27-29 June.

Dixon, P.B., Parmenter B.R., Sutton, J., & Vincent, D.P. (1982). *ORANI: A multisectoral model of the Australian economy*. Amsterdam: North Holland.

Domingues, E. & Lemos, M. (2004). Regional impacts of trade liberalization strategies in Brazil, paper presented at *the Input-Output and General Equilibrium Data, Modeling and Policy Analysis Conference,* Brussels, Belgium, 2-4 September.

Dubé, J. & Lemelin, A. (2005). Estimation expérimentale des flux d'échanges interrégionaux par la méthode de minimisation de l'Entropie croisée. *Revue Canadienne des Sciences Régionales/Canadian Journal of Regional Science*, *28*(3), 513-534.

Dwyer, L., Gill, A., & Seetaram, N. (2012). *Handbook of Research Methods in Tourism: Quantitative and Qualitative Approaches*. Cheltenham, UK: Edward Elgar Pub.

Elbehri, A., & Pearson, K. (2005). *Implementing Bilateral Tariff Rate Quotas in GTAP using GEMPACK* (GTAP Technical Paper No. 18). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=475.

Faunce, T.A. & Townsend, R. (2011). The Trans-Pacific Partnership Agreement: Challenges for Australian health and medicine policies. *Medicine and the Law*, *194*(2), 83-86.

Federal Reserve Bank of St. Louis Economic Data. (2016). FRED Economic Data. Retrieved from https://fred.stlouisfed.org.

Feenstra, R. (1994). New product varieties and the measurement of international prices. *American Economic Review*, *84*(1), 157-177.

Feenstra, R. (2004). *Advanced International Trade: Theory and Evidence*. Princeton and Oxford; Princeton University Press.

Filho, J. & Horridge, M. (2005). The Doha Round: Poverty and regional inequality in Brazil. *Policy Research Working Paper 3701,* World Bank, Washington D.C.

Flôres, R. J.J. (2008). Are CGE models still useful in economic policy making? *Ensaios Economicos, 674*. Retrieved from http://bibliotecadigital.fgv.br/dspace/bitstream/handle/10438/454/2296.pdf;jsessionid=F724473A75DC20AA910AA0C063D76115?sequence=1.

Francois, J., Worz, J., & Narayanan, B. (2013). ATC export tax equivalents. In B. G. Narayanan, A. Aguiar, & R. McDougall (Eds.), *Global Trade, Assistance, and Production: The GTAP 8 Data Base*. Center for Global Trade Analysis, Purdue University.

Gazel, R.C. (1996). Free trade agreements and interregional labor migration: The case of the US and Canada – Springer. *The Annals of Regional Science, 30*(4), 373-390.

Gehlhar, M. (1996). *Reconciling Bilateral Trade Data for Use in GTAP* (GTAP Technical Paper No. 10). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=313.

Gehlhar, M. (1997). Historical Analysis of Growth and Trade Patterns in the Pacific Rim. In T.W. Hertel (Ed.), *Global Trade Analysis: Modeling and Applications* (pp.349-363). New York, NY: Press Syndicate of the University of Cambridge.

Ghaith, Z. & Awad, M.A. (2011). Examining the long-term relationship between crude oil and food commodity prices: Co-integration and causality. *International Journal of Economics and Management Sciences, 1*(5), 62-72.

Ghazalian, P.L. (2017). The Effects of NAFTA/CUSFTA on Agricultural Trade Flows: An Empirical Investigation. *Canadian Journal of Agricultural Economics, 65*(2), 219-248.

Gillespie, G., McGregor, P.G., Swales, J.K., & Yin, Y.P. (2001). The displacement and multiplier effect of regional selective assistance: a computable general equilibrium analysis. *Regional Studies, 35*, 125-139.

Gohin, A. & Hertel, T. (2003). *A Note on the CES Functional Form and Its Use in the GTAP Model* (GTAP Research Memorandum No. 02). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1370.

Government of Canada, Global Affairs. (2013). Tariff rate quotas: Agricultural products. Retrieved from http://www.international.gc.ca/controls-controles/prod/agri/tarif.aspx?lang=eng

Government of Canada, Global Affairs. (2018a). Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP). Retrieved from http://international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/cptpp-ptpgp/faq.aspx?lang=eng.

Government of Canada, Global Affairs. (2018b). Overview and benefits of the CPTPP. Retrieved from http://international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/cptpp-ptpgp/overview-apercu.aspx?lang=eng.

Government of Canada, Global Affairs. (2018c). Benefits of the CPTPP for Saskatchewan. Retrieved from http://international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/cptpp-ptpgp/regions/SK.aspx?lang=eng.

Government of New Zealand, New Zealand Foreign Affairs and Trade. (2018a). CPTPP vs TPP. Retrieved from https://www.mfat.govt.nz/en/trade/free-trade-agreements/free-trade-agreements-concluded-but-not-in-force/cptpp/tpp-and-cptpp-the-differences-explained/.

Government of New Zealand, New Zealand Foreign Affairs and Trade. (2018b). Comprehensive and Progressive Agreement for Trans-Pacific Partnership text. Retrieved from https://www.mfat.govt.nz/en/trade/free-trade-agreements/free-trade-agreements-concluded-but-not-in-force/cptpp/comprehensive-and-progressive-agreement-for-trans-pacific-partnership-text/.

Government of Saskatchewan, Saskatchewan Bureau of Statistics (2017). *Economic Reports and Statistics.* Retrieved from http://www.saskatchewan.ca/government/government-data/bureau-of-statistics.

Government of Saskatchewan. (2012). Saskatchewan plan for growth. Retrieved from http://www.saskatchewan.ca/government/budget-planning-and-reporting/plan-for-growth.

Government of Saskatchewan. (2015). *Think big. Think Sask*. Retrieved from http://publications.gov.sk.ca/documents/310/93841-2016-08-19%20Economic%20Overview.pdf.

Gryga, K. (2015, November 24). *How the TPP will affect US imports part I*. Retrieved from https://tax.thomsonreuters.com/blog/onesource/how-tpp-will-affect-u-s-imports-part-1/.

