Université de Montréeal

International Competitiveness of Canada - A Value Added Approach

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Executive Summary

In recent decades, the discussion of international competitiveness has become frequent in books, media, and policy making. This is due to an increase in trade between countries thanks to the lowering of telecommunication costs, transportation costs, and investment/trade barriers. This led emerging economies to enter the global trade system and led to a rising discussion whether emerging economies have taken the reigns by having a larger share of exports compared to developed economies. Traditionally, export and import data has been used to assess a countries ranking of international competitiveness. However, global trade has increased dramatically in the last 20 years and the nature of exports have transformed. There has been growing awareness that traditional export data do not capture the value added activities nor services of a country and only focuses on what is produced locally, thus overstating or understating a countries international competitiveness.

This paper, makes use of a unique database, the TiVA database provided by the OECD, to decompose export data in a way not done before. It breaks gross exports down into different components including services and value added activities among others. This research paper uses this unique dataset to more accurately capture Canada's true trade and exchanges. By more accurately capturing Canada's trade, this paper validates how Canada's international competitiveness changes. This paper finds that Canada's international competitiveness is weaker than initially perceived by using gross exports methods.

Sommaire Exécutive

Durant ces dernières décennies, les débats sur la compétitivité internationale sont devenus de plus en plus fréquentes dans les livres, les médias et les prises de décisions. Ceci est dû à l'augmentation des échanges entre pays, grâce à la diminution des coûts de télécommunication et de transport ainsi que l'affaiblissement des barrières entre investissements et échanges. En résultat, les économies émergentes sont entrées dans le système d'échange international, et une discussion a surgi interrogeant si ces pays émergents ont pris les rênes en accumulant un large surplus d'exportations comparé aux pays développés. Traditionnellement, les données sur les importations et les exportations d'un pays sont utilisées pour évaluer sont niveau de compétitivité à l'échelle internationale. Pourtant, le commerce mondial a dramatiquement augmenté durant les 20 dernières années et la nature des exportations s'est transformée. Les ensemble de données traditionnelles n'enregistrent pas la valeur ajoutée à l'activité ni les services d'un pays et ne se concentrent que sur la production locale, ce qui selon le cas exagère ou minimise la compétitivité international d'un pays.

Cette étude emploie une base de données unique, la TiVA offerte par l'OECD, pour analyser les données d'exportations d'une manière inédite. Elle décompose les exportations brutte en différents constituants tels les services et la valeur ajoutée à l'activité, entre autres. Cette recherche utilise cet ensemble de données unique pour capturer avec plus de précision les vrai échanges commerciaux du Canada. En capturant plus précisément le commerce du Canada, cette recherche confirme le changement de la compétitivité internationale du Canada. Cette recherche conclut que la compétitivité internationale du canada est plus faible que prévus.

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I . Introduction

International competitiveness has become a newly discussed topic again. Current economic trends show a shift from developed countries to emerging countries through large economic trade deficits and the relocation of company activities. These emerging countries have strong economic growth, while developed nations growth is much weaker. The media reminds us every year on what the consequence of such a difference. They state that this affects "jobs, investments, tax revenues, and economic development" (Porter and Rivkin 2012). This brings about questions on whether the advanced economies are losing their international competitive edge and if a shift in powers is in process (Timmer, Los et al. 2013).

Whereas there is a growing interest in international competitiveness, it is also increasingly well known that our traditional measures are inaccurate. Traditional measures focus on export share and assumes that all exports are produced locally. However, as trade has become more global, new forces such as global value chains are challenging this assumption. This has led to a wide acknowledgement of how inaccurate gross measures have become in a global economy. The organization of production through global value chains has been driven by dropping costs of activities once seemed unfeasible. Significant reduction of costs in communication and transportation, with other obstacles to trade (trade, investment, and economic liberalization) has allowed firms to separate their value chains throughout the world (Van Assche 2012). Firms have used the value chain to increase their efficiency. They have even taken a step further by separating the production of goods and services into various stages linked across the world (Van Assche 2012). In addition, GVCs encompasses both the inputs of the products and the value added component for end users. UNCP (2014).

What does this mean for our measure of exports and imports? It demonstrates a key structural weakness in the measure. How do you capture each countries contribution to the creation of a product if, let's say, six countries are involved in its creation? Exports and imports states only where the final product has arrived from, ignoring the contributions of different nations through design, marketing, finance, manufacturing, etc... A new method is needed to capture these different forces.

This paper takes advantage of a new dataset from the OECD to more accurately assess international competitiveness between countries. The Trade in Value Added Database is a database that covers 57 economies for the years 1995, 2000, 2005, 2008, and 2009. The database is broken down into 18 industries (OECD 2013). It allows the analysis of various indicators for policy making. The indicators they include (direct from OECD):

- "Decomposition of gross exports by industry into their domestic and foreign content
- The services content of gross exports by exporting industry (broken down by foreign/domestic origin)
- Bilateral trade balances based on flows of value added embodied in domestic final demand
- Intermediate imports embodied in exports" (OECD 2013).

Its key contribution is that it provides a more detailed breakdown of gross exports which may lead to a more accurate analysis. It also captures what a country truly exchanges with other countries unlike traditional gross exports.

Since the TiVA database provides a more detailed breakdown of gross exports, revisiting Canada and its international competitiveness becomes necessary. It allows to more accurately capture Canada's true trade and exchanges to re-evaluate its international ranking. The analysis shows that Canada's export structure is fairly dependent on the United States; its main trade partner. Through traditional measures, 72% of Canada's exports have headed to the United states (a drop from 83% in the early 2000s, but significant nevertheless) (Van Assche 2012). However, when value added and services is considered, Canada's export drops to around 60% demonstrating Canada is less depending on the United States unlike previously thought (OECD 2013).

Interestingly, Canada's top two exports are metals and minerals with energy. Energy accounts for 24.1% of exports and metals and minerals consists of 15.3%. Together they are 28.4% of all exports. Thus, about 30% of all exports relying on natural resources.

Additionally, intermediate goods have become a key variable in today's world trade. Due to global value chains, these components are part of future exports of other countries. Canada's contribution is important. Canada exports lots of intermediate goods, yet a gap between exports and imports is wider for emerging countries such as Mexico and China. Also, Canada focuses on trading primary goods (natural resources) to developed countries, mostly to the United States. These findings are important because Canada tends to export intermediate goods to emerging countries (importing final products thereafter), while exporting primary goods to developed countries (Goldfarb and Beckman 2007),(Van Assche 2012).

When value added trade data is used, it validates that Canada's international competitiveness changes. When all industries are included, Canada's ranking is less than

previously thought at 16th in 2009 with slight changes over the years. On the surface, this may imply that Canada's decisions and its activities have led to maintaining its current levels. However, once the mining industry is removed. Canada's ranking changes. Canada's ranking drops to 26th in 2009. This signifies how Canada's has fallen behind technologically and maintaining its ranking is done through the mining industry. One can note that this is very low for a developed nation. Canada's ranking and competitiveness has dropped when a value approach is incorporated when the mining industry is removed. This may demonstrate Canada's concentration in increasing this industry. Why has Canada's ranking dropped so much?

Canada has reduced its competitiveness in transport and wood, while increasing the mining industry. Throughout the years, Canada has replaced its sophistication in various industries for mining. Canada has replaced its competitiveness in higher sophisticated industries with one that is lower.

Canada as a nation should consider revisiting its policies concerning its local industries. It is a blessing that Canada is endowed with such natural resources to allow its population to have a high standard of living, however steps need to be taken to complement those industries. This can be done on encouraging and fostering the growth of higher sophisticated industries relating to services. Consistently focusing on low value added industries at the cost of higher value industries will have harmful effects in the long term. This may lead to less income generated compared to its peers or even affect job creation. Canada can use its abundant resources to improve its economy and should not rely on it solely as the only means of growth in the country.

II. Literature Review

In this chapter, a comprehensive literature review is conducted to discuss definitions, key factors, and important trends. Section II.1 discusses a country's international competitiveness. Section II.2 illustrates how these traditional measures become unreliable when production is not concentrated in a single country. Section II.3 and section II.4 discusses the rise of global value chains and its impact. This phenomenon is key to understanding the change occurring. Section II.5 explains the current research through what value added is and makes a further argument on why the value added approach is necessary.

II.1 International Competitiveness:

The global economy has renewed interest in competitiveness between countries. International competitiveness has been discussed thoroughly with its definition changing over time. To understand international competitiveness, it is vital to explore the evolution of the definitions.

Traditionally, international competitiveness is linked to productivity of workers and an increase in national prosperity (Desai 2013). For example, Porter and Rivkin (2012) state "companies operating in the U.S. are able to compete successfully in the global economy while supporting high and rising living standards for the average American". A similar definition is stated by Tyson (1992) where it is to "*produce goods and services that meet the test of international competition while its citizens enjoy a rising and sustainable standard of living*". Dollar (1993)'s definition is "*a competitive nation is one that can succeed in international trade via high technology and productivity, with accompanying high income and wages*". Timmer, Los et al. (2013) define it as "*The ability to perform activities that meet the test of international*

competition and generate increasing income and employment". Therefore, a common theme involves a rising standard of livings, which is tied to long term income and employment growth.

Measuring international competitiveness has two different approaches, a "results" based approach or a "causes" based approached (Adams, Gangnes et al. 2004). A "results" based approach focuses on export performance while a "causes" based approach seeks to identify the reasons for a country's or industry's successes. "Results" based or export based, views strong exports through positive trade balances as a strong indicator of international competitiveness. Another way is exports growing at a faster pace than other countries.

When trying to measure international competitiveness, there has been a focus on a country's ability to capture market share (results based) (Adams, Gangnes et al. 2004). However, in the cost based perspective, exported products may be more competitive in the destined country or to other products from other countries. This may reflect a more cost efficient system of such a country where they have lower input costs or are more productive. It can also demonstrate dynamic forces in play such as exchange rates, tariffs, and transport costs. Further complex forces may be in play where learning by doing, technology advances, governmental policies, and capital accumulation results in a country becoming more competitive. At the micro level, a focus is placed on the competitiveness of an industry and how competitive it is in world markets. This is mostly done through a cost comparison with wages, material costs, and the level of productivity. Certain industries may be more competitive due to the natural environment of the country. An improvement in competitiveness may signify that a current industry provides new products or becomes more efficient due to various reasons such as advancing technology (Adams, Gangnes et al. 2004).

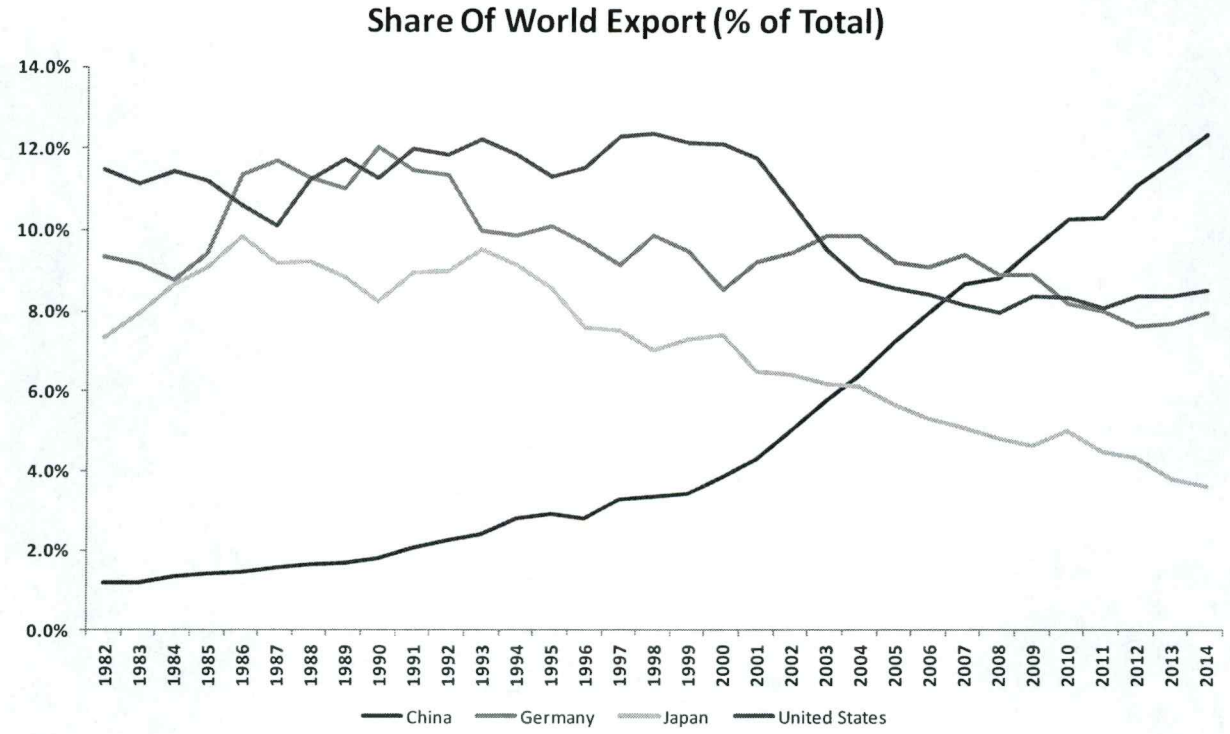
A "causes" based approach focuses on explaining why a country or industry is doing better than those of other countries. This method focusing on directly measuring international competitiveness unlike the "results" based approaches. Exchange rates are part of the explanations, but not completely. To do so, Adams, Gangnes et al. (2004) say there are "variance" factors to compare, such as:

- Comparing wage rates or capital costs
- Comparing unit labor or unit capital costs and
- Comparing unit total Costs

Certain measurements have been created to capture this cost based perspective such as World Economics Competitive Index by the OECD, different exchange rate measures of competition, and various measures/indices through the IMF.

