Exporting and Productivity: Panel Data Analysis of Manitoba and Saskatchewan's Traded Industries.

A Research Project Submitted to the College of Graduate Studies in Partial Fulfillment of the Requirements for the degree of Master of Arts in the Department of Economics University of Saskatchewan, Saskatoon, Saskatchewan, Canada

By

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April 2021

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ABSTRACT

Empirical evidence from exploring the relationship between exports activities and productivity growth has been mixed. In this study, I used panel data based on 27 traded industries from Saskatchewan and Manitoba to re-examine the relationship by employing the error-correction mechanism (ECM) models. Before the ECM can be used for analysis, unit root properties and cointegration relationships are investigated. Using the data for the period of 2002 to 2019, it is found that exports positively impacts productivity and productivity also positively impacts exports for both provinces. A further look into results of the ECM suggests that there is bi-directional causality between exports and productivity lending evidence to the validity of the presence of both the export-led growth hypothesis and the growth-driven export hypothesis in both provinces.

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ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to the Department of Economics, University of Saskatchewan for their enormous support and funding to help me undertake this postgraduate degree in Economics.

Also, a special thanks to my supervisor Prof. Joel Bruneau for his guidance, support and helpful comments.

I am equally grateful to, Prof. Maxym Chaban for his efforts in offering me with the needed corrections and suggestions.

Finally, my gratitude goes to Prof. Nazmi Sari for motiving us during these unprecedented times by creating a platform for I and my colleagues to meet regularly on Fridays during the 2020 Fall term to discuss the progress of our research work.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag Model
CIPS	Cross-sectional Im, Pesaran, and Shin
CSD	Cross-Section Dependence
DF	Dickey-Fuller
DFS	Dornbusch-Fischer-Samuelson
ECM	Error-Correction Mechanism
EXPO	Exposure
FE	Fixed Effect
GDP	Gross Domestic Product
GDPCAD	GDP of Canada
IPS	Im, Pesaran, and Shin
LM	Langrage Multiplier
LP	Labour Productivity
MG	Mean-Group
NAICS	North America Industry Classification System
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Sqaures
PMG	Pooled Mean-Group
SMAR	Subset Model Autoregression
SMEs	Small and Medium-Sized Enterprises
STEP	Saskatchewan Trade and Export Partnership
TFP	Total Factor Productivity
UNIDO	United Nations Industrial Development Organization
VAR	Vector Autoregressive Model
X	Export

CHAPTER ONE

INTRODUCTION

1.1 Background

The relationship between export activities and industry productivity is a much-debated topic. However, economic theory links international trade and productivity in the sense that, participating in international trade increases productivity and vice versa. Over the years, hypotheses have been formulated to explain this relationship between exports and productivity. These formulations mainly focus on whether export causes productivity growth or productivity growth rather causes export expansion. The core hypotheses formulated for this phenomenon are the Export-Led Growth Hypothesis and the Growth-Driven Export Hypothesis (Kunst and Martin, 1989; Henriques and Sadorsky, 1996).

The Export-led-growth hypothesis suggests that export growth causes positive productivity growth through various externalities. In contrast, the growth-driven export hypothesis promulgates that productivity growth induces trade flows.

Under the comparative cost theory, an agent will have a comparative advantage over other agents in producing a particular good if they can produce that good at a lower relative opportunity cost. In this framework, an agent whose workers are more efficient at producing a product will export that product. Developed by David Ricardo in 1817, the classical theory of comparative advantage implies an export-led growth hypothesis. Building on the comparative advantage framework, the Dornbusch-Fischer-Samuelson (DFS) model and the new trade theories initially associated with Paul Krugman all support the export-led growth hypothesis (Deme, 2002).

In contrast, more recent research has emerged investigating why exporting and productivity might be linked at the firm level and ultimately at the industry level. This recent research (a prominent example being Melitz's 2003 model) provides a theoretical framework suggesting that as more firms opened up to export trade, other firms within the industry would also rationalize themselves and therefore, result in productivity gains at the level of the industry. Implying that resources are reallocated from the less efficient firms to the more efficient firms so that exporting results in aggregate productivity gains at the industry level.

The introduction of the role of firm heterogeneity in international trade has unleashed literature (Porter, 1985; Porter 1991; Porter 1991; Porter and Claas van der Linde, 1995; and Porter and Claas van der Linde, 1995) that analyses the role of environmental regulations, green investments, innovation and labor market implications of trade liberalization in the context of heterogeneous firms. One such literature is the "porter hypothesis" that introduces a new perspective on the relationship between environmental regulation and the degree to which a country can produce goods and services to meet the test of international markets under free and fair market conditions.

Hence in theory, the presence of a link between exports and productivity seems to be obvious. However, there are differences in findings where conclusions have ranged from only export causing productivity and vice versa to both export and productivity causing the other one. These studies such as Kunst and Martin (1989), Yamada (1998), Nurhani (2011), Nesset (2004) and Dhiman and Sharma (2019) use time series aggregate data or such as Wagner (2007), Imbruno (2009), Lu & Tao (2020), and Brakman et al (2020) use firm level disaggregate data but rarely uses panel data. This has necessitated for this project to be aimed at re-examining and exploring the linkage between export and productivity using crucially a panel dataset of traded industries in Saskatchewan and Manitoba to contribute further knowledge into the field of this much-debated topic. The experience of Canada as a major exporting nation necessitates the need to exploit the channels through which productivity growth is related to export activities for Canada's provinces.

To explore the above objective, I will apply panel co-integration tests of Kao (1999) and Pedroni (1999) to examine the long-run relationships among the variables that I will be working with and test their causal links in an Error Correction Mechanism (ECM).

The project will employ the techniques developed by Engle-Granger in specifying the models of the ECM. The results of these models will be used in testing the Granger Causality for exports and productivity by testing the appropriate coefficients in the models. But before specifying the models, the stationary properties of the variables included in the model needs to be tested. This will be done with the techniques developed by Pesaran (2007) test for testing panel unit roots when there is cross – section dependence. The results will be analyzed in full to suit the research objectives.

1.2 Statement of the Problem

International trade is an important part of the economic activities of Saskatchewan and Manitoba. This, therefore, provides a unique opportunity to study the relationship between the export activities of these two provinces.

Manitoba, set right in the middle of the southern part of Canada, is often referred to as the keystone province (The Canadian encyclopedia). Manitoba's economy has a deep and long association with trade. For virtually 200 years, Winnipeg and the Hudson's Bay Company were the centres of the fur trade for all of North America as well as the foremost distribution centres for many other products and services (Documents on the city of Winnipeg 1873-1913). Manitoba's location in the middle south of Canada has always made it ideal as a centres for international trade. The development of CentrePort Canada, an inland port destined to be Canada's centre for global trade is, in many ways, a reaffirmation of the importance of Manitoba as a key player in international trade (Canada's Centre for Global Trade). Manitoba's economy is highly diversified and, although a notable number of large businesses are major players in the international marketplace, the bulk of the businesses in Manitoba are SMEs. There is a lack of data on the international trade activity of Manitoba SMEs, but national data indicates that there is considerable potential for growth. Manitoba exports billions in value of products such as oilseeds, seeds, energy products, machinery, motor vehicle parts, meat and nickel etc (Manitoba Bureau of Statistics). Imports include machinery, motor vehicle parts, steel, articles of iron, electrical products, energy-related products, misc, chemical products, plastics etc (Manitoba Bureau of Statistics).

Saskatchewan is a prairie and boreal province in western Canada. It is the only province without natural borders (The Canadian encyclopedia). Saskatchewan is a trading province. The current state of trade has largely been influenced by recent major global transitions, including price fluctuations experienced by major commodities and the rise of emerging and transition economies as major players in the world economy. Although Saskatchewan exports only account for 6% of Canada's total, the province is only home to 3% of the population (Saskatchewan State of trade report). Saskatchewan merchandise exports totalled nearly $30 billion in 2019. Saskatchewan's geographical endowments have enabled the province to build an impressive export economy focused on commodities, primarily centered on the three Fs: food, fuel and fertilizer. The recent volatility in commodity prices created a scenario that saw Saskatchewan commodity exports vary wildly. Beyond the three Fs, Saskatchewan has been able to build a trade economy that has taken those commodities and built value-added industries around them, which have spurred investment in the province. Saskatchewan Trade and Export Partnership (STEP) is the agency that works to increase the exports of Saskatchewan to established markets while tapping into new markets. Tapping markets is done through the initiation of sales, contracts and projects for Saskatchewan exporters. Saskatchewan imports, unlike exports, are not as correlated to price fluctuations among major commodities. Saskatchewan imports are significantly less than its exports, internationally. Saskatchewan's major imports is oil, which the province is also a major exporter of (Saskatchewan State of trade report). Followed by imports of combine harvesters for farming activities (Saskatchewan State of trade report). In addition to commodity products, Saskatchewan also imports a significant amount of manufactured equipment (Saskatchewan State of trade report).

Exports have contributed tremendously to the development of the economy of provinces across Canada by providing revenue to finance government and economic activities. It has also helped in the opening up of the Canadian economy to foreign markets through trade. But, there is a great deal of variation in the trading activities of provinces across Canada. Different provinces engage in the trade of different commodities. This provides a compelling reason to study the relationship between exports and other macro-economic variables for these provinces.

1.3 Objectives of the Study

The study I will carry out will focus on exploring the relationship between the volume of export and labor productivity growth using panel data of industries in Saskatchewan and Manitoba. This is because the trading activities of Saskatchewan and Manitoba are very similar in the sense that both export more to the US, followed by China and Japan. This provides a solid basis for studying the relationship between exports and productivity in these two provinces side by side. Further, the economies of Saskatchewan and Manitoba grew at a similar pace in the past few years. Saskatchewan had a GDP growth of 2.7 percent in 2017 about 1.2 percent in 2018, then accelerated to about 2.3 percent in 2019. Manitoba had a GDP of 2.6 percent in 2017, about 1.6 percent in

2018 and 1.2 percent in 2019. The relevance of these growth figures in this research is to justify why Saskatchewan and Manitoba are studied side by side. Saskatchewan emerged from years of recession brought about by low oil prices, but its slowdown was not as severe as in its neighboring province. Manitoba's economy is the most diverse in Western Canada, with strong construction and manufacturing sectors (Western Economic Diversification Canada).

Productivity is a key determinant of standard of living over the long term for these two provinces. It is essential to the competitiveness of firms and the economic and social well-being of its people. Productivity also offers an indirect indicator of innovation performance. Furthermore, Saskatchewan and Manitoba have similar productivity growth. For example, Manitoba productivity was up 1.1% in 2018, the third consecutive year of growth which was the same as the productivity growth (1.1%) in Saskatchewan in 2018 (Statistics Canada). It is against these similarities of the province that the objectives of this research work are formulated.

The major objective of this study is to explore the link between exports and productivity using panel data of 27 traded industries (N=27) in Saskatchewan and Manitoba for the period 2002 to 2019 (T=18). I will explore the relationship by testing the hypotheses of export-led and growth-driven using panel data made up of industries that export.

To this end, the specific objectives of this research work include

1. To examine the long-run and short-run relationships between export activities and productivity growth.
2. To examine the impact of other key macroeconomic variables (Exposure and GDP of Canada in this case) on export activities and productivity growth.
3. To suggest appropriate policy measures arising from the empirical findings.

1.4 Study Hypothesis

Ho: There is no link between exports and productivity at the industry level.

vs

Ha: There is a link between exports and productivity at the industry level.

If a link is found, that is if Ho is rejected and causality is found, what is the direction of causality? Does export cause productivity growth (export-led growth hypothesis) or does productivity growth cause export (growth-driven export hypothesis)? Or is there a bi-directional causality? The direction of the relationship between exports and productivity has very crucial insinuations for the way policy can be conducted to stimulate productivity growth and export activities.

1.5 Justification for the Study

Many of the previous work exploring the relationship between export activities and productivity growth has mostly used aggregate time-series data or disaggregate firm-level data. This project tries to use panel data to examine the same relationship by employing panel data analysis. Although not new, panel data analysis has not extensively been applied to this problem. I found just one paper (Nurhani, 2011) that used such techniques to study this same problem. Further, owing to the relatively short time span (T = 18) of my dataset, a panel data environment would be the most suitable to provide robust inference as long as the size of the panel is sufficiently large (Nurhani 2011).

Besides this, no previous studies of this nature have been done for the provinces of Saskatchewan and Manitoba. It is indisputable that the target of every economy is to attain the highest possible sustainable level of growth. For this reason, governments over the years have been pursuing policies that promote free international movement of goods and services as well as factors to achieve growth. Both Saskatchewan and Manitoba engage in international trade in order to bring about sustainable economic development. The experience of Canada as a major exporting nation necessitates the need to exploit the channels through which productivity growth is related to export activities for Canada's provinces.

This research, therefore, is anticipated to help researchers in the future to explore the relationship between exports and productivity using panel data. The research is also expected to help policymakers in the review and making of new policies that aim to either boost productivity or promote exports.

1.6 Scope of the Study

This study investigates the relationship between export activities and productivity growth in Saskatchewan and Manitoba using panel data set for the period 2002 to 2019. The choice of the period is as a result of data availability. Also, because panel data analysis was carried out, the research concentrates mainly on those traded industries (27) listed under the North America Industry Classification System (NAICS). These industries have available data for analysis. More is said about the data in chapter 3. The study employs four variables: Exports, Labour Productivity, Exposure and GDP of Canada.

Exposure is added to the study as a control variable to account for the productivity growth that didn't occur as a result of export growth and vice versa. According to IGI Global, exposure is defined as the orientation of a country's economy in the context of international trade. The degree of exposure is measured by the size of imports and exports of an economy. For the nature of the data used, sectorial exposure is used. Imports are used together with exports and outputs to calculate the variable, Exposure. Degree of exposure of an industry may also influence the nature of export-productivity causality. This is to assume that exposure can provide evidence of cross-sectional dependence (Dinda & Coondoo, 2006). More is said on this variable in chapter 3. In order to control for export growth which results neither from exports, productivity nor from openness but growth in the Canadian economy, the GDP of Canada is included in the panel series analysis.

Data for this research was obtained from Statistics Canada and information obtained from journals, seminar papers, articles and other unpublished materials.

1.7 Organization of the Study

The study was organized into five main chapters with each chapter further divided into sections and sub-sections. The first chapter deals with the general introduction to the study. Chapter two reviews both the theoretical and empirical literature on the relationship between export activities and productivity growth. Chapter three focuses on the specification of the empirical model used for the study. The results of the data collected for the study were analyzed and discussed in the fourth chapter. The fifth chapter presents the summary of findings, policy implications, recommendations and conclusion of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In this research, I explore the link between export activity and industry productivity. While the role of trade in promoting economic well-being has a long tradition in trade literature, discussions of the role of exports in stimulating growth in general, and productivity in particular, has been a much-debated topic and an ongoing one for many years. However, economic theory links international trade and export in the sense that, participating in international trade increases productivity. It is believed that there is a direct link between export and productivity even though empirical evidence has been mixed and inconclusive. In studying the relationship between export and productivity, a few issues arise: Is there causality between trade and productivity and, if causality exists, what is the direction of causality? Does productivity cause export growth or does export cause productivity growth?

Nowadays, the relationship between exports and productivity is being agreed on by most economists in three directions: The first states that the expansion of exports increases productivity by enabling a small open economy to exploit economies of scale (Kunst and Martin, 1989; Henriques and Sadorsky, 1996). The second direction states that there is a possibility that productivity leads to export expansion because productivity growth induces trade flows (Kunst and Martin, 1989; Henriques and Sadorsky, 1996) and comparative advantage. The final direction states that there can be a mutual feedback effect between trade and productivity (Konya, 2004; Kunst and Martin, 1989).

Although a couple of models have been constructed to explain the relationship between export and productivity, we cannot simply say that export and productivity are causally related. Different unanticipated and unaccounted factors could be driving the relationship between export and productivity. Hence this review aims to summarize relevant papers on the relationship between export and productivity.

This literature review is organized broadly into two as follows: theoretical literature and empirical literature. In the theoretical literature, we introduce the export-led productivity and the growth-driven export hypotheses. Also, classical and new trade models will be introduced and how these models explain the hypotheses will be explored. The empirical literature is aimed at review papers that have tried to examine the relationship between export and productivity.

2.1 Theoretical Literature

The theoretical literature discusses theoretical aspects and concepts that shape the discussions on the relationship between export and productivity.

2.1.1 Export-Led Growth Hypothesis vs Growth-Driven Export Hypothesis

Over the years, several hypotheses have been formulated to explain the relationship between exports and productivity. These formulations mainly focus on whether export causes productivity growth or productivity growth rather causes export expansion. The core hypotheses formulated for this phenomenon are the Export-Led Growth Hypothesis and the Growth-Driven Export Hypothesis. (Kunst and Martin, 1989; Henriques and Sadorsky, 1996).

The literature on international trade, which suggests that export growth causes positive productivity growth through various externalities is known as the export-led-growth hypothesis. This hypothesis postulates that export expansion or growth leads to productivity growth in the sense that an external demand enables a small open economy to exploit economies of scale which will make domestic firms competitive internationally and boost productivity growth. The proponents of this hypothesis argue that export promotion through policies such as exchange rate depreciation or export subsidies will have a significate effect on productivity. Proponents use several arguments to prove their points. However, the heart of the arguments underlying the export-led growth hypothesis is that competition in international markets boosts productivity and increases efficiency by concentrating resources in sectors in which the country has a comparative advantage in. (Kunst and Martin, 1989; Henriques and Sadorsky, 1996).

The second hypothesis, the productivity growth-driven export hypothesis, proposes a contrasting relationship between exports and productivity. It is based on the idea that productivity growth induces trade flows. It can also create comparative advantages in certain capacities leading to specialization and facilitation of exports (Konya, 2004). That is, when a country achieves high and sustained growth in productivity, it will lead to an expansion of that country's exports. Hence this hypothesis typically stresses the causality that runs from home-factor endowments and productivity to the supply of export.

However, these two hypotheses to explain the relationship can co-exist as far as the relationship between export and productivity growth is concerned. There exist a notion of a feedback relationship between exports and economic growth called the bi-directional causality which has gained much attention in empirical research these days (Konya, 2004; Kunst and Martin, 1989).

The direction of causation is therefore important to know because discovering the direction of causation has important policy implications for development strategies. It is worthy of note that if a definite unidirectional causality running from productivity to exports is found, then it would imply that a higher level of productivity is needed for export expansion. If the direction of causation is running from export expansion to productivity, then it would lead credence to the export-led growth strategy. If the causation is bi-directional, then exports and productivity have a reciprocal relationship. If there is no causality between exports and productivity, then it implies alternative strategies rather than export promotion may be needed to structurally transform an economy.

2.1.2 Classical Trade Theories and New Trade Theories

The starting point of the discussion comes from a basic question: whether countries engaging freely in international trade benefit from improved growth in general, and improved productivity in particular.

However, because different countries are associated with different kinds of specializations, they must engage in international trade. The theory of absolute advantage provided by Adam Smith in 1776 supports this claim and states that countries should only produce goods which it can produce at a lower cost than another country (implying that the country has an absolute advantage in that good). Furthermore, when a country has an absolute advantage in the production of a good, it also means that fewer inputs and less time are needed to provide the same amount of goods as compared to producing it in another country. Greater overall efficiency and particularly higher productivity in production create an absolute advantage, which allows for beneficial trade for all countries whereby countries can specialize and then, through trade, benefit from other countries' specialization. Hence, a country can improve its wealth if it is specialized in producing goods and services that it has an absolute advantage in, as compared to the other nations and should import those goods and services that it carries absolute disadvantage in. The theory of absolute advantage, however, had a certain limitation because it inherently suggested that a country will not import any good or service in case it had an absolute advantage in all goods and services it produces. (Dunn and Mutti, 2004).

The limitation in the theory of absolute advantage was overcome by the theory of comparative advantage advocated by Ricardo. The comparative advantage developed by David Ricardo in 1817 stated that a country under free trade will have a comparative advantage over other countries in producing a particular good or service if it can produce that good at a lower relative opportunity cost or higher relative productivity. Hence a country should specialize in the production of goods and services, which can be produced more economically as compared to other countries. This implies that absolute advantage arises when a country has a good with lower unit labour requirement and a higher labour productivity than another country. Even if one country is more efficient in the production of all goods (absolute advantage) than the other countries, all countries will still gain by trading with each other, as long as they have different relative efficiencies and productivity. This implies that, despite a country having absolute disadvantages in producing a good and service, the country can still export the goods and services that it carries the smallest absolute disadvantage in and import the goods and services it has the largest absolute disadvantage in. (Dunn and Mutti, 2004).

Likewise in the framework of comparative advantage, as it was in the theory of absolute advantage, a country whose labor was more efficient and productive at producing a good will produce and export that good.

These classical theories also suggest that productivity causes export growth. Absolute advantage indicates that a country will specialize in a good with a lower unit labor requirement and higher labor productivity than another country. Also, comparative advantage indicates that a country will specialize in a good in which the country has a relative productivity advantage (disadvantage) is the greatest (smallest). Furthermore, the Dornbusch-Fischer-Samuelson (DFS) model which extends the widely accepted theory of comparative advantage posits that growth in productivity causes more trade: intra-marginal trade rises (we export more of the same products) and marginal trade (we start to export in new product categories). These theories taken together suggest that countries will engage in exporting goods of an industry if that industry is productive as compared to industries of the same nature in other countries.

Notwithstanding the assumptions about labor made in classical trade theories, these classical trade theories also assumed the homogeneity of goods. However, in the 1980s, the so-called new trade theories assumed the heterogeneity of goods. The new trade theories initially associated with Paul Krugman suggested that an important factor in determining patterns of trade are the very significant economies of scale and network effects that can occur in key industries of different countries (Krugman 1987). These network effects and economies of scale can be so substantial that they outweigh the more classical trade theory of comparative advantage. In some industries, different countries may have no discernible differences in opportunity costs at a particular point in time. But, if a country specializes in a particular industry then it may gain economies of scale and other network benefits from its specialization. Economies of scale in this sense occurs when increasing production leads to lower long-run average costs. This means that as firms become big, they become more efficient. Also, the new trade theories suggest that opening to trade allows countries to take advantage of increasing returns to scale at either the firm or the industry level. Hence, trade promotes productivity (Neary, 2009). However, it should be noted that trade can lower productivity as sectors contract. Each of the above theories (absolute advantage, comparative advantage and new trade theories) basically supports the export-led growth hypothesis (Deme, 2002).

More recently, numerous research has emerged investigating why exporting and productivity might be linked at the firm level and ultimately at the industry level. These recent researches collectively referred to as the "new" new trade theories proceeded from firm heterogeneity in explaining the benefits of global production networks. These theories (prominent example being Melitz's 2003 model) provide a theoretical framework suggesting that as more firms opened up to export trade, other firms within the industry would either rationalize or exit from the export market. Implying that resources are reallocated from the less efficient firms to the more efficient firms. In this way, more productive firms will tend to enter export markets, forcing less productive firms to focus on the domestic markets and unproductive firms to exit the market. Therefore, this results in productivity gains at the level of the industry. Furthermore, the productivity of individual firms might stay unchanged, however, a country can still raise the level of productivity in an industry and even across all sectors through engaging in trade with other countries. However, these firms can increase their productivity as a consequence of exporting too. Hence, these "new" new trade theories eventually arrive at the conclusion that the trade induced reallocations towards more efficient firms explain why engaging in trade may generate aggregate industry productivity without necessarily improving the productive efficiency of individual firms.

The introduction of the role of firm heterogeneity in international trade has unleashed literature that analyses the role of investment, innovation and labor market implications of trade liberalization in the context of heterogeneous firms. One such literature is the "porter hypothesis" introduced in 1991 by Michael Porter. This hypothesis introduces a new perspective on the relationship between environmental regulation and the degree to which a country can produce goods and services to meet the test of international markets under free and fair market conditions. The porter hypothesis postulates that stringent environmental regulation, can induce efficiency and encourage innovations in firms that will not inevitably hinder competitive advantage. These strict environmental regulations cause the unearthing and introduction of environmental improvements and cleaner technologies (the innovation effect), making products and the production processes more efficient. In short, strict environmental regulation increases productivity and this exerts an influence on exporting (trading) activities of firms. In a similar vein, competition from world markets induces innovation and raises productivity of firms. (Wagner, 2004).