Guimbard, H., Jean, S., Mimouni, M., & Pichot, X. (2012). MAcMap-HS6 2007, An exhaustive and consistent measure of applied protection in 2007. *International Economics, 130,* 99-121.

Hanoch, G. (1975). Production and Demand Models with Direct or Indirect Implicit Additivity. *Econometrica, 43*(3), 395-419.

Harrison, W. & Pearson, K. (1998). *An introduction to GEMPACK* (4th ed.). Victoria, Australia: Centre of Policy Studies and Impact Project.

Hertel, I., Hertel, T.H., Hummels, D., Ivanic, M., & Keeney, R. (2004). How confident can we be in CGE-based assessments of Free Trade Agreements? *GTAP Working Paper No. 26*. West Lafayette, IN: Center for Global Trade Analysis.

Hertel, T., Hummels, D., & Walmsley, T. (2013). Developing a multi-region input-output framework from GTAP for analyzing the vulnerability of the Asia-Pacific supply chain to natural disasters, presented at the *16th Annual Conference on Global Economic Analysis,* Shanghai, China, 12-14 June.

Hertel, T.W. & Tsigas, M.E. (1988). Tax Policy and US Agriculture: A General Equilibrium Analysis. *American Journal of Agricultural Economics, 70*(2), 289-302.

Hertel, W.T. (Ed.). (1997). *Global Trade Analysis: Modelling and Applications*. New York, NY: Press Syndicate of the University of Cambridge.

Hinojosa-Ojeda, R.A. (2000). Brazil and the United States at the gateway of the FTAA: A CGE modelling approach to challenges and options, presented at *Economia Brasileira e os Processos de Integração Subregional e Hemisférico*, Brasilia, Brazil.

Hoekman, B.M. & Javorcik, B.K.S. (Eds.). (2006). *Global Integration and Technology Transfer*. Washington, DC: World Bank.

Holden, S., Lofgren, H., & Shiferaw, B. (2005*).* Economic Reforms and Soil Degradation in The Ethiopian Highlands: A Micro CGE Model With Transaction Costs, paper presented at *International Conference on Policy Modeling*, Istanbul, Turkey,29 June-1 July.

Horridge, M. & Laborde, D. (2008). *TASTE a program to adapt detailed trade and tariff data to GTAP-related purposes* (Presented at the 11th Annual Conference on Global Economic Analysis, Helsinki, Finland). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2666.

Horridge, M. & Wittwer, G. (2010). Bringing Regional Detail to a CGE Model Using CENSUS Data. *Spatial Economic Analysis, 5*(2), 229-255.

Horridge, M. (2000). ORANI-G: A General Equilibrium Model of the Australian Economy (Working Paper No. op-93). Centre of Policy Studies/IMPACT Centre. Retrieved from https://ideas.repec.org/p/cop/wpaper/op-93.html.

Horridge, M. (2011). *SplitReg – Programs to Disaggregate a GTAP region*. Melbourne, Australia: Center of Policy Studies

Huang, J., Li, N., & Rozelle, S. (2003). Trade Reform, Household Effects, and Poverty in Rural China. *American Journal of Agricultural Economics*, 85(5), 1292-1298.

International Monetary Fund. (2016). IMF Economic Outlook. Retrieved from https://www.imf.org/en/data.

International Trade Centre. (2016). Market Access Map database. Retrieved from http://www.intracen.org/itc/market-info-tools/trade-statistics/.

Ivus, O. & Strong, A. (2005). Modeling approaches to the analysis of trade policy: computable general equilibrium and gravity models. In W. Kerr & J. Gaisford (Eds.), *Handbook on International Trade Policy* (pp. 44-54). Cheltenham: Edward Elgar Publishing Limited.

Jacobs, J. (2016). *The Impact of TPP Tariff Removal on Canadian Trade*. Ottawa, ON, Canada: Canadian Centre for Policy Alternatives. Retrieved from https://www.policyalternatives.ca/sites/default/files/uploads/publications/National%20Office/2016/05/Impact_of_TPP_Tariff_Removal.pdf.

Japan International Cooperation Agency. (2012). *Customs valuation (CV) handbook for customs administration in the East African region*. Nairobi, Kenya: Japan International Cooperation Agency.

Jayasinghe, S., & Sarker, R., (2008). Effects of Regional Trade Agreements on Trade in Agrifood Products: Evidence from Gravity Modeling Using Disaggregated Data. *Applied Economic Perspectives and Policy*, 30(1), 61-18.

Jean, S. & Laborde, D. (2004). The impact of multilateral liberalisation on European regions: A CGE assessment, presented at the *Policy Modeling International Conference*, Paris, France, 30 June-2 July.

Jensen, S.B., Lehmijoki, U., & Rovenskaya, E. (2015). Non-Homothetic multisector growth models. *Review of Development Economics*, *19*(2), 221-243.

Johansen, L. (1960). *A multi-sectoral study of economic growth*. Amsterdam: North Holland.

Jomini, P., Zeitsch, J.F., McDougall, R., Welsh, A., Brown, S., Hambley, J., & Kelly, J. (1991). SALTER: A General Equilibrium Model of the world economy, vol. 1. Model Structure, Data Base, and Parameters. Canberra, Australia: Industry Commission.

Kawasaki, K. (2016). Potential macroeconomic implications of the Trans-Pacific Partnership. In World Bank (Ed.), *Global Economic Prospects, January 2016: Spillovers amid Weak Growth* (pp. 217-256). Washington, DC: World Bank Group.

Kehoe, P. J. & Kehoe, J. (1994). A Primer on static applied general equilibrium models. *Federal Reserve Bank of Minneapolis: Quarterly Review*, *18*(2), 2-16.

Kilkenny, M. (1998). Transport costs and rural development. *Journal of Regional Science*, *38*(2), 293-312.

Ko, J-H., & Britz, W. (2013). Does Regional and Sectoral Aggregation Matter? Sensitivity Analysis in the Context of an EU-Korea FTA, presented at the *16th Annual Conference on Global Economic Analysis*, Shanghai, China, 12-14 June.

Koks, E.E., Carrera, L., Jonkeren, O., Aerts, J.C.J.H., Husby, T.G., Thissen, M., Standardi, G., & Mysiak J. (2015). Regional disaster impact analysis: Comparing Input-Output and Computable General Equilibrium models. *Natural Hazards Earth System Sciences*, 3, 7053-7088.