Unlike cause based measurements, results based measurements have dominated the discussed measures of competitiveness. The first of them being a measure through market share. This method is very simple, the larger the share of exports a country has, the more competitive it is. This manner of measuring competitiveness is the general method that is seen in the media. Such results can be seen as the graph below.

World Export Share



Data from WTO database (stat.wto.org)

The graph demonstrates the world share of exports of the four largest exports. It demonstrates a rise in China's exports and drop in exports of the United States, Germany, and Japan. The share of an emerging country (China) has increased at the cost of these three developed nations. Such a measure may not explain the whole story and will be demonstrated later in this paper.

A second method to measure international competitiveness is the Revealed Comparative Advantaged (RCA) index by Balassa (1965).

$$\text{RCAi,c} = \left(\frac{xi,c}{Xc}\right)/\left(\frac{\sum_c xi,c}{\sum_c Xc}\right)$$

If xi,c signify the production value of an industry in country c, then $Xc = \sum_i xi, c$ *which equals country c's total output. A value greater than 1 means the country has a comparative advantage*

This measure focuses on the country's specialization in exports. In other words, a value greater than 1 indicates the country has a competitive advantage compared to the rest of the world by having a greater share of exports in the industry and a value less than one signifies a competitive disadvantage where it has a smaller share (Balassa 1965). Since subsidies and other incentives can come in play, Siggel (2006) explains that the RCA index is a measure of international competitiveness and not comparative advantage as its name would indicate. This model and other literature has focused on two goods or two countries.

This leads to a third method of measuring international competitiveness through the export sophistication method. This method expands the revealed comparative advantage by using the industry specialization to measure a country's overall international competitiveness. This is done through the equation below where

$$\text{Si} = \left(\frac{xi,c}{Xc}\right)/\left(\frac{\sum_c xi,c}{\sum_c Xc)}\right)*\text{Yc}$$

the first set (numerator) is the share of industry in the overal country. The second set (denominator) is the sum of this across all countries. Meaning, the index calculate is a weighted average of income and the weights demonstrate relative specialization of the industry. It shows how a country is more specilized in a specific industry (Rodrik 2006). This equation can be reaaranged so that it incorporates all other countries:

$$\text{Si} = \sum_c Wi,c\text{Yc}$$

Where:

$$\mathrm{Wi,c} = \frac{RCAi,c}{\sum_C RCAi,c}$$

This value of the sophistication index, Si, reviews the "average income of countries specialized in the export" of industry I (Van Assche and Gangnes 2010). There are two reasons why this value may increase. Foremost, the increase in more affluent countries is due to these countries specializing in this specific industry. Subsquently, those that specialize in such an industry may relatively become richer compared to others.

After calculating the sophistication index, one can calculate the country's technology index (CTI) as a weighted average of sophistication levels of the industry it is involved in (Rodrik (2006), Hausmann, Hwang et al. 2007). Since each country has different technology levels and endowed with different resources, this calculation would allow to properly weight it in compared to other countries.

These result based measures allow to obtain industry level export specialization. This allows for more detailed measures. Cost base measures however, have not been able to capture these factors. Additionally, it is more challenging to quantify cost base measures. Therefore, there has been a focus on result based measures.

II.2. Problems with traditional results based measures

The traditional measures have become unreliable in todays environment. It implicitly assumes that exports are made in a country. In other words, if a country increases its export share, then its local production is more competitive and if there is a reduction in its export share, then its local production is less competitive. The problem with this notion is that it is not true. This is due to production no longer being concentrated in a single country. If production is

separated throughout the world, then how can it be properly captured in these measurements? An example is needed to illustrate how they become unreliable when production is separated into different countries.

A classic case to illustrate the current situation, is the Apple IPod. Since the product is assembled in China, export data would suggest that it is a Chinese Product. Linden, Kraemer et al. (2007) and Dedrick, Kraemer et al. (2010) created a case study to show the origin of the components, where value is added, and the weaknesses of our methods. The first table below shows the breakdown of which country creates the most value in the price of the IPod and the source of the activity/firm. The table will make reference to a previous table where that previous table specified in $ amounts and the specific components in the production, which is too detailed for this example. These are all measured in $U.S.

	U.S.	Japan	Korea	Total
Distribution and Retail	$75			$75
Apple	$80			$80
Seven Identified Inputs in Table 1	$7	$26	$1	$34
PortalPlayer suppliers	$1*			*1
TOTAL	$163	$26	$1	$190

**PortalPlayer suppliers could also be located in Taiwan and assumes the unit is sold in the U.S. (Dedrick, Kraemer et al. 2010)*

The table above demonstrates the U.S. clearly benefits the most with a value of $163, even with the production being in China and the IPod being labeled as "Made in China". Therefore, about 85% of the value is created in the United States. This is followed by 13% of the creation made in Japan leaving <1% in South Korea and China. There are other numbers missing from this table that the authors mentioned, which would be in the Japan Column. These numbers are further breakdowns of the parts. Dedrick, Kraemer et al. (2010) have specified clear winners in the conclusion of their study. They have three key conclusions on who are the winners. First, Apple, the firm, benefits the most from this situation. They benefit by having mostly American employees and Shareholders. They create $80 or 42% of the value. Second, the countries that create the key components are located in Japan and the United States creating the bulk of the value. Finally, for each IPod sold in the United States, the trade deficit with China increases by about $150, however the value added in China is very little. (Dedrick, Kraemer et al. 2010). As a result, what is exported by China is not necessarily made in China.

Another study done with the Apple IPhone shows similar results. Xing and Detert (2010) analysis called "How the IPhone Widens the United States Trade Deficit with the People's Republic of China" show that just one product, the Apple IPhone, increases the U.S. trade deficit with China by U.S. $1.9 Billion. They further develop on how global production networks and specialized production processes reverse trade patterns. This results in developing economies such as China to export high tech goods, while developed countries import them. The outcome portrays inflated bilateral trade deficits between countries used as export platforms by firms like

Apple and their destination countries. This places a doubt in the measurement mentioned earlier, where a rising balance of trade results is viewed as being more internationally competitive. In the case of China, these measures inflate the trade data in their favor, distorting reality.

Van Assche and Gangnes (2010) discuss this distortion in their paper "Electronics Production Upgrading: Is China Exceptional?" and also Van Assche (2012) in "Global Value Chains and Canada's Trade Policy". They begin by demonstrating the current situation and what the current trade data shows, provided in the table below.

Table 1: The origin and destination of China's processing imports and exports, 2008

	Share of processing imports originating from:	Share of processing exports destined for:
East Asia	**72.8**	**28.2**
Japan	20.4	11.6
South Korea	17.3	6.0
Singapore	4.6	3.3
Taiwan	15.8	2.2
Malaysia	6.0	1.9
Thailand	4.5	1.0
Philippines	2.8	0.7
Vietnam	0.2	0.5
Indonesia	0.9	0.8
Macau	0.4	0.3
Non-Asian OECD	**19.4**	**59.6**
EU-19	9.1	27.5
US	7.4	25.7
Canada	0.7	1.8
Australia	0.7	1.7
Other non-Asian OECD	1.6	2.8
Rest of world	**7.8**	**12.2**

Source: Ma and Van Assche (2010).
Note: Figures may not add to 100 due to rounding.

In the table above, it demonstrates the share of processing imports and processing of exports of China and other countries. An interesting trend is shown and explained by Van Assche (2012). He shows that "Foreign processing inputs are predominantly imported from China's wealthier East Asian neighbors, while processed final goods are largely exported to Western

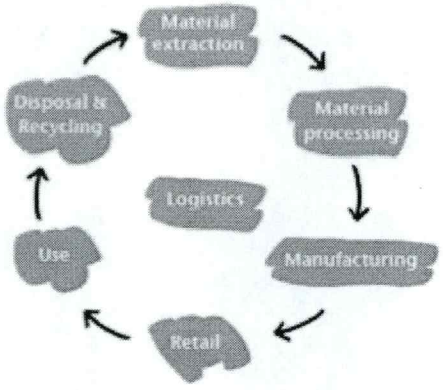
markets". Van Assche and Gangnes (2010) also explain that these East Asian countries (Japan, South Korea, and Taiwan) already manufactured key inputs in the west and moved manufacturing to China to take advantage of the lower labor costs. So rather than exporting directly to the western countries, Japan, South Korea, and Taiwan, send their inputs to be processed in China and then export them to the West after assembly. This means that China's increase in export share is a statistical mirage.

These findings are very interesting because they clearly demonstrate a need to look into the subject further. It arises questions on our current method to measure results based international competitiveness. It reveals the importance for a measure that captures the **value added** of production and **services** rather than the end point because it demonstrates China as a high technology maker, which is not necessarily the case. In the case of the Apple IPod (and many other electronics), China is not a high technology innovator nor maker and benefits greatly from foreign influence (Van Assche and Gangnes 2010, Wang and Wei 2010).

II.3 Rise of Global Value Chains

A global value chain is described as " the full range of activities which are required to bring a product or service from conception, through the different phases of production, delivery to final consumers, and final disposal after use." (Kaplinsky and Morris 2001). A value chain consists of many different activities such as preliminary activities ranging from design and production followed by retail activities of marketing and distribution. Below in the table is a standard model of a value chain. This standard model is considered a sustainable model displaying all the main stages necessary.

Main Stages of a Value Chain



Source: WBCSD (2011) Collaboration, innovation, transformation: Ideas and inspiration to accelerate sustainable growth - A value chain approach, p.3 & 5

In the above model, the firm begins by extracting its necessary materials. Then it processes and manufactures them into the desired product. Finally, the product is sold through retail segments and sold to the final user. In this specific model, the product is recycled to extract its key materials to repeat the process. Each of these activities is shown as its own category of activities. This separation of activities is the core of a value chain.

Firms have used the value chain to increase their efficiency. They have even taken a step further by separating the production of goods and services into various stages linked across the world (Van Assche 2012). In addition, GVCs encompass both the inputs of a product and the value added component for end users (UNCP). The concept of value added is the same as described earlier in the IPod example and the one which will be considered in the analysis.

The organization of production through global value chains has been driven by falling costs of activities once seemed unfeasible. Significant reduction of costs in communication and transportation, with other obstacles to trade (trade, investment, and economic liberalization) has

allowed firms to separate their value chains throughout the world (Van Assche 2012). Comparative advantage forces drove them to separate tasks into two groups, capital intensive tasks (capital focused) and labor intensive tasks (labor focused) (Van Assche 2012). Van Assche (2012) continues by stating that if communication costs are low, firms who are in labor scarce countries will have an economic incentive to relocate those activities to those developed countries who are labor abundant. These firms will still maintain their capital/knowledge intensive tasks in the developed nation. As a result, comparative advantage forces lead to a trade in tasks. Countries who have abundant labor will export labor intensive tasks, while those who have capital will export capital/knowledge tasks (Van Assche 2012).