Hence all these theories, both the classical, the new trade theories and dynamic trade theories taken together provide a concrete foundation to believe that there is a link between exports and productivity and provides us with more theoretical grounds to investigate this relation at the industry level.

2.1.3 Imports and Productivity

While this research focuses on the relationship between export activity and industry productivity, it should be stated that import (access to import market) activities have a relationship with productivity as well. Productivity is affected by imports through expanding input variety as well as improved input quality. Halpern, Koren and Szeidl (2005) explored this relationship using product-level import data for a panel of Hungarian manufacturing firms from 1992 to 2001. To do this, a model of importers that captures the fixed cost of importing a given product variety is built. This leads to a production function where productivity depends on the import share of inputs. The production function is estimated by using entry into import markets to back out productivity. The conclusion from the analysis indicated that greater imports have a large and significant effect on the productivity of firms. Irrespective of the importance of the relationship between imports and exports, it doesn't matter for some sectors. Imports matter for some industries, export for others. This research will very much focus on the industries and sectors where export matters. That been said, it doesn’t mean this research ignores imports entirely. Imports are used together with exports and outputs to calculate the variable, Exposure. Exposure is added to our model to account for the productivity growth that didn’t occur as a result of export growth and vice versa.

2.2 Empirical Literature

This section reviews the empirical studies relating to export activities and productivity growth. Given the importance of the subject and the wide divergence in theoretical positions, many empirical studies have been conducted to assess the relationship between export and productivity. It starts by discussing the relationship between imports and productivity. Productivity is then defined. Also, empirical studies using aggregate time series data are reviewed. Finally, empirical studies using firm-level data are reviewed.

2.2.1 Definition of Productivity

The first real issue that arises when carrying out an empirical investigation of the association between export and productivity is how productivity is going to be defined because the word has become synonymous with different purposes. The meaning of productivity has ranged from *efficiency to effectiveness*, to a measure of *rates of turnover*, to a measure of *customer satisfaction* (Oyeranti, 2000). But in general, productivity refers to output per unit of input. In many contexts, it may mean multifactor productivity, or partial productivity (e.g. labour productivity). It can also refer to total factor productivity (TFP), which adjusts labour productivity due to differences in capital and other inputs. Depending on the direction of the research or the availability of data, any of these definitions could be used.

Measuring productivity can be taken from the perspective of a single enterprise, industry or economy as a whole (Burinskiene 2012). Also, for any measure, there exist numerous approaches in estimating those measures. However, it is common to find studies of this nature such as Hwang and Wang (2004) and Naz, Ahmad and Naveed (2015) using TFP growth as a measure of productivity. This implies that capital, labour, and materials and their changes in value are aggregated and analyzed using the measure of total factor productivity index. However, a new issue arises which is that, in practice, both measurements of inputs and outputs involve aggregation problems. (Burinskiene 2012). For this research, labour productivity is used due to its data availability. Also, labour productivity and productivity is used interchangeably.

2.2.2 Aggregate Data Studies

To carry out empirical analysis, testing methodologies also varied. One approach examines causality using aggregate data. By examining causality between export and productivity using aggregate data, Kunst and Martin (1989), Yamada (1998), Nurhani (2011), Nesset (2004) and Dhiman and Sharma (2019) tested the export-led growth hypothesis. These literature used the volume of export of goods as the export variable in their study. Hence, in this case, the volume of trade mattered.

Measuring productivity as output per employee in the manufacturing sector, Kunst and Martin (1989) used Austrian time series data to test the export-led growth hypothesis. The granger causality method was applied using a four-variable vector autoregressive (VAR) model to assess the causality and the results from the analysis implied that export did not cause productivity growth, but productivity growth may Granger-cause export. Furthermore, the GDP of the OECD countries was included in the analysis to control for export growth which didn't result from productivity but growth in the world economy. A Subset Model Autoregression (SMAR) was implemented by restricting statistically insignificant lags to zero to account for medium-term influences. The export-led growth hypothesis was rejected after analysis.

Even though Kunst and Marin (1989) studied the direction of causality between exports and productivity using a four-variable vector VAR model (comprised of export, labor productivity, terms of trade, and GDP), their study suffered from a major weakness and their empirical results must be considered with an appropriate degree of caution. The weakness exhibited by their study is that they failed to consider the cointegration properties of the variables. To deal with this weakness, Yamada (1998) set up a four-variable VAR model for the analysis with the consideration of the cointegrated properties of the variables. He applied a Lag augmented VAR model and used the Granger causality test with the maximum order of integration of each variable, which was at most two. He essentially arrived at the same conclusion as Kunst and Marin (1989) found which was that there was no causal link from export to productivity. However, the research by Yamada (1998) also suffered from a weakness which was that although his study took the possibility of cointegration relations of the variables into account, the specification of his econometric model could be feasibly inaccurate because it imposes the assumption that at most one cointegrating relationship exists among the variables.

Nurhani (2011) has examined the direction of the causality between exports and productivity growth for Malaysian industries by using causality tests within an error-correction framework. The error correction mechanism (ECM) was applied to model the dynamic movement of the variables in any period that was related to the previous period's gap from its long-run equilibrium. Applying the ECM, the Engle–Granger two-step procedure was used. The first step involved estimating the long-run models and the second step involved transforming variables to first difference and lagging the error terms by one period. After confirming the long run or cointegration relation, the results of the ECM are checked to see if they are robust to the Granger multivariate causality models. The measure of productivity used in this study was Labor productivity which was defined as the real gross output (in US$) divided by the number of employees. Further, using a panel of 63 manufacturing industries and a total of 1197 observations for the period of 1981 to 1999 obtained from the United Nations Industrial Development Organization (UNIDO) dataset, the findings lend support to both the export-led growth and the growth-driven export hypotheses. This implied that there was a bidirectional causality between exports and productivity, and according to the author, it added to the possibilities of the existence of indirect causalities between them through capital intensity and size.

Nesset (2004) studied the direct relationship between growth in export and growth in productivity (the export-led growth hypothesis) using aggregated Norwegian quarterly time series data from 1968 to 1992. Techniques of multivariate cointegration and statistical congruent VAR model were employed for the identification of causal links. Productivity was measured as the value-added labor productivity in manufacturing and construction. The results indicated that labor productivity can be regarded as "super exogenous" concerning the parameters in a simultaneous system of export price and export volume. This lent support to the growth-driven export hypothesis as foretold by the Ricardian model of international trade or some of the models within the "new" trade theory. According to the author, this implied that the export model under consideration for this study seemed to be autonomous concerning productivity initiatives or to put it another way, productivity structurally causes export volume and prices. This lead to the policy recommendation that we should not promote policies that are export-oriented e.g. subsidies but instead give more preference to policies that provided direct productivity stimulus e.g. R&D, infrastructure or general educational support.

2.2.3 Firm-level Data Studies

The second empirical approach uses firm-level data to test the exporting-productivity relationship. Much modern research and literature in this area of research do not put much emphasis on the causal relationship between export and productivity at the industry level due to problems associated with the use of aggregate data that might influence the results of the study. One of the main points of this researches is that it might be more proper to examine the association between international trade and productivity at the firm level rather than at the industry level. Aggregate data is too high for trying to use it to answer the question of whether participation in international trade influences trade because these data could be affected by a country's macroeconomic policies. This trend of research is amplified by the prominent Melitz's (2003) model.

Using firm-level data, Wagner (2007), Imbruno (2009), Lu & Tao (2020), and Brakman et al (2020) have investigated empirically the exporting-productivity linkage from the perspective of the Melitz (2003) model. These literature were more focused on exports as firms are exposed to international trade or export markets. Hence, in this case, just the exposure to trade was enough for analysis to be carried out.

Imbruno (2009) used a panel of Italian manufacturing firms for investigation and concludes that exporters were more productive than non-exporters and this productivity gap could be due to high-performance firms being able to serve foreign markets rather than post-entry effects. The econometric methodology to arrive at this conclusion was divided into two. First, the correlation between firm productivity and sector trade intensity was analyzed to stress the gap between exporters and non-exporters. OLS estimation for panel data (Fixed effect, Random effect and pooled models) was used at this point. Second, the direction of causality between firm performance and exporter status was examined to test whether firms became productive by exporting or only highly productive firms entered the export market. At this point, only a cross-section OLS estimation was used. The results from this analysis found that solely the high-productive firms enter export markets as emphasized by Meltiz (2003) model.

This recent literature proposed prominently by Melitz's (2003) and tested empirically by Wagner (2007), Imbruno (2009), Lu & Tao (2020), and Brakman et al (2020) also proposes that as more firms open up to export trade, other firms within the industry would also rationalize themselves and therefore this results in productivity gains at the industry level. Although the firm-level studies use highly disaggregated data and the industry-level studies use highly aggregated data, the conclusion remains that exports and productivity are linked at the firm level and ultimately at the industry level through different dynamics. Furthermore, although the industry-level studies are unable to capture the heterogeneity of firms in the industry, such a study is justified not just because of the same theoretical conclusions arrived at by the theories driving both industry-level and firm-level studies, but also because of the confidential nature and complex issues faced in obtaining firm-level data.

To find a middle ground between using highly disaggregated data and aggregated data, this research uses panel data. This data is used due to the difficulty of obtaining firm-level data and because it contains more information, more variability and more efficiency than pure time series data or cross-sectional data. Panel data can also minimize estimation biases that may arise from aggregating groups into a single time series.

2.3 Summary

In Summary, it is clear from the above literature review that the evidence regarding the relationship between exports and productivity is mixed. A number of studies support the export-led growth hypothesis while others do not. It could be also be argued that both hypotheses of export-led and productivity-driven growth could be present. These differences in results might be due to variable selections, methods, the different time periods, and frequencies, or to the nonstationarity and (co)integrated properties that are used to run the causality tests. This problem is more of a statistical problem than an economic one. Hence, a suitable degree of carefulness must be considered before these results are interpreted (Yamada, 1998). Furthermore, studies on this topic either frequently uses highly aggregated time series data or highly disaggregated firm-level data, some of which we have indicated above. Therefore, to find a balance between highly aggregated data or highly disaggregated data, this research intends to use panel data analysis to explain the relationship for exports and productivity for Saskatchewan and Manitoba from 2002 to 2019. This study will provide useful information helpful to policy decision making. It can also serve as a reference to subsequent research works on the topic that tries to use panel data since such studies are scanty.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter focuses on the conceptual background of the model that will be used for the study. It consists of four sections. Section one provides the type and sources of data used for the study. The second section focuses on the econometric methodology used for the study. Section three discusses how the variables used for the study were defined and measured as well as the expected impact of the determinants. Section five deals with how the data was analyzed with emphasis on panel data analysis.

3.1 Data Type and Sources

The study used panel data that covers 18 years (T=18), from 2002 to 2019, and 27 industries (N=27) based on the North American Industry Classification System (NAICS) obtained from Statistics Canada. These 27 industries are used because full data exist for them. Initially, data was collected for 28 traded industries, but one, NAICS 115 – Support activities for agriculture and forestry industry, was dropped from the data set because it contained missing values (3 years missing for the industry in each province in the same years). These missing values could have been replaced but that would contaminate the process for the variables are assumed to be unit root processes. All variables are transformed into natural log for analysis. These transformations were done so that coefficients can be understood as a percentage change. Also, all estimations, as well as the various econometric tests, were carried out using the Stata econometric software.

The 27 traded industries that data was collected on are as follows:

Table 3.1: Industries contained in the dataset

NAICS Code	Industry Name	Panel ID
NAICS 111	Crop production	1
NAICS 112	Animal production and aquaculture	2
NAICS 113	Forestry and logging	3
NAICS 114	Fishing, hunting and trapping	4
NAICS 211	Oil and gas extraction	5
NAICS 212	Mining and quarrying (except oil and gas)	6
NAICS 221	Utilities	7
NAICS 311	Food manufacturing	8
NAICS 312	Beverage and tobacco product manufacturing	9
NAICS 313&4	Textile and textile product mills	10
NAICS 315&6	Clothing and leather and allied product manufacturing	11
NAICS 321	Wood product manufacturing	12
NAICS 322	Paper manufacturing	13
NAICS 323	Printing and related support activities	14
NAICS 324	Petroleum and coal product manufacturing	15
NAICS 325	Chemical manufacturing	16
NAICS 3261	Plastic product manufacturing	17
NAICS 3262	Rubber product manufacturing	18
NAICS 327	Non-metallic mineral product manufacturing	19
NAICS 331	Primary metal manufacturing	20
NAICS 332	Fabricated metal product manufacturing	21
NAICS 333	Machinery manufacturing	22
NAICS 334	Computer and electronic product manufacturing	23
NAICS 335	Electrical equipment, appliance and component manufacturing	24
NAICS 336	Transportation equipment manufacturing	25
NAICS 337	Furniture and related product manufacturing	26
NAICS 339	Miscellaneous manufacturing	27

Source: Statistics Canada

3.2 Estimation Technique

The estimation technique was taken from Nurhani (2011), Canning and Pedroni (1999), Dinda and Coondoo (2006), Blackburne and Frank (2007), Granger (1969), Enders (1995), Glasure and Lee (1997) and Asafu-Adjaye (2000). The estimation technique applied uses the error correction mechanism (ECM) and causality. The error correction mechanism is a way to investigate the relationship among variables in which the movement of the variables in any period is related to the previous period's gap from their long-run equilibrium. After each variable is tested for unit roots and the cointegration relationships confirmed, the short run relationship is estimated by constructing the ECM.

To apply the ECM technique, assume an autoregressive distributive lag (ARDL) (p, $q_1,\ldots,q_k$) dynamic panel specification of the form taken from Blackburne and Frank (2007), pp 2:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij}\, y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij}\, X_{i,t-j} + \mu_i + \epsilon_{it} \tag{3.1}$$

where t = 1, 2,…, T is the number of periods; i = 1, 2,…, N is the number of groups; X_{it} is a k×1 vector of explanatory variables; δ_{it} are the k×1 coefficient vectors; λ_{ij} are scalars, and; μ_i is the group-specific effect. Other fixed regressors and time trends may be included.

If the variables in equation (3.1) have unit roots and are cointegrated, then the error term is a stationary process for all i. Cointegrated variables are responsive to any deviation from long-run equilibrium which implies an error correction model in which the short-run dynamics of the variables in the system are influenced by the deviation from equilibrium (Blackburne and Frank, 2007). Hence, ARDL (3.1) is commonly reparameterized into the error correction equation:

$$\Delta y_{it} = \emptyset_i\left(y_{i,t-1} - \theta'_i X_{it}\right) + \sum_{j=1}^{p-1} \lambda^*_{ij}\, \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \delta'^*_{ij}\, \Delta X_{i,t-j} + \mu_i + \epsilon_{it} \tag{3.2}$$

where $\emptyset_i = -\left(1 - \sum_{j=1}^{p} \lambda_{ij}\right)$, $\theta_i = \sum_{j=0}^{q} \delta_{ij}/(1 - \sum_k \lambda_{ik})$, $\lambda^*_{ij} = -\sum_{m=j+1}^{p} \lambda_{im}$ j = 1,2,….,p-1, and $\delta^*_{ij} = -\sum_{m=j+1}^{q} \delta_{im}$ j = 1,2,….,q-1.

The parameter $\emptyset_i$is the error-correcting speed of adjustment term. When $\emptyset_i$ = 0, it means y_{it}would not respond if there is disequilibrium, but it may be still cointegrated with other variables. This would be evidence of a long-run relationship only if other variables are exogenous. This error-correcting speed of adjustment term is expected to be consistently negative and significant (Nurhani, 2011).

For this research, the error-correcting speed of adjustment term also indicates that the short-term disequilibrium between export and productivity relationship tends to be corrected (Nurhani, 2011). Following the methodology employed in Nurhani (2011), in the ECM, the first step is to estimate the long run models in equations (3.3) and (3.4).

$$lnlp_{it} = \gamma_t + \eta_i + \alpha_1 lnx_{it} + \alpha_2 lnexpo_{it} + \alpha_3 lngdpcad_{it} + u_{1it} , \tag{3.3}$$

$$u_{1it} = lnlp_{it} - \gamma_t - \eta_i - \alpha_1 lnx_{it} - \alpha_2 lnexpo_{it} - \alpha_3 lngdpcad_{it} , \tag{3.3a}$$

and

$$lnx_{it} = \gamma_t + \eta_i + \alpha_4 lnlp_{it} + \alpha_5 lnexpo_{it} + \alpha_6 lngdpcad_{it} + u_{2it}, \tag{3.4}$$

$$u_{2it} = lnx_{it} - \gamma_t - \eta_i - \alpha_4 lnlp_{it} - \alpha_5 lnexpo_{it} - \alpha_6 lngdpcad_{it} , \tag{3.4a}$$

where $lnlp$ denotes the natural logarithm of labour productivity (LP), lnx is exports (X) in natural logarithm, $lnexpo$ is exporsure (EXPO) in natural, $lngdpcad$ is the natural log of GDP of Canada (GDPCAD), γ_t is the time-specific effect, η_i is the individual effect, u is the error term and α is the coefficient of the respective variables. Subscripts *i* and *t* represent the 28 individual industries and 18 years, from 2002 to 2019, respectively. It must be noted that, if there is one cointegrating vector, the model needs to be estimated once. That is only one of equation 3.3 or 3.4 needs to be estimated.

In the second step, the variables are transformed to first difference, and the error terms u_{1it} from equation (3.3a) and u_{2it} from equation (3.4a) are lagged one period. The models are specified as follows:

$$\Delta lnlp_{it} = \alpha_{1i} + \delta_{1t} + \beta_{11}\Delta lnx_{it} + \beta_{12}\Delta lnexpo_{it} + \beta_{13}\Delta lngdpcad_{it} + \lambda_1 u_{1it-1} + v_{1it} \tag{3.5}$$

$$\Delta lnx_{it} = \alpha_{2i} + \delta_{2t} + \beta_{21}\Delta lnlp_{it} + \beta_{22}\Delta lnexpo_{it} + \beta_{23}\Delta lngdpcad_{it} + \lambda_2 u_{2it-1} + v_{2it} \tag{3.6}$$

where v is the random disturbance. Either $\Delta lnlp_{it}$ or Δlnx_{it} (or both) must be caused by u_{it-1} (which is itself a function of $lnlp_{it-1}$ and lnx_{it-1} respectively) to establish causality. This causality indicates the long run and short-run forecastability of one variable given that other variable changes (Nurhani, 2011). How far the variables are from the equilibrium relationship is represented by u_{it-1} and how these short-run variables adjust toward equilibrium to keep the long-run relationship sustainable is estimated by λ (Canning and Pedroni, 1999).

Using the precise analogy of Dinda & Coondoo, 2006, in this set up the nature of Granger causality is determined as follows:

1) if β_{11}= 0 and λ_1= 0, *lnx* (exports) may be said not to Granger cause *lnlp* (labour productivity);
2) if β_{21}= 0 and λ_2= 0, *lnlp*(labour productivity) may be said not to Granger cause *lnx* (exports);
3) if (1) holds but (2) does not, Granger causality may be said to be unidirectional from *lnlp*(labour productivity) to *lnx* (exports);
4) Conversely, if (1) does not hold but (2) does, Granger causality may be said to be unidirectional from *lnx* (exports) to *lnlp*(labour productivity);
5) if both (1) and (2) do not hold, Granger causality between *lnx* (exports) and *lnlp*(labour productivity) may be said to be bi-directional; and finally
6) if both (1) and (2) hold, Granger causality between *lnx* (exports) and *lnlp*(labour productivity) may be said to be absent (details contained in Enders, 1995; Glasure and Lee, 1997; and Asafu-Adjaye, 2000)

That is equations (3.5) and (3.6) were estimated separately, using the panel data set for the 27 industries. Inference about the nature of Granger causality between *lnx* (exports) and *lnlp*(labour productivity) were then drawn by performing appropriate test of hypothesis for the relevant parameters of equations (3.5) and (3.6), as laid down above. For example, to test the null hypothesis that *lnx* (exports) does not Granger cause *lnlp* (labour productivity), one should perform an F-test for the null hypothesis H_0: β_{11}= 0, λ_1= 0 using equation 3.5. Similarly, to test the null hypothesis that *lnlp* (labour productivity) does not Granger cause that *lnx* (exports), an F-test for the null hypothesis H_0: if β_{21}= 0 and λ_2= 0 using equation 3.6 will be required. Given the results of these two basic F-tests, the remaining null hypotheses (3) - (6) laid down above can be tested.

3.3 Definition and Measurement of Variables in the Model

Labour Productivity (LP)

According to Statistics Canada, Labour productivity is defined as the ratio between real value added and hours worked. For this data, the labour productivity is real output per worker. Real value added for each industry and each aggregate is calculated from a Fisher chain index. Data on labour productivity for this study was obtained from Statistics Canada. (Statistics Canada, Table 36-10-0480-01).

Exports (X)

Exports comprise all goods leaving the country through customs for a foreign destination. In the case of Canada, it entails the sum of domestic exports and re-exports i.e Exports = Domestic Exports + Re-exports. Exports are valued in Canadian dollars. Data on exports were obtained from the Statistics Canada website. (Statistics Canada, Trade Data Online).

Imports (IN)

Total imports of the traded industries included in this study comprises of all goods which have entered Canada by crossing the borders, whether for instant domestic consumption or storage in customs bonded warehouses. For the case of Canada, goods re-entering Canada (re-imports) after having been exported abroad without having been materially altered or significantly improved in value while abroad are included. Imports are valued in Canadian dollars. Data on imports were obtained from the Statistics Canada website (Statistics Canada, Trade Data Online). Imports are used together with exports and GDP of the province to compute the variable, Exposure.

Exposure (EXPO)

For the nature of the data, sectorial exposure is used in this study. Degree of competitive forces within an industry can make firms to be exposed to trade even if one does not trade as you must compete with all firms in the market. Hence, even sectors that have little exposure to exports could be fully exposed to competition through imports. This suggest that exports are caused or that cause productivity. Hence, exposure is a control variable that accounts for competitive pressures that are not directly related to exports. Exposure (EXPO) is the sum of exports and imports of goods and services measured as a ratio to gross domestic product (Sjoholm, 1999). Thus, for an industry i in the dataset, exposure is calculated as imports + exports in industry i / output in that industry i.

GDP of Canada (GDPCAD)

GDP is the total value of goods and services produced within the borders of an economy or a country during a given period of time measured in market prices. Hence, the GDP of Canada by industry chained at 2012 dollars (meaning the aggregates of the sum are not equal to the sum of its components) is a measure of the economic production that takes place within the geographical borders of Canada. The cost associated with the depreciation of capital assets (buildings, machinery and equipment), is included in the computation of these estimates. GDP of Canada is reported in Canadian dollars and data on GDP of Canada was obtained from the Statistics Canada website (Statistics Canada, Table 36-10-0402-01). In order to control our model for export growth which results neither from productivity nor from openness but growth in the Canadian economy, the GDP of Canada is included in the panel series analysis.

GDP of Saskatchewan (GDPSK)

GDP of Saskatchewan by industry chained at 2012 dollars (meaning the aggregates of the sum are not equal to the sum of its components) is a measure of the economic production which takes place within the geographical borders of the province of Saskatchewan. GDP of Saskatchewan is reported in Canadian dollars and data on GDP of Saskatchewan was obtained from the Statistics Canada website (Statistics Canada, Table 36-10-0402-01). GDP of Saskatchewan was used in addition to exports and imports to compute the variable Exposure for industries in Saskatchewan.

GDP of Manitoba (GDPMB)

GDP of Manitoba by industry chained at 2012 dollars (meaning the aggregates of the sum are not equal to the sum of its components) is a measure of the economic production which takes place within the geographical borders of the province of Manitoba. GDP of Manitoba is reported in Canadian dollars and data on GDP of Manitoba was obtained from the Statistics Canada website (Statistics Canada, Table 36-10-0402-01). GDP of Manitoba was used in addition to exports and imports to compute the variable Exposure for industries in Manitoba.