Kuiper, M. & Tongeren, F., van. (2004). Growing together or growing apart? A village level study of the impact of the Doha Round on rural China, prepared for the *7th Annual Conference on Global Economic Analysis*, Washington D.C., 17-19 June.

Kulshreshtha, S. & Thompson, W. (2005). Economic impacts of the Saskatchewan Agriculture and food cluster on the Saskatchewan Economy. Report prepared for Saskatchewan Agriculture and Food-Regina. Department of Agricultural Economics, University of Saskatchewan, Saskatoon, Canada.

Lanz, B. & Rutherford, TF. (2016). GTAPINGAMS, version 9: Multiregional and small open economy models with alternative demand systems. *IRENE, Working paper 16-08*. University of Neuchatel, Institute of Economic Research. Retrieved from https://www.unine.ch/files/live/sites/irene/files/shared/documents/Publications/Working%20papers/2016/WP_16-08.pdf.

Laub, Z. & McBride J. (2017, May 30). *The Group of Seven (G7)*. Retrieved from https://www.cfr.org/backgrounder/group-seven-g7.

Lee, H. & Itakura, K. (2014). TPP, RCEP, and Japan's agricultural policy reforms. *Discussion Paper: DP-2014-E-003*. Osaka, Japan: Osaka School of International Public Policy

Leontief, W. (1937). Interrelation of prices, output, savings and investment. *Review of Economics and Statistics*, 19(3), 109–132.

Leontief, W., Morgan, A., Polenske, K., Simpson, D., & Tower, E. (1965). The Economic Impact-Industrial and Regional of An Arms Cut. *The Review of Economics and Statistics, 47*(3), 217-241.

Li, P.C. & Rose, A. (1995). Global warming policy and the Pennsylvania economy: A computable general equilibrium analysis. *Economic Systems Research*, *7*(2), 151-172.

Liew, L.H. (1984). "Tops-down" versus "bottoms-up" approaches to regional modelling. *Journal of Policy Modelling*, *6*, 351-367.

Lloyd, P.J. & MacLaren, D. (2002). Measures of trade openness using CGE analysis. *Journal of Policy Modeling*, *24*(1), 67-81.

Lofgren, H., Harris, R. L., & Robinson, S. (2002). *A standard Computable General Equilibrium (CGE) model in GAMS*. Washington, DC: International Food Policy Research Institute.

Lysenko, D., Ciuriak, D., & Xiao, J. (2015). Trade policy analysis at a subnational level: Replacing Canada by its Provinces in the GTAP Model. *Social Science Research Network Electronic Journal*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2594581.

Madden, J.R., & Giesecke, J.A. (2013). Regional CGE Modeling. In P. Dixon & D. Jorgenson (Eds.), *Handbook of Computable General Equilibrium Modeling 1 B* (pp. 379-475). Amsterdam: North Holland.

Martin, W. & Pham, C.S. (2015). Estimating the gravity model when zero trade flows are frequent and economically determined. *SSRN Scholarly Paper,* No. ID 2619473. Rochester, NY: Social Science Research Network. Retrieved from http://papers.ssrn.com/abstract=2619473.

Martinez-Zarzoso, I. & Nowak-Lehmann, F. (2003). Augmented gravity model: An empirical application to Mercosur-European Union trade flows. *Journal of Applied Economics*, *6*(2), 291-316.

Martinez-Zarzoso, I. (2003). Gravity model: An application to trade between regional blocs. *Atlantic Economic Journal*. Retrieved from https://www.researchgate.net/publication/5144057_Gravity_model_An_application_to_trade_between_regional_blocs

McCallum, J. (1995). National borders matter: Canada-US regional trade patterns. *The American Economic Review, 85*(3), 615-623. Retrieved from http://www.jstor.org/stable/2118191.

McDougall, R. (2002). *A New Regional Household Demand System for GTAP* (GTAP Technical Paper No. 20). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=942.

Millington, D. (2016). *Low Crude Oil Prices and Their Impact on The Canadian Economy*. Calgary, Canada: Canadian Energy Research Institute.

Monge, J.J., Bryant, H. L., & Anderson, D. P. (2014). Development of regional social accounting matrices with detailed agricultural land rent data and improved value-added components for the USA. *Economic Systems Research*, *26*(4), 486-510.

Morgan, W., Mutti, J., & Rickman, D. (1996). Tax exporting, regional economic growth, and welfare. *Journal of Urban Economics*, *39*(2), 131-159.

Muhammad, A., Seale, L.J., Meade, B.J., & Regmi, A. (2011). *International evidence on food consumption patterns: An update using 2005 international comparison program data, TB-1929*. Washington, DC: US Department of Agriculture, Economic Research Service.

Narayanan, B. (2016). *Chapter 8.F: Representative Table and Composite Regions* (Center for Global Trade Analysis). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5136.

Office of the US Trade Representative. (2017). The United States officially withdraws from the Trans-Pacific Partnership. Retrieved from https://ustr.gov/about-us/policy-offices/press-office/press-releases/2017/january/US-Withdraws-From-TPP.

Office of the US Trade Representative. (2018). United States-Mexico-Canada Agreement Text. Retrieved from https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement/united-states-mexico.

Oliver, S. (2015, December 2). How quickly are tariffs eliminated in the TPP? PIIE trade and Investment policy watch Blog. Washington, D.C.: Peterson Institute for International Economics.

Parliament of Canada. (2017). Parliamentary Information and Research Service. Retrieved from https://lop.parl.ca/content/lop/ResearchPublications/toctrade-e.htm.

Partridge, M.D. & Rickman, D.S. (1998). Regional computable general equilibrium modelling: A survey and critical appraisal. *International Regional Science Review*, *21*(3), 205–248.

Paulo, de S. Porto., Canuto, O., & Morini, C. (2015). The impacts of trade facilitation measures on international trade flows (Working Paper No. WPS7367). Washington, DC: The World Bank. Retrieved from http://documents.worldbank.org/curated/en/2015/07/24779062/impacts-trade-facilitation-measures-international-trade-flows.