This allows firms to take advantage of each countries comparative advantage. This is demonstrated in Mudambi's Curve below:

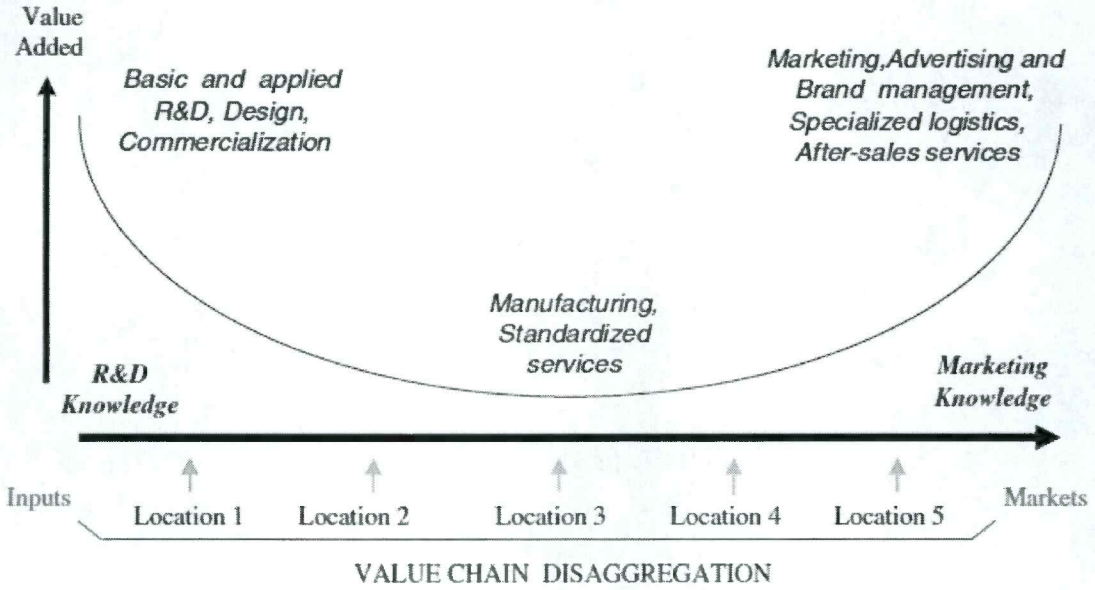


Figure 1. The smile of value creation (Mudambi, 2007).

(Mudambi 2008)

What Mudambi (2008) demonstrates and Van Assche (2012) expands is where such activities should take place and where a value chain has many interlinked tasks. For R&D (upstream) and Marketing (downstream) for example, they should be located in more capital intensive locations (usually developed countries), while manufacturing (middle) should take place in more labor intensive locations (usually developing countries). Such patterns and activities are seen in the electronics industry as the IPod example above and also for the Nokia95 Smartphone (Dedrick, Kraemer et al. 2010, Ali-Yrkkö, Rouvinen et al. 2011). This can be done in many different ways, such as intermediate parts can be exported by developed nations to developing nations to be assembled like the case of Japan and South Korea in the Apple IPod example (Linden, Kraemer et al. 2007, Dedrick, Kraemer et al. 2010). In actuality, most upstream and downstream activities are kept in developed nations (usually the home country) and manufacturing is primarily in developing nations (in those two mentioned cases - East Asia). Mudambi (2008) argues that the interaction between comparative advantage and competitive advantage establishes how much a firm can outsource and the best location to offshore. He also states that the activities at both ends of the value chain are rigorous in how they apply both knowledge and creativity. Therefore, high value activities are located in advanced economies and the opposite in more developing economies (Mudambi 2008). Similar results were found by Pedersen (2006) and Belussi, Sammarra et al. (2010) with Danish companies and the off shoring process of international firms (respectively).

II.4 Gross exports accounting:

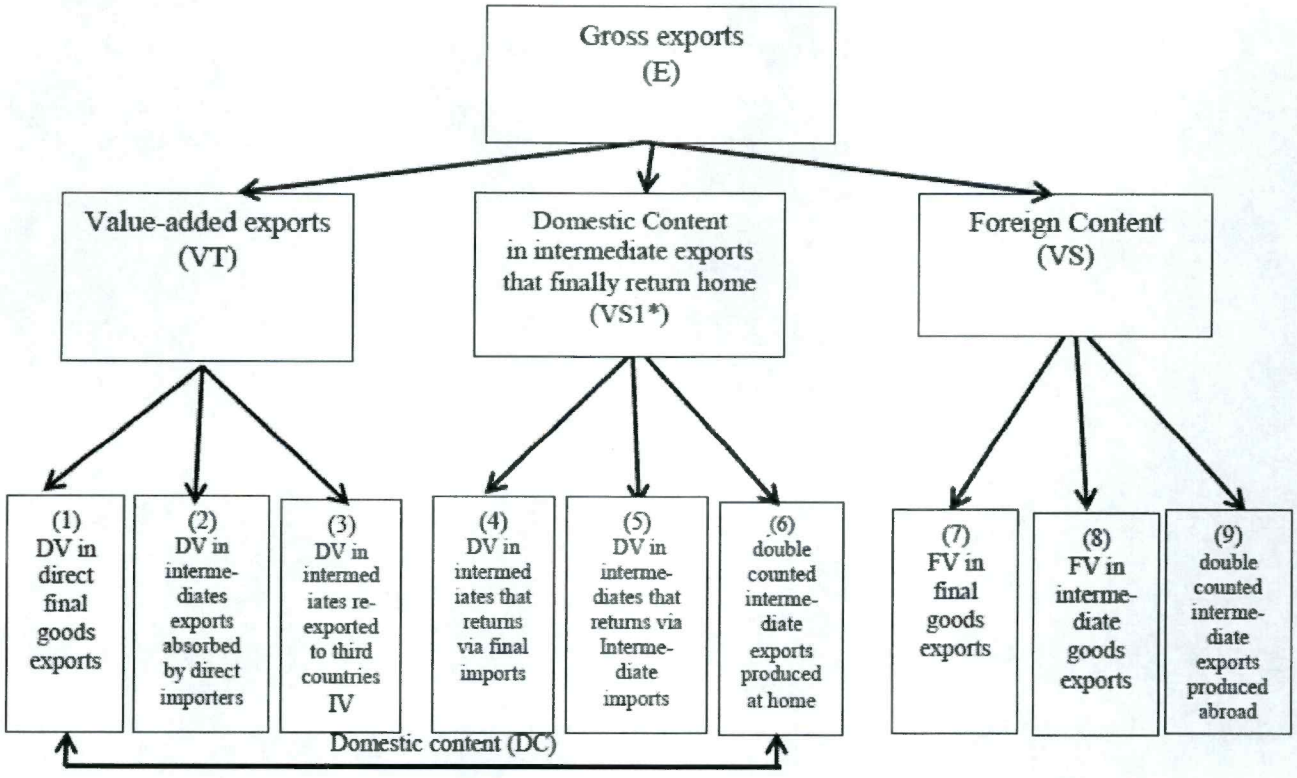
To capture these forces Koopman, Wang et al. (2012) summarized three main blocks of gross exports that have been used throughout the literature (in the figure below). Various authors have worked on the model where Hummels, Ishii et al. (2001) placed the foundation of

incorporating direct and indirect contents of exports. The component of intermediary exports as mentioned previously has become prevalent and important in measuring exports (Daudin, Rifflart et al. 2011). Thus, expanding the model beyond a two country model is necessary to incorporate the role of others. Emphasis is placed on the domestic content and foreign content of exports which is illustrated in the figure further below.

The domestic content in intermediate exports that return home, is known as VS1*.This is also broken down into 3 sub components of domestic value of intermediate exports that return back to the country through final imports, domestic value of intermediate exports that return back to the country as intermediate imports, and double counted intermediate exports produced at home (Koopman, Wang et al. 2012). When the value added component and the domestic content that return home are combined, then it brings together the domestic content of a country's exports (Koopman, Wang et al. 2012).

The final component is foreign content in gross exports also known as VS. Foreign content is broken down into three subcomponents which includes: foreign value in final goods exports, foreign value in intermediate goods exports, and double counted intermediate exports produced abroad. Both the components of domestic content in intermediate exports (VS1*) and foreign content (VS) include the value added that is measured two times or more. This is due to the intermediate components, which cross multiple countries that lead to multiple counting in trade statistics (Koopman, Wang et al. 2012).

Figure 1 Accounting of gross exports: concepts



Note:

a. value-added exports by a country equals (1) + (2) +(3) .

b. GDP in exports (1) + (2) + (3) + (4) +(5).

c. domestic content in a country's exports equals (1) + (2) + (3) + (4) +(5)+(6).

d. (7)+(8)+(9) is labeled as VS, and (3) + (4)+(5)+(6) is part of VS1 labeled by HIY (2001).

e. (4) are also labeled as VS1 by Daudin et al (2011).*

f. (4) through (9) involve value added that crosses national borders at least twice, and are the sources of multiple counting in official trade statistics. (should not be included in double counting, because when this value crosses a border for the second time, it becomes foreign value in the direct importer's exports. For this reason, it is not included as double counting to avoid an over-correction (Koopman, Wang et al. 2012)

To begin measuring, one would need to go through a two step approach. Johnson (2014) begins by stating that one needs to first measure the output from each sourced country. This is done to see the final consumption in the final country. Second, is to see the local value added created of the gross output. This is to specifically see how much value is created in making one of the parts (or service) such as Japan's value added activity in the disc drive of the Apple IPod (Johnson 2014). To implement this approach, one needs to measure the value of final goods of each country, how it's used, and its value added throughout the value chain. This can be done through a global input-output framework where:

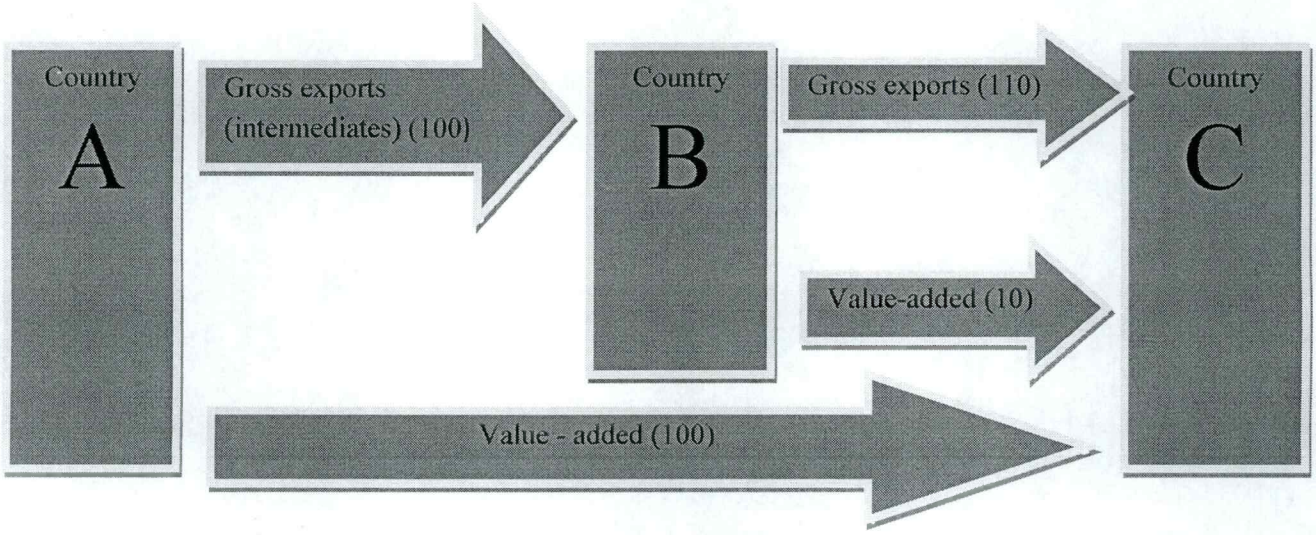
> "On the input side, global input-output tables record the sectors and countries from which inputs are sourced to produce output in a given country and sector. On the output side, they record the destinations to which final goods from each sector are shipped. Combining these, we can take final goods shipments and trace backwards using input requirements to allocate the value added in those final goods to their source".
>
> (Johnson 2014)

In addition, Koopman, Wang et al. (2012) demonstrates "that a country's domestic content can be further broken down into sub-components that reveal the destinations for a country's exported value added, including its own value added that returns home in its imports and what is double counted due to cross border intermediate goods trade" as shown in the figure. It also includes any foreign sources used in a country's exports. It does so by showing the value added from a given country and eliminating any double counting of components as stated earlier (Johnson and Noguera 2012, Johnson and Noguera 2014). Due to the development of this technique, it provided the tools to analyze macroeconomic imbalances such as those of Europe by Ederer and

Reschenhofer (2014) and Timmer, Los et al. (2013) with the German car industry. Interestingly, Timmer, Los et al. (2013) illustrates that once all these variables are considered, the German car industry is more competitive (more jobs and income) even though it has off-shored its manufacturing. It did so by specializing in high skilled activities and contributes through technology and services. Without this technique, such an insight would have been very difficult to uncover.

