

**MANUFACTURING EMPLOYMENT ADJUSTMENT: ASSESSING THE  
EFFECT OF TRADE EXPOSURE IN CANADA**

**MOHAMMED ABUBAKARI**  
**Bachelor of Arts, University of Ghana, 2010**

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MOHAMMED ABUBAKARI

Date of Defence: June 7, 2018

Dr. Richard Mueller Supervisor	Professor	Ph.D.
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Dr. Kien Tran Thesis Examination Committee Member	Professor	Ph.D.
--	-----------	-------

Dr. Pascal Ghazalian Thesis Examination Committee Member	Associate Professor	Ph.D.
---	---------------------	-------

Dr. Kamar Ali Chair, Thesis Examination Committee	Associate Professor	Ph.D.
--	---------------------	-------

## **Abstract**

Using data from the 10 Canadian provinces, we assess the effect of manufacturing sector exposure to trade on employment adjustment based on static, partial and general models of adjustment. From the results across these adjustment models, real exports and real imports have positive and negative effects on manufacturing employment, respectively. This is quite consistent with the popular assertion that exports create jobs and imports displace them. However, based on the net effects analysis, there was not enough evidence to predict that trade exposure is responsible for the declining trend in manufacturing sector employment over the last two decades. When we look at trade intensity effect by country of origin, employment adjustment has different impacts, with import intensities from the U.S. and China showing positive effect, while the effect of E.U. import intensity is negative.

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## CHAPTER 1

### 1.1 Introduction

Manufacturing sector employment has been going through adjustments throughout the world, much to the dislike of many advanced countries including the U.S., Canada, and other Organization of Economic Cooperation and Development (OECD) countries. This phenomenon is much disliked in a sense that the loss of jobs in the manufacturing establishments in these advanced countries raises concerns over maintaining livelihoods, and governments having to support people who have lost their jobs with welfare programs which are extra burden on budgetary allocation and spending. The concerns about this situation are commonly that of despair as many believe that these jobs are never coming back. Dragicevic (2014) and Tencer (2014) having considered data on OECD countries, argue that manufacturing jobs are gone and not coming back. Their views are indicative of the discussion generated in the media as a result of manufacturing sector job loss in OECD countries. While Tencer (2014) points out that Canada's manufacturing crisis is the worst among 19 industrialized countries, and blames cheap labour from developing countries as well as automation, Dragicevic (2014) blames globalization, exchange rates fluctuations and low productivity for the job loss in the manufacturing sector. Back in the 1980s, Grossman (1982, p. 271) asserted that: "The extent to which imports provide a perfect substitute for domestically produced goods will have an important bearing on the future of many industries in the United States." On the part of Capeluck (2015), trade liberalization, as it opens the gate to cheaper imported

goods, and the loss of competitiveness due to appreciation of the Canadian dollar after the year 2000, are some of causes of the manufacturing sector decline in Canada.

To put the loss of jobs in perspective, from 1998 to 2008 the United States (Canada's largest trading partner) lost 4.1 million manufacturing jobs compared with Canada's loss of 278,000 jobs over this same period (Statistics Canada, 2011). The E.U., which is one of Canada's top trading partners has had their share of manufacturing employment adjustment as well. While Germany may have had 442,000 additional jobs (including retaining manufacturing sector jobs) contributing to reduction in its unemployment rate since the inception of the E.U. (Dauth, Findeisen, & Suedekum, 2014), countries such as Belgium, Sweden, France, and the UK have grappled with some significant falls in manufacturing sector employment between 1993 and 2010. Among these countries, the range of decline was around 14-29%; the UK experienced a 29% decline, while France had the lowest at 14% (Bernard, 2009; Statistics Canada, 2011). Although, this decline may not be pervasive across the globe, it is quite noticeable among the OECD countries, and in relative terms within each year of the first five years of the millennium, the BRIC (Brazil, Russia, India and China) put together have created 22 million in total jobs compared with 3.7 million jobs in the OCED (OECD, 2007).

Canada's manufacturing sector's (classified under North American Industry Classification System NAICS codes 31-33) employment decline compared to OECD countries has been perceived as relatively lower (Canadian Manufacturers and Exporters, 2016). For a period of 45 years, Baldwin and Macdonald (2009) show a fall in manufacturing employment as a share of total employment and admit it is less than many other industrialized countries. Nonetheless, it is still evident that manufacturing sector

employment in the 2000s has not gotten back to the level achieved in the 1990s. There were 339,400 fewer manufacturing jobs in 2010 compared with 1990. In the 21st century, precisely between 2000 and 2016,<sup>1</sup> Canada has lost some 547,500 manufacturing jobs. This manufacturing sector job loss also impacted Canadian provinces differently. For example, Ontario and Quebec, which together constituted 73% of Canada's manufacturing employment in 2008, lost a combined total of 285,300 jobs in the manufacturing sector from 2004 to 2008 (Bernard, 2009) more than the other provinces combined. Dupuis and Noreau (2014) also show that, while aggregate industry employment in Quebec was up from 3.5 million to 4.0 million between 2007 and 2013, manufacturing sector employment fell from 550,000 to 486,600 over the same period.

Many reasons, some of which are outlined by Dragicevic (2014) and Tencer (2014), have been given for the continuous job decline in manufacturing employment. However, trade exposure – as the world is experiencing today – has received much attention in the analysis of manufacturing sector job decline in the advanced economies. The aspect of trade most often attributed to the decline is import penetration into advanced economies and which is why people in these countries often question the benefits of open trade. Countries such as the U.S., Canada, and other advanced economies are concerned about increasing levels of import penetration, and rightly so because of its potential adverse effect on demand for domestic output and thereby domestic labour demand.

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<sup>1</sup> Author's own calculations from Statistics Canada CANSIM Table 282-0008 which is under the North American Industry Classification System. Codes 31-33 and 14 represent manufacturing sector and all industry employment, respectively.

Having import penetration as the focus, it is important to expand the focus in this thesis by attempting to address the following questions: (1) How do trade variables, in terms of both level and growth, affect manufacturing employment adjustment in Canada? (2) To what extent do Canada's top three trading partners - the U.S., the E.U., and China – affect manufacturing employment adjustment in Canada? (3) What is the net effect of exports and imports on manufacturing sector employment adjustment?

## **1.2 Background**

In the later years of the twentieth century, the manufacturing sectors in many countries began to experience stiff competition, which can be explained partially by some events that had occurred in trade relationships. Between the 1980s and 1990s there were rapid economic reforms, notably the one initiated by China which expanded global manufacturing production through rapid productivity growth in industry (Naughton, 2007; Zhu, 2012). The Canada-U.S. Free Trade Agreement was expanded to include Mexico and gave birth to the North American Free Trade Agreement (NAFTA); a trade agreement that has been documented to have a negative impact on labour employment at Canadian manufacturing firms (Bruneau and Moran, 2017). The emergence of newly industrialized economies from developing countries, the strengthening of the E.U. as a major trading bloc, and other bilateral trade policies altered the nature of global manufacturing from less competitive to more competitive. The 2001 accession of China to the World Trade Organization further opened up industrialized economies, (especially the U.S., whose largest value of imports are coming from China), to the shock of Chinese exports (Autor, Dorn, and Hanson, 2016; Pierce and Schott, 2016). The increase in competition for Canadian manufactures intensified with the emergence of industrial

powers including Japan, China and Europe, and by the end of the 20<sup>th</sup> century Canada's share of global manufactured goods was back to 4.5% as compared to its initial 6% share in the 1960s ( Laurent, 2015) .

Indeed, this global trade competition faced by Canadian manufacturers, coupled with economic and regulatory effects, translated into the decline in manufacturing employment starting in the year 2000 (Pierce and Schott, 2016). And between 2004 and 2008, Bernard (2009) observes that one in seven, or 322,000, jobs in the manufacturing sector had disappeared. This experience according to Capeluck (2015) was not peculiar to Canada, but many OECD countries had also experienced declines in manufacturing sector employment. While Canada lost 20% of manufacturing jobs between 1990 and 2014, the U.K. and the U.S. lost 49% and 31%, respectively (Canadian Manufacturers & Exporters, 2016). Despite Canada's relative lower job loss compared to other OCED countries, manufacturing sector employment in Canada in 2014 is still below its level in the 1990s.

Today, economies that are opened to trade have, in addition to their domestic markets, access to foreign markets. As compared to other nations, evidently, Canada in the post-world war period was more integrated through increased export orientation, heavy dependence on imported intermediate inputs, and thereby exposure to foreign competition (Dion, 2000). And as the employment hypotheses<sup>2</sup> regarding trade persist (as discussed by Dooley, Folkerts-Landau, and Garber (2007) and Feenstra and Chang

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<sup>2</sup> There are two employment hypotheses associated with open trade. Foremost is expanding exports helps create employment in those industries with a high concentration of exports. Second is foreign competition concentrated in industries with a high level of import penetration decrease employment.

(2007)), the effect of increasing trade would always impact employment adjustment in the very sectors whose activities are related to exports and imports. This sets the basis of our inquiry into the effect of trade on employment adjustment in the Canadian manufacturing sector. Generally, in spite of the many empirical attempts to find answers to employment adjustment, there has not been a rule of thumb regarding the effect of trade exposure on domestic employment, particularly in the manufacturing sector. And as such, the trade exposure effect on employment adjustment continues to be investigated under different countries' dynamics.

There are many reasons provided in the literature to explain employment adjustments. There is cyclical effect which is joblessness associated with normal recessions (Brynjolfsson and McAfee, 2011). The cyclical reason basically has to do with the business life cycle analysis of an economy. At a recession point of the cycle, an economy including its manufacturing sector, will simply lose jobs, and does not grow enough to provide new jobs. Thus, cyclical prevents the creation of new jobs, and at the same time a channel through which many people will lose their jobs in the case of a deep recession (Brynjolfsson and McAfee, 2011).

Foreign direct investment (FDI) is seen to enhance manufacturing sector production in terms of cost and efficiency in host nations including developing countries; Li, Liu, and Parker (2001) see the presence of foreign firms in China as a source of productivity gains for locally-owned firms. Through FDI (either vertical or horizontal) developed countries such as the U.S. and Canada have seen their manufacturing plants set up in low-wage countries causing more widespread global production of manufactured products (Cheung and Rossiter (2008) see the phenomenon of production

relocation as cost saving strategy). Essentially these products that are produced in low-wage countries and brought to the developed countries are relatively cheaper than those produced domestically. Wright (2014) puts the effects of production process relocation on developed countries' employment into three channels: direct displacement of industry jobs; productivity gains which increase production and impacts employment positively; and substitution effect among factors (i.e. labour with other factors).

On outsourcing as a threat to jobs in advanced countries, Johnson and Morissette (2007) use evidence from within industry-level across Canada to argue that there is no correlation or at least a modest likely impact between employment evolution and worker displacement on one the hand, and foreign outsourcing on the other. Their study however focuses on a limited scope of outsourcing as it only captures Canada's trade in services, computer and information communication products. On a broader scope, this means that production process outsourcing could still be a potential source of job loss especially in the durable sector (for example clothing and textile industry) whose production outsourcing has had a negative impact on employment (Laurent, 2015).

Furthermore, there is also rapid development in the technology industry which results in less need for humans across the stages of production. The development in technology, as discussed in most of the literature, is biased towards the skilled labour force in a sense that their jobs are sustained at the expense of the unskilled labour force. Yan (2005) notes that Information Communication Technology (ICT) is an important contributor to the demand for labour in the Canadian manufacturing industry. Interestingly, technological development seems to be a double-edge sword from two points of views: stagnation and the end-of-work. While proponents of stagnation argue

that too little progress in technology causes downturns in employment, the end-of-work proponents assert that technological advancement in industrialized nations has led to the replacement of humans with machines in the production process over the past number of years (Brynjolfsson and McAfee (2011) elaborate more on these two concepts).

Brynjolfsson and McAfee conclusively assert that some human skills remain valuable even in the age of powerful digital technology and that other skills will become worthless as people in that category have little to offer employers. In sum, despite fears of unemployment given rapid technological advancement, neoclassical economists are of the view that technology induced lay-offs are only temporary, and that people will find jobs in other sectors that match their skills after some period of being unemployed .

The analyses of the effects of technology, flows of FDI into the developing world, outsourcing, and cyclical adjustment continue to evolve in the literature, however, the objective of this thesis is to look at Canada's manufacturing employment adjustment in the face of merchandise trade flows. So far as this objective is concerned, Autor, Dorn, and Hanson (2013a) and Rothwell (2017) have reached varied conclusions regarding the impact of Chinese export supply on manufacturing employment in the U.S. areas with a common labour market . Whereas Autor et al. (2013a) find slow job growth and higher unemployment at local levels because of import competition with China, Rothwell (2017) fails to reject the null hypothesis that import competition has no negative impact on employment growth in the U.S. local areas except in manufacturing sector during the most recent period (referring to 2000-2007). In fact, Rothwell asserts that domestic shocks better explain employment and



wage growth, and that foreign competition does not appear to raise the risk of job loss higher than domestic competition.

While some of these differences exist, in our empirical analysis of employment adjustment in the manufacturing sector in Canada, the growth in Chinese export supply presents a mild threat to the provincial economies relative to the U.S. and the top seven E.U. countries.<sup>3</sup> For example, between 2011 and 2016, China maintained 3<sup>rd</sup> position among the principal trading partners of Canada. In 2016, imports from China represented 6.87% of total imports into the Canadian economy as compared with 65.78% and 9.55% from the U.S. and the seven E.U. countries, respectively.<sup>4</sup> While U.S. is the largest exporter into Canadian economy, China is the largest exporter into the U.S. economy. The difference in this respective dominance is that, whereas the U.S. has a balance of trade deficit with China, the opposite is the case of Canada's trade with the U.S. in merchandise goods (this includes manufactured goods). Hence, the impact on manufacturing employment could be expected to differ. Indeed, Autor et al. (2013a) did indicate that the impact of import competition with China on the absolute level of employment in U.S. manufacturing exists as long as the trade imbalance persists.

With this difference, empirical analysis of the impact of U.S. imports on Canada's manufacturing employment may not produce the same results as those in the Autor et al. (2013a) study on the effect of rising Chinese import competition on local U.S. labour markets. This is because U.S. trade with China is based on low-cost manufacturing as compared with the natural resource-based trade between Canada and

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<sup>3</sup> These countries are: Germany, the United Kingdom, Spain, Netherlands, France, Belgium and Italy

<sup>4</sup> Source: Author's own calculation from Statistics Canada, CANSIM, Table 228-0069.

U.S. Moreover, the support to our claim of the differences in results is evident in the analysis of the impact of trade on manufacturing employment through the exchange rate. While Bruneau and Moran (2017) find exchange rates to have significant long-term effects on the labour inputs of Canadian manufacturing firms, Campa and Goldberg (2001) observe a smaller impact of U.S. exchange rate fluctuations on employment and hours worked. The variations in the two countries' trade balances perhaps explain the differences in these empirical findings. In examining the effect of the trade balance on North American jobs, Weir (2007) argues that Canada's trade surplus with the U.S. almost entirely emanates from its natural resources exports, products which the U.S. cannot produce itself. Hence, the trade surplus cannot be seen to displace jobs in the overall sectors of the economy as claimed by critics of NAFTA in the U. S. (Weir, 2007).

By and large, this thesis explores manufacturing sector employment adjustment in two ways. First, it focuses on manufacturing sector employment adjustment giving data on provincial-level exposure to merchandize trade with the rest of the world. Second, we narrow trade flows by paying attention to the top three trading partners: the U.S., the E.U. and China. The criterion for selection of top three partners is based on the percentage share of Canada's total trade flows in exports and imports. The study therefore adds to the previous studies on Canada that rely on the fluctuations in the exchange rate to explain the effect of trade on manufacturing employment.

### **1.3 Problem Statement**

Employment over the past decade shows a decreasing trend in the Canadian manufacturing sector. Between 1990 and 2014, Canada lost 20% of the jobs in the manufacturing sector (Canadian Manufacturers and Exporters, 2016). Given this

background, trade – particularly import penetration – is most often seen as the channel through which jobs are lost in the manufacturing sector.

As far as trade is concerned, the emergence of China is seen to have impacted economies across the globe (Berger and Wolff, 2017). For example, E.U. countries whose global trade shares declined between 1998 and 2015 include: Italy, a 39% decrease; France almost halved its share; and Germany, a 20% decrease. This according to Berger and Wolff (2017) is partly attributable to the rise in China's trade. In translating China's rise in trade shares into an employment effect, Dauth et al. (2014) observe that increased imports from China have had an unfavorable impact on workers in Germany's import competing industries – meaning some loss of jobs as a consequence. Same is observed in Denmark where import competition from China accounted for a 17% decline in mid-wage employment (Keller and Utar, 2016). Bernard Jensen and Schott (2006) also observe that plant survival and growth in America are inversely related with industry exposure to imports from low-wage countries.

However, the story is a mixed one in Australia where Tombazos (1999) finds that imports from its East Asia and Pacific neighbours are a labour demand stimulant in that it complements domestic employment demand, with imports from the U.K. having a higher partial elasticity of substitution with domestic labour rather a real threat to domestic labour demand. Rothwell (2017) finds that foreign competition, which is usually a consequence of widespread imports, appears to be less of risk to job loss compared with domestic competition. In fact, simply the risk of job loss has not increased with intense import competition from China. Rothwell's findings are in contrast with the empirical investigation by Autor et al. (2013a) who attribute one-quarter of the fall in

manufacturing jobs between 1990 and 2007 in the U.S. to rise in import competition from China. While we notice two contrasting conclusions on Australia trade with different geographical areas under investigation by Tombazos (1999), Autor et al. (2013a) and Rothwell (2017) used the same data (originally assembled by Autor et al. (2013a) on the U.S., but all arrived at different conclusions.

Economists in the last two decades have conducted more studies on the effect of rising imports on manufacturing employment adjustment for both developed and developing countries. Nonetheless, it remains to be clearly established and accepted whether the loss of jobs in any manufacturing establishment is indeed the result of trade exposure – especially in advanced countries including Canada. Following the above analyses, this study seeks to better understand the relationship between trade and employment gains or losses in the Canadian manufacturing sector.