Pelikan, J., & Brockmeier, M. (2008). Methods to Aggregate Import Tariffs and their Impacts on Modeling Results. *Journal of Economic Integration*, *23*(3), 685-708.

Pérez-Blanco, C.D., Standardi, G., Mysiak, J., Parrado, R., & Gutiérrez-Martín, C. (2016). Incremental water charging in agriculture. A case study of the Regione Emilia Romagna in Italy. *Environmental Modelling & Software*, 78(2016), 202-215.

Peter, M.W., Horridge, M., Meagher, G.A., Naqvi, F., & Parmenter, P.R. (1996). The Theoretical Structure of MONASH-MRF (Working Paper No. op-85). Victoria, Australia: Centre of Policy Studies.

Petersen, T. W. (1997). *An introduction to CGE-Modelling and an illustrative application to Eastern European Integration with the EU*. Copenhagen, Denmark: Institute of Economics.

Peterson, E. (2016). Chapter 8.A: Food and Agricultural Data Base. In B.G Narayanan, A. Aguiar, & R. McDougall (Ed.), Global Trade, Assistance, and Production: The GTAP 8 Data Base. New York, NY: Press Syndicate of the University of Cambridge.

Petri, P.A. & Plummer, M.G. (2012). *The Trans-Pacific Partnership and Asia-Pacific Integration: Policy Implications*. Washington, DC: Peterson Institute for International Economics.

Petri, P.A. & Plummer, M.G. (2016). *The economic effects of the Trans-Pacific Partnership: New estimates*. Washington, DC: Peterson Institute for International Economics.

Petri, P.A., Plummer, M.G., & Zhai, F. (2012). *The Trans-Pacific Partnership and Asia-Pacific integration: A quantitative assessment*. Washington, DC: Peterson Institute for International Economics.

Piermartini, R. & Teh, R. (2005). Demystifying Modelling Methods for Trade Policy. *Discussion Papers 10, 1-49*. Geneva, Switzerland: World Trade Organization.

Powell, A. & Gruen, F. (1968). The constant elasticity of transformation production frontier and linear supply system. *International Economic Review, 9*(3), 315-328.

PwC. (2017). The Long View How will the global economic order change by 2050. Retrieved from https://www.wto.org/english/res_e/booksp_e/tariff_profiles17_e.pdf.

Qiao, F., Lohmar, B., Huang, J., Rozelle, S., & Zhang, L. (2003). Producer benefits from input market and trade liberalization: The case of fertilizer in China. *American Journal of Agricultural Economics, 85*(5), 1223-1227.

Rae, A. N. (2001). Trade in Livestock Products and the WTO Millenium Round: Projections to 2005 and Problems with TRQs, paper presented at the *International Agricultural Trade Consortium Symposium on Trade in Livestock Products. Auckland, New Zealand, January 18- 19.*

Reimer, J. & Hertel, T.W. (2004). International cross section estimates of demand for use in the GTAP Model. *GTAP Technical paper, 23*. Center for Global Trade Analysis, West Lafayette, Indiana.

Rickman, D.S. (1992). Estimating the impacts of regional business assistance programs: alternative closures in a regional model. *Papers in Regional Science, 71*, 421-435.

Robinson S. (2006). Macro models and multipliers: Leontief, Stone, Keynes, and CGE Models. In A. Janvry, & R. Kanbur (Eds.). *Poverty, Inequality and Development. Economic Studies in Inequality, Social Exclusion and Well-being*, vol 1., Boston, MA: Springer.

Rodriguez, U.E. (2007). State-of-the-Art in regional computable general equilibrium modelling with a case study of the Philippines. *Agricultural Economics Research Review, 20*, 1-28.

Rose, A. (1995). Input-output economics and computable general equilibrium models. *Structural Change and Economic Dynamics, 6*(3), 295-304.

Rosnick, D. (2013). *Gains from trade? The net effect of the Trans-Pacific partnership agreement on US wages*. Washington, DC: Center for Economic and Policy Research.

Roson, R. (2006). Introducing imperfect competition in CGE Models: Technical aspects and implications *Computational Economics, 28*(1), 29-49.

Saskatchewan Trade and Export Partnership (STEP). (2011). Saskatchewan State of Trade. Retrieved from https://www.sasktrade.com/public/uploads/files/Saskatchewan%20State%20of%20Trade.pdf.

Sawe, B.E. (2017, April 25). Important Facts About the Economy Of Canada. *World Atlas*. Retrieved from https://www.worldatlas.com/articles/important-facts-related-to-the-economy-of-canada.html.

Schiff, M.W. & Winters, L.A. (2003). *Regional Integration and Development*. Washington, Dc: World Bank Publications.

Serlenga, L. & Shin, L. (2007). Gravity models of intra-EU trade: application of the CCEP-HT estimation in heterogeneous panels with unobserved common time-specific factors. *Journal of Applied Econometrics, 22*(2), 361-381.

Seung, C.K., Harris, T.R., Englin, J.E., & Netusil, N.R. (1999). Application of a computable general equilibrium (CGE) model to evaluate surface water reallocation policies. *Review of Regional Studies, 29*(2), 139-155.

Shantayanan, D. & Delfin, S. (1998). The simplest dynamic General-Equilibrium Model of an open economy. *Journal of Policy Modeling, 20*(6), 677-714.

Shoven, J. & Whalley, J. (1984). Applied general equilibrium models for taxation and international trade: An introduction and survey. *Journal of Economic Literature, 22*(3), 1007-1052.

Shoven, J. B. & Whalley, J. (1992). *Applying general equilibrium*. Cambridge, UK: Cambridge University Press.

Simola, A. (2013). Agricultural land use in AGE model production functions, presented at the *16th Annual Conference on Global Economic Analysis,* Shanghai, China, 12-14 June.

Skully, D. (1999). The Economic of TRQ Administration (Working Paper No. 99-6). *International Agricultural Trade Research Consortium*. Retrieved from http://ageconsearch.umn.edu/record/14584/files/wp9906.pdf.

Standardi, G. & Eboli, F. (2015). *Sea Level Rise in the Italian regions: a macroeconomic assessment*. Lecce, Italy: Centro Euro-Mediterraneo per i Cambiamenti Climatici.