II.5 What is Value Added and Why?:

Value added measures "flows related to the **value** that is **added** (labor compensation, other taxes, and operation surplus or profits) by a country in the production of any good or service that is exported" (Ahmad 2013). A graphic illustration of Value added is recreated below provided by Ahmad (2013) and an example comparing traditional methods with the value added method:



Traditional method: (Using the graphic illustration above).

Country A produces entirely 100$ worth of goods, which is exported to Country B. Country B processes it further and exports it to Country C where it is finally consumed. Country

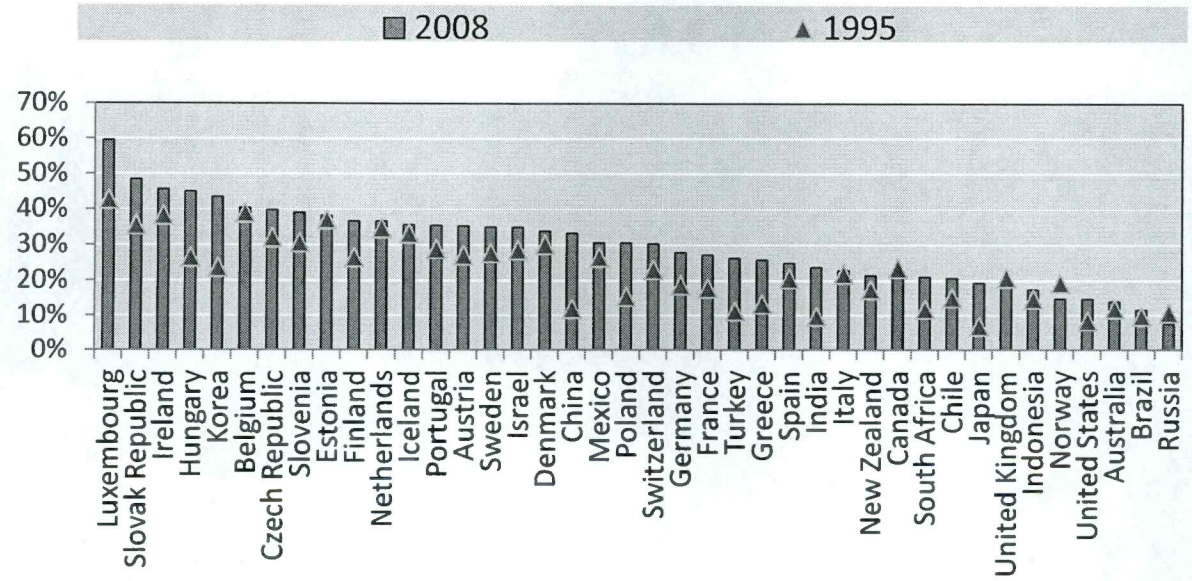
B adds a value of 10$ and exports it at a value of 110$ to Country C. Traditional measures shows a global export and imports of 210$ but only 110$ of value added has been created. The traditional measure also shows that Country C has a trade deficit of 110$ with Country B and no trade with Country A, even though Country A benefits most of Country C usage (Ahmad 2013).

Value Added: (Using the graphic illustration above)

This method shows a different picture. A value added approach changes Country C's Standing with Country A and Country B. By focusing on Value added, it reduces the Deficit between Country C to Country B to 10$. When it is done compared to Country A, it is 100$. The overall trade remains at 100$, but what changes is the trade deficit/relation. This example demonstrates how the output of one country can be affected by the consumers of another. These have immense implications/insights on trade policy and how certain measures can have strong consequences on this relationship (Ahmad 2013). Therefore, the value added approach provides a more accurate measure of international competitiveness.

II.6 Value added found in both exports and imports:

Share of foreign value added in gross exports, by country (1995 and 2008)

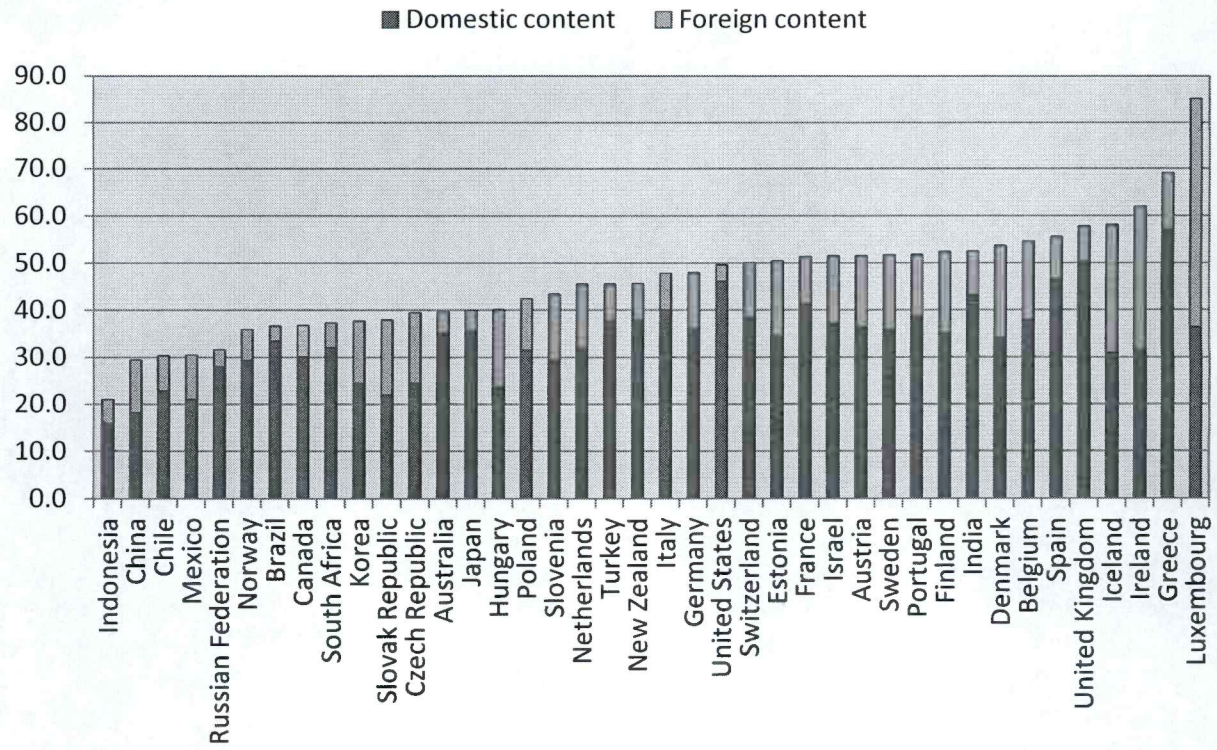


Provided by De Backer et Miroudot (2014)

Above demonstrates the share of foreign value in exports for a set of countries for 1995 and 2008 leaving the remainder to be domestic content. The figure demonstrates clearly why we should be careful with export based competitiveness measures. This is due to most countries have increased their involvement in the global value chains by decreasing their domestic share. Firms can reduce their costs by off shoring their tasks to countries who have a comparative advantage in those activities (Van Assche 2012). This can be seen in the above diagram where the majority of the countries have more foreign value in their gross exports. It is also interesting to note that small countries like Luxembourg have lowered their domestic share, while large ones like Canada and Russia have reduced them. This situation further biases export based measures due to constant shifting of where value is added. On one hand, if the share of domestic activities contributing to value decreases, this may be due to a drop in competitiveness. On the other hand, it could mean the opposite, where something larger is at play. Pursuing this question may have fascinating results.

Another factor to look into is the role of services in exports. Services have become predominant in importance and are contributing more. One can see their importance in the diagram below, domestic and foreign services play a key role in exports.

Services value added as a percentage of gross exports (2009)



Provided by De Backer et Miroudot (2014)

Value added of services are not tangible yet play an important role for many economies ranging from 20% for Indonesia and over 80% for Luxembourg. The importance of services has been discussed by Michael Porter in 2011:

> "Services are where the high value is today, not in manufacturing. Manufacturing stuff per se is relatively low value. That is why it is being done in China or

> Thailand. It's the service functions of manufacturing that are where the high value is today, and that is what America can excel in if we have the right kind of workforce and we have the right kind of environment. We have to stop this notion [of believing] that manufacturing is [essential]. It's a real problem because it distorts our thinking." *provided by Pisano and Shih (2012)*

On one hand, the view of Porter demonstrates the possible future in exports and imports. Services is where the value is created through marketing, research and development, finance, etc... On the other hand, focusing too much on services may be detrimental. Pisano and Shih (2012) argue that the United States has lost ground in new technologies because of this. They state that manufacturing is important for research and development and if separated, the true value of that service, innovation, is lost. This is due to not maintaining expertise and knowledge because of a lack of interaction with manufacturing. It is interesting to note that currently developed countries create a larger portion of their export value through services compared to more developing nations.

Perspective: Trade with a value added perspective is able to better show how upstream domestic industries contribute to exports, even if they have little to no international exposure. Mudambi (2008) already demonstrates this in his curve where they produce the largest value. Currently, Gross trade statistics demonstrate than less than 25% of total global trade is services, however, in a value added perspective, it is much higher as demonstrated in the three previous tables above. This perspective can allow the creating of policies that encourages trade liberalization (in a service perspective). This would allow an improvement in services access, which can lead to more FDI and more competitiveness of industries (Ahmad 2013).

Global Imbalances: As already shown above, accounting for trade in value added takes into consideration and redistributes the surpluses and deficits across their trading partners (Koopman, Wang et al. 2012, Ahmad 2013). When looking at bilateral trade balances in gross terms, the deficit with the final destination is exaggerated because it includes the foreign inputs (Dedrick, Kraemer et al. 2010, Ahmad 2013). It does not include services, intermediate goods, nor the true value of each activity. Pressure from countries come to balance theses deficits, however they are inaccurate.

Impact of Macro-Economic Shocks: Ahmad (2013) discusses macro-economic shocks by explaining how "the 2008-2009 financial crisis was characterized by a synchronized trade collapse in all economies. Authors have discussed the role of global supply chains in the transmission of what was initially a shock on demand in markets affected by a credit shortage. In particular, the literature has emphasized the "bullwhip" effect" of global value chains. When there is a sudden drop in demand firms delay orders and run down inventories with the consequence that the fall in demand is amplified along the supply chain and can translate into a standstill for companies located upstream" (Chen, Drezner et al. 2000, Altomonte, Di Mauro et al. 2011). A good understanding of a value added perspective may create tools to anticipate these shocks and create proper policies for them. Looking at such shocks in a gross trade flow perspective is more likely to be biased and miss them. (Ahmad 2013).