#### **1.4 Contribution**

We observe that the attempts in the literature to understand sources of manufacturing sector employment adjustment have been focused on the effect of Canada's exchange rate on trade (Bruneau and Moran, 2017; Coulombe, 2008; Huang, Pang and Tang, 2014). However, this is one of the many ways of assessing the effect of trade exposure on employment. In fact, import exposure is one factor which in addition to export exposure provides a holistic approach to discussing the employment effect of trade exposure. On this basis, our study examines manufacturing employment adjustments to export and import exposures while also capturing the effect of domestic demand shocks. Autor et al. (2013a, 2016) examine increased imports from China to determine its effect on U.S. manufacturing employment, additionally in this thesis we pay attention to exports

as an important variable in employment adjustment across Canada. The direct incorporation of exports in the econometric estimation model of employment adjustment represents one of the thesis' contributions to the literature. We re-emphasize that using the output variable in the labour demand equation allows us to see the channel through which trade could affect manufacturing employment, while also capturing the effect of domestic consumption.

We observe that factor content and growth accounting techniques are used for modelling employment adjustment to increased trade (Greenaway, Hine, and Wright, 1999). While the factor content is identified to underestimate the employment effect of trade, the growth accounting approach limitation is its assumption of independence of the components accounting for employment growth; this does not allow additional effects of say, import-induced productivity growth (Wood, 1995). To avoid the limitation identified with these two approaches, we follow the regression approach which is fairly rare in the literature, and mostly applied to U.S. data. Hence applying this approach on Canadian data with a focus on dynamic labour demand model to determine the manufacturing employment response to export and import exposures represents yet another contribution to the literature.

The impact of import penetration from China on U.S. labour markets -with a focus on manufacturing sector employment adjustments – has been considered by Autor, Dorn, and Hanson in two separate empirical analyses (2013a and 2016) and many others. Two reasons may explain the results of the analysis on the China's trade effect on the U.S. in Autor et al. (2013a). First, the growth of Chinese exports in recent times is recognized as a shock to the domestic demand for products manufactured domestically. Secondly,

China and its Asian countries continue to account for the largest share of U.S. imports from the rest of the world.<sup>5</sup> However, rather than looking at Chinese export supply shocks on Canada, our study seeks to separately analyse the effect of Canada's merchandise trade (exports and imports) with its top three trading partners on manufacturing employment adjustment. This analysis is in addition to Canada's merchandise trade with the rest of world. Our study therefore tells the Canadian story of manufacturing employment adjustment from the perspective of trade with the rest of the world and the three principal trading partners.

## **1.5 Thesis Organization**

The remainder of the thesis is structured as follows. Chapter Two is the literature review on the effect of trade on employment, and on the manufacturing sector in particular. We discuss the findings of empirical studies over the past two decades, and briefly we demonstrate in the review, the theories and econometric procedures that have often been used to assess trade effects on employment while also looking into findings on other factors that also have affected employment in the manufacturing sector. We proceed with trends analysis on trade and employment in Chapter Three. A detailed discussion is done in this chapter of both provincial and national trends on employment, exports, imports as well as the manufacturing employment outlook from the global perspective.

In Chapter Four we focus on the methodology, and we build our estimation model by incorporating exports and imports into a labour demand function. This chapter outlines

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<sup>5</sup> 45.7 % of American imports in 2016 were bought from Asian countries (Workman, 2017).

the econometric procedure appropriate to the thesis and data sources and descriptions of variables to be used in the estimations.

In the penultimate chapter (Chapter Five), the study discusses the econometric results in three parts. First, the discussion centers on Canada's overall trade exposure to the rest of the world vis-à-vis its effect on manufacturing employment. Second, we assess the effect of trade exposure intensity (specifically import intensity) from the top three principal trading partners on manufacturing employment across Canada. Finally, we evaluate the net effect of trade exposure on manufacturing employment across the static, partial and general adjustment models. Chapter Six of the study offers a summary of findings, concludes, and proposes policy recommendations arising out of this study.

## CHAPTER 2

### 2.1 Trade and Manufacturing Employment Adjustment: Review of the Literature

In the last two decades, the empirical analysis of labour market outcomes in relation to trade has been well considered and continues to attract empirical attention. Trade effects on employment has been studied at several levels including: the national, local, worker, group and according to establishment (Acemoglu et al., 2016; Autor et al., 2013a; Dauth et al., 2014; Ebenstein, 2014; Milner and Peter, 1998). In assessing the effects of trade on employment, these studies have considered the development characteristics, institutional framework, sector differences and the category of labour utilized across sectors of an economy. (Bernard and Winters, 2005; Lee and Vivarelli, 2004; Rigby, Kemeny, and Cooke, 2017; Yan, 2005). Also, in these studies, theories including the Ricardian comparative advantage, factor endowment and economics of scale have been brought to bear on the analysis of the effects of trade on employment. Thus, creating a linkage between labour resource utilization and international trade.

In perspective, Ricardian comparative advantage holds productivity differences as the main the driver of trade among countries. As Krugman, Obstfeld, and Melitz (2012) note about the Ricardian Model, there is reallocation of a country's resources (which in this case is labour only) to the production of goods in which it has lower relative opportunity cost. While countries specialize and trade in their comparative advantage, the implication on the labour market adjustment is the movement of labour from less-productive to more-productive establishments. This, according to the neoclassical economists, will occur with workers bearing some amount of the adjustment cost. Newfarmer and Sztajerowska (2012) have a view similar to that of the neoclassicals in



that trade-induced growth entails the continual reallocation of resources – including labour resources - away from less to more productive activities. Dutt, Mitra, and Ranjan (2009) support the Ricardian prediction of a continuous movement of labour to productive areas with the evidence of an inverse relationship between unemployment and trade openness (or, conversely, protection and unemployment are positively related).

Following the factor endowment theory also known as factor proportions theory in Krugman et al. (2012), trade patterns reflect an abundance of a country's resources and, unlike the Ricardian model, two inputs are assumed to be engaged in the production of two commodities. The implication of trade on employment under this theory extends the Ricardian prediction to include factor substitution in the production of the two commodities. The Heckscher-Ohlin-Samuelson (H-O-S) model indicates that, because of trade, an increase in the relative prices of labour-intensive products leads to increase labour demand, whereas a rise in wage relative to rent influences employers to substitute labour for capital. However, both labour and capital may be induced to reallocate to sectors where relative prices have increased assuming both markets are perfect. Both Heckscher-Ohlin-Samuelson and Ricardo-Viner (specific factors model) models of international trade predict that greater import competition for one sector reduces the relative price of its final good and causes reallocation of labour and capital to sectors whose relative prices have increased (Feenstra, 2003). In determining the employment effect of trade exposure, economists have notably used these trade models in combination with various procedures including factor content, growth accounting, input-output and regression analyses to demonstrate the extent to which employment is affected by a country's engagement in trade.

Inquiries into the effect of trade on employment adjustment have intensified in the 2000s and beyond, especially given the emergence of Chinese export supply as a shock to global economies. Employment in the U.S. manufacturing industry has been the center of studies on import competition, this is partly due to Chinese exports dominance on the U.S. market since the turn of the millennium. Sachs, Shatz, Deardorff, and Hall (1994) observe a negative correlation between imports penetration and growth of employment in U.S. manufacturing. Autor et al. (2013a) find for the U.S. that increased trade with China is related to higher unemployment and lower wages in regional U.S. labour markets. Pierce and Schott (2016) also observe increase in imports from China is associated with employments losses in U.S. industries where the threat of an increase in tariffs declines.

In looking for answers to manufacturing sector employment adjustment, labour and trade analysts are stuck with growing imports (especially Chinese imports competing with domestic products in major developed countries) apparently as the major reason for employment decline. Even among these studies, few have given recognition to the net effect of trade. Hence the fact that trade is a give-and-take endeavor is not well considered. Partridge, Rickman, Rose Olfert, and Tan (2017) separate the effects of domestic shocks from international shocks on regional labour market outcomes by considering both exports and imports in their regression model. Dauth et al. (2014) observe a net increase in manufacturing employment as result of Germany's trade with the countries of Eastern Europe and China. Thus, assessing the net effect of trade to some extent reflects a fair effect of trade (exports and imports) on manufacturing employment adjustment in advanced economies where the sense of doubt about trade benefits is emerging among the citizens. In just analyzing imports alone, Acemoglu et al. (2016)

argue that the U.S. manufacturing would have lost 560,000 fewer manufacturing had import from China not grown after 1999. Export growth after 1999 equally has maintained and created some new jobs, which they failed to indicate. In fact, Acemoglu et al. (2016) admit that the absence of exports in their instrument that measures U.S. import growth from China was a source of concern. The effect of exports on manufacturing employment therefore has not particularly been given the explicit attention in the literature.

While the U.S. may have been covered extensively in the empirical studies of manufacturing employment adjustment to trade, to the best of our knowledge, there exists no direct assessment of the effect of Canada's growing trade exposure on manufacturing employment adjustment with provincial level data. Studies such as Bruneau and Moran (2017), Coulombe (2008), Huang et al. (2014) mainly focus on the exchange rate fluctuation effect on trade to explain Canada's manufacturing sector employment decline. However, given a stable currency regime, how trade flows will impact employment in the manufacturing sector is worth studying.

In the economic geography literature, we find two reasons why trade may have differential effect across regions.<sup>6</sup> First, Partridge et al. (2017) assert that differences in industry concentration and composition with varying degrees of international import and export intensities explain employment adjustment variation across regions. For instance, manufacturing employment in Ontario and Quebec, which constitute the largest industrial hub of Canada, will respond significantly to the shocks of changing patterns of trade

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<sup>6</sup> Regions as used here are similar to provinces in the case of Canada in the sense that they are the geographical partitioning of an independent state

compared to the other provinces. Bernard et al. (2006) and Bernard , Redding, and Schott (2007) indeed confirm that there have been differences in the impact of trade on employment adjustment across local areas in the U.S. given the nature of the spread of industries in those areas. Different geographical locations have different industry concentrations, and quite a few recent studies of labour market adjustment to trade exposure have paid attention to geographical areas (Autor et al., 2013a; Chiquiar, 2008; Dauth et al., 2014; Kovak, 2011; Partridge et al., 2017; Topalova, 2010). Autor et al. (2013a) find evidence of variations in manufacturing employment adjustment of Commuting Zones (CZs)<sup>7</sup>, with more exposed CZs experiencing substantial decline in employment due to increased import competition from China. Also, U.S. imports from NAFTA partners had a significant negative impact on worker wages across regional industries (Chiquiar, 2008). Increased imports from developing countries adversely effected regions specialized in the production of labour-intensive goods (Autor et al., 2013a). And limited regional worker mobility causes peculiar shocks to have large redistributive effects across regions (Partridge et al., 2015).

Aside from industry composition and trade intensities across regions, Acemoglu et al. (2016) identify differences in resource endowments and firm specializations that also explain why employment adjustments due to increased exposure to trade may vary across regions. In fact, employment is not the only economic variable that is affected differently by exports and imports across regions. Topalova (2010) confirms that the slower decline in poverty and lower consumption growth in India were peculiar to trade exposed production sectors. Kovak (2011), who designed a specific-factors model of regional

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<sup>7</sup> Encompasses all metropolitan and nonmetropolitan areas in the United States. See Autor et al. (2013a:2122).

economies to measure the impact of national price changes on local labour, finds wage declines in regions where workers are concentrated in industries facing the largest import tariff cut.

Delving into empirical techniques, studies quite often use econometric procedures in determining labour market responses to trade. Acemoglu et al. (2016) base their empirical exposition on two procedures. First, the direct effect of exposure to import competition on industry employment at the U.S. national level, using changes in employment across four-digit manufacturing industries as a function of industry exposure to Chinese import competition. The direct effect of Chinese import competition they conclude is negative, sizable, and robust on manufacturing employment. The second procedure is input-output linkages which measure the downstream and upstream trade effects for both manufacturing and nonmanufacturing sectors where they observe the effects of the upstream to be negative and sizable while the downstream effect estimates were unstable in sign.

Acemoglu et al. (2016) is one of the studies that applied regression at industry-level to analyse the direct impact of import competition on employment in exposed industries. Another study is Coulombe's (2008) dynamic analysis of employment response in highly trade-exposed manufacturing sectors to Canadian dollar appreciation. Our empirical analysis adopts the regression approach, nonetheless, grounded in the derivation of a labour demand function while incorporating aggregate trade variables through aggregate output. Greenaway et al. (1999) and Bruno, Falzoni, and Helg (2004) used the labour demand function derivation strategy to measure the impact of trade liberalization and globalization respectively, on labour demand elasticity. The application

of the regression-based approach is increasingly used in empirical analysis, which allows the direct estimation of the employment impact of trade, especially showing the signs of the relationships between trade variables and employment adjustment.

Substitution and output effects play significant role in analyzing the effect of increased trade competition on labour demand at the firm and industry level. Whereas the substitution effect arises from relatively high factor prices leading to the replacement of labour inputs with capital; the output effect emanates from the demand side as a consequence of the changes in own price of labour firms incorporate into their product price. How these effects are triggered by trade, Bruno et al. (2004) explain that greater international openness allows firms to employ a variety of capital equipment which will provide firms the opportunity for the direct substitution between foreign and domestic factors of production. Rodrik (1997) discusses substitution and output effects of trade openness due to the impact of globalization labour demand elasticity. He argues that globalization makes the demand for services of unskilled and semiskilled workers more elastic to substitution with other labour tasks across national boundaries. Thus, trade basically acts as catalyst for transforming industry labour demand relationships in a domestic country. Haouas and Yagoubi (2008), Peluffo (2013) also discuss substitution and output effects in their empirical analyses. Haouas and Yagoubi (2008) provide empirical evidence that shows a weak link between trade liberalization and labor demand elasticity. Peluffo (2013) finds a significant increase in the probability of unemployment

and wage dispersion following Mercosur's creation<sup>8</sup>, which liberalized the Uruguay's economy.

## **2.2 Other Contributing Factors**

From the foregoing discussion, there is quite a number of empirical studies that have attributed trade to manufacturing sector employment adjustment. Nonetheless, many other perspectives considered alongside trade include: exchange rate fluctuations, technology, productivity growth, domestic demand and price shocks, all of which are worth attention in this review. First, volumes of trade over time have been impacted by the rate of currency exchange on the global market. Currency exchange rate affects demand for final industrial goods in both the foreign and the domestic markets, and this has both direct and indirect implications for employment adjustment in the manufacturing sector. In determining the effect of exchange rate fluctuations, Coulombe (2008) finds varied effects of movements in the real exchange rate on manufacturing employment in highly exposed trade areas across provinces, with greater significance shown in both Ontario and Quebec. Consistent with this finding, Bruneau and Moran's (2017) study of 20 manufacturing industries in Canada establishes a long-term effect of exchange rates on labour inputs in manufacturing industries, with this effect stronger in trade-oriented industries. With a steady depreciation of the Canadian dollar in the 1990s, hours of work were found to be increasing, whereas in the early 2000s – a period marked by the appreciation of the currency – hours retrenchment in the manufacturing sector occurred (Bruneau and Moran, 2017). These papers argue that employment adjustment to

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<sup>8</sup> The South American trade bloc whose membership includes Argentina, Brazil, Paraguay, Uruguay and (until 2016) Venezuela.

exchange rates in the manufacturing sector occur on a gradual basis following any shock to the Canadian dollar. A continued appreciation of the Canadian currency against the U.S. dollar renders Canadian exports less competitive on the world market (Capeluck, 2015). This affects demand for products of export-oriented industries in the global market and thereby its domestic labour demand, at least in theory. Huang et al. (2014) attribute employment adjustment in Canada to export-weighted exchange rate changes which provide shocks to Canada's exports flows with some level of effect on industry labour demand, particularly the manufacturing sector. Indeed, they observe that the boom in commodity market prices tends to drive the appreciation of the Canadian dollar leading to some 0.8% decrease in manufacturing employment. In a similar observation, Hua (2007) using a panel data of 29 Chinese provinces spanning 1993 to 2002, finds the real appreciation of the renminbi to have significant negative effect on manufacturing employment. On the flip side of the exchange rate, Huang and Tang (2016) observe a 1% depreciation of the U.S. real exchange rate leads to a 0.98% direct positive impact on manufacturing employment across cities in the U.S., with some variations depending on industry composition. Their empirical observation confirms the view that depreciation of the U.S. dollar is the solution to the decline in manufacturing employment.

Furthermore, new technologies and innovations has featured greatly in the discussion of employment decline in the manufacturing sector. Flynn (1985) analyzes the employment effects of process innovation using 200 case studies over the 1940-1982 period. He finds process innovation (categorized as automation of production or distribution and office automation) eliminating low-skilled jobs, in contrast to the view that process innovation eliminates high-skilled jobs in favor of low-skilled jobs. As the



debate of job displacement fallout of technology gathers momentum, Osterman (1986) investigates the impact of emerging information technologies on office and clerical employment and, observes that job displacement arising from innovative technology was offset by the expansion in jobs demand for automated activities. However, Hunt, and Hunt (1986) assert that changes in and the diffusion of technology unfold at a slow pace and thus could not have accounted for the spread of job displacement as described by many studies. The views and findings on technology and employment from the 1990s to the 2000s have not changed significantly and continue to alternate between negative and positive employment effects.

While technology is touted as causing job displacement, the unskilled category of labour in developed countries are said to bear the brunt of job displacement in the manufacturing sector when firms are exposed to new technologies. This has literally been the ex-ante view that economic analysts have advanced subtly in defense of international trade vis-à-vis its cost to developed countries. However, this is dependent on whether technology and trade indeed play a separate role on employment based on category of workers. Indeed, Autor, Dorn, and Hanson (2013b) conclude that it is possible to separate the impact of recent changes in trade and technology on U.S. regional economies including employment as major indicator.