3.4 Data Analysis

This part essentially reviews panel data analysis concerning unit root test and cointegration test. A unit root test would be conducted to ascertain the order of integration of the data used in the model to avoid the spurious regression problem. Cointegration test is used to establish the long run relationship.

3.4.1 Panel Unit Roots

The Unit root test will provide information about the stationary properties and the order of integration among the variables that are being studied. This is done to test if there is any problem with spurious correlation. A spurious correlation is said to occur when the errors of different periods are correlated due to the nonstationarity of the data. To avoid the problem of spurious correlation, it must be ensured that the data is stationary or trend-stationary. There exists various unit root test to detect this problem, however, the study uses the unit root test developed by Pesaran (2007). This test is used because it controls for the cross-sectional dependence (CSD) among variables whose presence is natural in the study of these types of data. To understand the test developed by Pesaran (2007), we must look at the Im et al. (2003) (IPS) unit root test which assumes cross-sectional independence.

To understand the IPS test, consider doing a unit root test for the regression:

$$\Delta y_{it} = \beta_i y_{it-1} + u_i \qquad i = 1, 2, 3,\ldots,N \qquad t = 1,2,3,\ldots,T \tag{3.7}$$

As opposed to testing H_o: $\beta_i = 0$ against the one sided alternative that H_a: $\beta_i < 0$ for i = 1 in time series data, the hypothesis we are interested in testing for panel data is

$$Ho: \beta_i = 0 \text{ against } Ha: \beta_i < 0 \text{ for } i = 1,2,3,\ldots,N.$$

This hypothesis is tested to deal with the non-stationary from the time series and the increased data and power from the cross-section. Panel unit root tests is based on the following univariate regression:

$$\Delta y_t = \beta_i y_{it-1} + z'_{it}\gamma + u_{it} \tag{3.8}$$

where i = 1,2,..., N is the individual (in this case, the industry), t = 1,2,...,T time series observations are available, z'_{it} is the deterministic component and u_{it} is a stationary process. z'_{it} could be zero, one, the fixed effects (μ_i), or fixed effect as well as a time trend (t).

The null hypothesis that is tested against an alternative is

$$\beta_i = 0 \text{ for all i.}$$

Im, Pesaran and Shin (2003) (IPS) uses the likelihood framework to propose a computationally simple unit root testing technique for panels (which is referred to as t-bar statistic), that allows for simultaneous stationary and non-stationary series (i.e. β_i can differ between individuals). Furthermore, the test allows for heterogeneity in the value of β_i under the alternative hypothesis. The alternative hypothesis allows for some (but not all) of the individual series to have unit roots (Hurlin and Mignon, 2007). Therefore, instead of pooling the data, IPS uses a separate unit root test for the N cross-section units. The mean of (augmented) Dickey-Fuller statistics is computed for each cross-section unit in the panel when the error term u_{it} of the model (3.8) is serially correlated. This is done possibly with different serial correlation patterns across cross-sectional units and T and N are sufficiently large. This gives us a u_{it} of

$$u_{it} = \sum_{j=1}^{\beta i} \Theta_{it} U_{it-j} + \varepsilon_{it}$$

Substituting this u_{it} in equation (3.8), and considering a linear trend for each of the N cross-section units, we get

$$\Delta y_t = \alpha_{0i} + \beta_i y_{it-1} + \sum_{j=1}^{\beta i} \Theta_{it} \Delta y_{it-j} + \varepsilon_{it} \quad \text{where i = 1,2,..., N, t = 1,2,...,T.}$$

The null hypothesis is :

$$H_0: \beta_i = 0 \text{ for all i}$$

against the alternative:

Ha: $\beta_i < 0$ for i = 1,..., N_1 and $\beta_i = 0$ for i = $N_1 + 1, \ldots, N$ with $0 < N_1 \leq N$ that allows for some (but not all) of individuals series to have unit roots.

The IPS statistics which computes separate unit root tests for the N cross-section units and define their t-bar statistic as a simple average of the individual Augmented Dickey-Fuller statistics is then defined as

$$\bar{t} = \frac{1}{N}\sum_{i=0}^{N} t_{iT}$$

where t_{iT} is assumed to be i.i.d and have finite mean and variance. Hence, by Lindeberg-Levy's central limit theorem, the standardized t-bar statistic congregates to standard normal as N approaches ∞ under the null hypothesis.

The values of the mean and the variance have been computed via Monte Carlo methods for different values of T and β_i's and tabulated by IPS (2003) to propose a standardization of the t-bar statistic. Further, it is important to note that only balanced panel data are considered in this procedure. More simulations must be carried out to get critical values when unbalanced data are used. (Barbieri, 2005).

The above illustrates the concept of the IPS unit root test. Due to the lack of independence among the panels assumed in the IPS unit test, the IPS test cannot be used. This is the reason why the test by Pesaran (2007) is employed.

Pesaran (2007) uses the idea of incorporating the averages to the regressions per panel to immunize the IPS unit-root test against the presence of unobservable factors. The relevant equation to evaluate the presence of a unit root is

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \delta_{0i}\overline{\Delta y}_t + \delta_{1i}\bar{y}_{t-1} + \epsilon_{it}, \quad i = 1,2,..., N,\ t = 1,2,...,T. \qquad (3.9)$$

that is, the standard equation augmented by the averages of the units of both the dependent variable, Δy_{it}, and the regressor y_{it}. The hypothesis would consist in evaluating $\beta i = 0$ using a panel test.

Like the IPS (2003), the proposal of Pesaran (2007) consists in averaging the ti statistics corresponding to βi of (3.9). Pesaran has shown that the effect of cross section dependence can be eliminated by using model 3.9 (Shariff and Hamzah, 2015). The new statistic, called the cross-sectional Im, Pesaran, and Shin (CIPS) by Pesaran, has a nonstandard distribution, even with a large N. The results obtained from this test statistics is diff erent from the result obtained by IPS (2003). Since IPS assumes the independence of panels, the IPS statistic is distributed according to a normal distribution for a large N. (Burdisso & Sangiácomo, 2016)

3.4.2. Panel Cointegration Test

Once the unit roots are confirmed, the next step is to examine whether there exists a long-run equilibrium relationship among the variables. This calls for cointegration analysis. To do this, Kao (1999) and Pedroni (1999) are used. These tests are residual-based tests developed to ward against the "spurious regression" problem that can arise when dealing with I(1) variables. The Kao (1999) method of testing for cointegration in panel data is applied here because it assumes the coefficients of the OLS bias-correction and dynamic OLS used to generate the residuals are common across all industries (Nurhani, 2011). Pedroni (1999) test is also used because it allows for heterogeneity for each industry (Nurhani, 2011). This combines to provide evidence from two groups of tests that considers different assumptions.

Kao (1999) Tests

Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) type tests for the null hypothesis of no cointegration in panel data are the cointegration test presented by Kao (1999). Suppose y_{it} and x_{it} are incorrectly estimated by least squares for all I using panel data, the spurious regression model is

$$y_{it} = x'_{it}\beta + z'_{it}\gamma + e_{it}, \tag{3.10}$$

From the estimated residuals in model (3.17), the DF type tests from Kao can be calculated as

$$\hat{e}_{it} = \rho\hat{e}_{it-1} + v_{it} \tag{3.11}$$

where

$$\hat{e}_{it} = \tilde{y}_{it} - \tilde{x}_{it}\hat{\beta},$$

$$\tilde{y}_{it} = x_{it} - \sum_{s=1}^{T} h(t,s)y_{is}$$

and

$$\tilde{x}_{it} = x_{it} - \sum_{s=1}^{T} h(t,s)x_{is}$$

The null can be written as $H_0 : \rho = 1$ to test the null hypothesis of no cointegration. The OLS estimate of ρ and the t-statistics are given as

$$\hat{\rho} = \frac{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{e}_{it}\hat{e}_{it-1}}{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{e}_{it}^{2}}$$

and

$$t_{\rho} = \frac{(\hat{\rho}-1)\sqrt{\sum_{t=1}^{N}\sum_{t=2}^{T}\hat{e}_{it-1}^{2}}}{s_e}$$

where $s_e^2 = \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=2}^{T}(\hat{e}_{it} - \hat{\rho}\hat{e}_{it-1})^2$

The following four DF type tests were proposed by Kao by assuming that $Z_{it} = \{\mu_i\}$:

$$DF_\rho = \frac{\sqrt{N}T(\hat{\rho}-1)+3\sqrt{N}}{\sqrt{10.2}}$$

$$DF_t = \sqrt{1.25t_\rho} + \sqrt{1.875N}$$

$$DF_\rho^* = \frac{\sqrt{N}T(\hat{\rho}-1)+\frac{3\sqrt{N}\hat{\sigma}_v^2}{\hat{\sigma}_{0v}^2}}{\sqrt{3+\frac{36\hat{\sigma}_v^4}{5\hat{\sigma}_{0v}^4}}}$$

and

$$DF_t^* = \frac{t_\rho+\frac{\sqrt{6N}\hat{\sigma}_v}{2\hat{\sigma}_{0v}}}{\sqrt{\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_v^2}+\frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}}$$

where

$$\hat{\sigma}_v^2 = \widehat{\textstyle\sum_u} - \widehat{\textstyle\sum_{u\varepsilon}}\ \widehat{\textstyle\sum_\varepsilon^{-1}} \quad \text{and} \quad \hat{\sigma}_{0v}^2 = \hat{\Omega}_u - \hat{\Omega}_{u\varepsilon}\hat{\Omega}_\varepsilon^{-1}$$

From the proposals of Kao (1999), DF_ρ and DF_t tests are based on the strong exogeneity of the regressors and errors. DF_ρ^* and DF_t^* tests are for the cointegration with endogenous relationship between regressors and errors (Baltagi and Kao, 2000)

The following regression for the ADF test is run:

$$\hat{e}_{it} = \rho\hat{e}_{it-1} + \sum_{j=1}^{p}\delta_j\Delta\hat{e}_{it-j} + v_{itp} \tag{3.12}$$

For the null hypothesis of no cointegration, the ADF test statistics can be constructed as

$$ADF = \frac{t_{ADF}+\frac{\sqrt{6N}\hat{\sigma}_v}{2\hat{\sigma}_{0v}}}{\sqrt{\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_v^2}+\frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}}$$

where t_{ADF} is the t-statistics of ρ in equation (3.12). Also, by the sequential limit theory, the asymptotic distribution of DF_ρ, DF_t, DF_ρ^*, DF_t^* and ADF will converge to standard normal distribution N(0,1) (Baltagi and Kao, 2000).

Pedroni (1999) Tests

Pedroni (1999), following the introduction of the residual-based panel cointegration tests in 1995, extended the panel cointegration testing procedure to allow for more than one independent variable in the regression equation. Pedroni (1999) recommended several tests for the null hypothesis of cointegration in a panel data model that allows for considerable heterogeneity (Baltagi and Kao, 2000). The first set of tests involved averaging test statistics for cointegration in the time series across cross-sections (panel-ρ and panel-*t*). The second set of tests group the statistics such that instead of averaging across statistics, the averaging is done in pieces so that the limiting distributions are based on limits of piecewise numerator and denominator terms (group-ρ and group-*t*). The panel-ρ statistic is an extension of the non-parametric Phillips-Perron ρ-statistic. The parametric panel-*t* statistic is an extension of the Augmented Dickey-Fuller (ADF) *t*-statistic. Pedroni (1999)'s residual-based panel cointegration test statistics is the computation of the residuals of the hypothesized cointegrating regression:

$$y_{i,t} = \alpha_i + \beta_{1i,t}x_{2i,t} + \cdots + \beta_{Mi}x_{Mi,t} + e_{i,t}, \qquad t = 1,\ldots\ldots,T; \quad i = 1,\ldots.,N \qquad (3.13)$$

where T is the number of observations over time, N denotes the number of individual members in the panel, and M is the number of independent variables. In this regression, it is assumed that the member-specific intercept α_i and the slope coefficients $\beta_{1i}, \ldots\ldots, \beta_{Mi}$ can vary across each cross-section (Örsal, 2007).

For each cross-section, the cointegration regression in (3.13) is estimated by OLS to compute the relevant panel cointergration test statistics. Additionally, the within-dimension based test statistics (panel-ρ and panel-t statistics) are computed by taking the first-difference of the original series and estimating the residuals of the following regression:

$$\Delta y_{i,t} = b_{1i,t}\Delta x_{1i,t} + b_{2i,t}\Delta x_{2i,t} + \cdots + b_{Mi}\Delta x_{Mi,t} + \pi_{i,t} \tag{3.14}$$

Using a Newey & West (1987) estimator with the residuals from the differenced regression (3.14), the long run variance of $\hat{\pi}_{i,t}$ is computed and represented as $\hat{L}^2_{11i}$. (Örsal, 2007)

To estimate the non-parametric statistics (panel-ρ and group-ρ), the regression $\hat{e}_{i,t} = \hat{\gamma}_i \hat{e}_{i.t-1} + \hat{u}_{i,t}$ is estimated using the residuals $\hat{e}_{i,t}$ from the cointegration regression (3.13). Then the contemporaneous variance ($\hat{s}_i^2$) and the long-run variance ($\hat{\sigma}_i^2$) of $\hat{u}_{i,t}$ are calculated. To estimate $\hat{\sigma}_i^2$, Pedroni (1995) used $4(\frac{T}{100})^{\frac{2}{9}}$ as the lag truncation function for the Newey-West kernel estimation as recommended in Newey & West (1994). The lag length for different T dimensions is given by the nearest integer (Örsal, 2007).

Now, with the help of the residuals $\hat{e}_{i,t}$ from cointegration regression (3.13), the parametric test statistics (panel-t and group-t) are estimated. $\hat{e}_{i,t} = \hat{\gamma}_i \hat{e}_{i.t-1} + \sum_{t=1}^{K_i} \hat{\gamma}_{i,k} \Delta \hat{e}_{i.t-k} + \hat{u}^*_{i,t}$ and the variance of $\hat{u}^*_{i,t}$ is calculated and denoted as $\hat{s}_i^{*2}$. For the ADF t-statistics, the step-down procedure and the Schwarz lag order selection criterion are used to determine the lag truncation order.

Using the following expressions in the two preceding paragraphs, the relevant test statistics can be constructed as

a. Panel-ρ statistic

$$T\sqrt{N}Z_{\hat{\rho}N,T-1} = T\sqrt{N}\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^{2}\right)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t} - \hat{\lambda}_i\right)$$

b. Panel-*t* statistic

$$Z_{tN,T}^{*} = \left(\tilde{S}_{N,T}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^{2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}$$

c. Group-ρ statistic

$$TN^{-1/2}\tilde{Z}_{\hat{\rho}N,T-1} = TN^{-1/2}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{e}_{i,t-1}^{2}\right)^{-1}\sum_{t=1}^{T}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t} - \hat{\lambda}_i\right)$$

d. Group-*t* statistic

$$N^{-1/2}\tilde{Z}_{tN,T}^{*} = N^{-1/2}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{s}_i^{*2}\hat{e}_{i,t-1}^{2}\right)^{-1/2}\sum_{t=1}^{T}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}$$

where $\hat{\lambda}_i = \frac{1}{2}(\hat{\sigma}_i^2 - \hat{s}_i^2)$ and $\tilde{S}_{N,T}^{*2} = \frac{1}{N}\sum_{t=1}^{T}\hat{s}_i^{*2}$

For the test statistics to be asymptotically standard normally distributed, the appropriate mean and variance adjustment terms are applied after the calculation of the panel cointegration test statistics (Pedroni, 1999).

The null hypothesis of no cointegration for the cointegration test is the same for each statistic,

$$H_0 : \gamma_i = 1 \text{ for all } i = 1,\ldots.,N,$$

However, the alternative hypothesis for the (group-p and group-t) and (panel-p and panel t) panel cointegration tests differs. The alternative hypothesis for the group-p and group-t statistics is

$$H_1 : \gamma_i < 1 \text{ for all } i = 1,\ldots.,N,$$

where a common value for $\gamma_i = \gamma$ is not assumed.

For (panel-p and panel t) statistics the alternative hypothesis is

$$H_1 : \gamma_i = \gamma < 1 \text{ for all } i = 1,\ldots,N,$$

where a common value is assumed for γ. i.e $\gamma_i = \gamma$.

Under the alternative hypothesis, all the panel cointegration test statistics considered in Pedroni (1999) diverge to negative infinity and thus, the left tail of the standard normal distribution is used to reject the null hypothesis.

In this chapter, we have outlined the methodology of the study. The methods explained here will be used in the next chapter to analyse the data collected.

CHAPTER FOUR

RESULTS AND FINDINGS

4.0 Introduction

This chapter presents a thorough analysis and discussion of the results of the study. Results are presented for the data obtained for the provinces of Saskatchewan and Manitoba. The chapter is divided into five sections. Section one examines the descriptive statistics of the data. It presents the summary statistics and the correlation properties of these variables. The second section presents and discusses the stationary properties of the data. The third section discusses the cointegration relationships among the variables under study. The results of the Error Correction Mechanism is presented and analyzed in the fourth section. Section five discusses causality and the direction of causality using the Granger causality analysis. Analyses and estimations were carried out using the Stata econometric software.

4.1 Descriptive Statistics

Export, labour productivity, exposure, and GDP of Canada are the macroeconomic variables used in this study. Graphs and summary statistics for these variables are provided below. Graphs are plotted for productivity growth by sector (start date-finish) versus export growth. To plot the graphs, the industries are grouped into sectors. These industries are grouped based on the first two digits of their NAICS codes. Industries with NAICS first two digits of 11 are grouped as NAICS 11 - Agriculture, forestry, fishing and hunting. Industries with NAICS first two digits of 21 are grouped as NAICS 21 - Mining, quarrying, and oil and gas extraction. Industries with NAICS first two digits of 31 are grouped as NAICS 31 - Manufacturing group 1. Industries with NAICS first two digits of 32 are grouped as NAICS 32 - Manufacturing group 2. Industries with NAICS first two digits of 33 are grouped as NAICS 33 - Manufacturing group 3. Only utility stood as a sector on its own because it had a unique NAICS code of 22. However, for convenience sake, its graph was plotted together with the sector NAICS 21 - Mining, quarrying, and oil and gas extraction. Further, all variables were transformed into log before the graph was plotted. Below are the graphs and summary statistics.

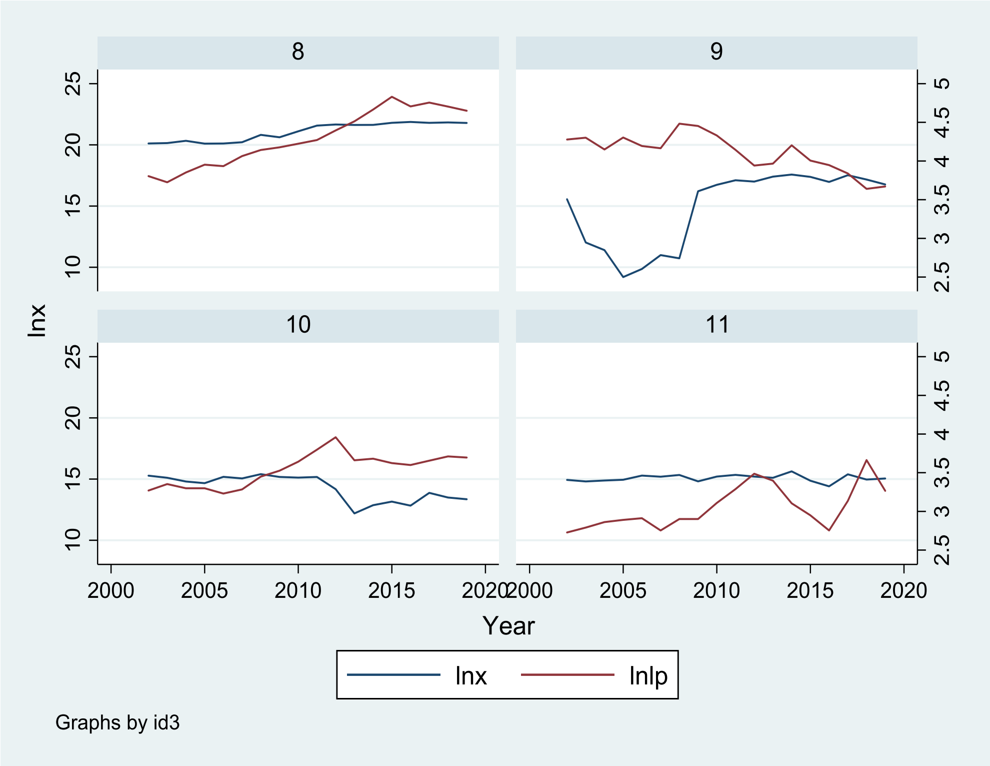
Saskatchewan

Fig 4.1: Exports and Labour Productivity

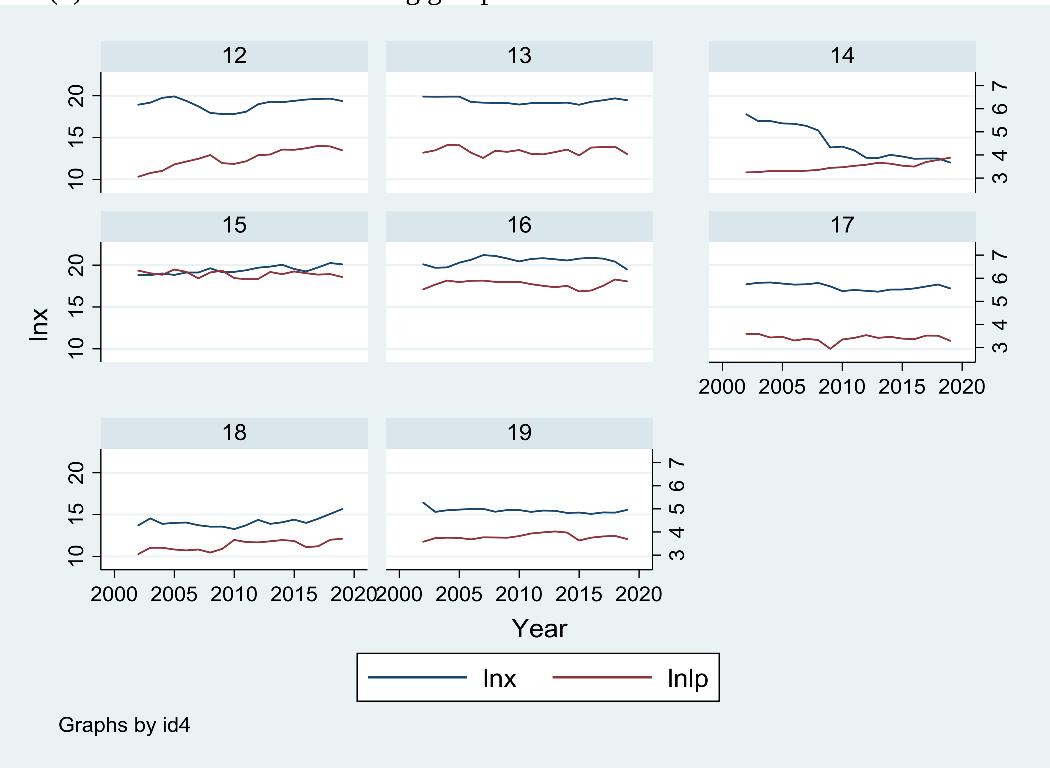
(a) NAICS 21 - Mining, quarrying, and oil and gas extraction

(b) NAICS 21 - Mining, quarrying, and oil and gas extraction & NAICS 21 - Mining

(c) NAICS 31 - Manufacturing group 1



(d) NAICS 32 - Manufacturing group 2



(e) NAICS 31 - Manufacturing group 1

From fig 4. 1 (a) and 4.1 (b), export and labour productivity move similarly in the same direction. In years that exports were increasing, labour productivity was increasing too. In years exports decreased, labour productivity also decreased. From fig 4.1 (c), for the industries Beverage and tobacco product manufacturing (graph 9), export and labour productivity seem to move differently. But for the remaining graphs on fig 4.1(c), export and productivity graphs seems to move in the same directions over the years.