Trade and Employment: Numerous studies on trade liberalization's impact on labor markets has attempted to estimate the job portion of trade. This becomes more relevant when looking through a value added perspective of trade. Such a perspective allows to view where these jobs are created and who benefits from the trade (Ahmad 2013). Looking at the German Car industry, manufacturing was moved outside of Germany. Initially, this is seen as a loss of

jobs, however when looking at it with a value added perspective, a different view is shown. There was a loss of jobs in terms of manufacturing, however looking at indirect positions (finance, marketing, research and development) have risen (Timmer, Los et al. 2013). As Ahmad (2013) states, "when comparative advantages apply to "tasks" rather than to "final products", the skill composition of labor imbedded in the domestic content of exports reflects the relative development level of participating countries". As already seen earlier, this allows industrialized countries to specialize in high skill tasks (which are usually paid better and capture more value added), while moving the less skilled work away (Mudambi 2008, Van Assche 2012, Ahmad 2013, Timmer, Los et al. 2013). Timmer, Los et al. (2013) demonstrate in the German Car Industry how more jobs were created in Germany as a result of this shift and how there was a shift from low skilled workers to high skilled workers. They also showed how more value was created in Germany and that Germany benefitted mostly from such a move. The IPod example above demonstrates a similar situation, where the assembly of the IPod is in China, yet most of the value added is capture by the United States (Linden, Kraemer et al. 2007, Dedrick, Kraemer et al. 2010). This demonstrates another key component of current international trade, where exports require imported components, thus the need to properly measure the components that go into a product.

Trade and Environment: Trade flows with a value added approach can become very interesting for policymakers to evaluate the environmental impact of trade. Since concerns of greenhouse gas emissions and their role on climate change has become very important to the world, a value added approach would allow to see where goods are produced, hence where the CO_2 is produced (Ahmad 2013).

II.7 Summary

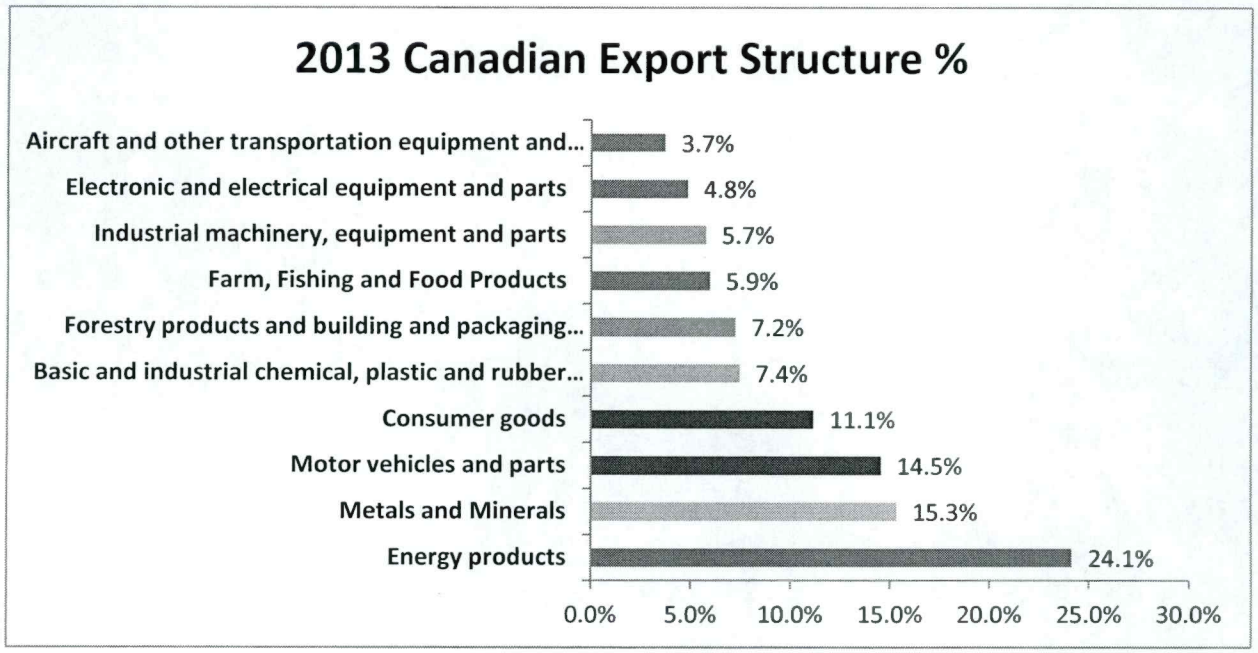
This chapter has shown that there may be severe implications in the way international competitiveness is measured. Traditional measures of international competitiveness assume that all production is done locally. However, there has been a rise in global value chains where firms have dissected their value chains globally by having activities in different countries and trade going back and forth between them. This means that these measures distort the reality by not capturing where the true value is added in the production of a product nor the roles of the different countries involved. Secondly, services are not incorporated in these traditional measures because they are not tangible products. Services have increased in importance because many developed countries such as the example of Luxembourg above, has focused on services to drive their economies rather than traditional manufacturing. These services tend to contribute the highest value of a product through marketing, research and development, and finance, unlike the manufacturing of the product itself. Therefore, an analysis with methods to reduce such biases is necessary to demonstrate a more accurate reflection of reality. This paper addresses the weaknesses in these measures and revisits Canada to develop new insights in Canada's international competitiveness position.

III. Canada

This section briefly covers different aspects of the Canadian economy. This review is important to demonstrate the structure of Canada's exports and its role in the global value chain.

The structure of Canada's exports become important for our analyses. Thus, a further breakdown beyond countries and status is necessary. Below is a graph created from the 2013 Annual merchandise trade: North America Production Classification System - Seasonally adjusted, current dollars data from Stats Canada. This Graph Demonstrates the structure of Canada's exports in percents broken down by sector (Canada 2014).

Table 1



Source: authors creations with Statistics Canada Data

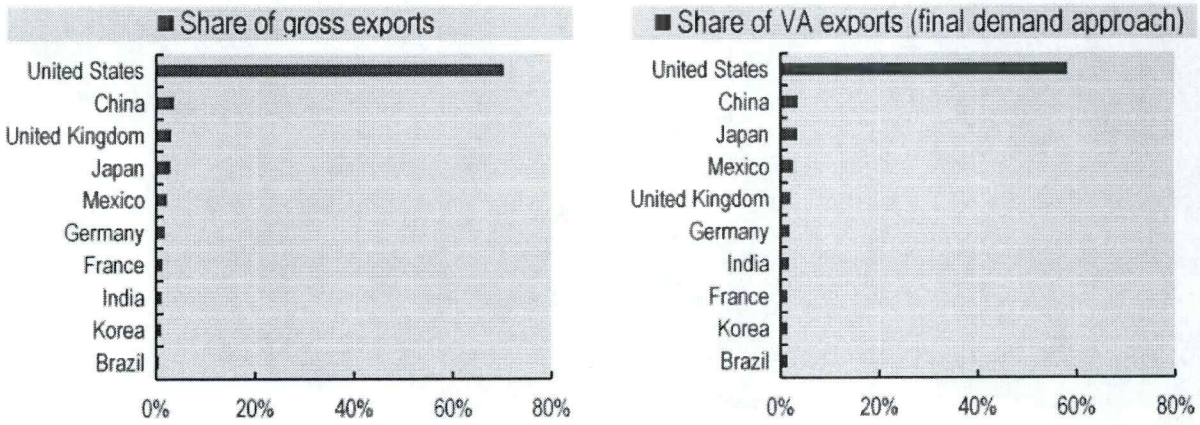
As seen in the table above, the top two exports are metals and minerals with energy. Energy accounts for 24.1% of exports and metals and minerals consists of 15.3%. Together they

are 28.4% of all exports. Thus, about 30% of all exports relying on natural resources. This is followed by motor vehicles and parts with 14.5%.

Canada has strong overall exports and is initially seen to be fairly dependent on the United States, its main trade partner. This can be seen by traditional export measures where 72% of exports have headed to the United states (a drop from 83% in the early 2000s, but significant nevertheless) (Van Assche 2012). However, When value added perspective is considered, this value surprisingly drops to around 60% (OECD 2013). Again, the traditional measures have shown a higher dependence on the United States unlike the current reality.

Below are two tables on Canada's overview from the OECD TiVA Database. It consists of share gross export destinations of Canada in percentage by country and share of gross exports destinations by value added as discussed earlier for the year 2009.

Table 2

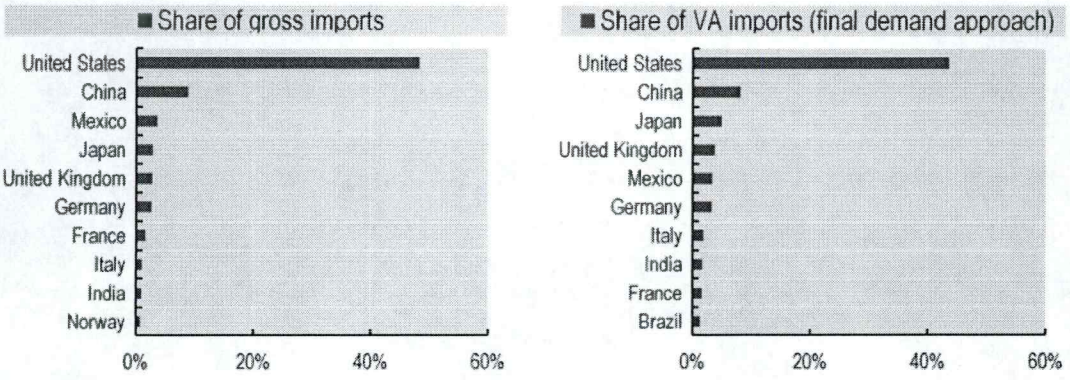


Source: OECD Website Canada section

The United States is still Canada's main trading partner in terms of exports even when value added is taken into account. It drops slightly to under 60% as already noted. In addition, it is interesting to see where Canada's imports come from. A familiar pattern is noted however the

percentages are much less. Below are the figures from the same OECD source.

Table 3

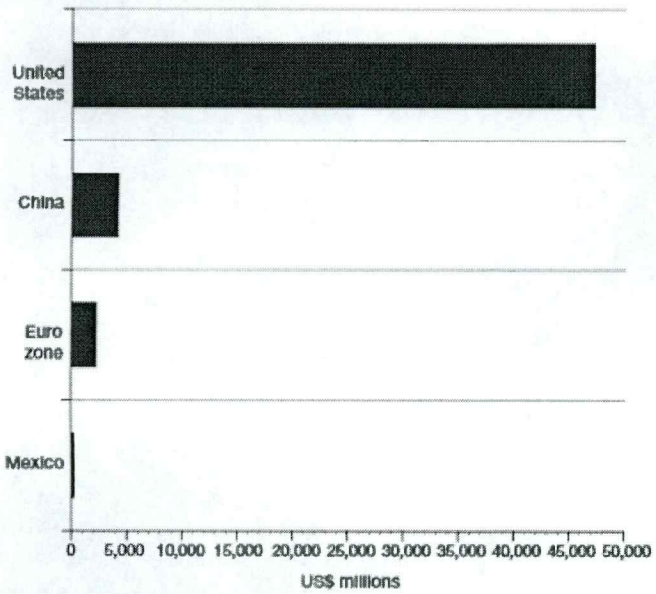


Source: OECD website Canada section

The share of gross imports is less than exports at a value slightly above 40%. The value drops very slightly once value added is considered. The trade partners and their importance remain slightly similar where the United States and China are the top two partners. This may be due to the United States closeness and the NAFTA agreement. In China's case it may be due to their large export oriented economy and recent rise in the global value chains. A more careful look shows Canada is more integrated in global value chains.

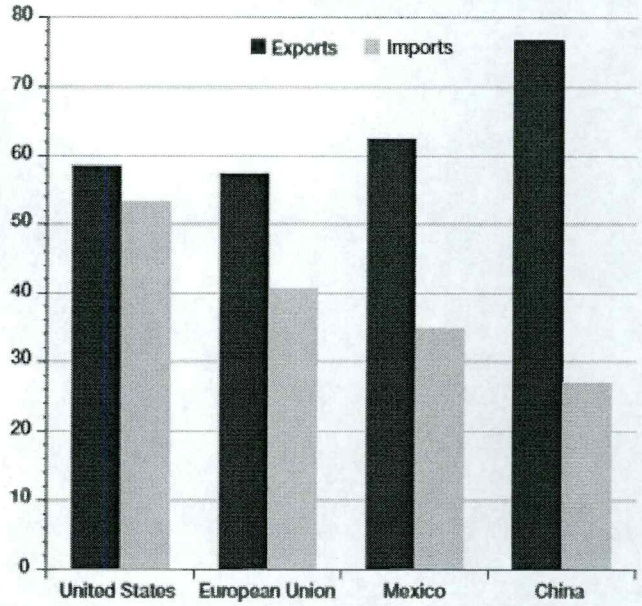
Table 4

Figure 5: Canada's trade balance in primary goods with selected countries and regions, 2009



Source: Author's calculations using Base pour l'Analyse du Commerce International trade data from Centre d'Etudes Prospectives et d'Informations Internationales.