Beyond the quantitative analysis of the effects of new technology on workers, Vivarelli (2013) looks at the effects on various categories of workers thereby discussing the qualitative aspect of the new technology, which is skill-biased in a sense that existing and new tasks on jobs demand skilled workers. Stephan (1997) observes that from the beginning of the 1980s the gap between the incomes of high and low-skilled workers has

grown. Nonetheless economists, he asserts, attribute a larger portion of this gap to technology and innovation with international trade assuming a smaller portion. While there exists complementarity between new technologies and skilled workers resulting in an increase in their employment, unskilled workers are largely substitutable with new technologies in the manufacturing sector (Meschi, Taymaz, and Vivarelli, 2011). Skilled workers therefore gain vis-à-vis the unskilled workers given firm level adoption of new technology that results from integration or foreign direct investment (Fajnzylber and Fernandes, 2009; Feenstra and Hanson, 1997; Hanson and Harrison, 1999). In effect, both technology and trade play a role in employment adjustment by type of worker in the manufacturing sector of many countries across the globe.

Taking on the output demand effect on employment, Capeluck (2015) observes that employment growth is positively related to output and product demand growth. And, according to Mian and Sufi (2014), employment in the non-tradable sector depends on local demand, and tradable sector employment relies on both local and foreign demand. As expected, the demand for a product will fall due to high prices induced by high wages or the presence of lower priced import-competing products in the domestic market. Firms are expected to act rationally and will reduce their demand for labour due to decrease in product demand induced by increase in the price of labour inputs or stiff competition from cheap import-competing products. Domestic prices essentially are influenced by trade and translate into employment adjustment across geographic locations. Consistent with this assertion, De Loecker, Goldberg, Khandelwal, and Pavcnik (2016) find trade liberalization to have a negative effect on domestic prices in India. By interpretation, a more liberalized economy undercuts some domestic firms – in terms of the pricing of

their product – resulting in lay-offs, and it explains why domestic firms are unable to survive foreign competition. In fact, it has been argued that in the event of incomplete reallocation of labour away from sectors that are weakened by competitive pricing, the aggregate demand is further depressed leading to more loss of jobs even in sectors that are not exposed to foreign competition (Acemoglu et al., 2016, Mian and Sufi, 2014). While trade liberalization may affect prices, it also introduces new product varieties through the greater availability of imported intermediate products (Goldberg, Khandelwal, Pavcnik, and Topalova, 2010). The consumer gains in terms of lower prices and the existence of a wide variety of products, however the result can be a reduction in employment since downward pressure on domestic prices can undercut domestic industries.

Glossing over productivity – a factor which also affects industry labour demand adjustment – firms are said to maximize profits at the point where the value of the marginal product of labour is equal to the marginal cost of that labour (i.e., the wage rate). By implication as long as value of the marginal product of labour continues to increase, firms will continue to demand more labour given that the wage is not above the value of the labour productivity. Theoretically, this suggests a positive relationship between productivity growth and employment, but under the assumption that labour is the source of productivity growth. In reality, however, labour-induced productivity growth is rare given rapid advancements in technology and capital investments in the manufacturing sector. This is why industries with above average labour productivity growth before the year 2000 experienced decreases in its employment shares (Capeluck, 2015). And indeed, in an attempt to answer the question why aggregate employment growth lags behind

output growth during the process of industrialization, Singer (1987) as cited in Iyer (2013) argues that improvements in productivity have been associated with huge capital investments per worker, improved technology, better skills and human capital formation, and the replacement of labour-intensive industries with capital-intensive industries whose employment absorption rates are quite low.

An array of factors as we have seen in empirical studies have been considered in the analysis of manufacturing sector employment adjustment. In this thesis, we focus on the combined effects of exports and imports on employment adjustment in Canada at the provincial level.

## **CHAPTER 3**

### **3.1 Trend Analysis**

International trade is a mechanism for promoting economic growth leading to job creation and welfare enhancement. It is on the basis of this assertion that economies open up their borders to trade across the globe. In addition to the assertion that trade promotes economic growth, a widespread variety of goods and the resulting lower prices consumers may face are essential arguments in favor of open trade. Nevertheless, as we have seen in the literature review, international trade and import competition in particular appears to be the reason why manufacturing sector employment is declining. In this light, prior to presenting empirical results on the effect of trade exposure on manufacturing sector employment adjustment, we discuss the trends in manufacturing sector employment, exports, and imports - at both the national and the provincial levels - as well as place Canada in the global context.

### **3.2 Employment Trend**

This section analyzes the annual Labour Force Survey of Statistics Canada with focus on manufacturing employment in relation to all industries. All industries include the primary and tertiary industries as well as the utility and construction subsectors of the secondary industries (North American Industry Classification System, NAICS). The data are split into two overlapping 10-year sub-periods: the first from 1990-2000 and the second from 2000-2010. The first sub-period characterizes Canada during the implementation of the Free Trade Agreement (FTA) and later the adoption of the North American Free Trade Agreement (NAFTA). These trade policies -at least the later years

of the FTA implementation- impacted employment in the Canadian economy (Gaston and Trefler, 1997).

The second sub-period marks a world of increased competitiveness on the global market, economic integration and open markets. During this period and beyond, Dooner (2014) discusses the volatility of pricing primary commodities, the primary demand growth shifting towards emerging markets, and growing trade liberalization; these are all drivers of change in the manufacturing sector. The second sub-period also notably includes the global financial crisis that hit the United States of America and transmitted to the rest of the world including Canada as a neighbor and major trading partner. Within this sub-period, Dooner (2014) observes a decline in Canada's share of global manufacturing GDP from 2.1% in 2005 to 1.5% in 2010, and the manufacturing sector lost over 500,000 jobs between 2000 and 2010. The 21st century, indeed, has seen some significant developments in the global manufacturing sector that have impacted Canadian manufacturing firms, and their contribution to aggregate employment.

The two overlapping periods are depicted in Figure 3.2-A. This will allow us to comparatively analyse employment trends in all industries and manufacturing sectors across provinces and, particularly, Canada at large. In fact, between 1990-2000, the percentage change in employment looks good for all industries and manufacturing at both the national and provincial levels. In aggregate terms, the national level shows a 12.79% and 9.38% increase in employment for all industries and manufacturing, respectively. This positive outlook reflects an increase in all industries and manufacturing sector employment at the provincial levels, except in Newfoundland in which employment in all industries and the manufacturing sector declined by 3.91% and 29.25%, respectively.

The other provinces, except Nova Scotia, have seen an employment increase in all industries and the manufacturing sectors. Nova Scotia joins Newfoundland with a decline of 3.23% in manufacturing sector employment. Alberta, British Columbia, Manitoba, Prince Edward Island, New Brunswick, and Saskatchewan all had double digit increases in employment, either in all industries or manufacturing, or both in the earlier period.

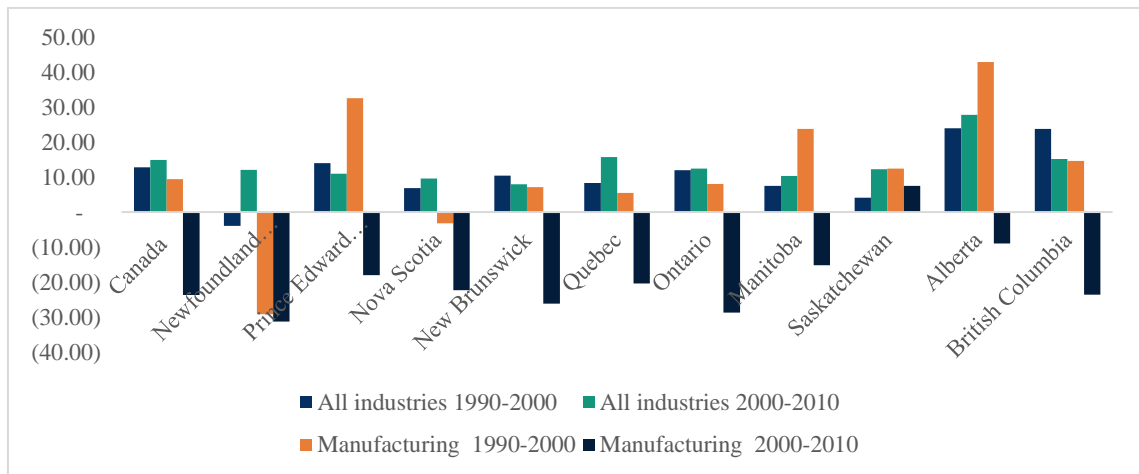


Figure 3.2-A: Manufacturing employment trends

Source: Researcher’s own calculation based on Statistics Canada, CANSIM Table 282-0008

Alberta had the most significant increases of 23.99% and 42.89% in employment for all industries and manufacturing, respectively. From 2000-2010, as shown in Figure 3.2-A, it is clear that while all industries at the national and provincial levels showed increases in employment, manufacturing employment declined at both the national and provincial levels, except Saskatchewan, which recorded 7.5% increase in employment.

The highest decline in manufacturing employment was in Newfoundland at 31.33%, followed by Ontario’s 28.78%. However, in absolute values, Ontario and Quebec have lost a significant number of jobs between 2000 and 2010. In Figure 3.2-A,

we see that percentage change in employment in the manufacturing sector is negative at the national level and across provinces (except Saskatchewan) for the period 2000 to 2010. This contrasts the increase in employment in all industries at the national and provincial levels.

From this analysis thus far, it is reasonable to conclude that employment in all industries has been growing over the last two decades, whereas in the manufacturing sector, employment has been declining, but only after 2000 in general. By extension, the share of manufacturing employment in all industry employment has also been declining in the last two decades.

### **3.3 Manufacturing Employment Growth: Canada in the Global Context**

Manufacturing is a critical sector of every economy in the world. It is an engine that drives economic growth in both developed and developing countries (Dooner, 2014). The manufacturing sector is the largest exporting sector constituting 61% of Canada's total exports in 2014. However, in the last two decades the sector has witnessed job decline across major high-income economies in the world. Levinson (2017) observes that all of the advanced economies including the U.S., Canada, Japan, Sweden, France, Italy, United Kingdom for which data are available have experienced declines in manufacturing employment for a long-time period. Figure 3.3-A shows some of these high-income economies' manufacturing employment growth rates<sup>9</sup> for two overlapping 10-year periods that fall within the period under study.

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<sup>9</sup> These are calculated using the compound annual growth rate formula:  $g = \left(\frac{e_0}{e_t}\right)^{\frac{1}{t}} - 1$ . Where  $e_0$  and  $e_t$  are employment at the start and end respectively and  $t$  is the time period in between.



Among the high-income economies as shown in Figure 3.3-A, none has recorded positive growth rates in employment in the two periods. The highest positive growth from 1995 to 2005 is recorded by Spain (1.84%) followed by Canada (0.92%). The United Kingdom leads in terms of negative manufacturing employment growth at 2.66% and closely followed by Japan. While the U.S. experiences a negative decline in both time periods, Canada moves from a positive growth to a 2.96% decline, the second largest negative growth in 2005-2015. With the exception of Germany and Spain which had both positive and negative growth rates, the rest of the E.U. countries recorded negative growth rates in both periods. On average, over these two periods, the United Kingdom was the worst hit economy so far as the manufacturing employment decline is concerned with a negative growth rate of 2.30%. Averaging the growth rates over these two periods, Canada ranks fourth with an average worse decline of 0.64% after Spain, Germany, and South Korea who recorded -0.56%, -0.49% and 0.25%, respectively.

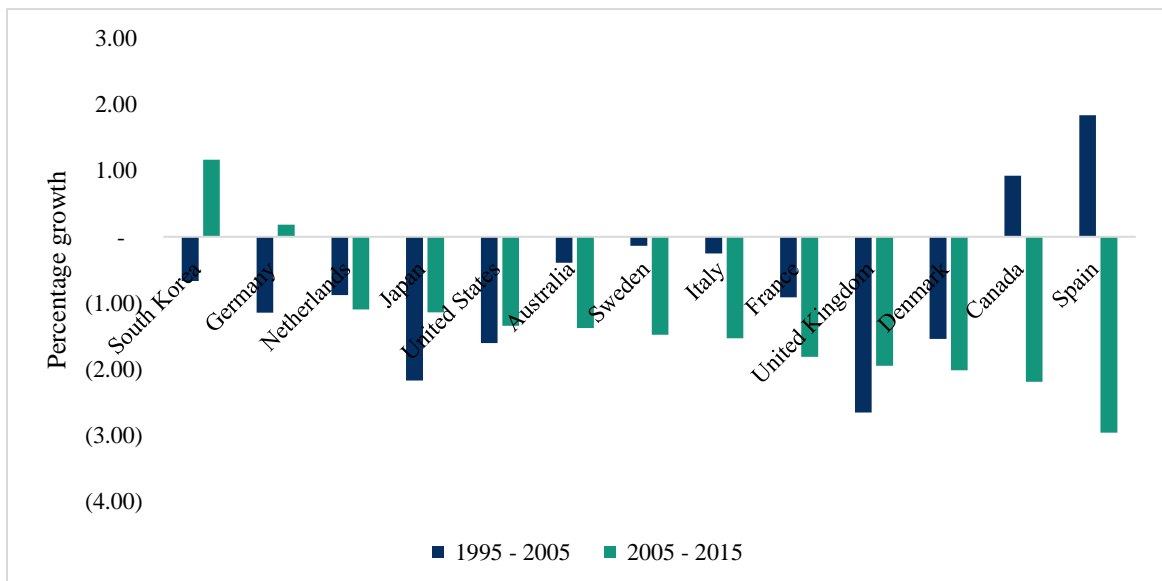


Figure 3.3-A: All employed persons in manufacturing, annual percentage change

Source: Researcher's own calculation based on The Conference Board; international comparisons of manufacturing productivity and unit labour cost data.

In Figure 3.3-A, Korea, Germany, Canada and Spain are the economies with some positive growth rates in the two separate time periods. While Korea and Germany record their positive growth in the most recent period, Canada and Spain occur to the mid-90s and mid-2000s. Comparatively, in Levinson (2017) analysis of U.S. manufacturing in the international perspective from 2008-2015, Canada's manufacturing employment declined in total by 9.10% and, except for Germany, South Korea, and Taiwan, the rest of high-income countries witnessed employment declines in the range of 8% to 16%.

### **3.4 Export and Import Trends**

Canada is one country that relies on exports and imports. Relying on trade as ratio of GDP, Canada's economy shows a great deal of openness to the world relative to some high-income economies. Indeed, the World Bank (2015) development indicators show that in 2000 Canada's imports and exports of goods and services constituted 38.62% and 44.24% of its GDP, respectively. This is second to Netherlands (imports 59.96% and exports 66.49%) and higher than that of Germany, France, United States, United Kingdom, Korea, and Japan.

Fifteen years later, in addition to the Netherlands, Korea and Germany are the economies that are more open to trade than Canada. Import and export shares of Canada's GDP in 2015 stood at 33.84% and 31.53%, respectively. Which is 38, 6, and 5 percentage points less than Netherlands, Germany, and South Korea imports shares; and 51%, 15% and 14% less in terms of these countries exports shares<sup>10</sup> respectively. To further make the Canadian economy more open, the country has free trade agreements with 44

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<sup>10</sup> Export and import shares calculation is extracted from the World Bank's Development Indicators Database

countries compared with 4 countries in 2016 (Government of Canada, 2015). While these agreements make external markets accessible to Canadian manufacturing firms, they also allow into the Canadian market products from its trading partners. Lately, Canada’s openness to trade has been evolving into growing imports over exports and for four consecutive years (i.e. from 2012 to 2015 statistics show a trade deficit trade increasing by 73% from 2012 to 2015) (Statistics Canada, 2016).

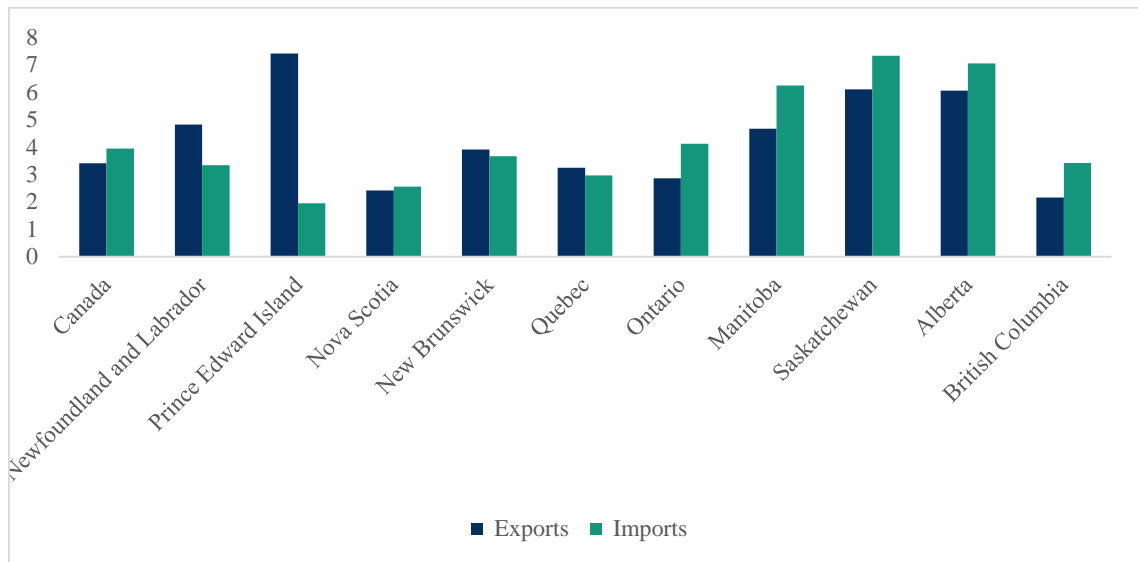


Figure 3.4-A: Export and import ratios 2015/1990

Source: Researcher’s own calculation using CANSIM Table 228-0060

Given the evidence of Canada’s openness to trade and the growing overall trade, there is no denying that exports and imports at the provincial level are growing too. Figure 3.4-A presents the ratios of trade variables between 1990 and 2015 that measure the extent to which exports and imports have increased in Canada. Imports and exports in 2015 increased by 3.94 and 3.4 times, respectively compared to 1990. This trend permeates all ten provinces, where both exports and imports in 2015 increased at least two times their values in nominal terms in 1990. Going down the provincial level, while

Prince Edward Island, Newfoundland, New Brunswick, and Quebec have had their export ratios higher than their imports ratios, the rest have recorded the reverse. And for most provinces, imports grew more than exports over the last two and half decades.

Between 1990 and 2015 in Figure 3.4-A, imports have grown over exports in six provinces namely: Ontario, Manitoba, Nova Scotia, Saskatchewan, Alberta, British, and Columbia. This sums up the trend at the national level where imports have risen above exports.