In fig 4.1 (d) and fig 4.1 (e), the direction of growth for exports and labour productivity is the same for almost all the industries under this grouping except for Printing and related support activities industry (graph 14) and Furniture and related product manufacturing (graph 26). For these industries, exports and productivity seems to grow in different directions with exports reducing for both industries and labour productivity steadily rising over the years for both industries.

Hence in the exception of few industries, it could be argued that exports and productivity exhibit a positive correlation. Another crucial observations is that the Oil and Gas extraction (graph 5), Mining and quarrying industry (graph 6), Petroleum and coal product manufacturing (graph 15), Chemical manufacturing, and Crop production (graph 1) industries exhibit both higher productivity growths with higher export growths. However, the utility industry (graph 7) exhibits the opposite where exports continually declined during the years but productivity growth were relatively higher. In addition, the variables plotted on the graphs are trending.

Table 4.1: Correlation Matrix

	Ln*lp*	Ln*expo*	Ln*x*	Ln*gdpcad*
Lnlp	1.0000			
Lnexpo	-0.2717	1.0000		
Lnx	0.5315	0.2201	1.0000	
Lngdpcad	0.6844	-0.1473	0.7462	1.0000

Source: Author's computation

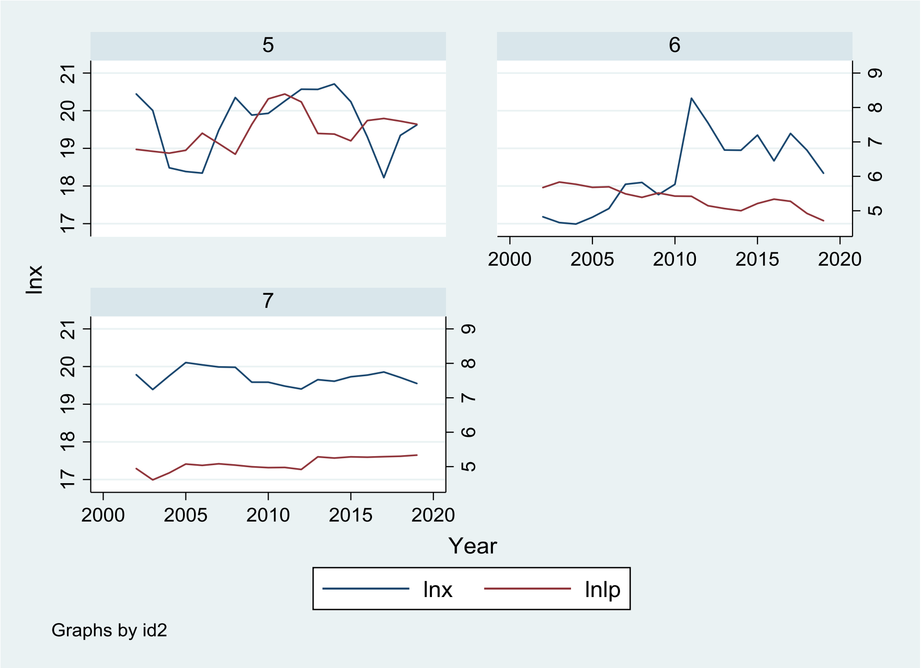
Table 4.1 shows the correlation among the variables used in the model (in natural logarithm). There is a lower negative correlation between Labour Productivity and Exposure, and GDP of Canada and Exposure. However, all the remaining are significantly positively correlated. This is not to say that any variables causes the other but just to give us an idea as to the directions in which the variables move together.

Manitoba

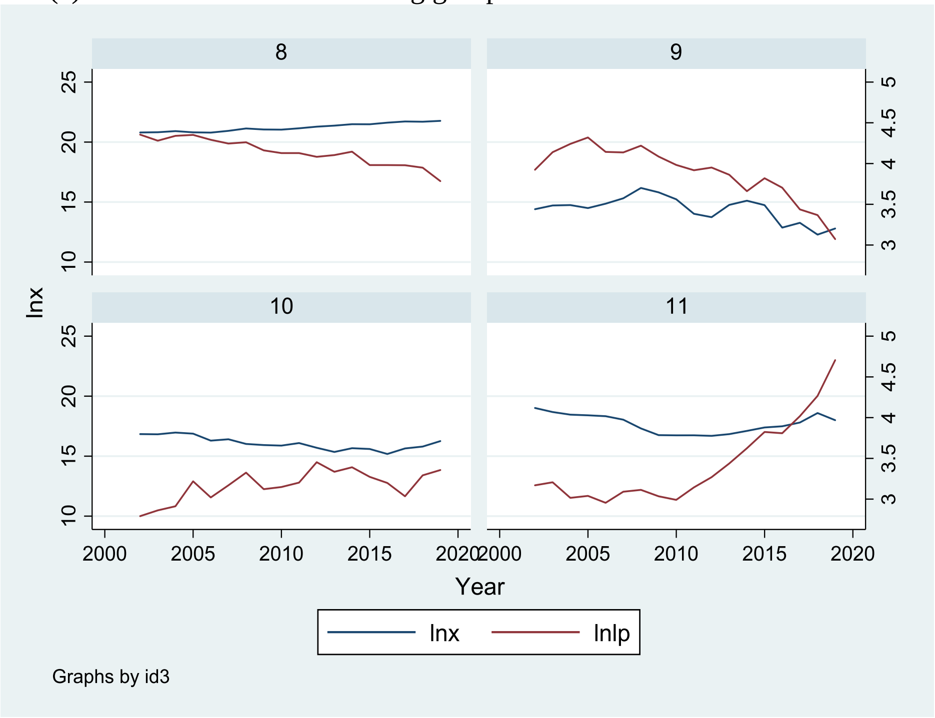
Fig 4.2: Exports and Labour Productivity

(a) NAICS 21 - Mining, quarrying, and oil and gas extraction

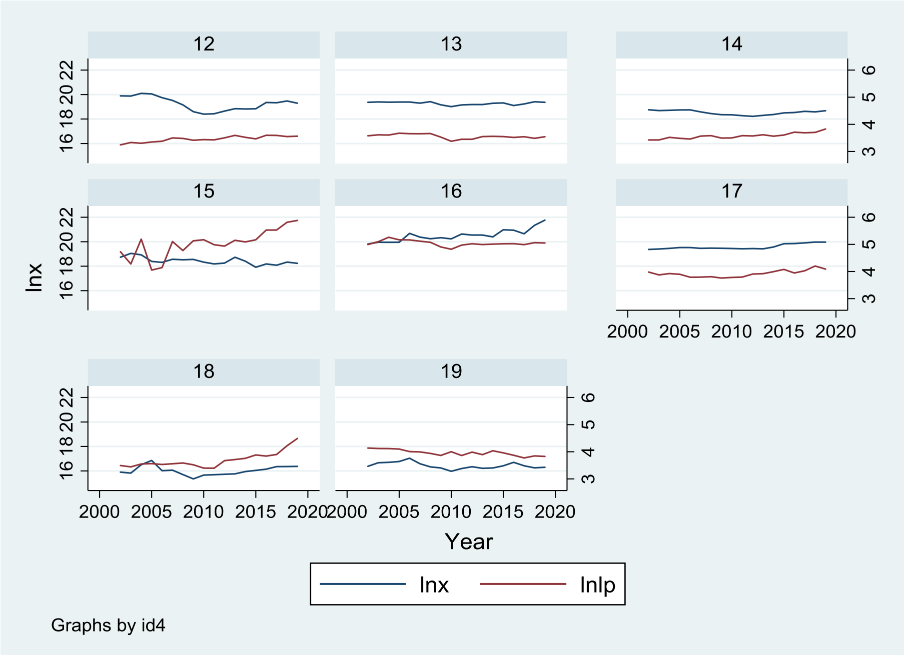
(b) NAICS 21 - Mining, quarrying, and oil and gas extraction & NAICS 21 - Utility



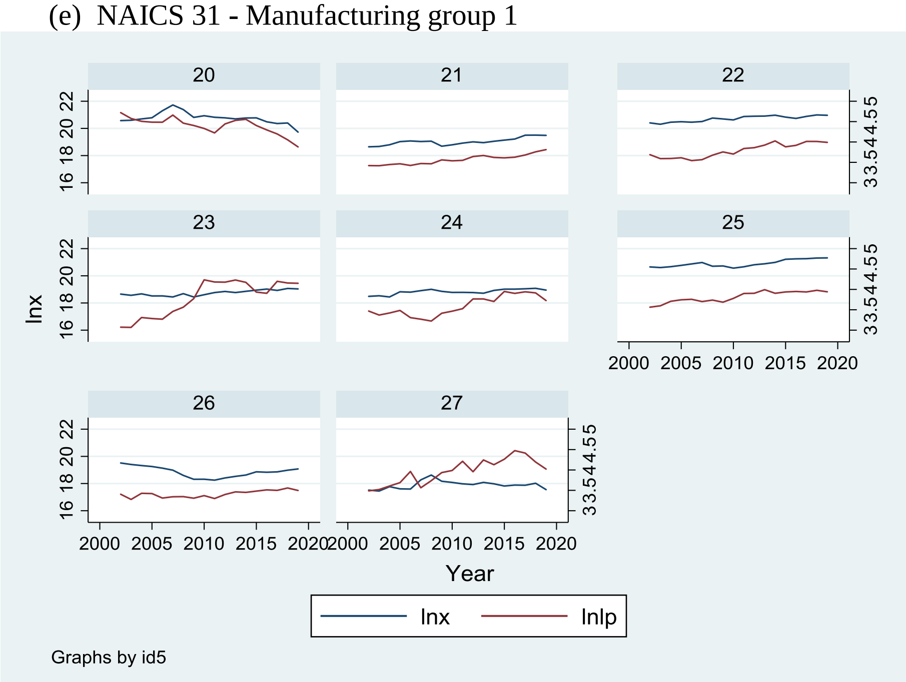
(c) NAICS 31 – Manufacturing group 1



(d) NAICS 32 - Manufacturing group 2



(e) NAICS 31 - Manufacturing group 1



From fig 4.2 (a), export and labour productivity move similarly in the same direction for Animal production and Aquaculture (graph 2) and Forestry and logging (graph 3). But for Crop production (graph 1) and Fishing, Hunting and trapping (graph 4), exports growth remain steady over time but labour productivity continues to fluctuate during the entire period under consideration.

From fig 4.2 (b), productivity growth mimics the growth in exports except for the Oil and gas extraction (graph 6). From fig 4.2 (c), apart from the Food manufacturing industry (graph 8) where export and labour productivity seem to grow in different directions with exports increasing over time but labour productivity falling steadily within those same periods. For the remaining industries on the graph, exports and labour productivity grew in the same direction over the period under consideration.

In fig 4.2 (d) and fig 4.2 (e), the direction of growth for exports and labour productivity is the same for almost all the industries under this grouping.

Aside from the exception of a few industries, it could be concluded that exports and productivity exhibit a positive correlation. In addition, the variables plotted on the graphs are trending.

Table 4.2: Correlation Matrix

	Ln*lp*	Ln*expo*	Ln*x*	Ln*gdpcad*
lnlp	1.0000			
lnexpo	-0.1931	1.0000		
Lnx	0.2705	0.2749	1.0000	
Lngdpcad	0.7087	-0.1897	0.6201	1.0000

Source: Author's computation

Table 4.2 shows the correlation matrix respectively for the variables (in natural logarithm) used in the model. Apart from the correlation between GDP of Canada and Exposure, which is also negative. The correlation between Labour productivity and Exposure, and GDP of Canada and Exposure is negative. The rest are positively correlated with means that these variables increase in the same direction positively.

4.2 Unit Root Results

Next, we analyze the statistical properties of our data. In the first step, we test whether our panel data have unit root or not. Following the test procedure described in the previous chapter, section 3.4.1, the test is performed and summarized in Tables below. The test was done at both levels and first difference. It is assumed that individual effects and individual linear trends are exogenous variables. Since the lag selection is a very essential step in the modelling processes, the study uses Schwarz Information Criterion of lag 1 (as a rule of thumb for the data is a yearly panel data). Also, it was clear from the about graphs in the previous section that the variables are trending. Hence, as a rule of thumb, we include both a constant and trend in our analysis. Further, as a rule of thumb, a useful rule for determining the maximum lag, p-max (8 in this study for T=18) was suggested by Schwert(1989):

$$p_{\mathsf{max}} = \left[12 \cdot \left(\frac{T}{100}\right)^{1/4}\right]$$

Saskatchewan

To be sure of our use of the test developed by Pesaran (2007) to test unit roots, we first implement a cross-section independence test. These tests include the LM test by Breusch and Pagan (1980); the bias-adjusted LM test by Pesaran, Ullah, and Yamagata (2008); and the CD test by Pesaran (2004). We evaluate the null hypothesis of no correlation among the variables from the data of 27 panels. The results of the test is displayed below:

Table 4.3: Cross-Section independence test with trend included.

Test	Statistics	p-value
LM	481.7	0.0000
LM adj*	4.674	0.0000
LM CD*	-1.014	0.3107

*(i) * denotes a two-sided test*

Test results show that while LM and bias-adjusted LM rejects the null hypothesis of no correlation at all levels among the industries for all t, the LM CD test by Pesaran (2004) fails to reject it. Thus, for the LM CD test, some of the levels of the industries exhibits cross section independence. But for the LM and bias-adjusted LM test, there is a clear evidence of cross section dependence.

Table 4.4: Pesaran (2007) unit root test with trend and intercept included.

Variables	Levels	First Difference

Lnlp	-2.209	-3.852***
Lnexpo	-2.335	-4.155***
Lnx	-2.344	-3.845***
Lngdpcad	-2.284	-3.485***

*Notes: (i). *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*
Source: Author's computation

As previously mentioned, the limiting distribution of the CIPS statistic is not normal, and the corresponding critical values are tabulated and reported in Pesaran (2007). These critical values are displayed with the test statistics in Stata. In this test, the critical values reported for the test at levels are -2.58 for 10% sig level, -2.67 for 5% sig level and -2.83 for 1% sig level. The critical values reported for the test at first difference are -2.07 for 10% sig level, -2.15 for 5% sig level and -2.32 for 1% sig level.

From table 4.4, the test fails to reject the hypothesis of unit root process at levels for all the variables at all significant levels. Indicating that all variables have unit root processes However, the test rejected the null hypothesis of unit root for all the variables at first difference. These were significant at 1%. Hence, the test suggests that the first difference of these variables are stationary, I(0).

Manitoba

Cross-section independence tests that includes the LM test by Breusch and Pagan (1980); the bias-adjusted LM test by Pesaran, Ullah, and Yamagata (2008); and the CD test by Pesaran (2004) are performed to evaluate the null hypothesis of no correlation among the variables from the data of 27 industries. The results of the test is displayed below:

Table 4.5: Cross-Section independence test with trend included.

Test	Statistics	p-value
LM	520.3	0.0000
LM adj*	7.719	0.0000
LM CD*	0.0246	0.9804

*(i) * denotes a two-sided test*

Test results show that while LM and bias-adjusted LM rejects the null hypothesis of no correlation at all levels among the industries for all t, the LM CD test by Pesaran (2004) fails to reject it. Thus, for the LM CD test, some of the levels of the industries exhibits cross section independence. But for the LM and bias-adjusted LM test, there is a clear evidence of cross section dependence.

Table 4.6: Pesaran (2007) unit root test with trend and intercept included.

Variables	**Levels**	**First Difference**
Lnlp	-2.405	-3.988***
Lnexpo	-2.577	-4.001***
Lnx	-2.041	-3.490***
Lngdpcad	-2.284	-3.485***

*Notes: (i) *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*

In this test, the critical values reported for the test at levels are -2.58 for 10% sig level, -2.67 for 5% sig level and -2.83 for 1% sig level. The critical values reported for the test at first difference are -2.07 for 10% sig level, -2.15 for 5% sig level and -2.32 for 1% sig level. It can be observed from table 4.6, the test procedure considered failed to reject the null hypothesis of unit root for all the variables at their levels. The first difference of all the variables are significant at 1% which means that the variables are stationary at this instance. Evident from the Pesaran (2007) test implies that all the variables are integrated of order one, I(1) with their first difference being stationary.

4.3 Panel Cointegration Testing

Since variables are integrated of the same order I(1), we perform the cointegration test using Kao (1999) and Pedroni (1999) for a possible cointegration relation(s) among the variables. The Schwarz Information Criterion, together with Newey-West automatic bandwidth selection and Bartlett kernel were used to obtain the optimal lag to include in the model.

Saskatchewan

Table 4.7 shows the results of Kao (199) and Pedroni (1999) cointegration tests using Productivity as the dependent variable. Over here, since if a variable y is cointegrated with x, then x is cointegrated with y. Only the labour productivity variable is treated as endogenous.

Table 4.7: Panel Cointegration Test Using Labour Productivity as Dependent Variable

Kao (1999) test		**Pedroni (1999) test**	
Test Statistic	**Statistic (p-valve)**	**Test Statistic**	**Statistic (p-valve)**
Modified Dickey-Fuller t	-0.4508 (0.3261)	Modified Phillips-Perron t	4.0769 (0.0000)***
Dickey-Fuller t	-2.4671 (0.0068)**	Phillips-Perron t	-2.2870 (0.0111)**
Augmented Dickey-Fuller t	-0.9290 (0.1764)	Augmented Dickey-Fuller t	-2.6431 (0.0041)***
Unadjusted modified Dickey Fuller t	-3.6139 (0.0002)***		
Unadjusted Dickey-Fuller t	-4.3585 (0.0001)***		

*Notes: (i) The p-value of the test statistics are provided in parenthesis. (ii) *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*
Source: Author's computation

From the results displayed above, when Kao (1999) cointegration tests are performed, the test statistics cannot reject the null hypothesis of no cointegration for the Modified Dickey-Fuller *t* and Augmented Dickey-Fuller *t*. All the other test statistics does reject the null hypothesis of no cointegration. On the other hand, Pedroni (1999) tests reject the null of no cointegration. This means that there exist cointegration relations among the export, labour productivity, exposure and GDP of Canada variables. The obvious drawback of residual-based tests is that they assume at most one cointegrating vector.

Manitoba

Since if a variable *y* is cointegrated with *x*, then *x* is cointegrated with *y*. Only the labour productivity variable is treated as endogenous. Table 4.8 shows the results of Kao (199) and Pedroni (1999) cointegration tests using Productivity as the dependent variable.

Table 4.8: Panel Cointegration Test Using Productivity as Dependent Variable

Kao (1999) test		**Pedroni (1999) test**	
Test Statistic	**Statistic (p-valve)**	**Test Statistic**	**Statistic (p-valve)**
Modified Dickey-Fuller t	-0.2364 (0.4066)	Modified Phillips-Perron t	3.5686 (0.0002)***
Dickey-Fuller t	-0.8237 (0.2051)	Phillips-Perron t	-5.1687 (0.0000)***
Augmented Dickey-Fuller t	0.2441 (0.4036)	Augmented Dickey-Fuller t	-5.2073 (0.0000)***
Unadjusted modified Dickey Fuller t	-3.3556 (0.0004)***		
Unadjusted Dickey-Fuller t	-2.7524 (0.0030)***		

*Notes: (i) The p-value of the test statistics are provided in parenthesis. (ii) *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*

When Kao (1999) cointegration tests are performed on productivity (in Table 4.8), it cannot reject the null hypothesis of no cointegration for the Modified Dickey-Fuller *t*, Dickey-Fuller t and the Augmented Dickey-Fuller *t* tests. However, it rejects the null of no cointegration for the remaining Kao (1999) test statistics. On the other hand, Pedroni (1999) tests all reject the null of no cointegration. This means that there exist cointegration relations among the export, labour productivity, exposure and GDP of Canada variables.

These test results displayed in the section above suggest to us to study the short term relationships that exist among the variables and the direction of causality that might run among the variables in the long term. We estimate the Error Correction Mechanism (ECM) model which is consistent with the foregoing analysis and discusses the short term relationship among the variables

4.4 Error Correction Mechanism

A very essential part of this study is the estimation of the correct model that best describes the data generating process of our variables to ensure a good statistical inference. Based on the long run or cointegration relationship results, we estimate an ECM which provides means to analyze the dynamic disequilibrium of our variables both in the short run and the long run.

To estimate the Error Correction Mechanism models, Stata implements the pool mean-group (PMG) estimators proposed by Pesaran, Shin, and Smith (1997, 1999) that combines both pooling and averaging. This estimator is an intermediate between the mean-group (MG) estimator and the fixed effect (FE) estimator. The PMG allows the intercept, short-run coefficients, and error variances to differ across the groups (as would the MG estimator) but constrains the long-run coefficients to be equal across groups (as would the FE estimator) (Blackburne and Frank, 2007).

Since equation 3.2 in chapter 3 is nonlinear in the parameters, Pesaran, Shin, and Smith (1999) develop a maximum likelihood method to estimate the parameters and the command xtpmg uses Stata's powerful ml framework to implement the PMG estimator.

In this context this research, the PMG model allows for heterogeneous short-run dynamics and common long-run elasticities based on equation 3.2. Often only the long-run parameters are of interest (Blackburne and Frank, 2007). The default results of the pmg option include the long-run parameter estimates and the averaged short-run parameter estimates (this is the one presented in this section).

The full option of the PMG estimator model estimates and saves an N + 1 multiple-equation model based on equation 3.2 which reports different coefficients for different i in the short run model. The first equation displayed in the results (labeled per option *ec*) presents the normalized cointegrating vector. Further, the variable *ec* in the short run model represents u_{it-1} from the equations 3.5 and 3.6 respectively in chapter 3. The remaining N equations list the group-specific short-run coefficients (this result is displayed fully in the appendix of this project work).

Saskatchewan

Table 4.9: Error-correction Model Dependent Variable: Productivity

	D.lnlp	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
ec							
	lnx	.1985***	.0305	6.50	0.0000	.1386	.2583
	lnexpo	-.1871***	.0338	-5.53	0.0000	-.2533	-.1208
	lngdpcad	-.5521***	.1026	-5.38	0.0000	-.7532	-.3510
	Year	.0017	.0027	0.64	0.5240	-.0036	.0071
SR							
	Ec	-.3323	.0593	-5.60	0.0000	-.4486	-.2160
	lnx						
	D1.	.0543	.0444	1.22	0.2210	-.0327	.1413
	lnexpo						
	D1.	-.1033	.0532	-1.94	0.0520	-.2076	.0009
	lngdpcad						
	D1.	.3728	.2774	1.34	0.1790	-.1709	.9164

_cons	3.2638	.5824	5.60	0.0000	2.1223	4.4053

*Notes:(i) *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*
Source: Author's computation.

It is hypothesized that if export activities drive the industries to improve their productivity, due to greater competitive pressures, then there exists a long-term contemporaneous relationship between export and productivity. Such a relation suggests that export and productivity are cointegrated. According to the long run results in table 4.9, export has a positive impact on productivity. This implies that an increase in exports in an industry will lead to a rise in productivity of that industry. In an economic sense, the possibility to expand into larger (exports) markets provides incentives to improve the efficacy or quality of production, thereby boosting productivity within industries. This relation is also significant at 1% level. However, exposure and GDP of Canada have a negative impact on productivity. This means that an increase in exposure to trade and GDP of Canada will lead to a decrease in the labour productivity of that industry. From an economics perspective, we would expect the opposite (positive) of such a relation. But the evidence could potentially suggest that other economic activities (eg 2008 financial crisis or 2014-2016 oil price crash) that affected industries during the years under study played an important role in affecting labour productivity. However, this needs further investigation. These relations are also significant at 1% level and all these relations are for the general sample in the long run. From the short run model, the coefficients of the variables and the error variances (*ec*) are not the same for each industry (full results shown in appendix 2a). Thus, the coefficients cannot be interpreted as it was for the long run. However, because results are displayed for the full sample, in this case, the error correction term (*ec*) shows that any deviation from the long run equilibrium is corrected at the 33.23% adjustment speed. As expected, the coefficient of *ec* is significant at 1% level and negative.