Figure 6: The share of intermediate goods in Canada's nonprimary goods trade with selected countries and regions, 2009



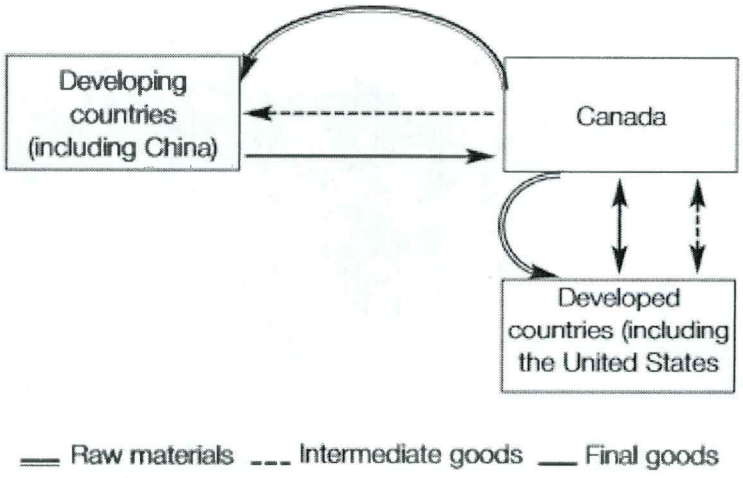
Source: Author's calculations using Base pour l'Analyse du Commerce International trade data from Centre d'Etudes Prospectives et d'Informations Internationales.

Source: Van Assche (2012)

Additionally, intermediate goods have become a key variable in today's world trade. Due to global value chains, these components are part of future exports of other countries. Canada's contribution is important. Below are two tables demonstrating Canada's Role. As seen in table 4 provided by Van Assche (2012), Canada exports lots of intermediate goods, yet a gap between exports and imports is wider for emerging countries such as Mexico and China. Also, Canada focuses on trading primary goods to developed countries, mostly the United States. These findings are interesting because Canada tends to export intermediate goods to emerging countries (importing final products thereafter), while exporting primary goods to developed countries (Goldfarb and Beckman 2007),(Van Assche 2012). This leads to the table below.

Table 5

Figure 4: Canada's role in global value chains



Source: (Van Assche 2012)

This table summarizes the relationship between Canada with developed and developing nations. Canada Provides raw materials (primary goods) and intermediate goods to developing nations, while importing final goods. In the case of developed nations, Canada exports primary goods, but both imports and exports intermediate goods and final goods (Goldfarb and Beckman 2007),(Van Assche 2012).

Canada's main focus of its exports is metals and energy as shown above. This brings about the question of how competitive is Canada compared to other countries when the reduction of biases of gross exports is corrected? How important is the role of this industry? Does the component of exports matter compared to the others? Is there a difference in value? This paper will attempt to answer these questions.

IV. Data and Methodology

In order to measure the international competitiveness of Canada (the revealed comparative advantage, sophistication index, and technology index) compared to other countries, the Trade in Value Added Database (TiVA), which is released by OECD and WTO is used. A review of the World Input-Output Database is discussed due to much research has been done with this database. It is included to complement the understanding of the TiVA database. These two databases allow the analysis of those indices because they go beyond the traditional import and export data. They include the necessary intermediate imports and other important variables.

IV.2 World Input-Output Database (WIOD)

The World Input-Output Database is a database that covers a total of 40 countries from the period 1995-2009. It has been created to allow the analysis of the effects of globalization on trading patterns, environmental pressures, and socio-economic changes across a large spectrum of countries (27 EU countries and 13 other major countries) (Timmer and Erumban 2012). The WIOD uses World Input-Output Tables (WIOT) and Use Tables (SUT) for its construction, where WIOT show the intra-industry flows within a country. It shows the source of each product (both domestic industries and imports). On the other hand, SUTs show the destination of each product ("intermediate use by domestic industries, domestic final demand, or exports") (Timmer, Los et al. 2013). A great advantage of SUTs is they can easily be combined with trade statistics, which are product based and employment statistics that are industry based (which becomes very important for our analysis) (Timmer, Los et al. 2013).

The WIOD time series consists of the following four main sections. The sections and descriptions are presented by Timmer and Erumban (2012) and taken directly from them:

"World Tables (annual, 1995-2009)

- International Supply and Use table at current and previous year prices, with use split into domestic and import by country (35 industries by 59 products)
- World input-output table at current prices and at previous year prices (35 industries by 35 industries)
- Interregional Input-Output table for 6 regions (35 industries by 35 industries)

National Tables (annual, 1995-2009)

- National supply and use tables at current and previous year prices (35 industries by 59 products)
- National Input-Output tables in current prices (35 industries by 35 industries)

Socio-Economic Accounts (annual, 1995-2009)

- Industry output, value added, at current and constant price (35 industries)
- Capital stock, investment (35 industries)
- Wages and employment by skill type (low-, medium- and high-skilled) (35 industries)

Environmental accounts (annual, 1995-2009)

- Gross energy use by sector and energy commodity
- Emission relevant energy use by sector and energy commodity
- CO2 Emissions modeled by sector and energy commodity
- Emissions to air by sector and pollutant
- Land use, Materials use and Water use by type and sector".

They present another table with the full list of countries that include the data above in the WIOD database (which includes the focus of this paper Canada) (Timmer and Erumban 2012). The countries represented are:

European Union - Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom

North America - Canada, United States

Latin America - Brazil, Mexico

Asia and Pacific - China, India, Japan, South Korea, Australia, Taiwan, Turkey, Indonesia, Russia.

The WIOD also includes services data. As mentioned previously, services is becoming a grand factor in international trade, thus its incorporation is key in research and policy making. This dataset includes more than 20 economic activities according to the balance of payment (BOP) classification. (Timmer and Erumban 2012). Four modes are of supply has been defined (by the WTO) which the WIOD attempts to capture. They are below as explained by Timmer and Erumban (2012):

- "Mode 1 - Cross-border: services supplied from the territory of one country into the territory of another.
- Mode 2 - Consumption abroad: services supplied in the territory of a nation to the consumers of another.

- Mode 3 - Commercial presence: services supplied through any type of business or professional establishment of one country in the territory of another (i.e., FDI).
- Mode 4 - Presence of natural persons: services supplied by nationals of a country in the territory of another."

It is important to note that the database captures mode 1 and 2, due to the data being available. However, mode 3 and 4 are more limited due to the lack of data, but currently is the best available approximation available.

IV.3 Trade in Value Added (TiVA)

The Trade in Value Added Database is a database that covers 57 economies for the years 1995, 2000, 2005, 2008, and 2009. The database is broken down into 18 industries (OECD 2013). It is similar to the WIOD in purpose, where it allows the analysis of various indicators for policy making. The indicators they include:

- "Decomposition of gross exports by industry into their domestic and foreign content
- The services content of gross exports by exporting industry (broken down by foreign/domestic origin)
- Bilateral trade balances based on flows of value added embodied in domestic final demand
- Intermediate imports embodied in exports" (OECD 2013).

The purpose of the TiVA database is to allow policy making that will address many of the situations mentioned earlier such as:

- "The significant higher contributions made by services in global value chains
- The role of imports in export performance
- The true nature of economic interdependencies
- The role of emerging economies in GVCs
- How supply and demand shocks might impact on downstream and upstream productions" (OECD 2013).

The TiVA database covers the following countries (in alphabetical order by country code):

Argentina, Australia, Austria, Belgium, Bulgaria, Brazil, Brunei Darussalam, Canada, Switzerland, Chile, China, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hong Kong (China), Hungary, Indonesia, India, Ireland, Iceland, Israel, Italy, Japan, Cambodia, Korea, Lithuania, Luxembourg, Latvia, Mexico, Malta, Malaysia, Netherlands, Norway, New Zealand, Philippines, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Singapore, Slovak Republic, Slovenia, Sweden, Thailand, Turkey, Chinese Taipei, United States, Vietnam, South Africa (OECD 2013).

It can be seen already that the TiVA database is more rich in countries compared to the WIOD.

Similar to the WIOD, there are caveats to the Database. There are three main Caveats (assumptions used) of the TiVA (which WIOD shares).

Production Assumption

Due to the nature of the Input Output tables necessary to create the TiVA Database, any indicator assumes "that all consumers of a given country's output purchase exactly the same shares of products produced by all of the firms allocated to that industry" (OECD 2013). This

means that there is an assumption of only one technique of production for all the firms (which is not true). There are also differentiated products, which are destined for different consumers. Due to the nature of many exports being intermediates (in a global value chain), "exporting firms are generally more integrated into value-added chains they will typically have higher foreign content ratios, particularly when they are foreign-owned, as such the estimates provided in this release should be considered as prudent. Generally they will point to lower shares of foreign content than might be recorded if more detailed input-output tables were available, with consequences for all other indicators presented" (OECD 2013).

Proportionality Assumption

Since the quantity and quality of information varies between industries, this assumption is used, where information is not available. This means "for a given product, one assumes that the proportion of intermediates that an industry purchases from abroad is equal to the ratio of imports to domestic demand in that product" (OECD 2013). In other words, " if an industry such as electronics relies on semiconductors and 10% of all semiconductors are imported, it is assumed that 10% of the semiconductors used by the electronics industry is imported" (Ma and Van Assche 2010). This assumption has allowed other scholars to further research when many imported and exported components are involved in the production network such as Hummels, Ishii et al. (2001) and Johnson and Noguera (2012). Whenever this was used, further techniques were used to refine the data to differentiate between imported goods that are intermediate and those for final domestic demand. This does not affect the results to be biased towards any direction (OECD 2013).

Dealing with internationally inconsistent official trade statistics

Global trade data is not consistent. This can be seen easily where total global gross exports to not equal those of global gross imports. The variation increases when these measures are looked into at the bilateral level and even more when looking at the product level. A lot of these inconsistencies are solved with the global input output tables used to create the TiVA database. As stated by the OECD, " Total exports and total imports of a given country will be consistent with totals recorded in their official National Accounts statistics but the balancing process will necessarily introduce coherence adjustments to bilateral trade flows that will lead to differences between official recorded bilateral gross trade flows and those reflected within the input-output table" (OECD 2013). This necessary balancing is stated to not introduce any directional or structural bias.

For the purpose of this paper, the TiVA database will be used due to its ease of use. The WIOD database is mentioned for two reasons. First, many authors cited have used the WIOD database in their research, illustrating the importance of it. Second, it is mentioned for completeness and contribution.

IV.4 Methodology

The Revealed comparative advantage (RCA) indices is often used to measure competitiveness between different countries. The TIVA dataset expanded this term where it calculated two forms of RCA; the traditional calculation for RCA and the value added RCA. The difference is the value added incorporates the concept of trade in value added and services. It is a statistical approach where it estimates the source of value by country and industry. Specifically, where this value is added. The concept of RCA is taken from Balassa (1965). It is specifically a measure of trade specialization as shown below. The same methodology is used as the traditional method, however, value added (including services) inputs are used separately. If xi,c signify the

production value of an industry in country c, then Xc = $\sum_i$ xi, c which equals country c's total output. Therefore the Revealed advantage is given by:

$$\text{RCAi,c} = \left(\frac{xi,c}{Xc}\right)/\left(\frac{\sum_c xi,c}{\sum_c Xc}\right)$$

A value greater than 1 indicates the country has a competitive advantage compared to the rest of the world by having a greater share of exports in the category and a value less than one signifies a competitive disadvantage where it has a smaller share. In addition, the RCA formula above can be used with value added in trade, thus expanding the original formula to include services. The revealed comparative advantage is a key component for further calculations as will be demonstrated further on.