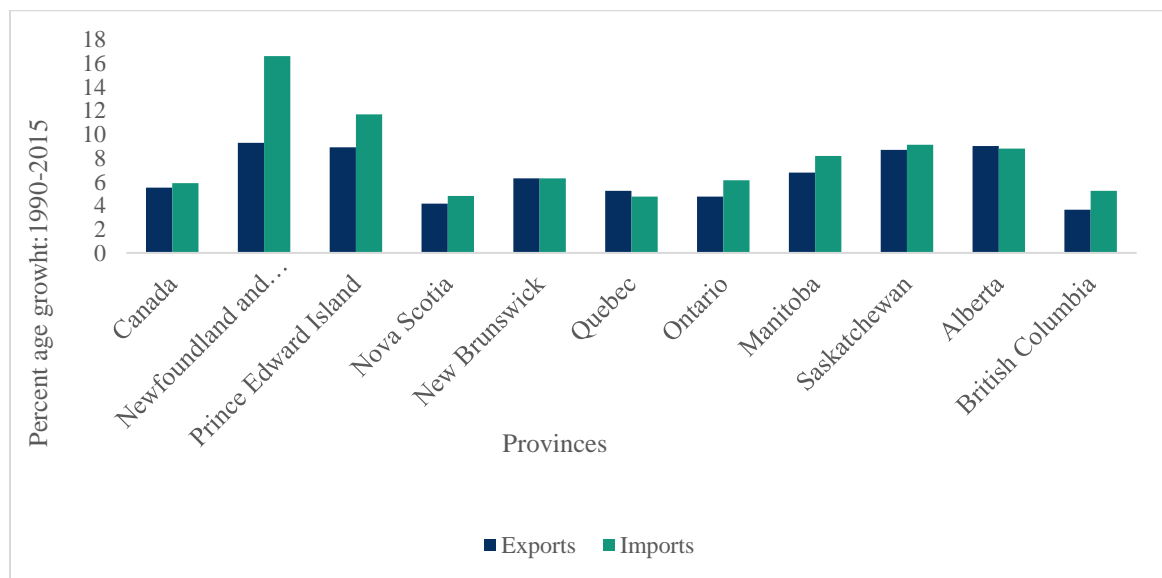


Figure 3.4-B: Average growth of exports and imports: 1990 to 2015

Source: Researcher’s own calculation using merchandise trade in CANSIM Table 228-0060.

Looking at merchandise trade from an annual average growth perspective, imports grew at 5.90% compared with 5.50% for export growth from 1990 to 2015. Indeed, this makes sense because imports have outgrown exports in eight of the provinces and is shown in Figure 3.4-B. Clearly from both Figures 3.4-A and 3.4-B, merchandise trade over the last 25 years in Canada has increased both in terms of exports and imports.

The performance of the manufacturing sector in terms of employment growth across high-income economies has been less encouraging. Also, as we have discussed in this chapter, at the country level, manufacturing sector employment continues to decline in contrast with a rising all industries employment. Relatively, while exports and imports are rising at the national and provincial levels in Canada, employment in the manufacturing sector has been decreasing. The trend analysis therefore shows a negative relationship between manufacturing sector employment and merchandise trade. However, further empirical analysis is really important as it will put this relationship into perspective by showing how exports and imports relate to manufacturing sector employment adjustment.

## CHAPTER 4

### 4.1 Methodology

In this chapter, we derive the labour demand function and show the incorporation of the trade variables into the output variable such that we have a static model to start the empirical analysis. The chapter also presents and discusses the variables used, as well as the econometric techniques for estimating dynamic labour demand. To analyse manufacturing adjustment to trade exposure, we set up two models in addition to the static model, which include both partial and general adjustment models. The former has the lag of employment as an independent variable, and the latter has the lags of both exports and imports as well as the other control variables as additional regressors. The last section explains the sources of the data we use in this study.

### 4.2 Model Specification and Variables

In this thesis, we set out to examine the effect of trade exposure on manufacturing employment adjustment in Canada by using provincial manufacturing employment as a weight for determining provincial exposure to both imports and exports while controlling for other variables that influence employment adjustment in the manufacturing sector (i.e., exchange rate fluctuations, technology and demand). We rely on a panel dataset of the 10 provinces in Canada observed in the period from 1990 to 2015. This sample period is particularly important because of the trend of adjustment, and the unique economic occurrences (e.g., an era of increased trade exposure and a global recession). Also, the financial crisis in 2008 occurred during this period and it had a profound effect on the global economy. The use of time period is central to Rothwell's departure from the conclusions of the study by Autor et al. on U.S. manufacturing industry employment in

local areas. While Autor et al. (2013a) find import competition from China to be associated with a slower wage growth, and higher unemployment in U.S. local areas, Rothwell (2017) faults their conclusion and uses the performance of the U.S. economy at different periods as the basis of the criticism (i.e., 2000-2007 was weaker relative to the 1990s). The criticism here is that relative to the U.S., which was greatly affected by the 2008 economic recession, for Canada it was not such a major problem, and hence weaker macroeconomic performance may not be so important in our empirical results. However, we provided trend analysis in Chapter Three taking into consideration the idiosyncrasies of these different time periods.

We shift focus to the derivation of the labour factor demand function. The labour demand function in microeconomic theory, which is the outcome of a typical firm's profit maximization, provides us with the framework to analyse the determinants of industry labour demand decisions. Evidently, many empirical studies have relied on this derivation to set up a regression model that allows the econometric assessment of the effect of trade on employment.<sup>11</sup> In similar way to what has been used in the literature, we begin by adopting a representative firm aggregated at the provincial levels. The two main inputs

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<sup>11</sup> Bruno et al. (2004), Chris and Peter (1998), Gaston and Trefler (1994), Greenaway et al. (1999) have all used the labour demand derivation approach. However, as far as this approach is concerned, Golder (1986) and Iyer (2013) used the CES approach in specifying labour demand models.

are: capital (K) and labour (L) at a price of  $r$  and  $w$ , respectively, which are used in the production of output (Q) for a price of  $p$ . Normalizing by  $p$ , our real wage for domestic labour is  $w = \frac{W}{p}$ . In the product market, factors of production are assumed to be perfectly competitive across provinces, and firms have no control over wages. We will also use a Constant Elasticity of Substitution<sup>12</sup> (CES) production function of the form below (see Iyer (2013) for a similar application):

$$Q_{it} = \gamma [\alpha (L_{it})^{-\rho} + \beta (K_{it})^{-\rho}]^{-\frac{1}{\rho}} \quad (1)$$

Where  $Q$  is the provincial output in the manufacturing sector,  $\beta$  and  $\alpha$  are capital and labour share of output parameters, respectively. The degree of homogeneity of the production function is  $h$ , and  $\gamma$  is an efficiency parameter denoting total factor productivity.  $\rho$  is the degree of substitution whose value determines; increasing, decreasing or constant returns to scale of the production function. The elasticity of substitution between the factors of production is given by:

$$\sigma = \frac{1}{1+\rho}; \text{ making } \rho \text{ the subject we arrive at: } \rho = \frac{1-\sigma}{\sigma}$$

To understand the technological progress in the production process, two separate parameters  $\lambda$  and  $\theta$  are introduced to depict labour and capital augmenting technologies respectively (Iyer, 2013). These two parameters (labour and capital augmenting technologies) replace  $\gamma$  and hence our CES production function becomes:

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<sup>12</sup> Iyer (2013) indicates that in empirical research the CES production function fits well for employment growth models. However, Iyer did not estimate any of the parameters in the production function.



$$Q_t = [\alpha(e^{\lambda t}L_t)^{-\rho} + \beta(e^{\theta t}K_t)^{-\rho}]^{-\frac{1}{\rho}} \quad (2)$$

From Equation (2) above,  $e^{\lambda t}L_t$  and  $e^{\theta t}K_t$  measure labour and capital efficiencies in the production process respectively. However, given  $\rho = \frac{1-\sigma}{\sigma}$ , we can substitute  $-\rho$  with  $\frac{\sigma-1}{\sigma}$  and rewrite Equation (2) as:

$$Q = \left[ \alpha(e^{\lambda t}L)^{\frac{\sigma-1}{\sigma}} + \beta(e^{\theta t}K)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad (3)$$

A profit maximizing firm will demand labour to the point where the marginal product of labour (MPL) equal the real wage, which is  $MPL = w = \frac{W}{P}$ . But MPL is given by:

$$\begin{aligned} MPL &= \frac{\partial Q}{\partial L} = \alpha h e^{\lambda t} (e^{\lambda t}L)^{-\frac{1}{\sigma}} \cdot (Q)^{\left[1 - \frac{\sigma+1}{\sigma h}\right]} \\ w &= \alpha h e^{\lambda t} (e^{\lambda t}L)^{-\frac{1}{\sigma}} \cdot (Q)^{\left[\frac{h\sigma - \sigma + 1}{\sigma h}\right]} \end{aligned} \quad (4)$$

Then we solve for L which is represented as:

$$L = w^{-\sigma} (h\alpha)^{\sigma} (e^{\lambda t})^{\sigma-1} [Q]^{\frac{[\sigma h - \sigma + 1]}{h}} \quad (5)$$

To complete the derivation of our labour demand function, we take natural log of Equation (5) which gives us the equation:

$$\ln L = -\sigma \ln w + \sigma \ln(h\alpha) + (\sigma - 1)\lambda t + \frac{\sigma h - \sigma + 1}{h} \ln Q \quad (6)$$

And for the purposes of estimation;  $\mu_0 = \sigma \ln(h\alpha)$ ;  $\mu_1 = -\sigma$ ;  $\mu_2 = (\sigma - 1)$ ; and  $\mu_3 = \frac{\sigma h - \sigma + 1}{h}$ . So, equation (6) becomes:

$$\ln L_{it} = \mu_0 + \mu_1 \ln w_{it} + \mu_2 \lambda t + \mu_3 \ln Q_{it} \quad (7)$$

Equation (7) is a simplified function of an industry labour demand function which by assumption represents provincial aggregate manufacturing employment demand. Primarily Equation (7) depicts labour demand as a function of wages, output and time.  $\lambda t$  captures the technical efficiency of labour in the production process over time. We will assume that labour demand is optimally determined which allows us to estimate Equation (7) as static employment model, and then subsequently the partial and general adjustment models.

For the purpose of this thesis, we proceed to incorporate exports and imports through the output channel of the labour demand equation. Assuming that total provincial manufacturing output is composed of domestic consumption (DC)<sup>13</sup> of domestically produced goods, exports and imports. Thus, we will work with the following specification in the labour demand function.

$$\text{Output (Q)} = (\text{Domestic Consumption} - \text{Imports}) + (\text{Exports})$$

$$Q_{it} = (DC_{it} - IM_{it}) + EX_{it} \quad (8)$$

In this notation,  $Q_{it}$  and  $DC_{it}$  represent the output and domestic consumption of manufactures in province  $i$  at time  $t$ , respectively. While  $EX_{it}$  represents that part of output exported to other countries by province  $i$ ,  $IM_{it}$  accounts for the inflows to each province. This is similar to the Acemoglu et al. (2016) measure of domestic absorption of

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<sup>13</sup> Domestic consumption is the difference between domestic production and export plus imports into the domestic economy. Just as domestic producers access external markets so do external producers have access to domestic markets.  $DC = (Q - EX) + IM$

U.S. manufacturing products in their construction of Chinese import penetration ratios. Our study makes use of their output equation in which real imports are subtracted from real gross domestic output to arrive at net real domestic output. However, in the case of this thesis, imports remain important to the analysis of employment adjustment. Hence, we directly substitute the log sum of the variables in the output function of equation (8) into Equation (7), which gives us the extended labour demand equation of the form:

$$\ln L_{it} = \mu_0 + \mu_1 \ln w_{it} + \mu_2 \lambda t + \mu_3 \ln DC_{it} + \mu_4 \ln EX_{it} - \mu_5 \ln IM_{it} \quad (9)$$

Obviously, the implication of Equation (9) is simply that, the labour demand decision does not depend on the factor price alone, but also on the external and internal demand for manufactures, the competition from foreign products (imports) in the domestic market, and time which is seen to enhance labour productivity. It is expected that domestic consumption and exports will have a positive effect on labour demand whereas imports and wages will exert a negative effect on labour demand. These expectations are within the theoretical framework of labour demand.

Basically, we move from a theoretical derivation to an econometric representation of the labour demand function. And following the proper notation used in panel data literature, we present Equation (9) as follows:

$$N_{it}^* = TRVs_{it}\pi + X_{it}\omega + \epsilon_{it} \quad (10)$$

where  $\epsilon_{it} = u_i + \varphi_{it}$  and TRVs stands for trade variables

The control variables in  $X_{it}$  include: manufacturing wages, labour productivity, exchange rate domestic consumption of domestically produced goods, research and

development as ratio of manufacturing sales and the time trend. We choose these control variables because of their linkage with employment and there is a body of literature on how these variables have impacted employment over time. This has been discussed in the literature review section. Equation (10) can be described as the desired employment in aggregate; in other words, the static model to the extent that current values of the regressors are the determinants of labour demand. In both level and growth terms, this will allow us to capture the effect of trade exposure on employment adjustment. The  $\epsilon_{it}$  (error term) has two independent components:  $u_i$  the province fixed effect, and  $\varphi_{it}$ , the peculiar time shock for each province. The error term is assumed to vary across provinces and time periods with mean equal to zero and is uncorrelated with both the present and future values of the model regressors.  $N_{it}^*$  replaces  $\ln L_{it}$  which shows the desired manufacturing employment at time  $t$  in province  $i$ . TRVs represents a vector of export and import variables that each provincial manufacturing sector employment is exposed to.

The labour factor productivity variable will control for efficiency of labour in production, which apparently can be induced by technology and time. Nonetheless the research and development (R&D) intensity variable in our model can also be used to analyse the effect of industry adoption of technology<sup>14</sup> on labour demand. It will be expected to have a negative effect on labour demand because the higher the intensity, the more likely that industry employment demand will be low (Acharya, 2017; Bloom, Draca, and Van Reenen, 2016). However, this relationship is not conclusive as it may

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<sup>14</sup> Technology arising from industry investment into research and development. Research and development is conducted so as to find new ways of enhancing and increasing production.

also depend on the extent of industry adoption of technology arising from research and development. In determining the R&D intensity, we use manufacturing sales as the denominator, while Acharya (2017) used industry value added. The interpretation is similar, as in both cases, the aim is to determine the proportion of industry worth that is committed into research and development and how that affects its labour demand.

For the labour productivity effect on labour demand both signs are theoretically possible. On one hand, an increase in productivity for workers whose skills are relevant to a specific industry will result in increased demand for those workers, and on the other hand increase in productivity may also imply industries have adopted labor-saving technologies and are thus substituting capital for labour. In China, Fu and Balasubramanyam (2005) argue that the 1978 agricultural reforms (modernization of Chinese economy under which investments were geared towards labor-saving technologies) did raise labour productivity and altered the production pattern from labour-intensive to less labour-intensive methods. And according Taylor (1998), this contributed to an increased labour surplus in rural China. The analysis of labour factor productivity effect on employment is broad and obviously it is not within the scope of this thesis to discuss it extensively.

Annual exchange rate controls for the effect of exchange rate fluctuations of the Canadian dollar on labour demand and, as a control variable, we expect its effect on employment adjustment to be negative or positive depending which term is used. The exchange rate term that will be used in our model is the price of a U.S. dollar in terms of Canadian dollar. In essence, how many Canadian dollars will buy one U.S. dollar. An increase in this rate therefore means depreciation of the Canadian dollar, and the impact

on employment should be positive as it makes Canadian exports competitive and imports less competitive.

Given the assumption of the effect of past on current levels of employment, and the fact we want to capture employment evolution overtime, we extend the base model to include a year's lag of employment. Indeed, this is one of the assumptions underlining the labour demand model derived from CES production function (Iyer, 2013). Besides, in estimating a lagged dependent variable model (LDV) Keele and Kelly (2006a) argue that the inclusion of the lag of the dependent variable rids the model of autocorrelation, which by the assumption of the OLS consistency proof, the error term is independently and identically distributed with the inclusion of the lag of the dependent variable. The specification induced autocorrelation in the model is thus corrected by the introduction of the lagged dependent variable (see Keele and Kelly (2006a) for elaboration). The restricted dynamic level model, which is also referred to as partial adjustment model is derived as follows:

$$N_{it} - N_{i,t-1} = \emptyset (N_{it}^* - N_{it})$$

The above identity shows partial employment adjustment where the adjustment coefficient is  $\emptyset$ ,  $N_{it}^*$  is the desired level of  $N_{it}$  (actual aggregate employment). By putting Equation (10) into the partial adjustment above and solving for current level of employment  $N_{it}$  we arrive at:

$$N_{it} = \tau N_{i,t-1} + TRV_{sit} \mathfrak{N}_1 + X_{it} \mathfrak{N}_2 + \varepsilon_{it} \quad (11)$$

where,  $\tau = (1 - \emptyset)$ ;  $\mathfrak{N}_1 = \emptyset \pi$   $\mathfrak{N}_2 = \emptyset \omega$ ; and  $\varepsilon_{it} = \emptyset \varepsilon_{it} = \emptyset (\mu_i + \varphi_{it})$

$$E[\mu_i] = E[\varphi_{it}] = E[\mu_i\varphi_{it}] = 0$$

Having the of lag of the dependent variable, we follow the Greenaway, et al. (1999) estimation procedure by adopting Autoregressive Distributed Lag Model (ADL) (1,1) and this makes the employment adjustment a general adjustment model. With reference to De Boef and Keele (2008), the distributed lag allows us to determine how the effect of exports and imports exposure on employment adjustment is distributed across time. Inevitably, the introduction of the lag of the dependent variable imposes a restriction<sup>15</sup> on the evolution of employment in Equation (11) given a change in any of the explanatory variables and to relax this restriction we adopt a distributed lag for the independent variables (Greenaway et al., 1999). Greenaway et al. (1999) relate the uncertainty of the source of dynamics<sup>16</sup> in labour employment equations as the reason why lagged independent variables may be included in dynamic model. More importantly, the inclusion of the lag structure in a dynamic labour demand model helps the modelling of sluggishness of employment adjustment to changes in factors such as wages, capital stock and demand for firms' output (Arellano and Bond, 1991; Roodman, 2009). It must also be mentioned that the strict exogeneity assumption of the explanatory variables underpinning Equation (11) is relaxed by introducing the lags of the independent variables (especially the variables of interest) in the dynamic model. The dynamic model for a panel of ten provinces is thus transformed below to depict the general model of ADL (1, 1).