Standardi, G. (2013). A subnational version of the GTAP model for Italy, presented at the *16th Annual Conference on Global Economic Analysis,* Shanghai, China, 12-14 June.

Statistics Canada. (2016). Canadian International Merchandise Trade Database. Retrieved from http://www5.statcan.gc.ca/cimt-cicm/home-accueil?lang=eng.

Statistics Canada. (2017). Gross domestic product, income and expenditure, fourth quarter 2016. *Daily*. Retrieved from https://www.statcan.gc.ca/daily-quotidien/170302/dq170302a-eng.htm.

Strutt, A., Minor, P., & Rae, A. (2015). *A Dynamic Computable General Equilibrium (CGE) Analysis of the Trans-Pacific Partnership Agreement: Potential Impacts on the New Zealand Economy*. Wellington, New Zealand: Ministry of Foreign Affairs and Trade.

Suranovic, S. (2012). *Policy and Theory of International Trade*. Washington, DC: (n.p).

Susanto, D., Rosson, C.P., & Adcock, F.J. (2007). Trade Creation and Trade Diversion in the North American Free Trade Agreement: The Case of Agricultural Sector. *Journal of Agricultural and Applied Economics, 39*(1), 121-134.

Taheripour, F., Pena Levano, L., & Tyner, W. (2017). *Introducing first and second generation biofuels into GTAP data base version 9* (GTAP Research Memorandum No. 29). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5172.

Tariq, A., Yang, J., & Huang, J. (2012). GTAP-PBIO: A GTAP Model and Data Base that Incorporates Biofuels Sector of Pakistan. *International Journal of Management Sciences and Business Research*, 1(4), 1-13.

Tinbergen, J. (1962). Shaping the World Economy – Suggestions for an International Economic Policy. New York: The Twentieth Century Fund.

Todsadee, A., Kameyama, H., & Lutes, P. (2012). The implications of trade liberalization on TPP countries' livestock product sector. *Tech. Bull. Fac. Agr. Kagawa Univ, 64*(1), 1-6.

UNCTAD. (2010). *Non-tariff measures: Evidence from selected developing countries and future research agenda*. New York: NY: United Nations.

United Nations International Trade Statistics. (2016). *Harmonized Commodity Description and Coding Systems (HS).* New York: NY: United Nations.

United Nations. (2016). UN Comtrade Database. Retrieved from https://comtrade.un.org/data/

United States Census Bureau. (2018). International Programs, International Database. Retrieved from https://www.census.gov/data-tools/demo/idb/informationGateway.php.

US Department of Agriculture, Foreign Agricultural Service. (2017). Reports and Data. Retrieved March 17, 2017, from https://apps.fas.usda.gov/psdonline/app/index.html#/app/downloads.

van de Loo, J. (2018, February 15). Canada and the revival of the Pacific-Rim Trade Agreement. *The Public Policy and Governance Review.* Retrieved from https://ppgreview.ca/2018/02/15/canada-and-the-revival-of-the-pacific-rim-trade-agreement/.

van Leeuwen, N. & McDougall, R. (2016). *Chapter 9.D: Services Trade Data* (Center for Global Trade Analysis). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5137.

West, G. R. (1995). Comparison of input–output, input–output + econometric and computable general equilibrium impact models at the regional level. *Economic Systems Research, 7* (2), 209-67.

Whalley, J. (1985). Hidden challenges in recent applied general equilibrium exercises. In J. Piggott & J. Whalley (Ed.), *New development in apply general equilibrium analysis* (pp. 25-41). New York, NY: Cambridge University Press.

Wing, I.S. (2004). *Computable general equilibrium models and their use in economy wide policy analysis*. Cambridge, MA: Massachusetts Institute of Technology.

Winters, L.A. (2002). Trade, Trade Policy and Poverty: What are the Links? *Discussion Papers 2382*. London, UK: Centre for Economic Performance.

World Bank. (2016a). *World Bank country and lending groups*. Washington, DC: World Bank. Retrieved from https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

World Bank. (2016b). *GDP (Current US $), World Bank national accounts data, and OECD National Accounts data files*. Washington, DC: World Bank. Retrieved January 18, 2018 from https://data.worldbank.org/indicator/ny.gdp.mktp.cd.

World Bank. (2016c). *Trade (%of GDP), World Bank national accounts data, and OECD National Accounts data files*. Washington, DC: World Bank. Retrieved January 18, 2018 from https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS?end=2016&start=2003.

World Economic Forum. (2014, July 9). *What are mega-regional trade agreements?*. Retrieved from https://www.weforum.org/agenda/2014/07/trade-what-are-megaregionals/.

World Health Organization & Food and Agriculture Organization of the United States. (2003). *Diet, Nutrition and the Prevention of Chronic Diseases*. Geneva, Switzerland: World Heath Organization.

World Trade Organization. (2016). *Regional Trade Agreements Information System (RTA-IS)*. Geneva, Switzerland: World Trade Organization. Retrieved from http://rtais.wto.org/ui/publicallrtalist.aspx.

World Trade Organization. (2017). *World Tariff Profiles*. Geneva, Switzerland: World Trade Organization. Retrieved from https://www.wto.org/english/res_e/booksp_e/tariff_profiles17_e.pdf.

Appendices

Appendix A: Historical development of GTAP database

Version	Ref. year	Regions	Sectors	Notes
Version 1	1990	15	37	Based completely on SALTER database and used the same 13 I-O tables.
Version 2	1992	24	37	New regions were added and updated. The original SALTER I-O tables were used in version one.
Version 3	1992	30	37	New regions were added to make a total of 30 regions. This version was the last version based on SALTER I-O tables.
Version 4	1995	45	50	Replaced all remaining SALTER database and added new regions and sectors. Most of the additional sectoral addition were in the food and agriculture sector. Labour was divided into skilled and unskilled based on occupational split.
Version 5	1997	66	57	The number of regions was increased to 66 and an additional seven service sectors were added. Improvements in the tariff data of agricultural products were introduced by using Agriculture Market Analysis Database.
Version 6	2001	87	57	The number of regions were increased to 87 and a disaggregation of international transport margin by modes was added. A comprehensive treatment of trade preferences and import protection were added to this version. Market Access Map (MAcMap) database was used for tariff and imports protection.
Version 7	2004	113	57	The number of regions was increased to 113. Some regions were removed due to some data quality issues. The bilateral trade on services were obtained in this version from OECD to improve the quality of analysis, and data on subsidies payment was incorporated in this version. Agricultural export subsidy data was improved.
Version 8	2004 2007	129	57	The number of regions was increased to 129 with two reference years, and more detailed data on the physical energy flow were added. More comprehensive export subsidy data were added.
Version 9	2004 2007 2011	140	57	The number of regions was increased to 140 with three reference years of data and disaggregation of labour skills was increased to five categories.