Further, Granger Causality is tested using the methods of Dinda & Coondoo, 2006 as presented in chapter 3 section 3.2 of this research work. To test the null hypothesis that *lnx* (exports) may be said not to Granger cause *lnlp* (labour productivity), a simple f-test is used to test the appropriate coefficients. Displayed below is the result.

```
. test _b[SR:D.lnx] = 0, notest

 ( 1)  [SR]D.lnx = 0

. test _b[SR:ec] = 0, accum

 ( 1)  [SR]D.lnx = 0
 ( 2)  [SR]ec = 0

           chi2(  2) =   33.94
         Prob > chi2 =    0.0000

.
```

Since the p-value is 0.0000, we reject the null hypothesis and conclude that *lnx* (exports) may be said to Granger cause *lnlp* (labour productivity). This means that exports help to forecast labour productivity.

Now, at the first instance of estimating the ECM model using PMG command in Stata with exports as the dependent variable, an issue (the sign associated with the coefficient of labour productivity) arises that hinders interpretability of the relationship between labour productivity and export. To address this issue and work towards better interpretability, we run a mean group estimator (results shown in appendix 2b). We note that there are some industries where parameters swing widely and have high standard errors (Industries 7, 10, 14, 21, 22, 24, 26). This may be an indication of multicollinearity. Hence, these industries are dropped from the resulting estimated PMG model presented in table 4.10. Trend variable was also dropped due to the reason that it had insignificant t-statistics in the initially estimated PMG model. The resulting estimated model is presented below.

Table 4.10: Error-correction Model Dependent Variable: Export

	D.lnx	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
ec							
	lnlp	.3155*	.1863	1.69	0.0900	-.0497	.6807
	lnexpo	.1992**	.0924	2.16	0.0310	.0181	.3803

	lngdpcad	2.5517***	.3503	7.28	0.0000	1.8651	3.2384
SR							
	ec	-.2694	.0640	-4.21	0.0000	-.3948	-.1439
	lnlp						
	D1.	.2442	.0657	3.72	0.0000	.1154	.3729
	lnexpo						
	D1.	.7603	.1863	4.08	0.0000	.3952	1.1255
	lngdpcad						
	D1.	.6872	.9022	0.76	0.4460	-1.0811	2.4555
	_cons	-11.4482	2.7724	-4.13	0.0000	-16.8820	-6.0143

*Notes:(i) *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*
Source: Author's computation.

The long run model results from Table 4.10 indicates a positive association between productivity and exports. This implies that, an increase in productivity in an industry will lead to a rise in exports of that industry. This makes economic sense as boosting productivity before entering into export markets is bound to help industries compete at a higher level and thus induce increasing exports. This relation is significant at 10% level. Exposure and GDP of Canada have a positive impact on exports. This means that an increase in exposure to trade and GDP of Canada will lead to an increase in the exports of that industry. For an economic intuition, exports are bound to increase as a result of industries getting more and more access to international markets (Exposure). This increasing exposure means industries will have newer markets or expanded old markets to sell their products to. Likewise, GDP is the total value of the goods and services produced with a country. Hence as GDP increases, it could mean that more goods are being produced. With increased production of goods and services, more goods are bound to be exported. These relations are also significant at 1% level. The coefficients in the short run model cannot be interpreted as it was for the long run since the coefficients of the variables and the error variances (*ec*) are not the same for each industry (see appendix 1c for full short run model results). However, because results are displayed for the full sample in this case, the error correction term (ec) shows that, any deviation from the long run equilibrium is corrected at the 26.94% adjustment speed. This coefficient of *ec* is significant at 1% and negative as expected.

Granger Causality is tested using the methods of Dinda & Coondoo, 2006 as presented in chapter 3 section 3.2 of this research work. To test the null hypothesis that *lnlp* (labour productivity) may be said not to Granger cause *lnx* (exports), a simple f-test is used to test the appropriate coefficients. Displayed below is the results.

```
. test _b[SR:D.lnlp] = 0, notest

 ( 1)  [SR]D.lnlp = 0

. test _b[SR:ec] = 0, accum

 ( 1)  [SR]D.lnlp = 0
 ( 2)  [SR]ec = 0

           chi2(  2) =   40.09
         Prob > chi2 =    0.0000
```

Since the p-value is 0.0000, we reject the null hypothesis and conclude that *lnlp* (labour productivity) may be said to Granger cause *lnx* (exports). This means that labour productivity helps to forecast future values of export.

Based on the conclusions of the two simple f-tests above and point (5) of Granger causality hypotheses presented in chapter 3 section 3.2 of this research work, granger causality between *lnx* (exports) and *lnlp* (labour productivity) may be said to be bi-directional.

Manitoba

Table 4.11: Error-correction Model Dependent Variable: Productivity

	D.lnlp	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
ec							
	lnx	.2045***	.0218	9.36	0.0000	.1617	.2473
	lnexpo	-.6350***	.0320	-19.85	0.0000	-.6977	-.5722
	lngdpcad	.1981***	.0465	4.26	0.0000	.1070	.2892
	Year	.0317***	.0011	29.51	0.0000	.0296	.0338
SR							
	Ec	-.3561	.0589	-6.05	0.0000	-.4715	-.2407
	Lnx						
	D1.	.1088	.0403	2.70	0.0070	.0298	.1879
	lnexpo						

D1.	-.1068	.0377	-2.84	0.0050	-.1807	-.0330
Lngdpcad						
D1.	.1611	.1838	0.88	0.3810	-.1990	.5213
_cons	-24.0426	3.9943	-6.02	0.0000	-31.8713	-16.2138

*Notes: (i) *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*
Source: Author's computation.

According to the long run results in table 4.11, export has a positive impact on productivity. This implies that, an increase in export in an industry will lead to a rise in labour productivity of that industry. This relation is significant at 1% level. Exposure has negative relationship on labour productivity. However, GDP of Canada has a positive impact on labour productivity. This means that an increase in exposure to trade will lead to a decrease in the labour productivity of that industry but an increase in the GDP of Canada will lead to a rise in labour productivity in Manitoba for the industries considered. The relation between exposure, GDP of Canada and productivity are all significant at 1% level. This is for the general sample in the long run. For the short run, the coefficients of the variables and the error variances (*ec*) are not the same for each industry (see full results as appendix 2d). Thus, the coefficients cannot be interpreted as it was for the long run. The error correction term (*ec*) shows that, any deviation from the long run equilibrium is corrected at the 35.61% adjustment speed. It is also significant at 1% level and negative as expected.

Granger Causality is tested using the methods of Dinda & Coondoo, 2006 as presented in chapter 3 section 3.2 of this research work. To test the null hypothesis that *lnx* (exports) may be said not to Granger cause *lnlp* (labour productivity), a simple f-test is used to test the appropriate coefficients. Displayed below is the results:

```
. test _b[SR:D.lnx] = 0, notest

 ( 1)   [SR]D.lnx = 0

. test _b[SR:ec] = 0, accum

 ( 1)   [SR]D.lnx = 0
 ( 2)   [SR]ec = 0

           chi2(  2) =   52.29
         Prob > chi2 =    0.0000
```

Since the p-value is 0.0000, we reject the null hypothesis and conclude that *lnx* (exports) may be said to Granger cause *lnlp* (labour productivity). This means that exports help to forecast labour productivity.

Table 4.12: Error-correction Model Dependent Variable: Export

	D.lnx	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
Ec							
	lnlp	.6952***	.0801	8.67	0.0000	.5381	.8523
	lnexpo	1.1833***	.0407	29.09	0.0000	1.1036	1.2630
	lngdpcad	1.3452***	.1161	11.58	0.0000	1.1176	1.5728
	Year	-.0306***	.0026	-11.81	0.0000	-.0357	-.0255
SR							
	ec	-.2913	.0492	-5.92	0.0000	-.3878	-.1948
	lnlp						
	D1.	.2016	.0961	2.10	0.0360	.0132	.3900
	lnexpo						
	D1.	.2499	.0935	2.67	0.0080	.0666	.4332
	lngdpcad						
	D1.	.1328	.4027	0.33	0.7420	-.6565	.9226
	_cons	13.3941	2.3260	5.76	0.0000	8.8353	17.9529

*Notes:(i) *, ** and *** depicts significance at 10%, 5% and 1% levels respectively.*
Source: Author’s computation.

The long run model results from Table 4.12 indicates a positive association between productivity, exposure, GDP of Canada and exports. This implies that, an increase in productivity in an industry will lead to a rise in exports of that industry. An increase in exposure to trade and GDP of Canada will lead to an increase in the exports of that industry. These relations are significant at 1% level for each variable. Because coefficients of the variables and the error variances (*ec*) are not the same for each industry in the short run model, it cannot be interpreted as it was for the long run (full model results is displayed as appendix 2e). However, because results are displayed for the full sample in this case, the error correction term (*ec*) shows that, any deviation from the long run equilibrium is corrected at 29.13% adjustment speed. The coefficient on *ec* is negative and significant at 1% level.

Testing granger Causality based on the methods of Dinda & Coondoo, 2006 presented in chapter 3 section 3.2 of this research work. To test the null hypothesis that *lnlp* (labour productivity) may be said not to Granger cause *lnx* (exports), a simple f-test is used to test the appropriate coefficients. Displayed below is the results.

```
. test _b[SR:D.lnlp] = 0, notest

 ( 1)  [SR]D.lnlp = 0

. test _b[SR:ec] = 0, accum

 ( 1)  [SR]D.lnlp = 0
 ( 2)  [SR]ec = 0

           chi2(  2) =   45.28
         Prob > chi2 =    0.0000

.
end of do-file
```

Since the p-value is 0.0000, we reject the null hypothesis and conclude that *lnlp* (labour productivity) may be said to Granger cause *lnx* (exports). This means that labour productivity helps to forecast future values of export.

Based on the conclusions of the two simple f-tests above and point (5) of Granger causality hypotheses presented in chapter 3 section 3.2 of this research work, granger causality between *lnx* (exports) and *lnlp* (labour productivity) may be said to be bi-directional.

This chapter presented the findings of the empirical studies. This follows from the analysis of the data collected. The next chapter summarizes the key findings and offers some recommendations based on the findings of the study.

CHAPTER FIVE

FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.0 Introduction

This chapter aims to summarize the findings of this study, present the major conclusions, and draw recommendations for policymakers and future researchers.

5.1 Summary of Findings

After utilizing both economic and econometric tools to explore the relationship between export activities and labour productivity in the provinces of Saskatchewan and Manitoba, the following findings were obtained from the study;

- It was noted from the descriptive statistics of both provinces that export and labour productivity exhibit a positive correlation. This was observed both graphically and from the correlation matrix. Further from the graphs, it was noted that industries with higher export volumes tend to have higher productivity growth. This provides some evidence of a connection though does not tells us the causality. Further, it was noted the variables under consideration in this study were trending and hence trend was included in our econometric analysis.
- For both provinces, tests for stationarity indicated that all the variables were non-stationary in levels with trend. However, the first difference of the variables was stationary. For the purpose of supporting the assumption of cross-section dependence between the industries to justify the use of Pesaran (2007) unit root test, a cross-section independence test was carried out on the variables for both provinces. The test suggested that in both provinces, there was a cross-section dependence between the 27 traded industries. This means that any shock in one industry is being transmitted to another one.

- The study also revealed that based on the Kao (1999) and Pedroni (1999) cointegration test, for both provinces, the variables under study were found to be cointegrated. This implied intuitively that the variables do not drift too far apart from each other.
- The results of the long-run Error Correction Mechanism (ECM) model, for both provinces, found that exports do have a positive impact on labour productivity and productivity had a positive impact on exports. Using the coefficients on the variables in the long-run models, in both provinces, labour productivity seems to have a bigger impact on exports compared to the impacts of exports on labour productivity. These relationships were statistically significant.
- Still on the results of the long-run Error Correction Mechanism (ECM) model, in both provinces, exposure and GDP of Canada had a positive impact on exports. This simply implies that as industries got more access to markets and as the GDP of Canada grew, industries tend to export more. For both provinces, exposure had a negative impact on labour productivity. In Saskatchewan however, GDP of Canada had a negative impact on labour productivity. In Manitoba, GDP of Canada positively impacted labour productivity. These relationships were statistically significant.
- Based on the Granger Causality test methods employed using the results of the ECM, we noticed that, for both provinces, the test suggested that there exist bi-directional causality between *lnx* (exports) and *lnlp* (labour productivity). The finding lends evidence to the validity of both the export-led growth hypothesis and the growth-driven export hypothesis in both provinces. This finding is in line with the results of Nurhani (2011), the only paper I found that uses panel data to study this same problem. Nurhani (2011) concluded that there was a bidirectional causality between exports and productivity which added to the possibilities of the existence of indirect causalities between them through other macroeconomic variables, in the case of this study, exposure and GDP of Canada.

5.2 Policy implications and Recommendations

The findings outlined in section 5.1 have some policy implications. The results discussed in the previous chapter have thrown some light on some macroeconomic variables (exposure and GDP of Canada) that have a significant impact on exports and labour productivity for the period under consideration. Given this, recommendations will be made to help achieve higher and sustained levels of export and productivity growth in Saskatchewan and Manitoba.

- For both provinces, since exports have a positive impact on labour productivity and labour productivity also impacted exports positively, it will be advantageous to increase the volume of exports of industries. To do this, policies should be in place to assist firms in the industries to increase their volume of exports. An aim to increase export will lead to a growth in labour productivity based on the results of this study. Further, based on the results of this research, promoting increased growth in labour productivity is bound to reflect positively on exports. However, specific policies to promote productivity through exports or exports through labour productivity warrants additional study.
- Also, since exposure impacts exports positively in both provinces, it can be suggested that firms should be provided with an opportunity to penetrate and participate in international trade fairs to expose products made in the two provinces and create new markets for these products. However, since the finding revealed that exposure impacts negatively on labour productivity in both provinces, pursuing policies that allow domestic industries to be exposed to international markets will hamper productivity growth if the province aims to achieve higher productivity growth. As there are other benefits to exposure (eg lower prices), this results indicates that there are other costs to consider. Since there is a lag between policies and their results, policymakers of both Saskatchewan and Manitoba should also pay attention to other variables of growth such as the GDP of Canada that can have an impact on both exports and labour productivity in these provinces.

5.3 Limitations and Areas for Further Research

Attempts were made to ensure the validity of the study. However, like many academic endeavors, there are certain weaknesses of the study which could be addressed by future researchers. The following are the limitations of the study

- Although all data were obtained from Statistics Canada, a single source, the data for all variables included in the study was limited to a very short period of 2002 to 2019. The industries included in the study for each province was also limited to a very small number of 27. These limited data were all due to data availability and hence influenced the results. Because with a data set with a much larger number of years and industries, the results could be different. Since the data was collected for just two provinces, Saskatchewan and Manitoba, the results may not apply to other provinces or countries. Also, because the services industry wasn't included in the study, the results cannot be applied to the services sector.
- Even though the Error Correction Mechanism models present causality between the variables of these studies, the results of the ECM models need to be checked against Granger causality models for robustness. Something this study doesn't do. This can be done so that the Granger causality models provide different information as two variables are observed at a time. The basic idea is that x exerts a causal influence on y if past values of x are significant predictors of the current value of y even when past values of y has to be included in the model. The x and y variables can be interchanged to test for causality in the other direction, and it is possible to observe bidirectional causality (also called feedback). Although Granger causality tests may detect the impact of one variable on the other, this is not causation. It is correlation. Nevertheless, future researches of this nature should consider this.
- A more modern study will be a micro-level study that assesses the relationship between exports and productivity in the context of the Melitz 2003 model. A study of that nature will use firm-level data. However, due to the difficulty in obtaining firm-level data, this study did not examine the relationship between exports and productivity in the context of the Melitz 2003 model. Finally, this

project work could potentially neglect exports in the service sector. These are things future researchers should consider as well.

5.4 Conclusion

Theoretically, international trade and productivity have been linked in the sense that, participating in international trade increases productivity and vice versa. To explain these links, hypotheses were formulated. These formulations mainly focus on whether export causes productivity growth or productivity growth rather causes export expansion. The core hypotheses formulated for this phenomenon are the Export-Led Growth Hypothesis and the Growth-Driven Export Hypothesis (Kunst and Martin, 1989; Henriques and Sadorsky, 1996).

The major objective of this study is to explore the link between exports and productivity using panel data of 27 traded industries in Saskatchewan and Manitoba for the period 2002 to 2019. Panel data analysis of unit root test and co-integration tests were employed and the causal tested in an Error Correction Mechanism (ECM).

The empirical results of the study suggested that there is a bi-directional causality between *lnx* (exports) and *lnlp* (labour productivity) in both provinces. The implication of this finding is that it lends evidence to the validity of both the export-led growth hypothesis and the growth-driven export hypothesis in both provinces.

For both provinces, in the long run Error Correction model, exports do have a positive impact on labour productivity and productivity impacts exports positively.

The study recommended policies to either promote export activities or enhance labour productivity based on the results.

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APPENDIX

APPENDIX 1: DESCRIPTIVE STATISTICS

Saskatchewan

Table 4.1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnlp	486	4.1813	1.1833	1.6487	7.8150
lnexpo	486	.31239	1.6853	-5.8397	3.8227
lnx	486	17.6277	2.9723	9.1997	23.3049
lngdpcad	486	22.8549	1.0246	20.8180	25.4364

Source: Author's computation

Manitoba

Table 4.3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnlp	486	4.0475	.91562	2.6532	8.3904
lnexpo	486	.7514	1.4356	-3.9314	4.2122
lnx	486	18.5324	2.1713	10.9427	21.8097
lngdpcad	486	22.8549	1.0246	20.8180	25.4364

Source: Author's computation

APPENDIX 2: ERROR CORRELATION MECHANISM MODEL FULL RESULTS

Saskatchewan

(a) Error Correction Model Dependent Variable: Productivity

D.lnlp	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
ec						
lnx	.1984933	.0305389	6.50	0.000	.1386382	.2583483
lnexpo	-.1870617	.0338118	-5.53	0.000	-.2533316	-.1207918
lngdpcad	-.5520612	.1026036	-5.38	0.000	-.7531606	-.3509618
Year	.0017301	.0027146	0.64	0.524	-.0035903	.0070506
I_id_1						
ec	-.1146148	.1605551	-0.71	0.475	-.429297	.2000675
lnx						
D1.	.4648648	.4562571	1.02	0.308	-.4293827	1.359112
lnexpo						
D1.	-.676205	.4170483	-1.62	0.105	-1.493605	.1411945
lngdpcad						
D1.	.3180048	.8460793	0.38	0.707	-1.34028	1.97629
_cons	1.106996	1.738563	0.64	0.524	-2.300525	4.514517
I_id_2						

ec	-.28618	.1903077	-1.50	0.133	-.6591763	.0868163
lnx						
D1.	.1165415	.5026425	0.23	0.817	-.8686198	1.101703
lnexpo						
D1.	-.0180217	.5328591	-0.03	0.973	-1.062406	1.026363
lngdpcad						
D1.	3.665036	1.891457	1.94	0.053	-.0421509	7.372223
_cons	2.022429	2.245058	0.90	0.368	-2.377804	6.422662
I_id_3						
ec	-.607933	.2148927	-2.83	0.005	-1.029115	-.1867511
lnx						
D1.	-.061887	.1908617	-0.32	0.746	-.4359691	.312195
lnexpo						
D1.	-.0802734	.1254408	-0.64	0.522	-.3261328	.165586
lngdpcad						
D1.	.605089	.7161435	0.84	0.398	-.7985264	2.008704
_cons	5.65649	4.424419	1.28	0.201	-3.015211	14.32819
I_id_4						
ec	-.2140021	.0982678	-2.18	0.029	-.4066034	-.0214008
lnx						
D1.	-.0618976	.0950793	-0.65	0.515	-.2482496	.1244544
lnexpo						
D1.	.1487675	.1131859	1.31	0.189	-.0730727	.3706077
lngdpcad						
D1.	-4.722927	1.524565	-3.10	0.002	-7.71102	-1.734835
_cons	1.706392	1.621075	1.05	0.293	-1.470856	4.88364
I_id_5						
ec	-.2808398	.1145962	-2.45	0.014	-.5054443	-.0562353
lnx						
D1.	-.5042781	.3536281	-1.43	0.154	-1.197376	.1888202
lnexpo						
D1.	.3679893	.3852412	0.96	0.339	-.3870696	1.123048

lngdpcad						
D1.	1.706739	.7144513	2.39	0.017	.3064397	3.107037
_cons	3.714334	2.286229	1.62	0.104	-.7665927	8.195261
I_id_6						
ec	.0049501	.0623565	0.08	0.937	-.1172664	.1271665
lnx						
D1.	.6869113	.3751453	1.83	0.067	-.0483599	1.422183
lnexpo						
D1.	-.8167703	.3430387	-2.38	0.017	-1.489114	-.1444268
lngdpcad						
D1.	.2375648	.8842241	0.27	0.788	-1.495483	1.970612
_cons	-.114187	.727281	-0.16	0.875	-1.539632	1.311258
I_id_7						
ec	-.3797347	.1549494	-2.45	0.014	-.68343	-.0760394
lnx						
D1.	-.0895281	.0500915	-1.79	0.074	-.1877056	.0086495
lnexpo						
D1.	.0415892	.0773095	0.54	0.591	-.1099346	.193113
lngdpcad						
D1.	-.6828037	.95602	-0.71	0.475	-2.556568	1.190961
_cons	4.346974	3.311774	1.31	0.189	-2.143983	10.83793
I_id_8						
ec	-.085033	.0683338	-1.24	0.213	-.2189649	.0488989
lnx						
D1.	.1113909	.2852269	0.39	0.696	-.4476435	.6704254
lnexpo						
D1.	-.0923118	.3171838	-0.29	0.771	-.7139807	.529357
lngdpcad						
D1.	1.106445	.9214373	1.20	0.230	-.6995387	2.912429
_cons	.8721145	.8532835	1.02	0.307	-.8002904	2.544519
I_id_9						

ec	.0395483	.0614856	0.64	0.520	-.0809612	.1600578
lnx						
D1.	.0139175	.0261758	0.53	0.595	-.0373861	.0652211
lnexpo						
D1.	-.2087957	.1358997	-1.54	0.124	-.4751542	.0575628
lngdpcad						
D1.	-1.568956	1.108435	-1.42	0.157	-3.741449	.6035376
_cons	-.4470347	.6828199	-0.65	0.513	-1.785337	.8912676
I_id_10						
ec	-.3048136	.0851665	-3.58	0.000	-.4717368	-.1378903
lnx						
D1.	-.018231	.0343293	-0.53	0.595	-.0855152	.0490532
lnexpo						
D1.	-.0384481	.0993111	-0.39	0.699	-.2330943	.156198
lngdpcad						
D1.	.5611023	.2570747	2.18	0.029	.057245	1.064959
_cons	2.805207	2.064324	1.36	0.174	-1.240794	6.851208
I_id_11						
ec	-.5403667	.193754	-2.79	0.005	-.9201175	-.160616
lnx						
D1.	.0102838	.0979278	0.11	0.916	-.1816511	.2022187
lnexpo						
D1.	-.2019939	.1029322	-1.96	0.050	-.4037373	-.0002505
lngdpcad						
D1.	1.718809	.6185776	2.78	0.005	.5064189	2.931199
_cons	4.786514	3.746334	1.28	0.201	-2.556165	12.12919
I_id_12						
ec	-.1370957	.0876587	-1.56	0.118	-.3089035	.0347122
lnx						
D1.	-.0548844	.1140757	-0.48	0.630	-.2784686	.1686998
lnexpo						
D1.	-.2443422	.2786974	-0.88	0.381	-.7905791	.3018947