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<sup>15</sup> The lagged coefficients of the explanatory variables (the exports and imports variables and including the control variables) are set equal to zero in the case of Equation 11 implying partial adjustment

<sup>16</sup> For the factors that account for employment dynamics, they outlined the presence of serially correlated technology shocks, bargaining consideration and heterogeneity effect due to variation in adjustment costs of employment among workers

$$N_{it} = \theta N_{i,t-1} + TRV_{S_{it}}\beta_1 + TRV_{S_{i,t-1}}\beta_2 + X_{it}\beta_3 + v_{it} \quad (12)$$

Where in Equation (12)  $v_{it}$  is the error term in this general adjustment model. Each coefficient in the model measures the elasticity of employment with respect to the appropriate variable. However, for net effect analysis of especially on the variables of interest (exports and imports), Equations (11) and (12) are particularly important to the estimation in this study.

Data on exports (EX) and imports (IM) are provincial aggregates so we follow Partridge, et al.'s (2014) apportionment approach by using the manufacturing employment share of all industry employment as weight of provincial merchandise trade to arrive at values for exports and imports. The apportionment is done in two parts: Canada's overall exports and imports with the rest of the world as the first part; and trade with its top three partners as the second part. In our empirical analysis, the outcome becomes an indicator of a province's manufacturing sector's exposure to imports and exports. From the top three trading partners' perspective, we see a dimension of how much of exports to and imports from the them are contributing to manufacturing employment adjustment in Canada. Symbolically, the determination of manufacturing sector trade exposure (TE) is presented below:

$$TE_{it} = \frac{N_{it,m}}{N_{i,t,j}} Z_{it}$$

Where  $i$ ,  $t$ ,  $j$ , and  $m$  index province, time, all industries and manufacturing employment, respectively. The numerator is manufacturing sector employment in province  $i$  at time  $t$  and the denominator is total employment in province  $i$  at time  $t$ .  $Z_{it}$  is the value of the



exports of province  $i$  at time  $t$ . This will help us to construct data for both export and import for all the ten provinces. The rationale for adopting this procedure (see Autor, et al. (2013a) for extended use of this procedure) is because we are assuming that manufacturing industries are widely spread across the ten (10) provinces, and are engaged in some form of export and import activities. Thus, all the manufacturing sectors across the ten provinces are exposed to trade. Also important is the fact that Canada's trade with its top trade partners are not disaggregated in terms of provinces, so the use of this identity will enable us to generate provincial-level merchandise trade data for the top-three trading partners.

To get our provincial data values for merchandise trade exposure intensity based on origin, we make a slight modification to identity above having in mind that export and import flows are with respect of Canada's trade with the U.S. the E.U. and China.

$$W_{it,x} = \frac{N_{it,m}}{N_{it,j}} \frac{S_{kt}}{GDP_{it}} * 100$$

$W_x$  is the origin's exposure intensity (of exports and imports) in province  $i$  at time  $t$  and  $S_{kt}$  represents aggregate merchandise trade (exports and imports) of a trading partner ( $k$  indexes Canada), and this is different from  $Z_{it}$  in terms of data source.  $GDP_{it}$  represents the gross domestic product of province  $i$  at time  $t$ . Trade intensity as shown in the identity above is similar to Acharya's (2017) industry-level derivation of export and import intensities (see also Bloom et al.'s (2016) measure of E.U. countries' exposure to Chinese imports). The values from the identity above will help us to test specific trading partner effects on employment adjustment. How do we assess this effect? To start with, we will have Canada's overall export and import exposure intensities in the employment

adjustment model, and then replace the overall import exposure intensity with the origin specific import exposure intensities. This way we are able to determine whether or not import exposure intensities by country of origin have different effects on employment adjustment.

### **4.3 Econometric Estimation**

The goal in this thesis is to investigate the implications of trade exposure on manufacturing employment adjustment in Canada. And to achieve this goal, we are estimating the transformed versions of Equations (11) and (12) that specify some relationship between employment demand and the trade variables. Generally, there are four types of estimation techniques for panel data: Pooled OLS, Fixed effects, Random effects and Generalized Method of Moment. The use of OLS in estimating Equations (11) and (12) is bound to produce biased and inconsistent estimates because of the presence of the lagged dependent variable ( $N_{t-1}$ ). According to Keele and Kelly (2006b), having lagged dependent variable as a regressor solves the problem of autocorrelation among residuals of the regression, but Davidson and MacKinnon (1993) and Nickell (1981) argue that lagged dependent variable is correlated with the fixed part of the error term ( $\mu_i$ ). Hence the fixed component of the error term will bias the coefficient on the lagged dependent variable if OLS is used in estimating the model. Besides having endogeneity problem, the assumption for consistency nonetheless will also be violated with the use of OLS approach. It is obvious that the OLS approach attributes the predictive power of the fixed effect to the lagged dependent variable thereby overestimating the coefficient of the lagged dependent variable. Therefore, using the OLS approach in estimating our dynamic labour demand model will result in spurious statistical inferences.

Regarding estimating dynamic labour demand models, Arellano and Bond's (1991) proposed Generalised Method of Moments (GMM) has been widely used over both fixed effects and random effects estimation techniques in empirical analysis. However, the reasons why it is inappropriate for us to use the fixed effects and random effects estimation techniques for Equations (11) and (12) are: the possibility of reverse causality and the presence of the lagged depend variable in the models. Some of the explanatory variables, for instance domestic demand and exports, may be endogenously determined with respect to industry labour demand such that a shock to labour demand might affect the levels of domestic demand or exports which will lead to reverse causality. Even with the assumption of no reverse causality, the fact that exports and imports are determinants of industry labour demand implies a correlation with lagged employment. This creates a potential for biased coefficients when we use fixed effects and random effects models. It is also important to note that the error term may be correlated with the lagged dependent variable making it a contributor to the coefficient on the lagged dependent variable. These challenges are remedied by using Difference of Generalized Method of Moments (DIF GMM). The challenge of endogeneity caused by the presence of the lagged dependent variable is resolved by first differencing the data under the assumption of no serial autocorrelation in the time-varying error term levels in this kind of dynamic model using second and third-order untransformed lags as instruments (Arellano and Bond, 1991). The moment condition for this becomes  $E(N_{it} \Delta\mu_i) = 0$ . Differencing both Equations (11) and (12) we obtain the following equations:

$$\Delta N_{it} = \tau \Delta N_{i,t-1} + \Delta TRV_{it} \aleph_1 + \Delta X_{it} \aleph_2 + \Delta \varepsilon_{it} \quad (13)$$

$$\Delta N_{it} = \theta \Delta N_{i,t-1} + \Delta TRV_{it} \gamma_1 + \Delta TVR_{i,t-1} \gamma_2 + \Delta X_{it} \gamma_3 + \Delta v_{it} \quad (14)$$

However, as it has been observed in Bond, Hoeffler, and Temple (2001) that DIF-GMM estimator may be weak given the presence of persistency in the dependent variable as well as the dominance of cross-section variability over time variability. To address this weakness, we follow Blundell and Bond's (1998) proposition of the SYS GMM technique for resolving dynamic panel bias. Unlike the Arellano-Bond's DIF GMM which transforms the regressors to get rid of the fixed effect, Blundell and Bond's SYS GMM transforms the instruments to make them independent of the fixed effect (Roodman, 2009). In practice therefore, the SYS GMM comprises two procedures; first, the usual DIF GMM which uses the lagged dependent variable as an instrument for the differenced equations; and second, instead of differencing regressors to get rid of the fixed effect, SYS GMM uses the difference of the instruments (which are exogenous to the fixed effect) in the level equations. This is plausible under an additional moment of restriction which is  $E[\Delta \omega_{it} \mu_i] = 0$  where  $\Delta \omega_{it}$  represents the instruments and  $\mu_i$  is the fixed effect (Roodman, 2009). Asymptotically, the SYS GMM is said to provide efficient estimates compared with the conventional approach of the DIF GMM given its added moment conditions.

For the purpose of clarity in terms of specific models that we seek to estimate, Equations (10), (13) and (14) present us the dimensions based on which we will assess the effect of trade exposure on manufacturing employment adjustment. Intuitively, these equations respectively indicate static, and partial and general adjustments mostly associated with dynamic models. De Boef and Keele (2008) provide a comprehensive discussion on these types of adjustment models. Having outlined the estimation technique

for Equations (13) and (14), it is important to indicate that SYS GMM includes lagged dependent variables among the list of regressors (i.e., the system is designed for estimation of dynamic models) which makes its use in the static model inappropriate. We therefore use the fixed effects estimation technique which will allow us to estimate Equation (10).

#### **4.4 Data Description**

A balanced panel of aggregate annual data on economic variables pertaining to the 10 provinces across Canada economy is considered for the estimation of the trade exposure effect on manufacturing employment. The dataset includes both province-specific and national aggregates from the period 1990 through 2015. Both province-specific and national aggregate data on employment, exports, imports, domestic sale of manufacturing products, gross domestic output, manufacturing wages, and the U.S. dollar exchange rate are obtained from Statistics Canada. Particularly to our interest of study, manufacturing employment data is obtained from the Labour Force Survey (CANSIM Table 282-0008) organized according to national and provincial aggregates by the North American Industry Classification System (NAICS).

While employment is organized according to NAICS, merchandise imports and exports for all countries are organized under CANSIM Table 228-0060 in conformity with the North American Product Classification System (NAPCS). CANSIM Table 228-0069 presents annual data from 1997 to 2015 on merchandise exports and imports by the principal trading partners of Canada. Nonetheless, both require some form of disaggregation across provinces and, to this end, we resort to the apportionment procedure that applies manufacturing employment's share of all industry employment at

the provincial levels as a weight to determine provinces volumes of exports and imports (refer to the trade exposure measure above). It would be ideal if we could assemble the data based on the manufacturing sectors across the provinces in Canada, and with these data also classify into imports and exports relating to these manufacturing sectors.

However, since we are limited by this, the share of manufacturing employment in all industries employment for weighting merchandise trade (exports and imports) provides the basis for some measure of provincial manufacturing sector exposure to trade. The outcome of which we interpret in two ways: first, the dollar value of exports needed to sustain and create manufacturing sector jobs; and second, the dollar value of imports likely to displace jobs in the manufacturing sector across all provinces.

Domestic retail demand by NAICS is a measure of domestic consumption of manufacturing products which is organized under CANSIM Table 080-0020 and disaggregated across the 10 provinces. It comes from monthly and quarterly economic indicators by province and is seasonally adjusted. The annual average of this data is however used for estimation. Implicit price indexes from Table 380-0066 for exports, imports and final domestic demand are used to obtain the real values of these variables.

Data on manufacturing wages, a variable controlling for the labour price effect on industry labour demand, is obtained from CANSIM Table 282-0151 Labour Force Survey (LFS) estimates, wages of employees by type of work, National Occupational Classification (NOC), sex, and age group, unadjusted for seasonality. It is the annual average wage in the manufacturing and utilities sector across the provinces in Canada. This annual average manufacturing wages are converted to real wages using the province-specific consumer price index from CANSIM Table 326-0021. Also, we obtain labour

factor productivity from CANSIM Table 383-0033 which is disaggregated data by province and territory under NAICS combined three-digit codes. Statistics Canada (2017) measures labour productivity based on real gross output per hour worked. O'Mahony and Timmer (2009) discuss how data on productivity measures is constructed at the industry level.

To control for employment adjustment associated with movements in the exchange rate (see Coulombe's (2008) study on Canadian dollar appreciation on employment in high-trade exposed manufacturing), we rely on Table 176-0064, Foreign exchange rates in Canadian dollars, Bank of Canada. This is the only variable that is fixed across all provinces. The Real Canadian Effective Exchange Rate (CEER) index produced by Bank of Canada would have been the better variable to use in employment adjustment due to movement in Canadian dollars because it is an index constructed taking into consideration currencies of Canada's major trading partners. But the data start from 1999 against this thesis' 1990.

Provincial expenditures on research and development as a ratio of manufacturing sales allows us to control for the effect of investment in product development and innovation on industry labour demand. CANSIM Table 358-0001 shows provincial gross domestic expenditures on research and development. Indeed, what we considered is the business sector funding for research at various institutions (universities and government agencies) as it closely provides us a general measure of innovation by industry. We express the expenditure on research and development as ratio of provincial manufacturing sales obtained from CANSIM Table 304-0015. This gives us the research and development intensity across the provinces.

In sum, Table 4.4-A below shows all the variables - along with their summary statistics - that we will use in this study. The first column contains the number of observations (N), the second is the mean, third is the standard deviation (sd), fourth is the minimum and last column is maximum.

Table 4.4-A: Summary statistics

VARIABLES	N	Mean	sd	Min	max
Manufacturing Employment	260	11.12	1.526	8.189	13.92
Real domestic demand	260	21.06	1.310	18.23	23.34
Real exports	260	18.92	2.025	14.17	23.71
Real imports	260	18.28	2.635	11.83	24.12
Exchange rat	260	1.255	0.176	0.989	1.570
R&D to manufacturing sales ratio	260	3.060	1.739	0.124	8.497
Real manufacturing wages	260	2.697	0.151	2.355	3.037
Labour productivity	260	3.748	0.250	2.892	4.286
Number of provinces	10	10	10	10	10

Source: Researcher's calculation based on data from Statistics Canada. The specific sources of these variables are discussed above.



## CHAPTER 5

### 5.1 Estimation and Econometric Results

In this chapter we present and discuss the results of the econometric models we derived in Chapter Four. There are static, partial and general adjustment employment models through which we seek to assess the employment effect of trade exposure. Essentially, the results emerging from these models reflect the level effect and change effect that trade exposure – with the rest of the world and by country-of-origin – is said to have on manufacturing employment adjustment. In both the partial and general adjustment cases we show employment equations in two ways: coefficient estimates with and without time trend variables. Time trend in the adjustment models will allow us to control for the effects of other variables on employment, which are either unknown or known but cannot be measured and are not included in our model.

### 5.2 Level Effect Across Adjustment Models

In this section we provide discussion on the level effect of trade exposure on manufacturing sector employment across the adjustment models. The objective is to understand employment adjustment in relation to the volume of Canadian exports that penetrate other markets, and the volume of imports that come into the Canadian economy. By the level effect we mean the volumes of exports and imports that the manufacturing sector across the ten provinces are exposed to. Expectedly, the volumes of exports and imports potentially create and displace jobs, respectively in the manufacturing sector and could as well impact other sectors of an open economy. In measuring trade exposure, we apply the apportionment-based procedure. Thus, instead of considering the overall merchandise trade volumes in the employment adjustment

regressions, we use manufacturing employment share of all industries employment as a weight of aggregate export and import for the level effect estimation. This is what we termed as manufacturing employment weighted merchandise exports and imports – a measure of manufacturing sector exposure to trade in this investigation. The values of exports and imports obtained are transformed into log form for the derivation of the labour demand function making the regression in the level effect a log-log model for most of the variables. Hence the coefficient estimates of our variable of interest are elasticities, which lend themselves to easy interpretation.

### **5.2.1 Static Model**

Consider the static model as the benchmark model for the initial assessment of the employment effect of trade exposure. In this light, we implement a fixed effects estimation that addresses the unobserved provincial heterogeneity that is assumed to be constant overtime. Basically, the fixed effects estimation assumes the presence of omitted variables whose values and effects are constant across time and they are also correlated with the regressors in the model. Using Fixed effects estimation for the static model will therefore control for these omitted variables to prevent the problem of omitted variable bias.

The results are shown in Table 5.2-A. The objective here is to show the static effect of employment adjustment to trade exposure given the assumption that employment is not dynamic. Apart from the exchange rate, time trend and the R&D-manufacturing sales ratio, the other variables (real exports, real imports, real wages, real domestic demand and labour productivity) are in log form across the level effect models.

Having estimated this static model, all the control variables have their expected signs and are statistically significant; especially the real manufacturing wage which shows a negative relationship with employment. In labour demand theory, the own price of labour is inversely related with quantity demanded, meaning that this result is consistent with the theoretical prediction. For this reason, it is to be expected that manufacturing employment on aggregate terms will fall given a rise in manufacturing wages – a primary determinant of labour demand.

Another primary variable arising from the derivation of labour demand function that is worth attention is domestic demand, a variable that controls for the employment response to shocks in aggregate domestic demand for manufactures. The coefficient is positive, which aligns with the theoretical interpretation that an increase in aggregate demand leads to increase in industry demand for labour, all things being equal. From our results, at 1% statistical significance, we expect real domestic demand to have a positive effect on employment decisions of manufacturing firms across the ten provinces in Canada.

Table 5.2-A: Static employment effect of level trade exposure

Variables	Equation 1	Equation 2
Real domestic demand	0.775*** (0.0547)	1.146*** (0.0745)
<b>Real exports</b>	0.0334 (0.0251)	0.0390* (0.0231)
<b>Real imports</b>	-0.0670*** (0.0248)	-0.0489** (0.0229)
Exchange rate	0.277*** (0.0412)	0.248*** (0.0381)
R&D-manufacturing sales ratio	-1.807** (0.754)	-0.331 (0.726)
Real wages	-0.642*** (0.117)	-0.615*** (0.108)
Labour productivity	-0.405*** (0.0568)	-0.269*** (0.0560)
Trend		-0.0185*** (0.00274)
Constant	-1.644* (0.899)	-10.24*** (1.518)
R-squared	0.550	0.621
Observations	260	260

Note: Robust standard errors in parentheses, \*\*\* (1%), \*\* (5%), and \* (10%) represent the levels of significance.

Before we proceed, it is important to note that Equation 1 in 5.2-A represents the basic regression to start with, which we admit does not present the complete specification of our model. Nonetheless, we report the results for the purpose of showing the relevance of time in manufacturing employment adjustment.