Below is a table demonstrating briefly Canada's appropriate RCA for both traditional (manufacturing) and value added for the year 2008 (**without services**) in each respective industry (taken directly from the TIVA database).

RCA with and without value added (services not included)

Industry	Manufacturing RCA	Value Added RCA
Wood/paper	2.1357	2.2957
Transport equipment	1.7465	1.548
Basic Metals	1.42	1.3339
Manufacturing/recycling	1.1003	1.1537
Chemical	1.02	1.0895
Food products	0.9195	0.9575
Machinery	0.5638	0.5443
Electrical	0.4154	0.4434
Textiles	0.2319	0.2325

TiVA Database

The table above presents the industries where Canada has is competitive in descending order. It is interesting to see that when a value added perspective is incorporated, the values change, whether increasing or decreasing competitiveness. Canada as a country is more competitive in the wood/paper and transport equipment. Once value added is incorporated, it is even more so in wood/paper, but less in transport equipment. Later on, the recalculations will be redone with services included.

To calculate Canada's technological position, a similar methodology to Rodrik (2006) and Van Assche and Gangnes (2010) is used. The first step is to calculate the level of technological sophistication of an industry by the weighted average income of the producers. The underlying principle is that richer more afluent countries tend to have characteristics that endow it with a comparative advantage in a more advanced industry. Such characteristics include capital, better technology, and more established institutions (Van Assche and Gangnes 2010). If Yc represents a country c's GDP per capita (for the respective year of data) with the other variables defined as before. Subsequently, the level of industry sophistication S for industry i is:

$$\text{Si} = \left(\frac{xi,c}{Xc}\right)/\left(\frac{\sum_c xi,c}{\sum_c Xc)}\right)*\text{Yc}$$

The first set (numerator) is the share of industry in the overal country. The second set (denominator) is the sum of this across all countries. Meaning, the index calculate is a weighted average of income and the weights demonstrate relative specialization of the industry. It shows how a country is more specilized in a specific industry. This equation can be reaaranged so that it incorporates all other countries:

$$\mathrm{Si} = \sum_{c} Wi,c\mathrm{Yc}$$

Where:

$$\mathrm{Wi,c} = \frac{RCAi,c}{\sum_{C} RCAi,c}$$

This value of the sophistication index, Si, reviews the "average income of countries specialized in the production" of industry I (Van Assche and Gangnes 2010). There are two reasons why this value may increase. Foremost, the increase in more affluent countries is due to these countries specializing in this specific industry. Subsquently, those that specialize in such an industry may relatively become richer compared to others.

After calculated the sophistication index as above, one can calculate the country's technology index (CTI) as a weighted average of sophistication levels of the industry it is involved in:

$$\mathrm{CTI} = \theta i, c * \mathrm{Si}$$

Where the weight $\theta i, c$ euqals the share of industry i in a country c's total output. Demonstrated below as:

$$\theta i, c = \left(\frac{xi,c}{Xc}\right)$$

V. Results:

This section presents the results in stages. First, the RCA including services for Canada is presented to demonstrate the difference in international competitiveness across industries. Second, the RCA is presented over time to show the potential trends in the Canadian economy. Third, the product sophistication index is introduced for each industry. It is ranked to show how the economies have changed over time and which industries have become more sophisticated over time Fourth, the technology index is presented over time for Canada compared to other countries. These countries include those in NAFTA (United States and Mexico), Australia (a good comparison to Canada), and China (a quickly growing economy).

A second exercise is presented where the same calculations are done as above, except without the mining industry. Since Canada's economy is dependent on mining exports, seeing how its economy fares without this industry would be interesting. Thus, a technology index ranking for Canada over time is presented without this industry. The same is done to the other countries mentioned above. To do such a calculation, a value of 0 was placed for the mentioned industries in the calculations of the technology index for all countries to maintain consistency with the methodology.

V.1 RCA Value Added With Services and Change Over Time

Figure 1 presents the industries with services included (value added + services) for Canada for the years 1995, 2000, 2005, 2008, and 2009 to demonstrate its differences to the previous values and demonstrate its gradual change. The value is calculated manually rather than taken directly from the TiVA database. Due to this manual calculation, it differs slightly from the table presented above in the methodology. This is due to using both services and the value added

in the variables. The biases of gross exports is reduced because the value added of each activity of the value chain is now captured unlike before. Furthermore, services which are not tangible exports, are more accurately represented in the data analyzed.

If the year 2009 is taken, Canada is more specialized in agriculture, mining, wood, basic metals, transport, electricity/gas/water, and other services. Their respective values are 1.86, 3.42, 1.98, 1.03, 1.22, 2.65, and 2.0. If the trend is observed, there has been an important increasing change in agriculture and mining. This can be seen where mining grew from a value of 2.39 in 1995 to a value of 3.42 in 2009 and agriculture has increased from 1.14 in 1995 to 1.86 in 2009. However, there has been a consistent decrease in wood, even though Canada has maintained a high level of specialization. It is interesting to note that the level of specialization for Canada is much higher (ex: mining) when services are included, while wood is less demonstrating how services have increased in importance for Canada's specialization especially in the mining industry.

Since mining is important to Canada's economy. It is interesting to note how it has increased consistently over time. It started in 1995 with a RCA of 2.39 and ended with a value of 3.31 in 2008 and 3.42 in 2009. This shows that Canada's mining industry has not just expanded during that period, but that a lot of concentration has been placed to make the industry more competitive. This may be Canada concentrating its overall competitiveness by focusing on this industry rather than the rest. Oil prices have also had an important appreciation during this time period, which may explain why Canada has focused on developing this industry. Oil with a price of over $80 per barrel seemed the new norm of the time, thus partially explaining some of the motivation.

Figure 1

Revealed Comparative Advantage with services					
	1995	2000	2005	2008	2009
RCA Agriculture	1.14	0.99	0.93	1.67	1.86
RCA Mining	2.39	2.68	2.93	3.31	3.42
RCA food	0.65	0.90	0.92	0.75	0.84
RCA textiles	0.32	0.40	0.30	0.20	0.21
RCA wood	3.44	3.15	3.00	1.92	1.98
RCA chemicals	0.71	0.79	0.80	0.84	0.82
RCA basic metals	1.24	1.25	1.14	1.01	1.03
RCA Machinery	0.37	0.58	0.49	0.41	0.45
RCA Electrical	0.46	0.41	0.30	0.35	0.36
RCA Transport	1.95	1.55	1.31	1.14	1.22
RCA manufacturing	1.06	1.15	0.98	0.89	0.88
RCA electricity/gas/water	1.32	3.29	1.70	1.65	2.65
RCA construction	0.03	0.04	0.07	0.27	0.15
RCA wholesale + retail trade (hotel/restaurant)	0.36	0.45	0.52	0.41	0.43
RCA transport + storage (post + telecom)	0.58	0.82	0.95	0.55	0.65
RCA Financial Intermediation	0.49	0.48	0.37	0.35	0.39
RCA business services	0.97	0.69	0.43	0.74	0.80
RCA other Services	2.01	1.33	1.22	1.93	2.00

Author's Calculations

V.2 Product Sophistication Index Industry Ranking

Figure 2 presents the sophistication level of all industries throughout 1995 to 2009. Many of the industries do not change in ranking and their rank is consistent with the nature of their work. For example, the financial intermediaries are at the top and maintained their levels by almost doubling by 2009. It is not surprising that it is a service sector and dominates the others. It is followed by in 2009 with other service oriented industries such as business services and other services.

Other industries have changed in ranking such as the transport industry. Once the 4th most sophisticated industry, it has now dropped to 10th. Electrical itself has also dropped from 3rd to 13th. Transport _ storage (post + telecom) has increased its ranking from 12th, to 6th, a significant jump. Mining had a small rise as well where it went from 15th to 12th in specialization. It is interesting to note that the industries of construction, agriculture, and textiles has remained at the bottom.

Figure 2

Sophistication Index With Services and Ranking										
	1995	Ranking	2000	Ranking	2005	Ranking	2008	Ranking	2009	Ranking
Financial Intermediation	26,411.68	1	26,663.24	1	44,536.68	1	56,178.46	1	50,312.27	1
Business Services	16,539.06	5	19,287.89	2	30,142.79	2	37,264.44	2	33,009.43	2
Other Services	16,139.44	6	13,590.55	10	24,126.34	5	33,602.43	4	31,492.44	3
Machinery	20,754.48	2	18,236.18	3	25,483.78	3	34,003.37	3	30,879.64	4
Electricity/Gas/Water	16,053.24	8	13,085.65	12	24,920.03	4	33,562.60	5	30,184.98	5
Transport + Storage (Post + Telecom)	14,291.26	12	15,137.82	7	23,492.13	6	31,600.13	6	28,175.44	6
Chemicals	16,113.68	7	15,428.67	6	23,184.11	7	30,175.29	7	27,880.74	7
Wholesale + Retail Trade (Hotel/Restaurant)	14,314.90	11	13,925.08	8	22,104.53	9	28,991.32	9	26,055.95	8
Basic Metals	14,876.19	10	13,585.69	11	20,478.76	12	27,521.68	11	24,825.81	9
Transport	18,494.93	4	16,141.51	5	22,202.54	8	27,520.87	12	24,660.80	10
Wood	15,091.52	9	13,739.17	9	21,645.55	10	29,103.65	8	24,539.99	11
Mining	9,931.08	15	11,968.83	13	19,219.70	13	28,976.42	10	22,988.61	12
Electrical	18,589.54	3	16,549.66	4	21,532.27	11	25,779.25	13	22,587.04	13
Food	12,651.77	14	11,531.33	15	19,138.84	14	24,717.61	14	22,147.70	14
Manufacturing	12,669.84	13	11,803.50	14	15,642.28	16	22,844.39	16	20,447.91	15
Construction	9,275.58	16	9,075.41	16	17,521.26	15	23,363.09	15	19,640.98	16
Agriculture	7,454.93	18	7,514.61	17	12,128.27	17	16,591.41	17	14,911.79	17
Textiles	7,832.64	17	7,156.34	18	11,157.79	18	15,914.84	18	14,103.20	18

Author's Calculation

One can see that certain developing nations such as China, that these industries (textiles) plays an important role in its exports.

V.3 Technology Index

Figure 3 presents the technology index of Canada and its appropriate ranking for all the aforementioned years. It represents the weighted average of sophistication levels of the industry it is involved in. When all industries are included, Canada's stays stagnant at 16th with slight changes over the years. These changes involve going from 16th in 1995 to 17th in 2000 followed by a slight improvement to 16th in 2005. It then improves further to 15th in 2008 and drops again to 16th in 2009 Meaning, Canada maintains its ranking over time when all the industries are incorporated. On the surface, this may imply that Canada's decisions and its activities have led to maintaining its current sophistication levels. The next section with mining removed will be most interesting to see the importance of this industry.

Figure 3

Technology Index for Canada				
	All industries	Ranking	Excluding Mining	Ranking
1995	677.41	16	603.57	20
2000	665.71	17	528.15	20
2005	1025.76	16	618.71	22
2008	1447.65	15	572.53	28
2009	1153.56	16	567.33	26

V.4 Revealed Comparative Advantage Without Mining

Since it was demonstrated in the previous section the importance section of mining. The calculations are being redone. Similar results have been received as the previous RCA and is place for completion purposes. The main differences lie with the technology Index.

Figure 4

Revealed Comparative Advantage Without Mining					
	1995	2000	2005	2008	2009
RCA Agriculture	1.14	0.99	0.93	1.67	1.86
RCA food	0.65	0.90	0.92	0.75	0.84
RCA textiles	0.32	0.40	0.30	0.20	0.21
RCA wood	3.44	3.15	3.00	1.92	1.98
RCA chemicals	0.71	0.79	0.80	0.84	0.82
RCA basic metals	1.24	1.25	1.14	1.01	1.03
RCA Machinery	0.37	0.58	0.49	0.41	0.45
RCA Electrical	0.46	0.41	0.30	0.35	0.36
RCA Transport	1.95	1.55	1.31	1.14	1.22
RCA manufacturing	1.06	1.15	0.98	0.89	0.88
RCA electricity/gas/water	1.32	3.29	1.70	1.65	2.65
RCA construction	0.03	0.04	0.07	0.27	0.15
RCA wholesale + retail trade (hotel/restaurant)	0.36	0.45	0.52	0.41	0.43
RCA transport + storage (post + telecom)	0.58	0.82	0.95	0.55	0.65
RCA Financial Intermediation	0.49	0.48	0.37	0.35	0.39
RCA business services	0.97	0.69	0.43	0.74	0.80
RCA other Services	2.01	1.33	1.22	1.93	2.00

(Author's Calculations)

V. 5 Product Sophistication Index Without Mining

Similar results have been maintained in the sophistication index. Services such as financial intermediaries have maintained the same evolution and are viewed as the most sophisticated, while construction, agriculture, and textiles are the least sophisticated.