lngdpcad						
D1.	1.317886	.4809527	2.74	0.006	.3752363	2.260536
_cons	1.33719	1.175588	1.14	0.255	-.9669209	3.641301
I_id_13						
ec	-1.234355	.2479567	-4.98	0.000	-1.720341	-.7483687
lnx						
D1.	.164077	.1482834	1.11	0.269	-.1265532	.4547071
lnexpo						
D1.	.1802275	.0786423	2.29	0.022	.0260915	.3343635
lngdpcad						
D1.	.3510363	.3727041	0.94	0.346	-.3794504	1.081523
_cons	12.11565	8.120826	1.49	0.136	-3.800871	28.03218
I_id_14						
ec	.0538056	.0465991	1.15	0.248	-.037527	.1451381
lnx						
D1.	.0142517	.0501865	0.28	0.776	-.084112	.1126154
lnexpo						
D1.	-.0596274	.0967781	-0.62	0.538	-.2493091	.1300543
lngdpcad						
D1.	-.3617845	.4204402	-0.86	0.390	-1.185832	.4622631
_cons	-.4678462	.5501375	-0.85	0.395	-1.546096	.6104036
I_id_15						
ec	-.5064736	.1818382	-2.79	0.005	-.86287	-.1500773
lnx						
D1.	.5702062	.2131162	2.68	0.007	.1525062	.9879062
lnexpo						
D1.	-.6215707	.1829151	-3.40	0.001	-.9800777	-.2630638
lngdpcad						
D1.	-.3212498	.7261657	-0.44	0.658	-1.744508	1.102009
_cons	5.789206	4.075886	1.42	0.156	-2.199382	13.7778
I_id_16						

ec	-.1406709	.164585	-0.85	0.393	-.4632516	.1819097
lnx						
D1.	.055279	.1182181	0.47	0.640	-.1764243	.2869823
lnexpo						
D1.	-.3515599	.2002141	-1.76	0.079	-.7439724	.0408526
lngdpcad						
D1.	-.2965381	.5964652	-0.50	0.619	-1.465588	.8725122
_cons	1.639572	2.107381	0.78	0.437	-2.490819	5.769963
I_id_17						
ec	-.6917202	.0928925	-7.45	0.000	-.8737861	-.5096542
lnx						
D1.	.1053656	.0548013	1.92	0.055	-.002043	.2127742
lnexpo						
D1.	-.0817601	.08788	-0.93	0.352	-.2540018	.0904816
lngdpcad						
D1.	2.006007	.2096488	9.57	0.000	1.595103	2.416911
_cons	6.508194	4.218498	1.54	0.123	-1.75991	14.7763
I_id_18						
ec	-.7403638	.1565505	-4.73	0.000	-1.047197	-.4335305
lnx						
D1.	-.0119933	.0590964	-0.20	0.839	-.1278202	.1038335
lnexpo						
D1.	-.0149241	.0840701	-0.18	0.859	-.1796984	.1498502
lngdpcad						
D1.	1.45822	.3671478	3.97	0.000	.738624	2.177817
_cons	6.985131	4.709326	1.48	0.138	-2.244979	16.21524
I_id_19						
ec	-.7258725	.2076152	-3.50	0.000	-1.132791	-.3189541
lnx						
D1.	-.1267623	.073062	-1.73	0.083	-.2699612	.0164365
lnexpo						
D1.	.1915768	.1635134	1.17	0.241	-.1289036	.5120572

lngdpcad						
D1.	.5781344	.395266	1.46	0.144	-.1965726	1.352841
_cons	7.048604	4.943889	1.43	0.154	-2.641241	16.73845
I_id_20						
ec	-.657174	.2055562	-3.20	0.001	-1.060057	-.2542913
lnx						
D1.	.1500903	.107787	1.39	0.164	-.0611683	.3613489
lnexpo						
D1.	-.337278	.23816	-1.42	0.157	-.804063	.129507
lngdpcad						
D1.	1.46412	.433012	3.38	0.001	.6154318	2.312807
_cons	6.831258	4.863347	1.40	0.160	-2.700728	16.36324
I_id_21						
ec	-.1545103	.0850008	-1.82	0.069	-.3211088	.0120881
lnx						
D1.	-.0875601	.0629217	-1.39	0.164	-.2108843	.0357641
lnexpo						
D1.	.1363256	.1357071	1.00	0.315	-.1296553	.4023066
lngdpcad						
D1.	.32095	.2713117	1.18	0.237	-.2108111	.8527111
_cons	1.524067	1.267092	1.20	0.229	-.9593866	4.007521
I_id_22						
ec	-.1815655	.0716662	-2.53	0.011	-.3220286	-.0411024
lnx						
D1.	.2052827	.1025044	2.00	0.045	.0043778	.4061876
lnexpo						
D1.	.0199396	.1199418	0.17	0.868	-.215142	.2550211
lngdpcad						
D1.	.2179195	.2237801	0.97	0.330	-.2206814	.6565203
_cons	1.752134	1.249164	1.40	0.161	-.6961831	4.200451
I_id_23						

ec	-.4957846	.1429553	-3.47	0.001	-.7759719	-.2155973
lnx						
D1.	-.1189772	.0817013	-1.46	0.145	-.2791089	.0411545
lnexpo						
D1.	.0518298	.1010764	0.51	0.608	-.1462763	.2499359
lngdpcad						
D1.	-.1770296	.2091439	-0.85	0.397	-.586944	.2328849
_cons	4.641729	3.382324	1.37	0.170	-1.987505	11.27096
I_id_24						
ec	-.4496423	.1695433	-2.65	0.008	-.781941	-.1173435
lnx						
D1.	-.0701208	.090507	-0.77	0.438	-.2475113	.1072698
lnexpo						
D1.	.1460994	.1286411	1.14	0.256	-.1060325	.3982313
lngdpcad						
D1.	.2061539	.5314988	0.39	0.698	-.8355646	1.247872
_cons	4.5153	3.345962	1.35	0.177	-2.042665	11.07327
I_id_25						
ec	-.0676715	.1646857	-0.41	0.681	-.3904496	.2551066
lnx						
D1.	.0158356	.1147386	0.14	0.890	-.209048	.2407191
lnexpo						
D1.	.131246	.1653427	0.79	0.427	-.1928197	.4553116
lngdpcad						
D1.	.2669167	.2800513	0.95	0.341	-.2819738	.8158073
_cons	.698516	1.715465	0.41	0.684	-2.663734	4.060766
I_id_26						
ec	.0171433	.0626097	0.27	0.784	-.1055695	.139856
lnx						
D1.	-.0170993	.0321737	-0.53	0.595	-.0801585	.04596
lnexpo						
D1.	-.1530184	.1378813	-1.11	0.267	-.4232607	.1172239

lngdpcad						
D1.	.2140621	.3264416	0.66	0.512	-.4257517	.853876
_cons	-.1139143	.5815514	-0.20	0.845	-1.253734	1.025905
I_id_27						
ec	-.0903296	.1202316	-0.75	0.452	-.3259792	.1453201
lnx						
D1.	.0047152	.126376	0.04	0.970	-.2429772	.2524076
lnexpo						
D1.	-.2088998	.101208	-2.06	0.039	-.4072638	-.0105358
lngdpcad						
D1.	-.1235872	.426085	-0.29	0.772	-.9586984	.7115241
_cons	.8626124	1.232866	0.70	0.484	-1.55376	3.278985

(b) Mean Group estimator Depended Variable: Exports.

D.lnx	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
I_id_1ec						
lnlp	-.3675381	.1183768	-3.10	0.002	-.5995525	-.1355238
lnexpo	1.336395	.1659812	8.05	0.000	1.011078	1.661712
lngdpcad	3.977849	.5643003	7.05	0.000	2.871841	5.083857
Year	-.1046389	.0263306	-3.97	0.000	-.1562459	-.0530318
I_id_1SR						
ec	-.9313215	.1895211	-4.91	0.000	-1.302776	-.559867
lnlp						
D1.	.3536798	.0868485	4.07	0.000	.1834599	.5238997
lnexpo						
D1.	-.193527	.2052835	-0.94	0.346	-.5958751	.2088212
lngdpcad						
D1.	-1.513489	.5062591	-2.99	0.003	-2.505739	-.5212395
_cons	130.1834	34.98456	3.72	0.000	61.61487	198.7518
I_id_2ec						
lnlp	-.1146347	.1393208	-0.82	0.411	-.3876984	.158429
lnexpo	.8062295	.0923015	8.73	0.000	.625322	.9871371
lngdpcad	-1.778513	1.668802	-1.07	0.287	-5.049305	1.492279
Year	.0052675	.015974	0.33	0.742	-.0260409	.0365759

I_id_2SR						
ec	-.6531641	.1821758	-3.59	0.000	-1.010222	-.296106
lnlp						
D1.	.0720687	.0776289	0.93	0.353	-.0800812	.2242185
lnexpo						
D1.	.4981402	.1823182	2.73	0.006	.140803	.8554773
lngdpcad						
D1.	1.861714	.6269016	2.97	0.003	.6330096	3.090419
_cons	31.8561	11.54724	2.76	0.006	9.223917	54.48828
I_id_3ec						
lnlp	.089936	.5363838	0.17	0.867	-.961357	1.141229
lnexpo	.0671569	.4134586	0.16	0.871	-.7432071	.8775208
lngdpcad	2.903389	1.399169	2.08	0.038	.161068	5.64571
Year	.030616	.0377663	0.81	0.418	-.0434045	.1046365
I_id_3SR						
ec	-.7463084	.2999257	-2.49	0.013	-1.334152	-.1584648
lnlp						
D1.	.0344037	.3534767	0.10	0.922	-.6583978	.7272052
lnexpo						
D1.	.2351624	.2359533	1.00	0.319	-.2272976	.6976225
lngdpcad						
D1.	-1.280761	1.225389	-1.05	0.296	-3.682478	1.120957
_cons	-83.4358	64.11452	-1.30	0.193	-209.0979	42.22635
I_id_4ec						
lnlp	.2248949	1.228603	0.18	0.855	-2.183122	2.632912
lnexpo	.8783456	.9540948	0.92	0.357	-.9916458	2.748337
lngdpcad	3.007641	12.01074	0.25	0.802	-20.53297	26.54825
Year	.115813	.2504256	0.46	0.644	-.3750121	.6066382
I_id_4SR						
ec	-.5505986	.3078154	-1.79	0.074	-1.153906	.0527084
lnlp						
D1.	-.0273554	.8392845	-0.03	0.974	-1.672323	1.617612
lnexpo						
D1.	.4410378	.4905476	0.90	0.369	-.5204178	1.402493

lngdpcad						
D1.	-1.474481	7.070112	-0.21	0.835	-15.33165	12.38268
_cons	-155.9542	376.5536	-0.41	0.679	-893.9857	582.0772
I_id_5ec						
lnlp	.3726601	.1727118	2.16	0.031	.0341511	.7111691
lnexpo	1.316033	.1129149	11.66	0.000	1.094724	1.537342
lngdpcad	.5273895	.3834431	1.38	0.169	-.2241451	1.278924
Year	-.038649	.014543	-2.66	0.008	-.0671528	-.0101452
I_id_5SR						
ec	-.8685637	.290838	-2.99	0.003	-1.438596	-.2985316
lnlp						
D1.	-.1572606	.1450082	-1.08	0.278	-.4414714	.1269503
lnexpo						
D1.	-.082309	.354278	-0.23	0.816	-.7766811	.6120632
lngdpcad						
D1.	.7808551	.4431461	1.76	0.078	-.0876953	1.649405
_cons	73.70189	22.37869	3.29	0.001	29.84046	117.5633
I_id_6ec						
lnlp	.2818325	.275196	1.02	0.306	-.2575419	.8212068
lnexpo	.7700506	.2498173	3.08	0.002	.2804176	1.259684
lngdpcad	.3250705	.7974356	0.41	0.684	-1.237875	1.888016
Year	.030822	.0255774	1.21	0.228	-.0193087	.0809527
I_id_6SR						
ec	-.7815248	.2313697	-3.38	0.001	-1.235001	-.3280485
lnlp						
D1.	.0403414	.1600526	0.25	0.801	-.273356	.3540387
lnexpo						
D1.	.3287651	.2929854	1.12	0.262	-.2454756	.9030058
lngdpcad						
D1.	1.074437	.5023297	2.14	0.032	.089889	2.058985
_cons	-38.27502	26.60852	-1.44	0.150	-90.42675	13.87671
I_id_7ec						
lnlp	-5.165073	6.027519	-0.86	0.391	-16.97879	6.648647
lnexpo	.6217933	.9420966	0.66	0.509	-1.224682	2.468269

lngdpcad	-42.63989	31.11973	-1.37	0.171	-103.6334	18.35366
Year	.4690527	.3176428	1.48	0.140	-.1535158	1.091621
I_id_7SR						
ec	-.4061729	.2455698	-1.65	0.098	-.8874809	.0751351
lnlp						
D1.	1.231128	1.344416	0.92	0.360	-1.40388	3.866135
lnexpo						
D1.	.4054217	.3894339	1.04	0.298	-.3578548	1.168698
lngdpcad						
D1.	15.29409	5.567491	2.75	0.006	4.38201	26.20617
_cons	58.02994	140.1621	0.41	0.679	-216.6828	332.7427
I_id_8ec						
lnlp	-.3090122	1.237644	-0.25	0.803	-2.734751	2.116726
lnexpo	.4848913	.6704956	0.72	0.470	-.8292561	1.799039
lngdpcad	-3.745086	6.541356	-0.57	0.567	-16.56591	9.075736
Year	.164193	.1708069	0.96	0.336	-.1705825	.4989684
I_id_8SR						
ec	-.3010882	.3297648	-0.91	0.361	-.9474155	.345239
lnlp						
D1.	.2935355	.3641682	0.81	0.420	-.4202211	1.007292
lnexpo						
D1.	.8792206	.2803678	3.14	0.002	.3297098	1.428731
lngdpcad						
D1.	.6316336	1.550482	0.41	0.684	-2.407255	3.670522
_cons	-65.8674	82.92546	-0.79	0.427	-228.3983	96.66352
I_id_9ec						
lnlp	5.787186	9.080221	0.64	0.524	-12.00972	23.58409
lnexpo	.0198651	5.455018	0.00	0.997	-10.67177	10.7115
lngdpcad	-22.90089	57.64578	-0.40	0.691	-135.8845	90.08275
Year	.536321	.450593	1.19	0.234	-.346825	1.419467
I_id_9SR						
ec	-.4990892	.3147311	-1.59	0.113	-1.115951	.1177725
lnlp						
D1.	-4.267966	3.162025	-1.35	0.177	-10.46542	1.929489

lnexpo						
D1.	.8523911	2.186781	0.39	0.697	-3.43362	5.138403
lngdpcad						
D1.	4.008844	18.92251	0.21	0.832	-33.07859	41.09628
_cons	-283.9872	925.3789	-0.31	0.759	-2097.696	1529.722
I_id_10ec						
lnlp	-7.198143	5.987126	-1.20	0.229	-18.93269	4.536408
lnexpo	.4254476	2.475467	0.17	0.864	-4.426378	5.277274
lngdpcad	-2.318246	3.561005	-0.65	0.515	-9.297687	4.661196
Year	-.0663182	.1010464	-0.66	0.512	-.2643656	.1317292
I_id_10SR						
ec	-.4614412	.2461	-1.88	0.061	-.9437883	.0209059
lnlp						
D1.	5.378294	1.315332	4.09	0.000	2.800291	7.956296
lnexpo						
D1.	.1737692	.8728273	0.20	0.842	-1.536941	1.884479
lngdpcad						
D1.	2.285556	1.749009	1.31	0.191	-1.142438	5.71355
_cons	102.3108	114.028	0.90	0.370	-121.18	325.8016
I_id_11ec						
lnlp	.1689952	.7163845	0.24	0.814	-1.235093	1.573083
lnexpo	-.0573684	.3526226	-0.16	0.871	-.748496	.6337592
lngdpcad	-.4846895	.6239754	-0.78	0.437	-1.707659	.7382797
Year	-.0358239	.1372739	-0.26	0.794	-.3048757	.2332279
I_id_11SR						
ec	-1.30213	.3061512	-4.25	0.000	-1.902175	-.7020846
lnlp						
D1.	.3402327	.6026454	0.56	0.572	-.8409306	1.521396
lnexpo						
D1.	.403066	.3359877	1.20	0.230	-.2554577	1.06159
lngdpcad						
D1.	1.04031	1.778741	0.58	0.559	-2.445959	4.526579
_cons	126.2279	385.6347	0.33	0.743	-629.6022	882.058
I_id_12ec						

lnlp	.4611286	.6194361	0.74	0.457	-.7529439	1.675201
lnexpo	1.588887	.6073785	2.62	0.009	.3984473	2.779327
lngdpcad	3.212249	1.221202	2.63	0.009	.8187362	5.605761
Year	.0264212	.0442686	0.60	0.551	-.0603437	.1131861
I_id_12SR						
ec	-1.29421	.570095	-2.27	0.023	-2.411575	-.1768442
lnlp						
D1.	-.7752293	.9312348	-0.83	0.405	-2.600416	1.049957
lnexpo						
D1.	.1991331	.8518052	0.23	0.815	-1.470374	1.868641
lngdpcad						
D1.	1.675911	1.532489	1.09	0.274	-1.327712	4.679534
_cons	-142.1849	140.8766	-1.01	0.313	-418.2979	133.9281
I_id_13ec						
lnlp	.7947105	1.695211	0.47	0.639	-2.527841	4.117262
lnexpo	-.2997605	.7385778	-0.41	0.685	-1.747346	1.147825
lngdpcad	2.190498	1.915583	1.14	0.253	-1.563976	5.944972
Year	.0930293	.0719854	1.29	0.196	-.0480594	.234118
I_id_13SR						
ec	-.4278803	.2386531	-1.79	0.073	-.8956317	.0398711
lnlp						
D1.	.2962364	.4902257	0.60	0.546	-.6645883	1.257061
lnexpo						
D1.	-.1012165	.2090837	-0.48	0.628	-.5110129	.30858
lngdpcad						
D1.	-.9333435	.822577	-1.13	0.257	-2.545565	.6788778
_cons	-94.43022	67.77756	-1.39	0.164	-227.2718	38.41135
I_id_14ec						
lnlp	-.6273088	1.250062	-0.50	0.616	-3.077386	1.822768
lnexpo	.9869393	.4921916	2.01	0.045	.0222614	1.951617
lngdpcad	5.605687	1.600777	3.50	0.000	2.468222	8.743153
Year	-.1143285	.0505093	-2.26	0.024	-.213325	-.015332
I_id_14SR						
ec	-1.204505	.4214826	-2.86	0.004	-2.030596	-.3784141
lnlp						

D1.	-.4726106	1.694872	-0.28	0.780	-3.794499	2.849277
lnexpo						
D1.	.2123875	.5446036	0.39	0.697	-.8550159	1.279791
lngdpcad						
D1.	.2504341	2.748015	0.09	0.927	-5.135577	5.636445
_cons	147.481	111.4515	1.32	0.186	-70.95985	365.9219
I_id_15ec						
lnlp	1.489966	.8725846	1.71	0.088	-.2202681	3.2002
lnexpo	.6092864	.2623423	2.32	0.020	.0951049	1.123468
lngdpcad	-4.72981	3.125827	-1.51	0.130	-10.85632	1.396697
Year	.0056725	.0246371	0.23	0.818	-.0426154	.0539604
I_id_15SR						
ec	-.5015512	.2320111	-2.16	0.031	-.9562847	-.0468178
lnlp						
D1.	.0711811	.2677507	0.27	0.790	-.4536006	.5959627
lnexpo						
D1.	.5545489	.2002433	2.77	0.006	.1620793	.9470186
lngdpcad						
D1.	1.788395	.9729604	1.84	0.066	-.118572	3.695363
_cons	54.81522	44.38754	1.23	0.217	-32.18276	141.8132
I_id_16ec						
lnlp	.8076185	1.144371	0.71	0.480	-1.435308	3.050545
lnexpo	2.049477	1.055996	1.94	0.052	-.020237	4.119192
lngdpcad	1.444456	4.546533	0.32	0.751	-7.466584	10.3555
Year	.0253581	.1066122	0.24	0.812	-.1835981	.2343142
I_id_16SR						
ec	.5244268	.7633827	0.69	0.492	-.9717759	2.020629
lnlp						
D1.	.8303537	.6179384	1.34	0.179	-.3807832	2.041491
lnexpo						
D1.	2.149884	.8314439	2.59	0.010	.5202845	3.779484
lngdpcad						
D1.	1.834039	2.434732	0.75	0.451	-2.937948	6.606026
_cons	37.33508	109.0275	0.34	0.732	-176.3549	251.0251

I_id_17ec						
lnlp	1.382326	1.974937	0.70	0.484	-2.48848	5.253132
lnexpo	-.3106187	.6593838	-0.47	0.638	-1.602987	.9817499
lngdpcad	2.629911	1.060136	2.48	0.013	.5520825	4.70774
Year	-.0128494	.0287924	-0.45	0.655	-.0692814	.0435827
I_id_17SR						
ec	-.6444501	.2972378	-2.17	0.030	-1.227025	-.0618748
lnlp						
D1.	.5289219	.5789887	0.91	0.361	-.605875	1.663719
lnexpo						
D1.	.2789433	.3982768	0.70	0.484	-.5016649	1.059552
lngdpcad						
D1.	-4.065249	1.564499	-2.60	0.009	-7.131612	-.9988869
_cons	-13.39678	32.45405	-0.41	0.680	-77.00555	50.21199
I_id_18ec						
lnlp	1.092724	.5497158	1.99	0.047	.0153011	2.170147
lnexpo	1.436478	.6038815	2.38	0.017	.2528923	2.620064
lngdpcad	3.790414	.3953665	9.59	0.000	3.01551	4.565318
Year	.0277893	.0229728	1.21	0.226	-.0172366	.0728152
I_id_18SR						
ec	-1.334219	.1853816	-7.20	0.000	-1.69756	-.9708774
lnlp						
D1.	-.4947311	.7445283	-0.66	0.506	-1.95398	.9645174
lnexpo						
D1.	-.9571107	.4014565	-2.38	0.017	-1.743951	-.1702705
lngdpcad						
D1.	-5.36133	1.065255	-5.03	0.000	-7.449191	-3.273469
_cons	-173.665	59.03684	-2.94	0.003	-289.375	-57.9549
I_id_19ec						
lnlp	.3679216	.5081442	0.72	0.469	-.6280228	1.363866
lnexpo	-.0139485	.2867381	-0.05	0.961	-.5759448	.5480478
lngdpcad	1.267284	.7918394	1.60	0.110	-.2846925	2.819261
Year	-.0183566	.0098808	-1.86	0.063	-.0377226	.0010095
I_id_19SR						
ec	-1.235192	.2535685	-4.87	0.000	-1.732177	-.7382067

lnlp						
D1.	-.235675	.504576	-0.47	0.640	-1.224626	.7532757
lnexpo						
D1.	-.2898892	.4379323	-0.66	0.508	-1.148221	.5684423
lngdpcad						
D1.	-1.097777	1.134986	-0.97	0.333	-3.322309	1.126754
_cons	27.56386	39.84105	0.69	0.489	-50.52316	105.6509
I_id_20ec						
lnlp	1.108555	.4968019	2.23	0.026	.134841	2.082269
lnexpo	1.098308	.4222827	2.60	0.009	.2706491	1.925967
lngdpcad	.1687754	.9540025	0.18	0.860	-1.701035	2.038586
Year	.0248649	.0131524	1.89	0.059	-.0009132	.0506431
I_id_20SR						
ec	-1.296259	.3705216	-3.50	0.000	-2.022468	-.57005
lnlp						
D1.	-.345994	.4661414	-0.74	0.458	-1.259614	.5676264
lnexpo						
D1.	-.4078033	.6964769	-0.59	0.558	-1.772873	.9572664
lngdpcad						
D1.	-1.102205	1.163713	-0.95	0.344	-3.38304	1.17863
_cons	-52.83074	59.04105	-0.89	0.371	-168.5491	62.88759
I_id_21ec						
lnlp	-2.234647	1.08733	-2.06	0.040	-4.365775	-.1035189
lnexpo	-.128345	1.50964	-0.09	0.932	-3.087185	2.830495
lngdpcad	2.448825	1.463167	1.67	0.094	-.4189288	5.316579
Year	-.0197523	.0614248	-0.32	0.748	-.1401427	.100638
I_id_21SR						
ec	-.7004593	.3022313	-2.32	0.020	-1.292822	-.1080968
lnlp						
D1.	1.164193	1.194408	0.97	0.330	-1.176804	3.505189
lnexpo						
D1.	.9137699	.8999522	1.02	0.310	-.850104	2.677644
lngdpcad						
D1.	-1.515786	1.260175	-1.20	0.229	-3.985684	.9541107