Focusing attention on the variables of interest in this study, notice that the coefficients on real exports and imports match the theoretical expectations of trade exposure on employment. Whereas the coefficient on real import exposure is negative and statistically significant at 1% and 5% in Equations 1 and 2, respectively, the real

export coefficient is positive, but only significant in Equation 2 at 10%. To situate the static results in the context of trade analysis, we refer to the explanation by Acharya (2017) that the export sector is the sector with the comparative advantage that gradually expands as trade increases to accommodate workers from the sectors where the economy has less comparative advantage. To this end, real export exposure, although not significant in Equation 1, the positive coefficients across the two employment equations are consistent with the theoretical framework for explaining the relationship between exports and employment. And by the type of the data used in this study, employment here is the aggregate manufacturing sector employment. The manufacturing sector when it experiences an increase in demand for its output abroad will be expected to expand and absorb more workers, assuming all other factors are constant. In terms of significance, the real export effect on employment seems not be captured by Equation 1 but the addition of the time trend in Equation 2 enhances the significance of the effect.

On the import side, it is to be expected that import exposure negatively affects labour demand in the sectors without a comparative advantage, and in an open economy like Canada, the effect would usually cut across all sectors engaged in importation. Imports are of two forms: final and intermediate products. Imported final products compete with domestic output and this will likely affect the demand for domestically produced goods. If this competition lowers the demand for domestically produced goods, like our results have shown the relationship between manufacturing employment and domestic demand in Table 5.2-A, we know that industry labour demand will also fall. Acting indirectly through the demand channel, import exposure may therefore affect labour demand through the its competitive influence on the reduction in demand for

domestic output. What if imports are intermediate products, which basically are used in further production, and or investments that enhance the processes of production? In such case, employment in both export-oriented and import-competing manufacturing industries will be affected. Despite the complementarity between imports with intermediate content and domestic labour (Tombazos, 1999), there is no doubt that less labour will be required in the production process of manufacturing industries who engage in the importation of intermediate goods – a practice described in the literature as foreign outsourcing. In perspective, empirical studies have shown that industry use of intermediate products tends to reduce their demand for unskilled-labour compared with skilled labour (Acharya, 2017; Fajnzylber and Fernandes, 2009; Yan, 2005).

The results in the static estimation show a negative effect of real imports on manufacturing employment, and we notice that its coefficient exceeds that of the real exports in the two equations. As a result, we find evidence to suggest there is a negative net effect on manufacturing employment, but only for the results of Equation 1 where the joint significance test shows a p-value of 0.00 meaning that real exports and real imports coefficients are jointly different from zero. Thus, given that everything else is equal, the static model indicates a reduced effect of trade exposure on manufacturing employment decline, and this is evidenced by the difference between the real export and import coefficients in Equation 1, which is -0.034% net effect of a 1% increase in trade exposure (i.e., with both imports and exports increasing by 1% in real terms). However, the test of joint statistical significance fails to back our net effect analysis for the coefficients of real exports and real imports in Equations 2 since the p-value of the test is 0.23. We will adopt the net effect analysis of Equation 2 since it has the time trend variable that completes the

static model. The fact that the two variables (exports and imports) are jointly not significantly different from zero means that the evidence under the static model is not robust to support the negative net effect of trade exposure on employment. Nonetheless, their separate effects on employment adjustment still hold true.

### **5.2.2 Partial adjustment**

There are two things that separate the static model and the partial adjustment model. First, in terms of model specification, lagged employment variable is included as a regressor which makes the partial adjustment model a dynamic model. Second is the estimation technique, the presence of the lagged dependent variable as a regressor requires that we use SYS GMM for the partial adjustment model instead of the fixed effects model as used in the static case. The SYS GMM uses standard set of equations in first difference of variables with their levels as instruments, and then additional set of equations in levels with lagged first difference as instruments. Levels are therefore used as instruments for the first difference of both our dependent variable (employment) and independent variables (real exports and real imports as well as all the other control variables) in the dynamic adjustment model. The validity of these instruments will be demonstrated through the p-values of Sargan test hypothesis, which will be reported alongside with the results.

The results as presented in Table 5.2-B Equations 1 and 2, show that in the partial adjustment model, real export exposure is positively related with manufacturing employment, while import exposure is negative. The coefficients are statistically significant at 1% for real exports in the two employment equations, but 1% and 5% for

real imports in Equations 1 and 2, respectively. Interpreting the results in line with the objective of this study means that a one percent increase in real export exposure will increase employment by 0.032% in Equation 1, the same increase in import exposure will reduce employment by 0.012%. Presumably, the magnitude of this effect will however vary across provinces given that provinces have differences in manufacturing industry concentration. In absolute numbers, a 0.032% increase in employment manufacturing due to a one percent increase in real exposure will certainly be greater in provinces where the manufacturing sector is large in both absolute terms and relative to the size of the provincial economy. On the other hand, a 0.012% country-wide decline in manufacturing employment due to a one percent increase in real import exposure will have a severe impact on jobs in manufacturing-dominated provinces. This is so because of the large number of manufacturing jobs in those provinces. Particularly, this will be fit for Ontario and Quebec because they have large number of manufacturing jobs. Nonetheless, it remains speculation since it is purely based on the fact that these two provinces are Canada's largest manufacturing centers rather than a province-specific coefficient which is not captured in our estimation.



Table 5.2-B Partial adjustment employment effect of level trade exposure

VARIABLES	Equation 1	Equation 2
Employment <sub>t-1</sub>	0.962*** (0.0171)	0.955*** (0.0199)
Real domestic demand	0.0314 (0.0289)	0.0306 (0.0308)
<b>Real exports</b>	<b>0.0322***</b> (0.00555)	<b>0.0345***</b> (0.00672)
<b>Real imports</b>	<b>-0.0118***</b> (0.00326)	<b>-0.00957**</b> (0.00397)
Exchange rate	0.142*** (0.0182)	0.131*** (0.0194)
R&D-manufacturing sales ratio	-0.159 (0.164)	0.0596 (0.111)
Real wages	-0.0533 (0.0542)	-0.0566 (0.0605)
Labour productivity	-0.0541*** (0.0189)	-0.0478*** (0.0194)
Trend		-0.00149*** (0.000481)
Constant	-0.458** (0.207)	-0.439** (0.217)
AR (2) Test, p-value	0.27	0.31
Sargan Test, p-value	0.12	0.083
Observations	250	250

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent the levels of significance.

The addition of the time trend variable provides grounds for us to believe in the completeness of the model specification. Notice in employment Equation 2, the coefficients on real exports and real imports have maintained their expected signs and statistical significance except a slight increase in the real exports effect and decrease in the real imports effect. Equation 2 therefore is no different in terms of interpretation and analysis from Equation 1. Quite revealing in Equation 2 is the secular decline in manufacturing sector employment as shown by the reduction of the lagged employment coefficient. The lagged employment coefficient falls from 0.962 to 0.955 when the time

trend is added to Equation 2. This decline is independent of exports and imports, and likely the result of the general decline in the overall importance of manufacturing as a share of our national income which will be reflected in the larger employment share for service and other expanding industries.

We have argued that in analyzing the effect of trade exposure on manufacturing sector employment both exports and imports must be considered for us to establish a fair prediction of the benefits and costs associated with opening an economy to international trade. Dauth et al. (2014) is one of the few studies which examined the net effect of increased trade exposure on employment in Germany. To test this argument, we will assume that no other factors in this partial adjustment model affect employment apart from real exports and imports. Now with this assumption in place, we realize that when employment is partially adjusting to changes in trade exposure, real exports positive coefficient is greater than the negative real imports coefficient. Let us go back to the results in Table 5.2-B, and starting with Equation 1, the net effect of exposure is 0.0204 (i.e.  $0.0322 - 0.0118$ ). This means that a 1% increase in manufacturing sector exposure to both real exports and real imports has a positive net effect of 0.020% on employment under the partial adjustment model. For Equation 2 when we take stock of time trend, the net effect on employment even increases to 0.025 (i.e.  $0.0345 - 0.0096$ ), which is because of an increase in the exports coefficient and a decrease in the effect of real imports. Apart from the individual statistical significance of the real exports and real imports coefficients, the joint test on these two coefficients also shows that they are statistically different from zero at 1%, and this renders further support to the net effect of trade exposure on employment adjustment. This net effect analysis is consistent with Dauth et

al. (2014) who find a net increase in Germany's manufacturing employment as result of increased trade exposure to China and the Eastern European countries. While the analysis by Dauth et al. is based on the origin in which they used trade flows of other high-income economies as instruments for exposure for the countries under their study, ours considers Canada's trade flows with the rest of the world, and hence we do not require instrumentation to overcome any estimation bias. Although the approach of Dauth et al. is quite different from what we have used in this study, our results give us an interpretation that is very similar.

Another part of the partial adjustment analysis worth highlighting is the coefficient of the lagged employment variable. The theoretical restriction placed on it, is that in any dynamic panel model the coefficient should always be less than one, and from this also we derive the speed of adjustment (see Roodman (2009) for elaboration). The coefficients are positive and statistically significant. The speed of employment adjustment given this partial adjustment is 0.038 (i.e.  $1-0.962$ ) and 0.045 (i.e.  $1-0.955$ ) for Equations 1 and 2 respectively. These values are an indication of how long it takes for employment to partially adjust to a desired level given a change in both real export and import exposures as well as the other controlled factors. By including the time trend as a regressor, we realize the speed increases by 0.007, which is the difference between 0.045 in Equation 2 and 0.038 in Equation 1.

The p-values of AR (2) and Sargan tests do not present evidence for the rejection of the null hypotheses of no autocorrelation and validity of instruments used, respectively. We have p-values of 0.27 and 0.31 in Equations 1 and 2, respectively for AR (2) indicating no autocorrelation in the model. With the account of the time trend where

Sargan p-value moves from 0.12 in Equation 1 to 0.083 in Equation 2, we will fail to reject the null hypothesis at both 1% and 5% significance levels and hence the results are valid based on the assumption that the instruments as a group are exogenous. Accepting the null hypothesis of Sargan test implies that the over-identifying restrictions are valid and that these instruments are not only exogenous as a group, but also uncorrelated with their residuals in the model.

### **5.2.3 General Adjustment**

In Table 5.2-C we present the results of the level effect of manufacturing sector employment exposure to trade under the general adjustment model. In general adjustment, we recognize that, in addition to the lagged employment variable, the past values of the variables of interest may have some effect on employment adjustment. We therefore include the one-year lag of both real exports and real imports as well as all the other control variables in the adjustment model. This is done under the theoretical motivation that employment decisions are slow to change in factors that affect industry labour demand, particularly real export and import exposures.

Starting with Equation 1 where we have the lag effect of real exports, real imports and manufacturing wages, the effect of real imports on employment adjustment although negative is not statistically significant. However, real exports, just like in both cases above, continue to have a significant positive effect on manufacturing employment adjustment. Having controlled for the lag effect of the variables in Equation 1, we notice clearly that the coefficients of the lagged import and export variables are not statistically significant. The p-values 0.44 and 0.28 reported for Arellano and Bond AR (2) and

Sargan tests, respectively, confirm the absence of autocorrelation and underscore the validity of the results.

In Equation 2 where we account for the time trend effect, the results are not significantly different from Equation 1. By explanation, the time trend variable helps us control for other factors that might affect employment adjustment, and in both Equations 2 and 4, they show a negative relationship with employment adjustment. While the real export coefficient is still positive and significant at 1%, the real import coefficient is negative but not statistically significant. The effect of the time trend on manufacturing sector employment is negative at the 1% significance level. There is no autocorrelation given a p-value of 0.45 for AR (2). And the results' validity is supported with a p-value of 0.28 for the Sargan test of over identifying restrictions.

Table 5.2-C General adjustment employment effect of level trade exposure

VARIABLES	Equation 1	Equation 2	Equation 3	Equation 4
Employment <sub>t-1</sub>	0.783*** (0.0317)	0.753*** (0.0363)	0.793*** (0.0221)	0.762*** (0.0228)
Real domestic demand	0.127*** (0.0406)	0.241*** (0.0630)	0.432*** (0.104)	0.476*** (0.107)
Real domestic demand <sub>t-1</sub>			-0.381*** (0.0955)	-0.319*** (0.0877)
<b>Real export</b>	<b>0.0412***</b> (0.0140)	<b>0.0405***</b> (0.0127)	<b>0.0489***</b> (0.0168)	<b>0.0482***</b> (0.0149)
Real export <sub>t-1</sub>	-0.0245 (0.0236)	-0.0228 (0.0251)	-0.0369 (0.0282)	-0.0348 (0.0283)
<b>Real import</b>	<b>-0.0157</b> (0.0117)	<b>-0.0133</b> (0.00941)	<b>-0.0210</b> (0.0137)	<b>-0.0189*</b> (0.0115)
Real import <sub>t-1</sub>	0.00573 (0.0196)	0.00733 (0.0215)	0.0282 (0.0244)	0.0294 (0.0255)
Exchange rate	0.182*** (0.0305)	0.178*** (0.0285)	0.0242 (0.0388)	0.00843 (0.0344)
Exchange rate <sub>t-1</sub>	-	-	0.184*** (0.0608)	0.199*** (0.0506)
R&D-manufacturing. Sales	-0.299 (0.539)	-0.0138 (0.546)	-0.322 (0.646)	-0.228 (0.642)
R&D-manuf. Sales <sub>t-1</sub>	-	-	0.655 (0.465)	0.823** (0.396)
Real wages	-0.246* (0.147)	-0.251* (0.148)	-0.117 (0.146)	-0.120 (0.145)
Real wages <sub>t-1</sub>	0.158 (0.122)	0.135 (0.128)	0.0858 (0.136)	0.0689 (0.135)
Labour productivity	-0.0819** (0.0408)	-0.0637 (0.0512)	-0.0400 (0.0707)	-0.0438 (0.0660)
Labour productivity <sub>t-1</sub>	-	-	-0.0525 (0.0412)	-0.0323 (0.0461)
Trend	-	-0.00444** (0.00217)	-	-0.00415** (0.00203)
Constant	-0.453** (0.227)	0.439* (0.230)	-0.151 (0.178)	-0.136 (0.194)
AR (2) Test, p-value	0.44	0.45	0.26	0.27
Sargan Test, p-value	0.28	0.28	0.22	0.20
Observations	250	250	250	250

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent the levels of significance.

In Equations 3 and 4, the empirical implementation is done taking into consideration the one-year lag of all the variables under the assumption that employment adjustment responds to the past levels of all of these variables, not just the lagged import and export variables as in Equations 1 and 2. Having accounted for the time trend in Equation 4, it can be seen that the real export and import variables continue to have the expected signs. Whereas the coefficient on real exports is statistically significant at 1%, the coefficient on real imports has gained a statistical significance of 10%. However, the lag effects of the two trade variables are not statistically significant. The AR (2) p-value test is 0.27 confirming no autocorrelation, and Sargan p-value test is 0.20 which supports the validity of instruments used and the results of the regression.

From the general adjustment model, we can argue that while increases in real export exposure would contribute more jobs to the manufacturing sector, real import exposure reinforces the decline in manufacturing sector employment. However, the net effect continues to be positive even in the case of the general adjustment model. Picking the last employment equation in Table 5.2-C, we can say that a one percent increase in volumes of Canada's real exports to the rest of the world will lead to an increase in manufacturing sector employment of 0.048% whereas the same increase in real imports into the Canadian economy will lead to decline in manufacturing sector employment of 0.019%. The net effect overall, however, is positive 0.029%, and a joint significant test on these variables (real exports and real imports) indicates that their coefficients are statistically different from zero. Again the net effect analysis in this general adjustment model is consistent with the findings of Dauth et al. (2014).

### **5.3 Growth Effect Across Adjustment Models**

In this section we seek to assess how growth in employment responds to growth in manufacturing sector exposure as measured by the trade variables. The simple mathematical strategy we employ in constructing the values of the dependent and independent variables is expressing a change in a variable between two periods over the initial period at various observation points (i.e., percentage growth in employment as a function of percentage growth in trade exposure)<sup>17</sup>. This empirical analysis can therefore be seen as investigating the year-over-year growth of the trade exposure effect on manufacturing employment growth. In most of the years under consideration, the real export and real import growth we computed are positive against fairly frequent negative growth in manufacturing sector employment, reflecting the decline in employment as we have discussed in Chapter Three. While this trend is observed it is still necessary to estimate an econometric model to better understand this phenomenon. Essentially, in this part of the study, we will be able to understand whether or not employment growth has same relationship as in level effect of trade exposure. In the level effect we have log-transformed variables, the growth effect variables, however, are in percentages but this still gives us similar interpretation of the regression coefficients.

#### **5.3.1 Static Model**

We begin this section with a clarification regarding estimation. This model and the subsequent ones in this section are identical to the models above, but with the use of growth rates of the variables instead of their levels. As a result, in running the regression,

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<sup>17</sup> Alternatively, the growth effect of trade exposure on employment could also be estimated by generating the first difference of the variables in the level effect of trade exposure.



we lose the initial observations in all the cross-sectional units that is due to the computation of the year-over-year growth of all the variables. Table 5.3-A presents results of the growth in real exports and imports and their effects on employment adjustment. The coefficients presented in both Equations 1 and 2 are the static employment equations based on year-over-year growth of the all the variables. In other words, we use the simple method of growth calculation to reset the data on all the variables from level to growth. And we regress this growth in the dependent variable (employment) on the growth of the respective independent variables.

From the study's objective perspective, the results under the static model allow us to analyse employment growth adjustment given that there is no past effect of employment growth on current employment growth. To put it differently, there is no sluggishness in employment response to growth of its determinants. This is why the model (refer to Equation 10) without a lagged employment growth variable as an additional regressor will be estimated using a fixed effects model. Unlike least squares dummy variable estimation, the fixed effects model by default controls for both province and time fixed effects, implying that we do not have to introduce dummies for province and time fixed effects. Notice the coefficient on real wage is negative but statistically insignificant. This seems to suggest that the growth of real wage does not relate to employment growth under the static determination. However, the statistical significance of this relationship improves as we move from partial to general adjustment estimation.