Source: Aguiar *et al.* (2016).

Appendix B: GTAP V.9 database major files

Arrays in the GTAP sets files

Name	Description
H1	Regions
H2	Traded commodities
H3	Non-saving commodities
H4	Demanded commodities
H5	Produced commodities
H6	Endowment commodities
H7	Sluggish endowment commodities
H8	Mobile endowment commodities
H9	Capital endowment commodities
MARG	Margin commodities
TARS	Types of tariffs

Arrays in the GTAP parameters files including elasticities

Name	Description
ESBD	Elasticity of substitution between domestic and imported products
ESBM	Elasticity of substitution between imports from different regions
ESBT	Elasticity of substitution between intermediate and value added
ESBV	Elasticity of substitution between primary factors
ETRE	Elasticity of transformation for sluggish primary factors endowments
RDLT	Binary switch mechanism of allocating investment funds
RFLX	Flexibility of expected net rate of return on capital stock with respect to investment
INCP	Expansion parameter in the CDE consumer demand system
SUBP	Substitution parameter in the CDE consumer demand system
SLUG	Sluggish-mobile switch parameter

Arrays in the GTAP data files

Name	Description
ADRV	Anti-dumping duty
DPSM	Sum of distribution parameters in the household demand system
EVFA	Primary factor purchases, at agents' prices
EVOA	Primary factor sales, at agents' prices
FBEP	Factor-based subsidies
FTRV	Factor employment tax revenue
ISEP	Intermediate input subsidies
MFRV	Export tax equivalent of multi-fiber agreement (MFA) quota premium
OSEP	Ordinary output subsidy
POP	Population
PURV	Export tax equivalent of price undertakings
SAVE	Net saving, by region
TFRV	Ordinary import duty
TVOM	Sales of domestic product, at market prices
VDEP	Capital depreciation
VDFA	Domestic purchases, by firms, at agents' prices
VDFM	Domestic purchases, by firms, at market prices
VDGA	Domestic purchases, by government, at agents' prices
VDGM	Domestic purchases, by government, at market prices
VDPA	Domestic purchases, by households, at agents' prices
VDPM	Domestic purchases, by households, at market prices
VFM	Primary factor purchases, by households, at market prices
VIFA	Import purchases, by firms, at agents' prices
VIFM	Import purchases, by firms, at market prices
VIGA	Import purchases, by government, at agents' prices
VIGM	Import purchases, by government, at market prices
VIMS	Imports, at market prices
VIPA	Import purchases, by households, at agents' prices

VIPM	Import purchases, by households, at market prices
VIWS	Imports, at world prices
VKB	Capital stock
VRRV	Export subsidy equivalent of voluntary export restraints
VST	Margin exports
VTWR	Margins by margin commodity
VXMD	Non-margin exports, at market prices
VXWD	Non-margin exports, at world prices
XTRV	Ordinary export tax
VTSS	Value of specific and ad-valorem tariff revenue

Arrays in the GTAP energy volume data files

Name	Description
EC	Energy commodities
EDF	Volume of domestic input purchases by firms
EDP	Volume of domestic purchases by households
EDG	Volume of domestic purchases by government
EIF	Volume of imported input purchases by firms
EIP	Volume of imported purchases by households
EIG	Volume of imported purchases by government
EXI	Volume of bilateral trade

Arrays in the GTAP energy volume data files

Name	Description
FC	Fuel commodities
MDF	Emissions from domestic input purchases by firms
MDP	Emissions from domestic purchases by households
MDG	Emissions from domestic purchases by government
MIF	Emissions from imported input purchases by firms
MIP	Emissions from imported purchases by households
MIG	Emissions from imported purchases by government

Source: Aguiar *et al.* (2016).

Appendix C: Sectoral disaggregation in GTAP Database V.9

Name	Description	Name	Description
pdr	Paddy rice	lum	Wood products
wht	Wheat	ppp	Paper products, publishing
gro	Cereal grains, not elsewhere classified n.e.c.	p_c	Petroleum, coal products
v_f	Vegetables, fruit, nuts	crp	Chemical, rubber, plastic products
osd	Oil seeds	nmm	Mineral products n.e.c.
c_b	Sugar cane, sugar beet	i_s	Ferrous metals
pfb	Plant-based fibers	nfm	Metals n.e.c.
ocr	Crops n.e.c.	fmp	Metal products
ctl	Cattle, sheep, goats, horses	mvh	Motor vehicles and parts
oap	Animal products n.e.c.	otn	Transport equipment n.e.c.
rmk	Raw milk	ele	Electronic equipment
wol	Wool, silk-worm cocoons	ome	Machinery and equipment n.e.c.
frs	Forestry	omf	Manufactures n.e.c.
fsh	Fishing	ely	Electricity
coa	Coal	gdt	Gas manufacture, distribution
oil	Oil	wtr	Water
gas	Gas	cns	Construction
omn	Minerals n.e.c.	trd	Trade
cmt	Meat: cattle, sheep, goats, horses	otp	Transport n.e.c.
omt	Meat products n.e.c.	wtp	Sea transport
vol	Vegetable oils and fats	atp	Air transport
mil	Dairy products	cmn	Communication
pcr	Processed rice	ofi	Financial services n.e.c.
sgr	Sugar	isr	Insurance
ofd	Food products n.e.c.	obs	Business services n.e.c.
b_t	Beverages and tobacco products	ros	Recreation and other services
tex	Textiles	osg	PubAdmin/Defense/ Health/Education
wap	Wearing apparel	dwe	Dwellings
lea	Leather products		

Source: Aguiar *et al.* (2016).