Figure 5

Sophistication Index Without Mining										
	1995	Ranking	2000	Ranking	2005	Ranking	2008	Ranking	2009	Ranking
Financial Intermediation	26412	1	26663	1	44537	1	56178	1	50312	1
business services	16539	5	19288	2	30143	2	37264	2	33009	2
other Services	16139	6	13591	10	24126	5	33602	4	31492	3
Machinery	20754	2	18236	3	25484	3	34003	3	30880	4
electricity/gas/water	16053	8	13085	12	24920	4	33563	5	30185	5
Transport + storage (post + telecom)	14291	12	15138	7	23492	6	31600	6	28175	6
chemicals	16114	7	15429	6	23184	7	30175	7	27881	7
wholesale + retail trade (hotel/restaurant)	14315	11	13925	8	22105	9	28991	9	26056	8
basic metals	14876	10	13586	11	20479	12	27522	10	24826	9
Transport	18495	4	16142	5	22203	8	27521	11	24661	10
wood	15092	9	13739	9	21646	10	29104	8	24540	11
Electrical	18590	3	16550	4	21532	11	25779	12	22587	12
food	12652	14	11531	14	19139	13	24718	13	22148	13
manufacturing	12670	13	11803	13	15642	15	22844	15	20448	14
construction	9276	15	9075	15	17521	14	23363	14	19641	15
Agriculture	7455	17	7515	16	12128	16	16591	16	14912	16
textiles	7833	16	7156	17	11158	17	15915	17	14103	17

Author's Calculation

Since mining has been removed, the industries below it naturally move up. Those are electrical, food, manufacturing, construction, agriculture, and textiles which move up by one rank.

V. 6 Technology Index Without Mining

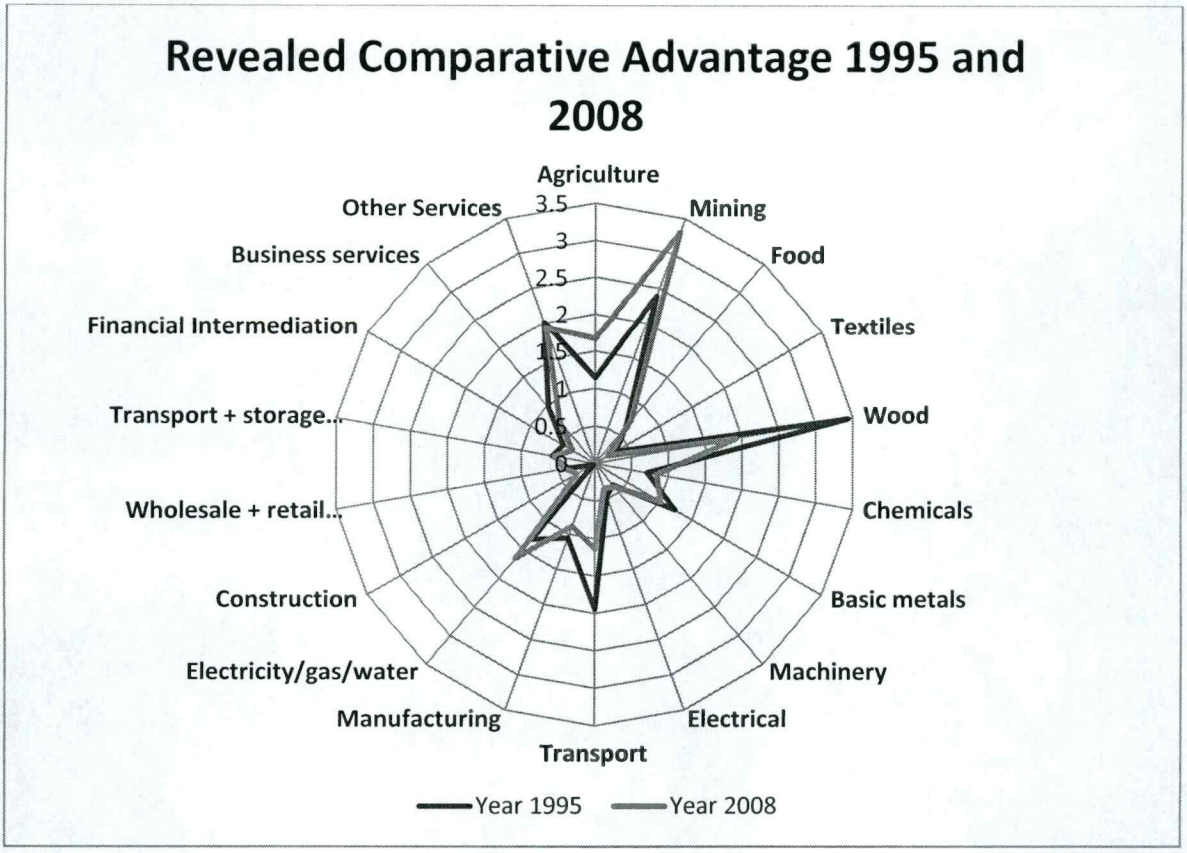
Once the mining industry is removed. Canada's ranking changes from what initially is found. Canada's ranking drops to 20th in 1995 and further drops to 26th in 2009. Overall, it drops to 22th in 2005, to 28th in 2008, and then 26th in 2009. This signifies how Canada's has fallen behind technologically and maintaining its ranking through the mining industry.

Technology Index for Canada				
	All industries	Ranking	Excluding Mining	Ranking
1995	677.41	16	603.57	20
2000	665.71	17	528.15	20
2005	1025.76	16	618.71	22
2008	1447.65	15	572.53	28
2009	1153.56	16	567.33	26

Author's Calculation

One can note that this is very low for a developed nation. Canada's ranking and competitiveness has dropped when a value approach (including services) is incorporated and when the mining industry is removed. This may demonstrate Canada's concentration in increasing this industry. Why has Canada's ranking dropped so much? To answer this question, a radar chart depicting the changes of the RCA from 1995 to 2008 is necessary. This is displayed in figure 6 below:

Figure 6



Based on Authors Calculations

As can be seen, Canada in 1995 has been predominantly competitive in mining, wood, and transport. A small shift can be seen in 2008. Canada has reduced its competitiveness in transport and wood, while increasing the mining industry. Basic metals has dropped slightly as well. Through those years, Canada has replaced its sophistication in transport and wood for mining. Transport + post is ranked higher in sophistication with a rank of 6, while the wood industry has a sophistication ranking of 11. Mining is sophisticatedly ranked 12th. Thus, Canada has replaced its competitiveness in higher sophisticated industries with one that is lower overall. It is worth

mentioning that Canada has slightly improved in other industries as can be seen in the RCA, but this change is petite and maintained its competitiveness in other services with slight changes.

The countries chosen to compare to are those in NAFTA (United States and Mexico), Australia (a similar economy to Canada), and China (to include one of the biggest exporters in the world). Figure 6 presents their technological indices and when mining is removed. It is not surprising to see China and Mexico to rank so low. This is due to their economy not being as sophisticated and their competitiveness relying on low sophisticated industries shown earlier. Australia, which is considered a good comparison to Canada, drops significantly in the technology index once natural resources are removed. It drops from 7 to 28 in 2009 demonstrating its dependency on the mining industry. Unlike Australia, Canada does not drop so much showing its diversity of resources, but still lacking in service oriented industries. Similarly to Canada, Australia has boosted its competitiveness with the mining industry, but with greater results.

Figure 7

Technology Index for United States				
	All industries	Ranking	Excluding Mining	Ranking
1995	261.87	31	677.89	13
2000	955.25	9	955.13	7
2005	1068.03	14	1067.55	11
2008	1100.96	21	1098.68	16
2009	1089.87	21	1088.30	17

Technology Index for Mexico				
	All industries	Ranking	Excluding Mining	Ranking
1995	104.61	39	96.21	38
2000	204.32	33	183.10	31
2005	236.68	39	185.65	39
2008	293.16	42	213.61	40
2009	233.86	43	189.57	42

Technology Index for Australia				
	All industries	Ranking	Excluding Mining	Ranking
1995	672.69	17	392.27	24
2000	738.21	14	431.60	23
2005	1264.51	10	524.56	26
2008	2823.78	4	439.14	32
2009	1906.39	7	527.28	28

Technology Index for China				
	All industries	Ranking	Excluding Mining	Ranking
1995	21.39	52	21.32	52
2000	33.27	50	33.15	49
2005	65.84	49	65.82	48
2008	142.69	48	142.64	45
2009	166.29	48	166.26	43

Authors Calculations

VI. Conclusion

This paper has measured Canada's competitiveness and involvement in the global value chain through the use of the TiVA Database. This dataset allows a more accurate analyses by including the value added contributions and the role of services. Such an analysis resulted in a very different perspective when compared to the traditional measures of Canada's exports. With the traditional measures of exports, Canada has done very well by maintaining its export levels and export shares. However, when value added and services is included, it illustrates a different situation. Firstly, it shows Canada's ranking to drop lower than previously thought. Second, it shows that Canada has focused on low value added industries to drive its exports at the cost of high value added industries. Thirdly, it is even more concentrated in these low value added industries than shown in traditional export measures such as the mining industry. Once the mining industry is removed, Canada drops significantly in international competitiveness rankings. This shows a reliance on this industry to maintain its ranking and drive growth.

Canada as a nation needs to revisit its policies concerning which local industry to foster. Canada is endowed with a vast amount of natural resources allowing its populations to have a high standard of living. Rather than depending on these resources to be the sole driver of growth, it should be used as a complement to other industries. If this industry is continued to be depended on as the sole or main driver of growth, it may have dire long term consequences. It may lead to sudden economic shocks as commodity price change resulting in economic slowdown, loss of jobs, and less international competitiveness. Thus, action is necessary to develop all key industries together rather than just one.

VI. 2 Limitations and Further Research

Even with these findings, there are several limitations that arise with this research. First the TiVA database does not include all the years. Therefore, pinpointing the year of where these shifts begin is very difficult and a macro interpretation is necessary. It would be ideal to have all these years for a more granular analysis and interpretation. Second, the TiVA data is fairly macro itself, meaning that it shows the end results of competitiveness for the RCA values, which are the core of the methodology. This means that to acquire government involvement such as subsidies is not described in this data. One would have to go beyond the dataset and add this interpretation. Finally, there may be a currency effect. The TiVA database is measured in U.S. Dollars. As a result, currency fluctuations are not considered in the values underlying all the variable. The Canadian dollar appreciated significantly during the period of the data used, which may skew the data. These aforementioned factors may affect the results of the analysis done.

Future research may expand and improve this analysis. First, developing the TiVA database to include all years would be a great benefit. It would allow for a granular analysis beyond the one done in this paper. If the TiVA database is not able to be expanded, then a new database with more variables can allow for a richer analysis. These new variables may control for certain factors that can affect the underlying values provided. There are some statistical assumptions done in these databases as mentioned in the data section. These assumptions may limit the results, thus a new method to address them would be superb. Second, this paper has focused on the mining industry. There are other key industries in Canada that are significant and a further analysis of them would provide more details for future policy making. In addition, the price of oil and commodities have fluctuated and may impact this industry. For example, from 2014 to 2015, the price of oil has fluctuated from over $100 per barrel to 50$ per barrel. Such a

shift would impact significantly the income generated by this industry. Third, a detailed analysis on GVC position with labor productivity or industry specialization on Canada may be interesting. A detailed study would allow to illustrate the best and most productive industry for Canada to focus on based on its GVC position. Such a study would provide rich information for Canadian policy makers and better allocate resources for industry development.

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