_cons	5.902767	92.72029	0.06	0.949	-175.8257	187.6312
I_id_22ec						
lnlp	-13.38785	299.446	-0.04	0.964	-600.2913	573.5156
lnexpo	4.271405	76.09733	0.06	0.955	-144.8766	153.4194
lngdpcad	58.05734	1155.448	0.05	0.960	-2206.58	2322.695
Year	-.1658023	2.515508	-0.07	0.947	-5.096107	4.764502
I_id_22SR						
ec	-.0196858	.3864817	-0.05	0.959	-.7771761	.7378045
lnlp						
D1.	1.499025	.7068003	2.12	0.034	.1137219	2.884328
lnexpo						
D1.	-.4560644	.3374415	-1.35	0.177	-1.117438	.2053089
lngdpcad						
D1.	-.0544678	.6078808	-0.09	0.929	-1.245892	1.136957
_cons	-18.94276	61.15566	-0.31	0.757	-138.8057	100.9201
I_id_23ec						
lnlp	1.107548	1.773032	0.62	0.532	-2.367531	4.582626
lnexpo	.4821915	1.016904	0.47	0.635	-1.510903	2.475286
lngdpcad	-1.317782	2.113484	-0.62	0.533	-5.460135	2.824571
Year	-.1077705	.089804	-1.20	0.230	-.2837831	.0682422
I_id_23SR						
ec	-.4974607	.4358754	-1.14	0.254	-1.351761	.3568394
lnlp						
D1.	-.569662	.9941305	-0.57	0.567	-2.518122	1.378798
lnexpo						
D1.	.4167591	.423592	0.98	0.325	-.4134658	1.246984
lngdpcad						
D1.	.0054332	1.152456	0.00	0.996	-2.253339	2.264206
_cons	129.5471	95.06726	1.36	0.173	-56.78133	315.8755
I_id_24ec						
lnlp	-1.215177	.5668709	-2.14	0.032	-2.326223	-.1041303
lnexpo	.7616631	.4008781	1.90	0.057	-.0240436	1.54737
lngdpcad	3.477073	1.569752	2.22	0.027	.4004162	6.55373
Year	-.0387114	.0272179	-1.42	0.155	-.0920575	.0146348

I_id_24SR						
ec	-.9012111	.2277758	-3.96	0.000	-1.347644	-.4547787
lnlp						
D1.	.9351004	.5024586	1.86	0.063	-.0497003	1.919901
lnexpo						
D1.	-.625948	.3261107	-1.92	0.055	-1.265113	.0132173
lngdpcad						
D1.	.4454067	1.233044	0.36	0.718	-1.971316	2.862129
_cons	19.93995	41.24214	0.48	0.629	-60.89316	100.7731
I_id_25ec						
lnlp	.9059735	.5720989	1.58	0.113	-.2153198	2.027267
lnexpo	-.9931804	.5132848	-1.93	0.053	-1.9992	.0128394
lngdpcad	1.979375	.2712311	7.30	0.000	1.447772	2.510978
Year	.0819245	.0523006	1.57	0.117	-.0205828	.1844319
I_id_25SR						
ec	-1.550548	.3727187	-4.16	0.000	-2.281064	-.8200332
lnlp						
D1.	-1.086947	.5507716	-1.97	0.048	-2.16644	-.0074545
lnexpo						
D1.	.431046	.5357001	0.80	0.421	-.6189068	1.480999
lngdpcad						
D1.	-.3512852	.5924347	-0.59	0.553	-1.512436	.8098655
_cons	-301.9565	151.2192	-2.00	0.046	-598.3406	-5.572363
I_id_26ec						
lnlp	-2.253598	1.551913	-1.45	0.146	-5.295292	.7880957
lnexpo	.9735465	.9879199	0.99	0.324	-.9627408	2.909834
lngdpcad	-1.431745	1.698035	-0.84	0.399	-4.759833	1.896344
Year	-.1411326	.0947621	-1.49	0.136	-.3268628	.0445977
I_id_26SR						
ec	-1.183393	.3348335	-3.53	0.000	-1.839655	-.5271312
lnlp						
D1.	2.049585	2.062876	0.99	0.320	-1.993578	6.092748
lnexpo						
D1.	-.7778378	1.138835	-0.68	0.495	-3.009912	1.454237

lngdpcad						
D1.	1.770183	2.79234	0.63	0.526	-3.702702	7.243068
_cons	400.6533	301.082	1.33	0.183	-189.4566	990.7631
I_id_27ec						
lnlp	-1.508527	.6873554	-2.19	0.028	-2.855719	-.1613357
lnexpo	.294514	.5138918	0.57	0.567	-.7126954	1.301723
lngdpcad	1.837114	.9047661	2.03	0.042	.0638046	3.610423
Year	-.0006598	.0193983	-0.03	0.973	-.0386799	.0373603
I_id_27SR						
ec	-.7371663	.2288912	-3.22	0.001	-1.185785	-.2885478
lnlp						
D1.	.9332229	.402116	2.32	0.020	.14509	1.721356
lnexpo						
D1.	.4054973	.2032401	2.00	0.046	.007154	.8038406
lngdpcad						
D1.	-1.811863	.7243367	-2.50	0.012	-3.231537	-.3921892
_cons	-14.10911	27.70424	-0.51	0.611	-68.40841	40.1902

(c) Error Correction Model Dependent Variable: Exports

D.lnx	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
ec						
lnlp	.3155219	.186331	1.69	0.090	-.0496802	.680724
lnexpo	.1992366	.0923946	2.16	0.031	.0181466	.3803267
lngdpcad	2.551739	.3503421	7.28	0.000	1.865081	3.238397
I_id_1						
ec	-.0200104	.0789933	-0.25	0.800	-.1748345	.1348137
lnlp						
D1.	.1645649	.1252728	1.31	0.189	-.0809653	.4100951
lnexpo						
D1.	.7661865	.1493902	5.13	0.000	.4733871	1.058986
lngdpcad						
D1.	1.047305	.3951055	2.65	0.008	.2729121	1.821697
_cons	-.7789633	3.128033	-0.25	0.803	-6.909796	5.351869
I_id_2						
ec	-.0850625	.0436228	-1.95	0.051	-.1705616	.0004366

lnlp						
D1.	.0418678	.0993435	0.42	0.673	-.1528418	.2365775
lnexpo						
D1.	.9834132	.0490345	20.06	0.000	.8873073	1.079519
lngdpcad						
D1.	1.357891	.83435	1.63	0.104	-.277405	2.993187
_cons	-3.289406	1.816816	-1.81	0.070	-6.850299	.2714868
I_id_3						
ec	-.6935948	.2084524	-3.33	0.001	-1.102154	-.2850356
lnlp						
D1.	-.090894	.2087353	-0.44	0.663	-.5000077	.3182198
lnexpo						
D1.	.1596269	.120188	1.33	0.184	-.0759373	.3951911
lngdpcad						
D1.	-1.042492	.8199121	-1.27	0.204	-2.649491	.5645057
_cons	-29.78506	10.56046	-2.82	0.005	-50.48319	-9.08693
I_id_4						
ec	-.3169806	.1380359	-2.30	0.022	-.5875259	-.0464352
lnlp						
D1.	.2599738	.5249358	0.50	0.620	-.7688814	1.288829
lnexpo						
D1.	.7599949	.2126844	3.57	0.000	.3431412	1.176849
lngdpcad						
D1.	-1.365205	4.403683	-0.31	0.757	-9.996265	7.265854
_cons	-13.39724	6.300701	-2.13	0.033	-25.74638	-1.048091
I_id_5						
ec	.0899676	.0338005	2.66	0.008	.02372	.1562153
lnlp						
D1.	-.1519138	.1404171	-1.08	0.279	-.4271264	.1232987
lnexpo						
D1.	1.114611	.0563527	19.78	0.000	1.004161	1.22506

lngdpcad						
D1.	1.318398	.416581	3.16	0.002	.5019138	2.134881
_cons	3.897308	1.561921	2.50	0.013	.8359995	6.958616
I_id_6						
ec	-.0101274	.0306502	-0.33	0.741	-.0702006	.0499458
lnlp						
D1.	.2283534	.1352613	1.69	0.091	-.0367538	.4934605
lnexpo						
D1.	.9179461	.0695486	13.20	0.000	.7816333	1.054259
lngdpcad						
D1.	1.801496	.2813211	6.40	0.000	1.250117	2.352875
_cons	-.412405	1.271357	-0.32	0.746	-2.904218	2.079408
I_id_8						
ec	-.094938	.0436879	-2.17	0.030	-.1805647	-.0093112
lnlp						
D1.	.240939	.1842712	1.31	0.191	-.120226	.6021039
lnexpo						
D1.	1.00985	.080212	12.59	0.000	.8526379	1.167063
lngdpcad						
D1.	.2229119	.7219773	0.31	0.758	-1.192138	1.637962
_cons	-3.894848	2.11208	-1.84	0.065	-8.034448	.2447524
I_id_9						
ec	-.0995853	.1178211	-0.85	0.398	-.3305105	.1313399
lnlp						
D1.	.3681872	2.307499	0.16	0.873	-4.154428	4.890803
lnexpo						
D1.	3.492783	1.03285	3.38	0.001	1.468434	5.517132
lngdpcad						
D1.	16.74987	10.57165	1.58	0.113	-3.970169	37.46992
_cons	-4.398347	5.284601	-0.83	0.405	-14.75597	5.959281
I_id_11						
ec	-.1564353	.1127535	-1.39	0.165	-.3774281	.0645575

lnlp						
D1.	.7112332	.4818528	1.48	0.140	-.233181	1.655647
lnexpo						
D1.	.3669227	.274551	1.34	0.181	-.1711874	.9050327
lngdpcad						
D1.	-.1164718	1.137804	-0.10	0.918	-2.346527	2.113584
_cons	-6.412118	4.508986	-1.42	0.155	-15.24957	2.425333
I_id_12						
ec	-.3286739	.1437961	-2.29	0.022	-.610509	-.0468388
lnlp						
D1.	.0541571	.4583458	0.12	0.906	-.8441841	.9524984
lnexpo						
D1.	1.382713	.4412469	3.13	0.002	.5178854	2.247541
lngdpcad						
D1.	2.59424	1.028287	2.52	0.012	.5788343	4.609647
_cons	-13.2727	6.911547	-1.92	0.055	-26.81909	.2736803
I_id_13						
ec	.026477	.1476865	0.18	0.858	-.2629832	.3159372
lnlp						
D1.	.6082809	.2353496	2.58	0.010	.1470041	1.069558
lnexpo						
D1.	-.1508324	.102304	-1.47	0.140	-.3513446	.0496797
lngdpcad						
D1.	-.1727151	.6273001	-0.28	0.783	-1.402201	1.05677
_cons	1.056074	6.004557	0.18	0.860	-10.71264	12.82479
I_id_15						
ec	-.0281379	.0501027	-0.56	0.574	-.1263374	.0700616
lnlp						
D1.	.5264792	.1407479	3.74	0.000	.2506184	.8023399
lnexpo						
D1.	.8704865	.0716351	12.15	0.000	.7300844	1.010889

lngdpcad						
D1.	.3041267	.6859496	0.44	0.658	-1.04031	1.648563
_cons	-1.134766	2.094308	-0.54	0.588	-5.239534	2.970001
I_id_16						
ec	-.0495229	.1296627	-0.38	0.703	-.3036571	.2046112
lnlp						
D1.	.3099061	.5464917	0.57	0.571	-.761198	1.38101
lnexpo						
D1.	1.368713	.3336752	4.10	0.000	.7147214	2.022704
lngdpcad						
D1.	.6800467	1.432498	0.47	0.635	-2.127598	3.487691
_cons	-2.142311	5.436442	-0.39	0.694	-12.79754	8.51292
I_id_17						
ec	-.5475401	.162149	-3.38	0.001	-.8653463	-.2297339
lnlp						
D1.	.696386	.4511447	1.54	0.123	-.1878414	1.580613
lnexpo						
D1.	.4530134	.3282712	1.38	0.168	-.1903864	1.096413
lngdpcad						
D1.	-2.769838	1.431678	-1.93	0.053	-5.575875	.036199
_cons	-23.14658	7.949385	-2.91	0.004	-38.72709	-7.566067
I_id_18						
ec	-.596356	.2785017	-2.14	0.032	-1.142209	-.0505027
lnlp						
D1.	.3552044	.6234304	0.57	0.569	-.8666967	1.577105
lnexpo						
D1.	-.1347759	.3303509	-0.41	0.683	-.7822518	.5127001
lngdpcad						
D1.	-.5240217	1.408813	-0.37	0.710	-3.285244	2.2372
_cons	-24.8372	12.5098	-1.99	0.047	-49.35595	-.3184464
I_id_19						
ec	-.930332	.1864153	-4.99	0.000	-1.295699	-.5649646

lnlp						
D1.	-.0507662	.391317	-0.13	0.897	-.8177334	.7162011
lnexpo						
D1.	-.3105978	.3455105	-0.90	0.369	-.987786	.3665904
lngdpcad						
D1.	-2.167719	.8652991	-2.51	0.012	-3.863674	-.4717641
_cons	-40.37252	9.803003	-4.12	0.000	-59.58605	-21.15898
I_id_20						
ec	-.3042447	.2727133	-1.12	0.265	-.8387528	.2302635
lnlp						
D1.	.7488124	.3774066	1.98	0.047	.0091091	1.488516
lnexpo						
D1.	1.240723	.5315435	2.33	0.020	.198917	2.282529
lngdpcad						
D1.	-2.434518	.9190731	-2.65	0.008	-4.235868	-.6331681
_cons	-12.55066	11.34673	-1.11	0.269	-34.78984	9.688512
I_id_23						
ec	-.2176314	.0909738	-2.39	0.017	-.3959368	-.039326
lnlp						
D1.	-.1578717	.7263302	-0.22	0.828	-1.581453	1.265709
lnexpo						
D1.	.7030573	.2349394	2.99	0.003	.2425846	1.16353
lngdpcad						
D1.	-.7836374	.7534752	-1.04	0.298	-2.260422	.6931469
_cons	-8.922347	3.781033	-2.36	0.018	-16.33304	-1.511658
I_id_25						
ec	-.6988924	.2366744	-2.95	0.003	-1.162766	-.2350191
lnlp						
D1.	-.0497682	.4328173	-0.11	0.908	-.8980746	.7985382
lnexpo						
D1.	-.2204759	.3034014	-0.73	0.467	-.8151316	.3741798

lngdpcad						
D1.	-.0848108	.5725114	-0.15	0.882	-1.206912	1.037291
_cons	-31.24341	11.78125	-2.65	0.008	-54.33424	-8.152588
I_id_27						
ec	-.3259503	.1416036	-2.30	0.021	-.6034884	-.0484123
lnlp						
D1.	.0705015	.415861	0.17	0.865	-.7445712	.8855742
lnexpo						
D1.	.4332934	.1631113	2.66	0.008	.1136011	.7529857
lngdpcad						
D1.	-.8706193	.908108	-0.96	0.338	-2.650478	.9092398
_cons	-13.92586	6.332602	-2.20	0.028	-26.33753	-1.514184

Manitoba

(d) Error Correction Model Dependent Variable: Productivity

D.lnlp	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
ec						
lnx	.2045024	.0218395	9.36	0.000	.1616978	.247307
lnexpo	-.6349506	.0319939	-19.85	0.000	-.6976574	-.5722438
lngdpcad	.1981112	.0464897	4.26	0.000	.1069931	.2892293
Year	.0316785	.0010734	29.51	0.000	.0295746	.0337824
I_id_1						
ec	-.8729896	.3605276	-2.42	0.015	-1.579611	-.1663685
lnx						
D1.	.0031756	.1545273	0.02	0.984	-.2996923	.3060434
lnexpo						
D1.	-.0941981	.2249166	-0.42	0.675	-.5350266	.3466304
lngdpcad						
D1.	.2965764	.4843334	0.61	0.540	-.6526996	1.245852
_cons	-59.59512	24.71811	-2.41	0.016	-108.0417	-11.14851
I_id_2						
ec	-.6038678	.137445	-4.39	0.000	-.873255	-.3344806
lnx						

D1.	.0712705	.2135661	0.33	0.739	-.3473113	.4898523
lnexpo						
D1.	.1000752	.2025817	0.49	0.621	-.2969776	.497128
lngdpcad						
D1.	-.5885019	.4912965	-1.20	0.231	-1.551425	.3744216
_cons	-41.8641	9.459509	-4.43	0.000	-60.4044	-23.32381
I_id_3						
ec	.0142979	.0755174	0.19	0.850	-.1337135	.1623093
lnx						
D1.	.0703985	.0514383	1.37	0.171	-.0304186	.1712156
lnexpo						
D1.	-.0249539	.0700204	-0.36	0.722	-.1621914	.1122835
lngdpcad						
D1.	-.3490426	.3890092	-0.90	0.370	-1.111487	.4134015
_cons	.9879991	5.20144	0.19	0.849	-9.206635	11.18263
I_id_4						
ec	-.2112274	.1430106	-1.48	0.140	-.491523	.0690682
lnx						
D1.	.3072957	.2222497	1.38	0.167	-.1283057	.7428971
lnexpo						
D1.	-.334282	.1827102	-1.83	0.067	-.6923874	.0238234
lngdpcad						
D1.	-.1698427	.643422	-0.26	0.792	-1.430927	1.091241
_cons	-14.34679	9.699407	-1.48	0.139	-33.35728	4.663694
I_id_5						
ec	-.3152879	.1877082	-1.68	0.093	-.6831892	.0526135
lnx						
D1.	-.0534146	.2403479	-0.22	0.824	-.5244878	.4176586
lnexpo						
D1.	-.1398683	.3371851	-0.41	0.678	-.800739	.5210025
lngdpcad						
D1.	-2.00781	2.406202	-0.83	0.404	-6.723879	2.708258

_cons	-20.60411	12.31745	-1.67	0.094	-44.74587	3.537646
I_id_6						
ec	-.4515553	.1512159	-2.99	0.003	-.747933	-.1551777
lnx						
D1.	.1662359	.0902695	1.84	0.066	-.0106892	.3431609
lnexpo						
D1.	-.0529133	.1257512	-0.42	0.674	-.2993812	.1935545
lngdpcad						
D1.	-.3396723	.2700623	-1.26	0.208	-.8689847	.1896401
_cons	-30.69504	10.20488	-3.01	0.003	-50.69623	-10.69385
I_id_7						
ec	-.1769673	.0896012	-1.98	0.048	-.3525825	-.0013521
lnx						
D1.	.5465332	.0900865	6.07	0.000	.3699669	.7230994
lnexpo						
D1.	-.1264675	.1191624	-1.06	0.289	-.3600214	.1070865
lngdpcad						
D1.	-.4784469	.7412702	-0.65	0.519	-1.93131	.974416
_cons	-12.08525	6.11531	-1.98	0.048	-24.07104	-.0994651
I_id_8						
ec	-.0060136	.0476981	-0.13	0.900	-.0995002	.087473
lnx						
D1.	.6748441	.146479	4.61	0.000	.3877506	.9619377
lnexpo						
D1.	-.4490989	.1163144	-3.86	0.000	-.6770709	-.2211268
lngdpcad						
D1.	.9017982	.4270349	2.11	0.035	.0648251	1.738771
_cons	-.4764242	3.251801	-0.15	0.884	-6.849837	5.896988
I_id_9						
ec	-.5885169	.1738211	-3.39	0.001	-.9292	-.2478338
lnx						

D1.	-.1273385	.0489202	-2.60	0.009	-.2232202	-.0314567
lnexpo						
D1.	.1474223	.1613391	0.91	0.361	-.1687965	.4636411
lngdpcad						
D1.	-.8633463	.7616673	-1.13	0.257	-2.356187	.6294942
_cons	-39.61067	11.8319	-3.35	0.001	-62.80078	-16.42057
I_id_10						
ec	-.1532694	.079269	-1.93	0.053	-.3086337	.0020949
lnx						
D1.	.0012058	.1263154	0.01	0.992	-.2463679	.2487795
lnexpo						
D1.	-.0165285	.346818	-0.05	0.962	-.6962793	.6632223
lngdpcad						
D1.	.2401893	.5164355	0.47	0.642	-.7720056	1.252384
_cons	-10.14638	5.276975	-1.92	0.055	-20.48906	.1963014
I_id_11						
ec	.0598013	.0798735	0.75	0.454	-.096748	.2163505
lnx						
D1.	-.0448923	.0706708	-0.64	0.525	-.1834045	.0936199
lnexpo						
D1.	-.1227556	.1053654	-1.17	0.244	-.329268	.0837568
lngdpcad						
D1.	1.126466	.3666137	3.07	0.002	.407916	1.845015
_cons	4.181449	5.387164	0.78	0.438	-6.377199	14.7401
I_id_12						
ec	-.5788518	.1905749	-3.04	0.002	-.9523717	-.2053318
lnx						
D1.	.0696962	.0580495	1.20	0.230	-.0440786	.183471
lnexpo						
D1.	.0444938	.1208772	0.37	0.713	-.1924212	.2814088
lngdpcad						
D1.	.298564	.2267632	1.32	0.188	-.1458837	.7430117

_cons	-39.47896	13.13397	-3.01	0.003	-65.22106	-13.73686
I_id_13						
ec	-.4514208	.1620856	-2.79	0.005	-.7691028	-.1337388
lnx						
D1.	.2159483	.1235673	1.75	0.081	-.0262392	.4581358
lnexpo						
D1.	-.1002664	.2011967	-0.50	0.618	-.4946047	.294072
lngdpcad						
D1.	-.3928774	.2091366	-1.88	0.060	-.8027775	.0170227
_cons	-30.48882	10.94511	-2.79	0.005	-51.94084	-9.036798
I_id_14						
ec	-.6354821	.2593044	-2.45	0.014	-1.143709	-.1272549
lnx						
D1.	-.1703876	.2108922	-0.81	0.419	-.5837287	.2429534
lnexpo						
D1.	.1697399	.1692558	1.00	0.316	-.1619955	.5014752
lngdpcad						
D1.	.5477234	.3059196	1.79	0.073	-.0518681	1.147315
_cons	-43.60055	17.66891	-2.47	0.014	-78.23098	-8.970127
I_id_15						
ec	-.507951	.2095857	-2.42	0.015	-.9187314	-.0971706
lnx						
D1.	.240722	.3472787	0.69	0.488	-.4399317	.9213757
lnexpo						
D1.	.1415151	.1550059	0.91	0.361	-.1622908	.4453211
lngdpcad						
D1.	3.835737	2.476549	1.55	0.121	-1.01821	8.689684
_cons	-33.00412	13.70926	-2.41	0.016	-59.87378	-6.134457
I_id_16						
ec	-.2629604	.1978687	-1.33	0.184	-.6507758	.124855
lnx						

D1.	.0810478	.0662884	1.22	0.221	-.048875	.2109706
lnexpo						
D1.	-.3988114	.1792647	-2.22	0.026	-.7501638	-.047459
lngdpcad						
D1.	.449746	.3446501	1.30	0.192	-.2257558	1.125248
_cons	-17.53975	13.242	-1.32	0.185	-43.49358	8.414086
I_id_17						
ec	-.5037153	.1162811	-4.33	0.000	-.7316221	-.2758085
lnx						
D1.	.4901987	.179521	2.73	0.006	.1383441	.8420534
lnexpo						
D1.	-.1312512	.1855799	-0.71	0.479	-.4949812	.2324787
lngdpcad						
D1.	-.0250179	.2123478	-0.12	0.906	-.441212	.3911762
_cons	-34.13557	7.890233	-4.33	0.000	-49.60014	-18.67099
I_id_18						
ec	-.311326	.2086803	-1.49	0.136	-.7203318	.0976798
lnx						
D1.	.0008682	.0868025	0.01	0.992	-.1692615	.1709979
lnexpo						
D1.	-.3356152	.140265	-2.39	0.017	-.6105295	-.060701
lngdpcad						
D1.	.1605599	.3892522	0.41	0.680	-.6023604	.9234802
_cons	-20.48757	13.76521	-1.49	0.137	-47.46689	6.491756
I_id_19						
ec	-.1012748	.184222	-0.55	0.582	-.4623433	.2597937
lnx						
D1.	-.0473457	.0901765	-0.53	0.600	-.2240885	.129397
lnexpo						
D1.	-.1921577	.222331	-0.86	0.387	-.6279185	.243603
lngdpcad						
D1.	.3733286	.3935948	0.95	0.343	-.398103	1.14476