Table 5.3-A Static employment growth effect of trade exposure

VARIABLES	Equation 1	Equation 2
Real domestic demand	0.612*** (0.0865)	0.594*** (0.0959)
<b>Real exports</b>	<b>0.0168**</b> (0.00741)	<b>0.0170**</b> (0.00732)
<b>Real imports</b>	<b>-0.0139*</b> (0.00627)	<b>-0.0139*</b> (0.00633)
Exchange rate/USD	0.127*** (0.0356)	0.125*** (0.0360)
R&D-Sales	-0.0323* (0.0175)	-0.0340* (0.0178)
Real wages	-0.212 (0.163)	-0.197 (0.172)
Labour productivity	0.00872 (0.0540)	0.00818 (0.0502)
Trend		-0.000418 (0.000353)
Constant	-0.0193*** (0.00357)	-0.0131* (0.00603)
Observations	250	250
R-squared	0.149	0.151

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent the levels of significance

Focusing on the variables of interest, the signs of the coefficients of growth in real exports and real imports match our expectation. Growth in export exposure is positively related to growth in employment, and import growth is negatively related to employment growth. Holding other factors constant, at the 10% significance level a one percent increase in real exports growth will lead to a 0.017% increase in manufacturing employment growth, while real imports growth of one percent will decrease employment growth by 0.014%. Notice that with the addition of the time-trend variable there is no significant difference in the effect of these variables of interest on employment growth between Equations 1 and 2. Aside from these variables of interest, we find that the growth

of the control variables – including real wages, exchange rate and R&D – have the expected sign of their associations with employment growth, although only the exchange rate and R&D variables are statistically significant at the 10% level.

Again, in relation to the argument of considering both export and import growth as variables which affect manufacturing employment, we see a positive net effect of the growth of these two variables. From the joint significance test with a p-value of 0.09 we reject the null hypothesis at 10% significance level that the coefficients on the real exports and real imports are jointly not different from zero. This is similar to what we obtained in the partial and general adjustment models in the level effect estimation of the previous section. Trade exposure in growth terms continues its minimal effect on manufacturing employment adjustment in Canada.

The results are consistent with the prediction that growth in an economy's exports will largely support more jobs, while increasing import growth affects the ability of an economy to sustain jobs in import-exposed manufacturing industries. In fact, Sachs et al. (1994) find the growth of U.S. manufacturing employment to be negatively related to import penetration, which is similar to our result on import exposure. Import penetration and import exposure are similar terms except that the methodologies used in their determination may vary, but they are both used to assess the impact of trade openness on employment as well as other economic variables. Acharya (2017) also shows a negative relationship between import growth and employment growth in almost all the sectors of the Canadian economy including manufacturing. Also, using the different empirical methodology of input-output analysis, Feenstra and Chang (2007) attribute a moderate implied employment growth to rising Chinese exports in global trade, and this supports

an earlier prediction by Dooley et al. (2007) that Chinese exports to the rest of the world accounts for 30% of the growth in employment . The tendency for exports to create jobs partly explains why economies including most European and Asian countries have promoted export-led growth strategies over the years. China is particularly noted in the literature for having benefited from this strategy (see Feenstra and Chang (2007)). Similarly, the negative effect of import exposure on employment also particularly explains why import substitution industrialization strategies were adopted, particularly by several Newly Industrializing Countries (e.g., Taiwan, Singapore, Hong Kong and Malaysia) to promote economic growth and consequently aggregate employment growth.

### **5.3.2 Partial Adjustment**

In a partial adjustment model of employment growth, both real export and real import growth perform very well. As can be seen in Table 5.3-B, these two variables have their expected signs and are statistically significant at 5% across the two equations whose only difference is the addition of a time trend in the second equation. The reported AR (2) p-values are 0.22 and 0.23 for Equations 1 and 2, respectively, confirming the absence of autocorrelation among the residuals of the regression. The high Sargan p-value of 0.28 in each of the equations confirms the validity of instruments used for difference equations.

Table 5.3-B Partial adjustment employment growth effect of trade exposure

VARIABLES	Equation 1	Equation 2
Employment <sub>t-1</sub>	0.105** (0.0525)	0.101* (0.0544)
Real domestic demand	0.529*** (0.0896)	0.471*** (0.104)
<b>Real exports</b>	<b>0.0170**</b> (0.00747)	<b>0.0176**</b> (0.00740)
<b>Real imports</b>	<b>-0.0144**</b> (0.00631)	<b>-0.0144**</b> (0.00639)
Real wages	-0.316** (0.140)	-0.295** (0.145)
Exchange rate/USD	0.103*** (0.0313)	0.0931*** (0.0315)
R&D	-0.0386** (0.0175)	-0.0419** (0.0183)
Labour productivity	0.0192 (0.0621)	0.0192 (0.0535)
Trend		-0.00112*** (0.000313)
Constant	-0.0126** (0.00578)	0.00416 (0.00773)
AR (2) Test, p-value	0.22	0.23
Sargan Test, p-value	0.28	0.28
Observations	230	230

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent significance levels.

The coefficient estimates on real exports and imports are almost identical when we compare Equation 1 to Equation 2. For real exports, a 1% increase in growth means a contribution of 0.017% to the growth of employment as employment partially adjusts towards its desired level. Real import growth in this case, however, reduces employment growth by 0.014%. After considering the time trend as an additional regressor – which in real sense completes the model specification – the real export growth coefficient increases slightly by 0.006. Although the time trend has shown negative effect on employment

growth, its addition has brought a modest increase in the real export growth effect on manufacturing employment adjustment.

Looking at the coefficients of the variables of interest, the positive effect of export growth on employment once again is stronger than that of the negative effect of real import growth. With all else equal, this leaves us with positive net effect of growth in trade exposure on employment adjustment. In this partial adjustment model, we find that when employment is assumed to partially adjusting towards desired a level and exhibiting some form of sluggishness to its determinants, the positive effect of export exposure on manufacturing employment exceeds that of the negative effect of growth in import exposure. To provide the base for the net effect analysis of trade exposure on employment, we resort to joint statistical significance test for the real export and real import coefficients. The p-value of 0.07 for this test implies a rejection of the null hypothesis that the coefficients on the real exports and real imports are not significantly different from zero. While the individual statistical significance of the two variables validates their effect on employment, their joint significance supports our net effect analysis of trade exposure on employment adjustment in both Equations 1 and 2 in which we have a positive net effect (i.e. adding the coefficients of real exports and real imports) of 0.0026% and 0.0032%, respectively.

We will pay some attention to the control variables in Table 5.3-B. The results of the partial adjustment further show that real wages and domestic demand domestic growth are negatively and positively related to employment growth, respectively. These variables are the primary determinants of industry labour demand. In theory, when manufacturing wages go up we expect the quantity of labour demanded to fall, and when

there is an increase in domestic demand for manufacturing products firms are expected to increase their demand for labour. In a restraint situation where firms do not want to increase labour demand given an increase in output demand, workers, especially those with part-time employment, will have more working hours. This is because firms may shy away from the extra fixed costs of hiring and training new workers. The coefficients on real wages and real domestic demand in Table 5.3-B therefore confirm the theoretical predictions of labour demand theory. A great number of empirical studies has shown this relationship over the years.

### **5.3.3 General Adjustment**

Table 5.3-C shows the estimation results from the general adjustment model based on four growth employment equations. In Equation 1, we regress employment growth on the current values of all the explanatory variables including the lag of real export growth, real import growth and the growth of manufacturing wages. For Equation 2 we add the trend variable as an additional explanatory variable. To understand further the coefficient estimates of the trade variables, we proceed with addition of a one-year lag of all the explanatory variables in the employment model as shown in Equations 3 and 4.

Throughout the four equations in Table 5.3-C, the coefficients of growth in real exports and imports – our main estimates of interest – have maintained the signs we expect, although the levels of statistical significance have declined. Still, similar to the partial adjustment model, growth in real exports and imports have positive and negative effects on employment growth, respectively, even in the case where we account for the lag effects of all the explanatory variables.

Table 5.3-C General adjustment employment growth effect of trade exposure

VARIABLES	Equation 1	Equation 2	Equation 3	Equation 4
Employment <sub>t-1</sub>	0.104* (0.0568)	0.101 (0.0613)	0.0853 (0.0674)	0.0830 (0.0719)
Real domestic demand	0.558*** (0.0902)	0.491*** (0.107)	0.509*** (0.102)	0.462*** (0.113)
Real domestic demand <sub>t-1</sub>	-	-	0.205* (0.120)	0.161 (0.123)
<b>Real exports</b>	<b>0.0183*</b> (0.0101)	<b>0.0199*</b> (0.0104)	<b>0.0191*</b> (0.00986)	<b>0.0202**</b> (0.0101)
Real export <sub>t-1</sub>	0.00463 (0.00815)	0.00590 (0.00847)	0.00527 (0.00836)	0.00625 (0.00872)
<b>Real imports</b>	<b>-0.0154*</b> (0.00858)	<b>-0.0158*</b> (0.00890)	<b>-0.0153*</b> (0.00853)	<b>-0.0157*</b> (0.00883)
Real import <sub>t-1</sub>	-0.00185 (0.00665)	-0.00182 (0.00700)	-0.00186 (0.00694)	-0.00185 (0.00730)
Real wages	-0.285** (0.121)	-0.231* (0.125)	-0.290** (0.118)	-0.242** (0.122)
Real wages <sub>t-1</sub>	0.0998 (0.176)	0.174 (0.176)	0.105 (0.187)	0.170 (0.189)
Exchange rate/USD	0.101*** (0.0312)	0.0856*** (0.0326)	0.0315 (0.0427)	0.0351 (0.0376)
Exchange rate/USD <sub>t-1</sub>	-	-	0.157* (0.0852)	0.118 (0.0856)
R&D-manufac. sales	-0.0351 (0.0228)	-0.0376 (0.0243)	-0.0296 (0.0227)	-0.0329 (0.0240)
R&D-manufac. sales <sub>t-1</sub>	-	-	-0.00111 (0.0122)	-0.00427 (0.0119)
Labour productivity	0.00951 (0.0780)	0.00702 (0.0684)	-0.0165 (0.0888)	-0.0144 (0.0793)
Labour productivity <sub>t-1</sub>	-	-	-0.0608 (0.0643)	-0.0548 (0.0572)
Trend		-0.00160*** (0.000202)	-	-0.00145*** (0.000205)
Constant	-0.0156*** (0.00572)	0.00637 (0.00699)	-0.0139*** (0.00493)	0.00694 (0.00585)
AR (2) p-value, test	0.37	0.50	0.44	0.56
Sargan p-value test	0.23	0.23	0.19	0.18
Observations	230	230	230	230

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent significance levels.



In Equation 1, if exports increase by one percent, employment growth will increase by 0.018%. Likewise, when the growth in real imports increases by one percent, employment growth will decline by 0.015%. In full model (Equation 4) where lagged regressors affect employment, we find the coefficients on real export growth and real import growth both increased in absolute value, to 0.020 and -0.016, respectively. All things being equal, this implies that the contemporaneous effect of one percent increase in trade exposure is that net employment growth will increase by 0.004%. The coefficients on the lagged variables have their expected signs, although they are statistically insignificant. Across all the employment equations, the respective p-values of AR (2) and Sargan across the equations support the validity of our results. This further supports the plausibility of our analyses on trade exposure effect on employment adjustment in Canada.

#### **5.4 Origin Effect Across Adjustment Models**

In this chapter, so far in our employment adjustment regressions, we have been using real exports and imports in terms of Canada's merchandise trade with the rest of the world. The results thus far establish the general effect of Canada's overall trade exposure on manufacturing sector employment. In this section, however, we wish to assess the manufacturing sector employment effect of Canada's trade with various countries including the U.S., E.U. and China. The objective of this empirical investigation is whether trade via different origins affects manufacturing employment differently.

Our empirical implementation is fairly simple because instead of using the absolute volumes of trade from these partners, we resort to trade exposure intensity (as discussed in the methodology section). This is measured by expressing the provincial

volumes of trade exposure (imports and exports) with each partner at specific time period as a ratio of provincial level gross domestic product multiplied by 100. Similar to the procedure followed in the level and change effect of employment adjustment analysis, we present and discuss the results of country-of-origin effect in static, partial and general adjustment models. However, with regard to data gathering process for the exports and imports, this section and the previous sections come from different sources of data organization. The only variables that are the same are the control variables, which remain unchanged.

Before proceeding, it is important to talk about the connotations of the major variables.  $W_x$  and  $W_m$  represent aggregate export and import exposure without reference to any specific partner ( $W$  means world). We start the regression in each adjustment model with these variables and subsequently replace the import ( $W_m$ ) variable with the import exposure of trade partners including the U.S., E.U. and China. The subscript 'm' attached to the names of these partners denotes the manufacturing sector's exposure intensity to individual imports from these partners. The coefficient estimates on these variables are what is of prime interest in this section. But, before we start discussing the results across the various employment adjustment models, it is imperative to also note that imports from these principal trading partners, which we used in the deriving the exposure intensity are aggregate merchandise imports which include: consumer goods, electrical, energy, mining, automotive, forestry, agricultural, aircraft and other. And we know merchandise trade based on intermediate and final goods play significant role in the employment effect analysis of trade exposure. Hence, we will draw on that inference to

explain the results, and in some cases, speculate about the results in order to motivate further research.

#### 5.4.1 Static Model

To lay the foundation for the analysis of the origin of trade exposure intensity effect on employment adjustment, we start with the static employment equation. The same as the previous static estimation, we estimate a fixed effects model starting with regressing employment on world export and import exposure intensities and the other control variables. The second regression replaces world import exposure intensity with the top three trading partners import exposure intensities, i.e., those from the U.S., E.U. and China (CH). How this intensity is derived is discussed in Chapter Four of this study.

Table 5.4-A Static employment effect of trade exposure intensity by origin

VARIABLES	Equation 1	Equation 2
Real domestic demand	0.910*** (0.107)	0.987*** (0.0967)
W <sub>x</sub>	-0.000242 (0.000832)	-0.00120** (0.000543)
W <sub>m</sub>	-0.00189* (0.000962)	
U.S. imports intensity	-	0.00739* (0.00388)
E.U imports intensity	-	-0.000358 (0.0208)
CH imports intensity	-	0.0711*** (0.0159)
Exchange Rate/USD	0.229*** (0.0487)	0.191*** (0.0457)
R&D- manufacturing sales	-0.00246 (0.00809)	0.00133 (0.00718)
Real manufacturing wages	-0.0247*** (0.00876)	-0.0209*** (0.00768)
Labour productivity	-0.00317* (0.00165)	0.000247 (0.00159)

Trend	-0.0366*** (0.00478)	-0.0481*** (0.00411)
Constant	-7.467*** (2.191)	-9.332*** (1.962)
R-squared	0.621	0.695
Observation	190	190

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent significance levels.

The results of Equation 1 in Table 5.4-A leave us little to discuss in terms of collectively interpreting the variables of interest: the world export and import exposure intensities are both negative, but only statistically significant for imports exposure intensity. A priori, we expect the export coefficient to be positive, and the import coefficient to be negative, which indeed it is at 10% significance level. The focus however is not so much on these two variables and, coupled with the fact the exports exposure intensity is insignificant, we concentrate on Equation 2. But before that, notice that in Equation 1 manufacturing wages and domestic demand coefficients are negative and positive, respectively, as expected.

The results in Equation 2 especially relating to our variables of interest are in contrast to the expectation characterizing the analysis of trade effect on employment. World export exposure intensity, a measure of the extent to which Canadian merchandise goods are available to the world, is expected to have positive relationship with employment adjustment in the manufacturing sector. Overall, when manufacturing industries are able to cover new export markets, output is expected to go up, and thereby increase industries use of labour resources in production. However, the export coefficient is negative making the interpretation rather more complex. One of the factors that could

account for this effect in export-oriented industries is the use of intermediate goods that enhance efficiency in the production process, and thereby leading to less use of labour resources. Indeed, Greenaway et al. (1999) attribute their negative effect of exports on employment to trade induced efficiencies in export industries. The sign on both U.S. and China import exposure intensities is positive, and statistically significant. Again, this is contrary to the expectation on the effect of imports exposure on employment. This outcome could be attributed to the skilled labour category of the workforce with the assumption that most of these imports are intermediate goods. However, this remains a speculation as our data have not disaggregated employment into skilled and unskilled as well as final and intermediate imports. The fact also remains that imports often come into one province and get distributed to other provinces, but our data are not disaggregated to the provincial level.

#### **5.4.2 Partial Adjustment**

For level and change effect analysis of employment adjustment discussed above, real import and real export exposures turn out to have negative and positive effects, respectively, on manufacturing sector employment adjustment. However, as far as this part of the study is concerned, we are focusing on trade exposure intensity via origin rather than just exposure. Thus, we may not have firm grounds to compare results as it is also that data on origin of trade has been obtained differently from trade with the rest of the world.

Before we proceed to discuss the results in Table 5.4-B, it is imperative to highlight the two statistical tests from the SYS GMM estimation technique. These

include: the Arellano and Bond autocorrelation and the Sargan test of valid instruments. As can be seen in Table 5.4-B, the p-values (0.17 and 0.23) for AR (2) maintain the absence of autocorrelation among regression residuals, and Sargan p-values (0.26 and 0.23) support the use of valid instruments and for that reason our results are valid. In either case we fail to reject their null hypotheses.

The primary control regressors including real wages and real domestic demand have the expected negative and positive signs, respectively. They are statistically significant at at least, 5% in the two employment equations. This implies that our employment model has maintained the inverse relationship between the own price of labour and the quantity demanded, and also the general positive relation with domestic output demand. The coefficient of the exchange rate, as we expect, is positive at 1% significance level in both equations. Which means that an increase in the price of U.S. dollar will make Canadian exports very competitive and imports less competitive. And these are expected to impact manufacturing sector employment positively.