Appendix D: Tariff elimination by sector upon full implementation of CPTPP agreement

	Country/region[1]											
Sector	**AU**	**BN**	**CA**	**CL**	**JP**	**MY**	**MX**	**NZ**	**PE**	**SG**	**VN**	**US[2]**
Rice	0%	0%	0%	0%	20%	0%	0%	0%	0%	0%	0%	0%
Wheat	0%	0%	0%	0%	15%	0%	0%	0%	0%	0%	0%	0%
Other grains	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%
Fruits/vegetables	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Oilseeds	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other crops	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Livestock	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Meat products	0%	0%	9%	0%	9%	2%	0%	0%	0%	0%	0%	2%
Raw milk	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dairy products	0%	0%	60%	0%	10%	0%	15%	0%	0%	0%	0%	7%
Processed foods	0%	0%	1%	0%	3%	0%	1%	0%	0%	0%	2%	0.5%
Extraction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Labour-intensive manufacturing	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Capital-intensive manufacturing	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.5%	0%
Services	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1]: AU: Australia, BN: Brunei-Darussalam, CL: Chile, JP: Japan, MY: Malaysia, MX: Mexico, MZ, New Zealand, PE: Peru, SG: Singapore, VN: Vietnam, US: United States.

[2:] Only under former TPP agreement.

Appendix E: Gross Domestic Product, population, and agricultural trade of CPTPP countries and the US, 2016

Country	Population (Millions USD)	GDP (Trillion USD)	Total imports (Million USD)	Total exports (Million USD)	Trade balance (Million USD)
Australia	8.61	1.339	189,308	189,555	247
Brunei Darussalam	0.42	0.01293	2,672	4,704	2,032
Canada	35.8	1.551	402,966	389,071	-13,895
Chile	17.9	0.240796	58,761	60,733	1,972
Japan	127	4.123	606,924	644,932	38,008
Malaysia	30.3	0.296283	168,375	189,414	21,039
Mexico	127	1.144	387,064	373,893	-13,171
New Zealand	23.8	0.173754	36,213	33,870	-2,343
Peru	31.4	0.189111	36,148	36,310	162
Singapore	5.5	0.292739	291,908	338,082	46,174
Vietnam	91.7	0.193599	174,978	176,581	1,603
United States	321	18.037	2,249,944	1,451,024	-798,920
Total	820.43	27.59	4,605,261	3,888,169	-717,092

Source: International Monetary Fund. (2016) and International Trade Centre (2016)

Appendix F: Free trade agreements between CPTPP countries/the US (other than CPTPP)

Country	Agreement
Australia	- ASEAN-Australia-New Zealand Free Trade Agreement - Canada Australia Trade Agreement (CANATA) - Australia-Chile Free Trade Agreement (ACl-FTA) - Japan-Australia Economic Partnership Agreement (JAEPA) - Malaysia-Australia Free Trade Agreement (MAFTA) - Australian New Zealand Closer Economic Relations Trade Agreement (ANZCERTA - Singapore-Australia Free Trade Agreement (SAFTA) - Australia-United States Free Trade Agreement (AUSFTA)
Brunei Darussalam	- ASEAN Free Trade Agreement - Brunei-Japan Economic Cooperation Partnership Agreement - ASEAN-Japan Comprehensive Economic Partnership (AJCEP) - ASEAN-Australia-New Zealand Free Trade Area (AANZFTA) - Trans-Pacific Strategic Economic Partnership Agreement (TPSEP/P4)
Canada	- Canada-Chile Free Trade Agreement - Canada-Japan Economic Partnership Agreement (not into force) - North American Free Trade Agreement (NAFTA) - Canada-Peru Free Trade Agreement - Canada-Singapore Free Trade Agreement Negotiations (not into force) - Canada-US Free Trade Agreement (CUSFTA)
Chile	- Canada-Chile Free Trade Agreement - Australia-Chile Free Trade Agreement (ACl-FTA) - P4: Chile, New Zealand, Singapore y Brunei Darussalam - Pacific Alliance: Chile, Colombia, Mexico y Peru - Chile-Peru Free Trade Agreement - US-Chile Free Trade Agreement
Japan	- Japan-Singapore Economic Partnership Agreement - Japan-Mexico Economic Partnership Agreement - Japan-Malaysia Economic Partnership Agreement

…cond.

	- Japan-Chile Economic Partnership Agreement - Japan-Brunei Economic Partnership Agreement - ASEAN-Japan Comprehensive Economic Partnership Agreement - Japan-Viet Nam Economic Partnership Agreement - Japan-Peru Economic Partnership Agreement - Japan-Australia Economic Partnership Agreement
Malaysia	- Japan-Malaysia Economic Partnership Agreement - Malaysia-Australia Free Trade Agreement (MAFTA) - Malaysia-Chile Free Trade Agreement - Malaysia-New Zealand Free Trade Agreement - ASEAN-Australia-New Zealand Free Trade Area (AANZFTA) - ASEAN-Japan Comprehensive Economic Partnership Agreement
Mexico	- Mexico-Peru Free Trade Agreement - Pacific Alliance: Chile, Colombia, Mexico, Peru - Japan-Mexico Economic Partnership Agreement - Mexico Chile Free Trade Agreement - North American Free Trade Agreement (NAFTA)
New Zealand	- Australian New Zealand Closer Economic Relations Trade Agreement (ANZCERTA) - ASEAN-Australia-New Zealand Free Trade Area (AANZFTA) - Malaysia-New Zealand Free Trade Agreement - New Zealand-Singapore Closer Economic Partnership - P4: Chile, New Zealand, Singapore y Brunei Darussalam.
Peru	- Peru-Canada Free Trade Agreement - Peru-Chile Free Trade Agreement - Japan-Peru Economic Partnership Agreement - Mexico-Peru Free Trade Agreement - Peru-Singapore Free Trade Agreement (PeSFTA)
Singapore	- Peru-Singapore Free Trade Agreement (PeSFTA) - New Zealand-Singapore Comprehensive Economic Partnership (ANZSCEP) - Singapore-Australia Free Trade Agreement (SAFTA) - United States-Singapore Free Trade Agreement (USSFTA) - ASEAN-Australia-New Zealand Free Trade Area (AANZFTA)

…cond.