_cons	-6.832716	12.40474	-0.55	0.582	-31.14555	17.48012
I_id_20						
ec	-.1159324	.1229972	-0.94	0.346	-.3570024	.1251377
lnx						
D1.	.3631917	.1276366	2.85	0.004	.1130286	.6133547
lnexpo						
D1.	-.2170797	.2216336	-0.98	0.327	-.6514735	.2173141
lngdpcad						
D1.	-.3532616	.357749	-0.99	0.323	-1.054437	.3479135
_cons	-7.806028	8.250332	-0.95	0.344	-23.97638	8.364325
I_id_21						
ec	-.1662387	.1555794	-1.07	0.285	-.4711688	.1386913
lnx						
D1.	-.0341379	.1099227	-0.31	0.756	-.2495824	.1813066
lnexpo						
D1.	-.1500011	.124694	-1.20	0.229	-.3943969	.0943946
lngdpcad						
D1.	.1494512	.1562862	0.96	0.339	-.1568641	.4557665
_cons	-11.25901	10.56958	-1.07	0.287	-31.975	9.456979
I_id_22						
ec	-1.386786	.1745324	-7.95	0.000	-1.728863	-1.044709
lnx						
D1.	.0471951	.0908388	0.52	0.603	-.1308458	.2252359
lnexpo						
D1.	.4271233	.0901442	4.74	0.000	.250444	.6038026
lngdpcad						
D1.	-.2309609	.0985076	-2.34	0.019	-.4240322	-.0378895
_cons	-93.53288	11.81977	-7.91	0.000	-116.6992	-70.36655
I_id_23						
ec	-.1344736	.1190315	-1.13	0.259	-.3677711	.0988239
lnx						

D1.	-.0663307	.2931328	-0.23	0.821	-.6408604	.5081991
lnexpo						
D1.	-.2732327	.230277	-1.19	0.235	-.7245673	.1781019
lngdpcad						
D1.	.510738	.5826089	0.88	0.381	-.6311545	1.65263
_cons	-8.860151	7.919964	-1.12	0.263	-24.383	6.662693
I_id_24						
ec	-.1505839	.1158171	-1.30	0.194	-.3775811	.0764134
lnx						
D1.	.1396807	.2044797	0.68	0.495	-.2610921	.5404535
lnexpo						
D1.	-.2035445	.1564207	-1.30	0.193	-.5101234	.1030344
lngdpcad						
D1.	.1564914	.3445387	0.45	0.650	-.5187921	.8317749
_cons	-10.03813	7.746609	-1.30	0.195	-25.2212	5.144947
I_id_25						
ec	-.2966135	.1870913	-1.59	0.113	-.6633057	.0700787
lnx						
D1.	-.0228823	.1147413	-0.20	0.842	-.2477712	.2020065
lnexpo						
D1.	-.0750337	.0951895	-0.79	0.431	-.2616017	.1115344
lngdpcad						
D1.	.2067338	.1446443	1.43	0.153	-.0767639	.4902315
_cons	-20.14243	12.72401	-1.58	0.113	-45.08103	4.796165
I_id_26						
ec	-.3048432	.2126148	-1.43	0.152	-.7215606	.1118742
lnx						
D1.	.0653191	.1257757	0.52	0.604	-.1811968	.311835
lnexpo						
D1.	-.1338282	.1612154	-0.83	0.406	-.4498045	.1821482
lngdpcad						
D1.	.3833475	.3055088	1.25	0.210	-.2154387	.9821338

_cons	-20.83578	14.5783	-1.43	0.153	-49.40873	7.737163
I_id_27						
ec	-.4003078	.2255657	-1.77	0.076	-.8424085	.041793
lnx						
D1.	-.0495848	.1275239	-0.39	0.697	-.2995271	.2003574
lnexpo						
D1.	-.342918	.2212428	-1.55	0.121	-.7765459	.0907099
lngdpcad						
D1.	.5119375	.8565327	0.60	0.550	-1.166836	2.190711
_cons	-26.85245	15.15168	-1.77	0.076	-56.5492	2.844307

(e) Error Correction Model Dependent Variable: Exports

D.lnx	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
ec						
lnlp	.6951967	.0801395	8.67	0.000	.5381261	.8522672
lnexpo	1.183331	.0406716	29.09	0.000	1.103617	1.263046
lngdpcad	1.345207	.1161352	11.58	0.000	1.117587	1.572828
Year	-.0306097	.0025923	-11.81	0.000	-.0356905	-.0255288
I_id_1						
ec	-.7200447	.2535905	-2.84	0.005	-1.217073	-.2230165
lnlp						
D1.	-.0988445	.3110953	-0.32	0.751	-.7085801	.5108911
lnexpo						
D1.	.2756096	.2566784	1.07	0.283	-.2274707	.77869
lngdpcad						
D1.	.4086804	.5190586	0.79	0.431	-.6086557	1.426017
_cons	34.31135	12.72535	2.70	0.007	9.370118	59.25259
I_id_2						
ec	-.9517027	.0793687	-11.99	0.000	-1.107262	-.796143
lnlp						
D1.	-.0649309	.0648569	-1.00	0.317	-.1920482	.0621863
lnexpo						
D1.	-.054202	.08403	-0.65	0.519	-.2188978	.1104939

lngdpcad						
D1.	-.9638315	.2005245	-4.81	0.000	-1.356852	-.5708107
_cons	47.25435	5.901685	8.01	0.000	35.68726	58.82144
I_id_3						
ec	-.2769076	.1530534	-1.81	0.070	-.5768867	.0230716
lnlp						
D1.	.8794724	.9876859	0.89	0.373	-1.056356	2.815301
lnexpo						
D1.	.3858571	.2651507	1.46	0.146	-.1338287	.9055428
lngdpcad						
D1.	1.142967	1.637193	0.70	0.485	-2.065871	4.351806
_cons	12.52643	7.143184	1.75	0.079	-1.473953	26.52682
I_id_4						
ec	.0171473	.0664444	0.26	0.796	-.1130813	.1473759
lnlp						
D1.	.4876876	.2185504	2.23	0.026	.0593366	.9160385
lnexpo						
D1.	.707161	.1164167	6.07	0.000	.4789884	.9353336
lngdpcad						
D1.	-.0272453	.6993475	-0.04	0.969	-1.397941	1.343451
_cons	-.8087368	3.118433	-0.26	0.795	-6.920753	5.30328
I_id_5						
ec	-.6107685	.1491657	-4.09	0.000	-.903128	-.318409
lnlp						
D1.	-.3361274	.1791376	-1.88	0.061	-.6872306	.0149759
lnexpo						
D1.	.701433	.1741796	4.03	0.000	.3600472	1.042819
lngdpcad						
D1.	-1.554443	1.873499	-0.83	0.407	-5.226434	2.117548
_cons	26.14161	7.195522	3.63	0.000	12.03864	40.24457
I_id_6						

ec	-.1649159	.1862385	-0.89	0.376	-.5299365	.2001048
lnlp						
D1.	.9637572	.4105142	2.35	0.019	.1591641	1.76835
lnexpo						
D1.	.8876737	.2340743	3.79	0.000	.4288966	1.346451
lngdpcad						
D1.	-.0848512	.635377	-0.13	0.894	-1.330167	1.160465
_cons	7.505298	8.567861	0.88	0.381	-9.287401	24.298
I_id_7						
ec	-.2394887	.0946918	-2.53	0.011	-.4250813	-.0538961
lnlp						
D1.	.9538086	.176973	5.39	0.000	.6069479	1.300669
lnexpo						
D1.	.0211443	.1755347	0.12	0.904	-.3228974	.365186
lngdpcad						
D1.	1.194477	.9307582	1.28	0.199	-.6297755	3.01873
_cons	11.14871	4.612701	2.42	0.016	2.107984	20.18944
I_id_8						
ec	-.060994	.0504592	-1.21	0.227	-.1598921	.0379042
lnlp						
D1.	.7777736	.1761386	4.42	0.000	.4325483	1.122999
lnexpo						
D1.	.5834681	.0894487	6.52	0.000	.408152	.7587843
lngdpcad						
D1.	-.641485	.4751745	-1.35	0.177	-1.57281	.2898399
_cons	2.93694	2.365648	1.24	0.214	-1.699645	7.573525
I_id_9						
ec	-.0921231	.1781783	-0.52	0.605	-.4413462	.2571
lnlp						
D1.	-.2200198	1.220477	-0.18	0.857	-2.61211	2.172071
lnexpo						
D1.	-.8149456	.9291864	-0.88	0.380	-2.636117	1.006226

lngdpcad						
D1.	-9.211788	4.167883	-2.21	0.027	-17.38069	-1.042888
_cons	3.801594	7.66046	0.50	0.620	-11.21263	18.81582
I_id_10						
ec	-.1052994	.1319185	-0.80	0.425	-.3638549	.1532562
lnlp						
D1.	.2434979	.4316822	0.56	0.573	-.6025837	1.089579
lnexpo						
D1.	-.2188731	.6623469	-0.33	0.741	-1.517049	1.079303
lngdpcad						
D1.	.9924301	1.021558	0.97	0.331	-1.009787	2.994647
_cons	4.667563	5.818603	0.80	0.422	-6.736689	16.07182
I_id_11						
ec	-.2528819	.1185447	-2.13	0.033	-.4852252	-.0205387
lnlp						
D1.	-.6065181	.7447777	-0.81	0.415	-2.066255	.8532193
lnexpo						
D1.	.2051968	.3573832	0.57	0.566	-.4952615	.9056551
lngdpcad						
D1.	3.344215	1.190722	2.81	0.005	1.010442	5.677989
_cons	12.08899	5.745113	2.10	0.035	.8287755	23.34921
I_id_12						
ec	-.3469551	.1033568	-3.36	0.001	-.5495308	-.1443795
lnlp						
D1.	.3411856	.6154444	0.55	0.579	-.8650634	1.547435
lnexpo						
D1.	-.4410041	.3141926	-1.40	0.160	-1.05681	.1748021
lngdpcad						
D1.	1.521137	.6414194	2.37	0.018	.2639783	2.778296
_cons	16.19478	5.352049	3.03	0.002	5.704959	26.68461
I_id_13						

ec	-.7350763	.2506254	-2.93	0.003	-1.226293	-.2438595
lnlp						
D1.	.537291	.2811186	1.91	0.056	-.0136914	1.088273
lnexpo						
D1.	.1482695	.3429543	0.43	0.666	-.5239086	.8204476
lngdpcad						
D1.	.0682145	.4401844	0.15	0.877	-.794531	.9309601
_cons	33.4905	12.34617	2.71	0.007	9.292445	57.68855
I_id_14						
ec	.1420371	.0640281	2.22	0.027	.0165442	.2675299
lnlp						
D1.	-.0113375	.224159	-0.05	0.960	-.4506811	.4280062
lnexpo						
D1.	.5242038	.1196002	4.38	0.000	.2897917	.7586158
lngdpcad						
D1.	.7363773	.3127061	2.35	0.019	.1234847	1.34927
_cons	-6.811489	3.23389	-2.11	0.035	-13.1498	-.4731802
I_id_15						
ec	.0327631	.1400682	0.23	0.815	-.2417655	.3072917
lnlp						
D1.	.2536949	.1437288	1.77	0.078	-.0280083	.5353981
lnexpo						
D1.	.1092213	.1176981	0.93	0.353	-.1214628	.3399054
lngdpcad						
D1.	-.0177826	1.912339	-0.01	0.993	-3.765898	3.730333
_cons	-1.416114	5.851193	-0.24	0.809	-12.88424	10.05201
I_id_16						
ec	-.457024	.2152693	-2.12	0.034	-.8789441	-.0351039
lnlp						
D1.	.979052	.749587	1.31	0.192	-.4901116	2.448216
lnexpo						
D1.	1.78346	.5257257	3.39	0.001	.753057	2.813864

lngdpcad						
D1.	.381337	1.225055	0.31	0.756	-2.019728	2.782402
_cons	20.63318	9.902235	2.08	0.037	1.225156	40.04121
I_id_17						
ec	-.1254049	.0740362	-1.69	0.090	-.2705133	.0197035
lnlp						
D1.	.3962162	.1638543	2.42	0.016	.0750678	.7173647
lnexpo						
D1.	.4213863	.1824919	2.31	0.021	.0637089	.7790638
lngdpcad						
D1.	.2644972	.2260717	1.17	0.242	-.1785952	.7075896
_cons	5.871729	3.521275	1.67	0.095	-1.029843	12.7733
I_id_18						
ec	-.423825	.1637096	-2.59	0.010	-.74469	-.10296
lnlp						
D1.	.1118976	.5429769	0.21	0.837	-.9523175	1.176113
lnexpo						
D1.	-.2042802	.382119	-0.53	0.593	-.9532197	.5446594
lngdpcad						
D1.	1.563843	.8433285	1.85	0.064	-.0890504	3.216737
_cons	18.43927	7.610715	2.42	0.015	3.52254	33.35599
I_id_19						
ec	-.4941739	.1919461	-2.57	0.010	-.8703813	-.1179665
lnlp						
D1.	-.9230417	.5816448	-1.59	0.113	-2.063045	.2169611
lnexpo						
D1.	-.019867	.5059299	-0.04	0.969	-1.011471	.9717374
lngdpcad						
D1.	1.156621	.8719575	1.33	0.185	-.552384	2.865626
_cons	21.91389	9.285369	2.36	0.018	3.714906	40.11288
I_id_20						

ec	-.4519626	.2183271	-2.07	0.038	-.8798759	-.0240493
lnlp						
D1.	.5267246	.3697751	1.42	0.154	-.1980214	1.251471
lnexpo						
D1.	.2368992	.456587	0.52	0.604	-.6579948	1.131793
lngdpcad						
D1.	.4138186	.5484301	0.75	0.451	-.6610846	1.488722
_cons	20.89334	10.42773	2.00	0.045	.4553665	41.33131
I_id_21						
ec	-.1173717	.2118416	-0.55	0.580	-.5325736	.2978302
lnlp						
D1.	.142458	.578684	0.25	0.806	-.9917417	1.276658
lnexpo						
D1.	.6432919	.2844098	2.26	0.024	.085859	1.200725
lngdpcad						
D1.	.6470669	.346388	1.87	0.062	-.0318412	1.325975
_cons	5.321099	9.585687	0.56	0.579	-13.4665	24.1087
I_id_22						
ec	-.202886	.0580156	-3.50	0.000	-.3165945	-.0891775
lnlp						
D1.	.7569813	.1907991	3.97	0.000	.3830219	1.130941
lnexpo						
D1.	-.1784755	.1299149	-1.37	0.170	-.4331041	.076153
lngdpcad						
D1.	.5673188	.1684008	3.37	0.001	.2372592	.8973784
_cons	9.27013	2.983216	3.11	0.002	3.423134	15.11713
I_id_23						
ec	-.1273444	.1173942	-1.08	0.278	-.3574328	.1027441
lnlp						
D1.	-.2120237	.2165461	-0.98	0.328	-.6364463	.2123989
lnexpo						
D1.	.0437987	.1909446	0.23	0.819	-.3304459	.4180432

lngdpcad						
D1.	.5846945	.4760446	1.23	0.219	-.3483358	1.517725
_cons	5.607347	5.246378	1.07	0.285	-4.675365	15.89006
I_id_24						
ec	-.2180138	.102008	-2.14	0.033	-.4179459	-.0180818
lnlp						
D1.	.1242093	.2392163	0.52	0.604	-.3446461	.5930647
lnexpo						
D1.	.0620567	.1815785	0.34	0.733	-.2938307	.4179441
lngdpcad						
D1.	.1781922	.3599612	0.50	0.621	-.5273188	.8837032
_cons	9.891008	4.752707	2.08	0.037	.5758725	19.20614
I_id_25						
ec	-.4456536	.102624	-4.34	0.000	-.646793	-.2445143
lnlp						
D1.	-.3152143	.3379184	-0.93	0.351	-.9775223	.3470936
lnexpo						
D1.	.4022209	.146116	2.75	0.006	.1158389	.688603
lngdpcad						
D1.	-.1560718	.2501785	-0.62	0.533	-.6464126	.334269
_cons	20.42765	5.442427	3.75	0.000	9.760686	31.09461
I_id_26						
ec	-.2341306	.1607716	-1.46	0.145	-.5492372	.080976
lnlp						
D1.	-.2178286	.4769736	-0.46	0.648	-1.15268	.7170226
lnexpo						
D1.	.2200805	.3125788	0.70	0.481	-.3925626	.8327236
lngdpcad						
D1.	1.510611	.4506331	3.35	0.001	.6273866	2.393836
_cons	11.16672	7.72659	1.45	0.148	-3.977119	26.31056
I_id_27						

ec	-.2020463	.1074364	-1.88	0.060	-.4126177	.0085252
lnlp						
D1.	-.0265256	.3913008	-0.07	0.946	-.7934611	.7404098
lnexpo						
D1.	.3160241	.3740972	0.84	0.398	-.417193	1.049241
lngdpcad						
D1.	-.4324891	1.442836	-0.30	0.764	-3.260396	2.395418
_cons	9.173165	5.049388	1.82	0.069	-.7234544	19.06978

APPENDIX 3: Stata Do-file

Saskatchewan

```
clear all
cd "C:\Users\nma380\Desktop\Analysis"
import excel "C:\Users\nma380\Desktop\Analysis\Saskatchewan.xlsx",
sheet("Sheet1") firstrow
capture log close
log using "Saskatchewan.txt", text replace
xtset I_id Year , yearly
rename Exports X
rename Imports IN
rename GDPofSaskatchewan GDPSK
rename Exposure EXPO
rename LabourProductivity LP
rename GDPofCanada GDPCAD
gen lnx = ln( X )
gen lnlp = ln( LP )
gen lngdpcad = ln( GDPCAD )
gen lnexpo = ln( EXPO )
gen id1= I_id if I_id < 5
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id1)
gen id2= I_id if I_id > 4 & I_id < 8
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id2)
gen id3= I_id if I_id > 7 & I_id < 12
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id3)
gen id4= I_id if I_id > 11 & I_id < 20
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id4)
gen id5= I_id if I_id > 19
```

```
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id5)
sum lnlp lnexpo lnx lngdpcad
correlate lnlp lnexpo lnx lngdpcad
xtcsi lnx lnlp lngdpcad lnexpo , trend
xtcips lnx , maxlags(8) bglags(1) trend
xtcips lnlp , maxlags(8) bglags(1) trend
xtcips lngdpcad , maxlags(8) bglags(1) trend
xtcips lnexpo , maxlags(8) bglags(1) trend
xtcips D.lnx , maxlags(8) bglags(1)
xtcips D.lnlp , maxlags(8) bglags(1)
xtcips D.lngdpcad , maxlags(8) bglags(1)
xtcips D.lnexpo , maxlags(8) bglags(1)
xtcointtest kao lnlp lnx  lnexpo lngdpcad, lags(bic 1)
xtcointtest pedroni lnlp lnx  lnexpo lngdpcad, trend lags(bic 1)
xtpmg d(lnlp lnx lnexpo lngdpcad), lr(l.lnlp lnx lnexpo lngdpcad Year)
ec(ec) replace full dif pmg
drop ec
drop _est_PMG
drop _est_pmg
xtpmg d(lnlp lnx lnexpo lngdpcad), lr(l.lnlp lnx lnexpo lngdpcad Year)
ec(ec) replace dif pmg
test _b[SR:D.lnx] = 0, notest
test _b[SR:ec] = 0, accum
drop ec
drop _est_PMG
drop _est_pmg
xtpmg d(lnx lnlp lnexpo lngdpcad), lr(l.lnx lnlp lnexpo lngdpcad Year)
ec(ec) replace full dif pmg
drop ec
drop _est_PMG
drop _est_pmg
xtpmg2 d(lnx lnlp lnexpo lngdpcad), lr(l.lnx lnlp lnexpo lngdpcad
Year) ec(ec) full dif mg
clear all
import excel "C:\Users\nma380\Desktop\Analysis\Saskatchewan2.xlsx",
sheet("Sheet1") firstrow
xtset I_id Year , yearly
rename Exports X
rename Imports IN
rename GDPofSaskatchewan GDPSK
rename Exposure EXPO
rename LabourProductivity LP
rename GDPofCanada GDPCAD
gen lnx = ln( X )
gen lnlp = ln( LP )
gen lngdpcad = ln( GDPCAD )
gen lnexpo = ln( EXPO )
```

```
xtpmg d(lnx lnlp lnexpo lngdpcad), lr(l.lnx lnlp lnexpo lngdpcad)
ec(ec) replace dif pmg
test _b[SR:D.lnlp] = 0, notest
test _b[SR:ec] = 0, accum
```

Manitoba

```
clear all
cd "C:\Users\nma380\Desktop\Analysis"
import excel "C:\Users\nma380\Desktop\Analysis\Manitoba.xlsx",
sheet("Sheet1") firstrow
capture log close
log using "Manitoba.txt", text replace
xtset I_id Year , yearly
rename Exports X
rename Imports IN
rename GDPofManitoba GDPMB
rename Exposure EXPO
rename LabourProductivity LP
rename GDPofCanada GDPCAD
gen lnx = ln( X )
gen lnlp = ln( LP )
gen lngdpcad = ln( GDPCAD )
gen lnexpo = ln( EXPO )
gen id1= I_id if I_id < 5
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id1)
gen id2= I_id if I_id > 4 & I_id < 8
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id2)
gen id3= I_id if I_id > 7 & I_id < 12
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id3)
gen id4= I_id if I_id > 11 & I_id < 20
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id4)
gen id5= I_id if I_id > 19
graph two (line lnx Year, yaxis(1)) (line lnlp Year, yaxis(2)), by
(id5)
sum lnlp lnexpo lnx lngdpcad
correlate lnlp lnexpo lnx lngdpcad
xtcsi lnx lnlp lngdpcad lnexpo , trend
xtcips lnx , maxlags(8) bglags(1) trend
xtcips lnlp , maxlags(8) bglags(1) trend
xtcips lnexpo , maxlags(8) bglags(1) trend
xtcips lngdpcad , maxlags(8) bglags(1) trend
xtcips D.lnx , maxlags(8) bglags(1)
xtcips D.lnlp , maxlags(8) bglags(1)
```

```
xtcips D.lngdpcad , maxlags(8) bglags(1)
xtcips D.lnexpo , maxlags(8) bglags(1)
xtcointtest kao lnlp lnx  lnexpo lngdpcad, lags(bic 1)
xtcointtest pedroni lnlp lnx  lnexpo lngdpcad, trend lags(bic 1)
xtpmg d(lnlp lnx lnexpo lngdpcad), lr(l.lnlp lnx lnexpo lngdpcad Year)
ec(ec) replace full dif pmg
drop ec
drop _est_PMG
drop _est_pmg
xtpmg d(lnlp lnx lnexpo lngdpcad), lr(l.lnlp lnx lnexpo lngdpcad Year)
ec(ec) replace dif pmg
test _b[SR:D.lnx] = 0, notest
test _b[SR:ec] = 0, accum
drop ec
drop _est_PMG
drop _est_pmg
xtpmg d(lnx lnlp lnexpo lngdpcad), lr(l.lnx lnlp lnexpo lngdpcad Year)
ec(ec) replace full dif pmg
drop ec
drop _est_PMG
drop _est_pmg
xtpmg d(lnx lnlp lnexpo lngdpcad), lr(l.lnx lnlp lnexpo lngdpcad Year)
ec(ec) replace dif pmg
test _b[SR:D.lnlp] = 0, notest
test _b[SR:ec] = 0, accum
```