Table 5.4-B Partial employment adjustment effect of trade exposure intensity by origin

VARIABLES	Equation 1	Equation 2
Employment <sub>t-1</sub>	0.702*** (0.0482)	0.650*** (0.0521)
Exchange rate/USD	0.0832*** (0.0231)	0.0700*** (0.0244)
R&D-manufacturing. Sales	-0.285 (0.712)	-0.240 (0.640)
Real wages	-0.00926** (0.00407)	-0.0117** (0.00459)
Labour productivity	-0.000919 (0.00156)	0.000353 (0.00174)
Domestic Demand	0.264** (0.109)	0.361*** (0.0682)
W <sub>x</sub>	0.000929 (0.000906)	0.000550 (0.000593)
W <sub>m</sub>	-0.000170 (0.000975)	-
E.U imports intensity	-	-0.0329*** (0.00759)
U.S. imports intensity	-	0.0100*** (0.00174)
CH imports intensity	-	0.0585*** (0.00721)
Trend	-0.0140** (0.00618)	-0.0206*** (0.00339)
Constant	-0.421 (0.305)	-1.298* (0.580)
AR (2) p-value, test	0.17	0.23
Sargan p-value, test	0.26	0.25
Observations	170	170

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent significance levels.

In Table 5.4-B Equation 1, the variables of interest are the world export and import intensities, both of which have the expected signs, but neither is statistically significant. In Equation 2, only the coefficient on E.U. import intensity is negative, meaning that a unit increase in E.U. import intensity will lead to decline in manufacturing

sector employment by 0.33%. Contrary to expectations, coefficients on import intensities for both the U.S. and China are positive. This means that a unit increase in import intensity from these countries will lead to increase in manufacturing sector employment by 0.1% and 0.5%, respectively.

Manufactured goods are the bulk of what Canada imports from China and E.U. Chinese imports are largely, clothing and apparel, furniture and stuffed furnishings, mechanical appliances and electrical equipment, plastic rubber, while imports from E.U. are aircraft and parts, wines, crude oil, refined petroleum and motor vehicle (see Gauthier and Simmon (2010)). We admit though that crude oil and refined petroleum importation may well be attributed to Multinationals Corporations (MNCs) including Royal Dutch Shell and British Petroleum. For the E.U., we can argue that the more manufactured goods that provinces continue to import from the European Union, the larger the share of imports in provincial GDP and the less capable manufacturing sectors become in creating jobs. This is at best a representation of the theoretical expectation.

The results for China and the U.S. go contrary to theoretical expectations that imports have the tendency of displacing jobs in the domestic competing sectors. In attempt to provide explanation to these results, we draw on the composition of imports from these two countries. The case of the U.S. could be attributed to trade based more on investment goods between Canada and the U.S., which may result in increases in industries' demand for more skilled labour and giving up the unskilled labour. Canada's imports from the U.S. are mainly vehicles, machinery, electrical machinery, mineral fuels and plastics. Most of these are intermediate products and are used in further production in the manufacturing sector giving us reason to suggest that the positive effect may only



explain more jobs for the skilled category of the labour force in the manufacturing sector. Indeed, for both durable and nondurable industries, Capeluck (2015) asserts that in both the pre- and post-2000 eras there has been a shift from a low-skilled, lower-paying workforce to a highly educated one. To do this type of analysis for skilled and unskilled labor, it is possible that manufacturing employment in Canada would likely favor increases in demand for skilled labour when U.S. import intensity grows over time, but this is beyond the scope of this thesis.

The trade between Canada and China is said to be largely dominated by finished consumable products, which is expected to have an impact on Canadian manufactures to compete with their Chinese counterparts in the domestic market. Giving some of these imports from China are finished products, which are competitive with Canadian finished products may undercut the less-efficient firms in the Canadian market. Therefore, there is no denying the job displacement effects on weak firms that cannot withstand the competition, but in aggregate terms (as the basis of the model), employment will remain positive. Perhaps it could be the case that Canadian manufacturing industries are now competitive with the Chinese imports. Hence the positive relationship between Chinese import intensity and manufacturing sector employment.

The pursuit of country-of-origin effects of trade on employment have shown mixed findings, and the results under this partial adjustment is no exception. To highlight some of these studies, Aw and Roberts (1985) use U.S. data and found that imports from industrialized and East Asian nations substitutable and complementary to domestic labour demand, respectively. Also, Greenaway et al. (1999) investigate whether or not U.K. trade by region-of-origin affected labour demand differently, and conclude that U.K.

trade with East Asia and Japan has less effect on labour demand as compared with imports from E.U. And while the effect of import penetration from the E.U., East Asian countries (Korea, Taiwan, Hong Kong and Singapore) and the U.S. are negative on employment, that from Japan and the Tigers (i.e. Thailand, Malaysia and Indonesia) are positive on employment. In effect, while we recognize that origin differences may exist, nonetheless, the results in this section have shown that imports intensity by country-of-origin affect employment adjustment differently.

### **5.4.3 General Adjustment**

The focus of our analysis is on Equations 2 and 3 in Table 5.4-C, which shows the general adjustment model with exposure intensity effects by country-of-origin. The AR (2) p-values in the range of 0.11 and 0.13 indicate the acceptance of the null hypothesis of no autocorrelation among the residuals of the regression. Sargan p-values which are in the range of 0.15 and 0.20 confirm the instruments used are valid. The time trend variable across the three equations is negative and significant at at least 5%, and this shows there exist other factors that are causing declines in employment over time. In this case, we do not have statistical significance for the coefficients on the world export ( $W_x$ ) and import ( $W_m$ ) exposure intensities. However, they are not of much interest to us in this section and hence we concentrate on the country-of-origin variables.

First of all, the inclusion of the lags as shown by Equations 2 and 3 has not changed the relationship between employment adjustment and the import exposure intensities associated with each trading partner, as seen in the previous section using partial adjustment estimation. Equation 2 has only the lags of the import exposure

intensities of partners, and we realize that the immediate effect of the U.S. and China is positive on employment adjustment and statistically significant at the 1% and 5% levels, respectively. That of the E.U. is still negative and also statistically significant at 1% in both Equations 2 and 3. The same analysis we outlined in the case of the partial adjustment model can be extended to these results. When employment is adjusting due to both the contemporaneous and lagged import exposure intensity variables, imports originating from the U.S and China are more likely to increase employment while that of the E.U. decrease employment.

Table 5.4-C: General employment adjustment effect of trade exposure intensity by origin

VARIABLES	Equation 1	Equation 2	Equation 3
Employment <sub>t-1</sub>	0.701*** (0.0460)	0.646*** (0.0528)	0.681*** (0.0472)
Exchange rate/US\$	0.0800*** (0.0300)	0.0490 (0.0373)	-0.0185 (0.0448)
Exchange rate <sub>t-1</sub>	-	-	0.0883 (0.0571)
R&D-manufac. Sales	-0.358 (0.688)	-0.142 (0.627)	-0.0409 (0.784)
R&D-manufacturing sales <sub>t-1</sub>	-	-	0.326 (0.397)
Real wages	-0.00965** (0.00459)	-0.0123** (0.00483)	-0.0145 (0.0114)
Real wages <sub>t-1</sub>	-	-	0.0194 (0.0121)
Labour productivity	-0.00126 (0.00196)	0.000319 (0.00187)	-0.000938 (0.00246)
Labour productivity <sub>t-1</sub>	-	-	0.000889 (0.00172)
Real domestic demand	0.264** (0.109)	0.365*** (0.0732)	0.628*** (0.132)
Real domestic demand <sub>t-1</sub>	-	-	-0.432*** (0.126)
W <sub>X</sub>	0.000106 (0.000895)	0.000546 (0.000624)	0.000270 (0.000643)

$W_{X_{t-1}}$	0.00114 (0.00104)	0.000144 (0.000529)	0.000531 (0.000532)
$W_m$	0.000719 (0.000881)	-	-
$W_{m_{t-1}}$	-0.00123 (0.00110)	-	-
E.U imports intensity	-	-0.0722*** (0.0151)	-0.0828*** (0.0215)
E.U imports intensity $_{t-1}$	-	0.00437 (0.0124)	0.0144 (0.0192)
U.S. imports intensity	-	0.00520** (0.00265)	0.00510** (0.00253)
U.S. imports intensity $_{t-1}$	-	0.00853*** (0.00311)	0.00863*** (0.00280)
CH imports intensity	-	0.117*** (0.0210)	0.110*** (0.0216)
CH import intensity $_{t-1}$	-	-0.0506*** (0.0162)	-0.0491** (0.0199)
Trend	-0.0138** (0.00650)	-0.0218*** (0.00376)	-0.0146*** (0.00364)
Constant	-0.457 (0.308)	-1.47* (0.572)	-0.489 (0.437)
AR (2) p-value, test	0.11	0.13	0.13
Sargan p-value test	0.20	0.19	0.15
Observations	170	170	170

Note: Robust standard errors in parentheses \*\*\* (1%), \*\* (5%), and \* (10%) represent significance levels.

Under this estimation, the summation of the coefficients of contemporaneous and lagged independent variable gives us the long-run effect of import exposure intensity on employment adjustment. In the case of the E.U., the positive lagged import intensity coefficient is not statistically significant, but the test of joint significance shows that its contemporaneous and lagged coefficients are statistically different from zero with a p-value of 0.00. To this extent, it thus permits us to say that the E.U. import exposure intensity effect on employment adjustment in the long run will be less given that the immediate effect is negative, and the lagged effect is positive. For the U.S, both the contemporaneous and the lagged coefficients are positive and statistically significant, and

their joint significance test indicates a p-value of 0.00. Holding all other things equal, this implies that the long-run effect of U.S import exposure is positive on employment. The case of China is similar to the E.U. only in respect of having opposing signs on the coefficients of the contemporaneous and lagged import intensity variables. The lagged variable turns out to have negative effect on employment adjustment, while the contemporaneous variable has positive, and both are statistically significant. Hence, we could say the coefficient of the lagged variable reduces the positive effect that Chinese import exposure intensity has on employment in the long run.

The overall objective of this part of the study is to find out whether trade exposure to Canada's top three trading partners affects employment adjustment differently. Indeed, the results – in the static, partial and general employment adjustment estimations – show that China and the U.S. import intensities relate positively with manufacturing employment while that of the E.U. is negative. In the case of the U.S. and China – both of which do not match our expectation – we believe that even if such relationship exists with manufacturing sector employment across the provinces in Canada; it is more likely to be associated with skilled labour than unskilled because processes in production are increasingly capital intensive rather labour intensive. This is, of course, rather speculative and further studies that are able to separate employment data into skilled and unskilled as well as merchandise imports into final and intermediate will better put the effect of trade by country-of-origin in perspective.

## CHAPTER 6

### 6.1 Summary and Conclusion

In this study we have assessed and discussed manufacturing employment adjustment. As we have seen in Chapter Three, merchandise exports and imports over two decades have trended up, a phenomenon which is an indication of openness of the Canadian economy to global trade. The trend has lately been also characterized by more imports than exports, which translates into unfavorable balance of trade with the rest of world. While this trend persists on the trade side, employment in the manufacturing sector of Canada has shown a declining trend. Other OECD countries have also grappled with declines in employment in their manufacturing sectors. In terms of provincial trends, the two biggest industrial hubs of Canada, Ontario and Quebec, were impacted heavily in absolute numbers of manufacturing job losses compared to the other provinces as expected. While both export and import of goods have risen over time, manufacturing employment has been declining. This paves the way for further analysis in which we resorted to econometric estimation in order to put this relationship in perspective.

With a labour demand model assessed based on static and dynamic estimation across two adjustment models: partial and general, the results in each of these models suggest that the decline in manufacturing sector has less to do with Canada's exposure to trade with the rest of the world. In the level and growth effect of trade exposure on employment adjustment, real imports undoubtedly show a negative effect on employment, and real exports, as it has been hypothesized, turned out to positively affect employment in the adjustment process. The net effect of the real exports and real imports has been largely positive on employment. It is therefore the case that export-oriented

industries may have over the years created more jobs than those lost in the import-competing sectors whose product demand may have been affected by import competition.

In view of the evidence presented in this study, the decline in manufacturing sector employment may not have been fairly attributed to Canada's exposure to trade, but some other major economic factors. In fact, there is the view that the decline emanates from the consequence of long-term structural change of the economy and not really so much with exposure to trade. The tertiary sector of every economy around the world is gaining significance over the primary and secondary sectors in terms of growth, employment and its contribution to GDP- Canada is no exception.

The two variables, which are real exports and real imports, put together indicate a net positive effect of trade on employment, although minimal. The decline in manufacturing sector employment is obvious given that the time trend variable shows a negative relationship with employment adjustment. However, it is not so depressing in general terms to the whole economy. Indeed, some argue that, the decline in manufacturing employment is not really an issue, but what is important is the quality of the new jobs and whether they are better than the old ones. We are convinced that some new jobs were created in other sectors of the economy. We notice that at the same time this decline has occurred in the manufacturing sector, employment in all industries has been on the rise. To this end, we can fairly argue in favor of some reallocation of workers from the manufacturing sector to other sectors of the economy, although in the transition process workers may experience long spells of layoffs resulting in some adjustment costs, mostly loss of earnings ( Ashournia, Munch, and Nguyen, 2014) . This argument is also consistent with Coulombe's (2008) assertion that a term of trade shock signals a

transfer of labour and capital from the trade-exposed manufacturing sector to the booming natural resource and domestic oriented sectors.

Having looked at Canada's overall trade with the rest of the world, another focus of this thesis has been to investigate the trade by country-of-origin's effect on employment adjustment, allowing us to determine whether import intensity by origin affects employment adjustment differently. In spite of the results in the case of the U.S. and China in not meeting the expectation of negative impacts of import exposure intensity on employment, there is still evidence to conclude that trade by country-of-origin will affect employment differently. Notwithstanding this expectation not being met, some explanations have been provided to the results obtained in this study.

## **6.2 Policy Recommendations**

As evidenced by the negative relationship between the time trend variable and employment across the adjustment models, it seems that the decade-long established declining trend in manufacturing sector employment is not expected to disappear or be easily reversed in the coming years. There is no doubt that some gains could be made along the coming years, but not so large that the levels of employment in the manufacturing sector seen in the 1990s would be achieved in the near future. The case of the Canadian economy recovering from manufacturing sector employment decline is made weak especially now that deindustrialization has been gaining attention in the empirical literature. That is the manufacturing sector losing significance in its contribution to most of the economic indicators compared to other sectors. And, looking at the manufacturing employment share of all industry employment as a measure of deindustrialization, the Canadian manufacturing sector is losing significance because this



share is declining. That notwithstanding, there are a number of strategies that policy makers could still look up to in a gradual move to maintain and create the expected number of jobs in the manufacturing sector or enhance the transition into other sectors of the economy:

1. Having embraced the reality of a continued job decline in the manufacturing sector, we encourage the implementation of employment policies that will enhance the quality of new jobs springing up in the other sectors of the economy. This recommendation stems from the fact that, at the same time that manufacturing sector employment is declining, all industries employment is rising and for that reason the government concern should focus on ensuring that workers are better off in their new jobs. To some extent, this will mitigate the impact of adjustment costs of workers as they transition from one occupation or sector to another.

2. The service sector of the economy is becoming important. The expansion and growth are leading to increases in jobs as shown by all industries employment trend analysis in Chapter Three. Some of the jobs springing up in these sectors, especially in the service sector, require higher level of education. Obviously, it is the responsibility of the government to promote education and retooling of skills among young people. The government could also provide tuition incentives for workers to go back to school in order to meet skills set of the expanding sectors. The idea behind this recommendation is not really about enhancing worker productivity (although we agree that education essentially promotes such outcome) but ensuring that workers will have the expanded and flexible skills set that allow them to move with less friction across sectors of the economy.

3. Seek expansion of export markets and promote Canadian business across the globe. As the country heavily relies on trade, it is reasonable to strengthen the export sector in a manner that would enable the sector to penetrate global markets by being competitive and increasing global demand for Canadian exports. We have seen the negative effect that import exposure has on employment in general and manufacturing sector in particular. The way to match up with this negative effect of import exposure is wider market exposure for Canadian exports and that better places the manufacturing sector to create and sustain jobs more than the import exposure could displace.

4. From the Canadian economy perspective, it is being documented that the success of the manufacturing sector in the mid-to-late 1990s was due to favorable growth of the U.S. economy (Capeluck, 2015). And when the manufacturing sector of the U.S. relatively does well, the Canadian manufacturing sector does well too (Baldwin and Macdonald, 2009). Therefore, the growth of the U.S. economy is key to the performance of the Canadian export sector. Policy wise, the Canadian government needs to encourage trade transparency and growth-engendered policies in its bilateral talks with the U.S. government: a diplomatic moral suasion policy. However, since Canada is the second largest importer of U.S. merchandise goods, it turns out to be a mutually beneficial policy that each party must pursue in order for their respective manufacturing sectors to flourish and provide employment to their citizens.

5. On competitiveness, we have, in this study, alluded to the fact that the global market today is very competitive. For this reason, the quest for recovery from the manufacturing sector employment decline is not a matter of minimizing or preventing domestic exposure to trade, but how the economy places its export-oriented industries on

the global market to be able to compete and increase demand for Canadian manufacturers. That way, even if employment is not created in the manufacturing sector, there certainly would be spill-over effect of this growth in demand in other sectors of the economy which will enhance indirect job creation.

6. Exchange rate stability is one of the ways of ensuring trade competitiveness. In the past two decades, it has indirectly affected, and continues to affect manufacturing employment through either strengthening or weakening the competitiveness of Canadian manufactures. The period in which the Canadian dollar depreciated against the U.S. dollar offered some reduced competitive pressures on Canadian manufactures (Baldwin and Macdonald, 2009). Similarly, it is fair to say that the period marked by appreciation of the currency exerted increased competitive pressures on manufacturers. All of these happening in the past affected the ability of the manufacturing sector across all the provinces to create jobs, and in some cases, they struggled to sustain existing jobs. It is important that the managers of the Canadian economy work towards achieving exchange rate stability and keeping it at a sustainable level. This will make Canadian exports competitive and result in increased demand for Canadian goods on the world market.

7. The positive net effect of trade exposure on manufacturing sector employment has been established by the results in both level and growth effect analyses. This points to the fact that when trade is considered holistically (exports and imports), it is unlikely to be source of the decline in both aggregate and provincial manufacturing sector employment. Nevertheless, the activities of Canadian manufacturing industry players in foreign countries as they seek cost-saving ways of production may have to be redirected to ensure value addition to products that are brought into the Canadian economy by these

players before they are sold on the market. As argued by Tombazos (1999), imports with intermediate (final) content are more likely to complement (substitute) domestic labour demand. For this reason, some of amount of jobs can be maintained in the manufacturing industries across Canada.

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