	- ASEAN-Japan Comprehensive Economic Partnership (AJCEP) - ASEAN Free Trade Area (AFTA)
Vietnam	- ASEAN - ASEAN-Australia-New Zealand Free Trade Area (AANZFTA) - ASEAN-Japan Comprehensive Economic Partnership Agreement - Chile-Viet Nam Free Trade Agreement - Japan-Viet Nam Economic Partnership Agreement
United States	- Australia-United States Free Trade Agreement - North American Free Trade Agreement (NAFTA) - Chile-United States Free Trade Agreement - Peru-United States Trade Promotion Agreement United States-Singapore Free Trade Agreement (USSFTA)

Source: World Trade Organization (2016).

Appendix G: Autoregressive and moving average models

Unit root tests

Unit-root tests are used to determine whether the time series is stationary or non-stationary. This is required to avoid the problem of spurious regression. There are several ways and tests for stationarity. For this particular analysis, the commonly used Augmented Dickey Fuller approach (ADF) was used to test whether the series under examination contained a unit-root (nonstationary) or not (stationary). The Akaike Criteria (AIC) was used to determine the optimal number of lags for the unit root test ADF test,expressed as:(Ghaith and Awad, 2011):

$$\Delta X_i = \alpha_1 + \alpha_2 t + \pi X_{t-1} + \sum_{j=1}^{k} X_j \Delta X_{t-j} + u_t \qquad (0.1)$$

Where X_i is the series under examination, at time t, and u_t is the error term. The ADF test results at level are illustrated in the Appendix G - Table 1. The results of the unit root test show that all series are non-stationary at level, all are stationary at the first or second difference.

Forecasting model

We use ARIMA model to forecast the growth of the capital stock and labour force till 2030. ARIMA models for different series are summarized in Appendix G – Table G.1 and Table G.2.

Table 0.1: Selected ARIMA model for capital stock and labour force

	Capital stock	**Labour force**
TPP country	**ARIMA model**	**ARIMA model**
Australia	ARIMA (3,1,3)	ARIMA (2,1,0)
Brunei Darussalam	ARIMA (2,1,3)	ARIMA (0,1,1)
Canada	ARIMA (2,1,0)	ARIMA (0,1,1)
Chile	ARIMA (1,1,1)	ARIMA (3,1,4)
Japan	ARIMA (0,1,3)	ARIMA (1,1,0)
Malaysia	ARIMA (0,1,0)	ARIMA (0,1,0)
Mexico	ARIMA (1,1,2)	ARIMA (1,1,0)
New Zealand	ARIMA (2,1,3)	ARIMA (1,1,0)
Peru	ARIMA (4,1,1)	ARIMA (0,1,0)
Singapore	ARIMA (1,1,4)	ARIMA (1,1,0)
Vietnam	ARIMA (0,1,0)	ARIMA (1,1,0)
United States	ARIMA (2,1,0)	ARIMA (0,1,1)
RoW	ARIMA (1,1,0)	ARIMA (0,1,1)

Table 0.2: ADF tests for series under examination at level, 1st difference, and 2nd difference

	Capital stock			Labour force		
Country/region	**Level (p-value)**	**1st difference (p-value)**	**2nd difference (p-value)**	**Level (p-value)**	**1st difference (p-value)**	**2nd difference (p-value)**
Australia	0.395294 (0.9985)	-4.4886 (0.0049)	-4.265832 (0.0089)	-0.585819 (0.9747)	-4.566046 (0.0037)	-5.793042 (0.0001)
Brunei Darussalam	0.924978 (0.9998)	-3.465060 (0.0562)	-7.637742 (0.0000)	-0.732033 (0.9620)	-5.796329 (0.0002)	-4.714150 (0.0039)
Canada	-0.835121 (0.9541)	-2.918 (0.1672)	-5.829 (0.0001)	-2.460758 (0.3450)	-4.284142 (0.0078)	-5.065275 (0.0010)
Chile	1.518550 (1.0000)	-2.753 (0.2215)	-8.046403 (0.0000)	-1.193833 (0.8995)	-5.740287 (0.0001)	-5.627875 (0.0002)
Japan	-2.611 (0.2777)	-3.9500 (0.0186)	-4.2978 (0.0080)	-1.396355 (0.8480)	-3.570045 (0.0445)	-7.688264 (0.0000)
Malaysia	1.760856 (1.0000)	-1.587531 (0.7815)	-6.276932 (0.0000)	-09.414024 0.9840)	-6.666758 (0.0000)	-6.723826 (0.0000)
Mexico	1.3825 (1.0000)	0.2865 (0.9979)	-11.04375 (0.0000)	-2.748984 (0.2235)	-9.778972 (0.0000)	-5.193536 (0.0008)
New Zealand	0.8620 (0.9997)	-4.570764 (0.0037)	-6.593380 (0.0000)	-0.913948 (0.9450)	-3.895016 (0.0208)	-8.696150 (0.0000)
Peru	2.0972 (1.0000)	-4.026 (0.0156)	-4.837285 (0.0020)	-1.883744 (0.6460)	-7.022923 (0.0000)	-6.442305 (0.0000)
Singapore	1.3118 (0.9999)	-2.711 (0.2372)	-6.710795 (0.0000)	0.041413 (0.9956)	-5.289043 (0.0005)	-10.43904 (0.0000)
Vietnam	0.4868 (0.9989)	-2.202723 (0.4761)	-6.558410 (0.0000)	-3.003546 (0.1431)	-5.024813 (0.0010)	-5.283966 (0.0006)
United States	-1.304288 (0.8732)	-4.462545 (0.0049)	-4.771509 (0.0023)	-2.264451 (0.4435)	-4.165389 (0.0111)	-5.009982 (0.0012)
RoW	1.248501 (0.9999)	-2.930 (0.1634)	-6.249203 (0.0000)	-2.202566 (0.4764)	-5.658300 (0.0002)	-5.677432 (0.0002)

Note. ADF test output.

[This page intentionally left blank]