An Overview on the Construction of North American Regional Supply-Use and Input-Output Tables and their Applications in Policy Analysis

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ABSTRACT

In section I, we introduce the trilateral and multiyear cooperative venture between Canada, Mexico, and the United States on constructing this North American Trade-in-Value Added (NA-TiVA) database, and the complementarities between this NA-TiVA project and similar APEC TiVA and OECD TiVA work. In section II, we introduce the conceptual methodology, data requirements, as well as technical issues for constructing regional supply-use and intercountry input-output tables. In section III, we discuss the ongoing trade statistics reconciliation work under the NA TiVA project. In section IV, we further describe in detail the features and architecture of a regional North American supply-use table (NASUT) and a regional North American inter-country input-output table (NAIOT). In section V, we highlight the immediate and future policy applications of the project's output, a (NA-TiVA) database, and the kinds of research questions that will be answerable because of this new database. This white paper is the first in a series on the subject.

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Section I

Introduction

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Introduction

Trade-in-Value Added (TiVA) is a statistical approach used to measure the interconnectivity and marginal contribution in production of participating economies in global value chains (GVCs) (Degain and Maurer, 2015). The advantage of TiVA over traditional trade statistics is that TiVA measures trade flows consistent with internationally, vertically integrated global production networks, often called GVCs. TiVA statistics allow us to better analyze three aspects of international trade: measuring the contribution of domestic versus foreign intermediates in the exports, tracing production across countries to their final destination, and finally quantifying how individual industries contribute to producing exports (Lewis, 2013).

TiVA statistics allow us to map and quantify the interdependencies between industries and economies, and help us develop better estimates of the contribution from each country in the production processes and, consequently, better measure the impact from GVC engagement for domestic economies. However, it is necessary to highlight the underlying compilation methodology of TiVA in order to better understand the characteristics, scope and interpretation of TiVA. Hence, it is important to remember that TiVA statistics are estimated statistics that are derived, in part, from official statistics. TiVA statistics are meant to complement but not to replace official statistics.

Measuring trade flows in value added as opposed to gross value of trade flows has become increasingly important as the influence that GVCs has on international trade continues to rise. (Johnson, 2014; Ahmad and Ribarsky, 2014). The proliferation of GVCs means that production has become increasingly fragmented and vertically integrated across countries (Jones and Kierzkowski, 1988; Hummels, Ishii, and Yi, 2001; OECD, 2013). At the micro level, this means that many firms in disparate countries are interconnected. Across international borders, these firms take part in particular stages of the production process, together forming a global supply chain. As a result, intermediate inputs may cross international borders several times before being used to produce final consumable goods. This matters for several reasons. First, when goods cross multiple borders multiple times, they are exposed to more trade costs, which accumulate and compound before the goods are sold for final consumption. Additionally, traditional gross trade flows are overstated because gross trade flows may count intermediates multiple times. Relatedly, gross trade flows obscure the marginal contributions of countries along GVCs. TiVA measures the flows related to the value that is added at each stage of production by each country and maps from where value is created, where it is exported, and how it is used, as final consumption or as an input for future exports. How we understand gains from trade from trade flows is fundamental, and value-added approaches lead to better understanding of GVCs and their role in international trade.

There are two ways to capture TiVA. The first method is a direct approach, which decomposes existing data on trade statistics. Johnson (2012) introduce a TiVA indicator using value-added to output ratios from the source country to compute the value-added associated with the implicit output transfer to each destination. Koopman, Wang, and Wei (2014) build on the literature in vertical specialization (e.g. Hummels, Ishii, and Yi 2001) and the literature on TiVA (e.g. Johnson and Noguera, 2012; Daudin, Rifflart, and Schweisguth, 2011) to implement a complete

decomposition of a country's gross exports by value added components. This work has evolved into a second, indirect method of capturing TiVA. The indirect method is employed in the regional North American supply-use table (NASUT) and the regional North American inter-country input-output table (NAIOT). Estimating TiVA this way relies on national and international input-output tables as well as bilateral trade statistics to derive the international intermediate and final supply-demand matrices. These matrices reveal the origin and use of goods and services produced and exchanged among the countries and industries within the table domain. Other major international input-output tables include the Asian International Input-Output (AIO) Tables published by the Institute of Developing Economies Japan External Trade Organization (IDE-JETRO), the Inter-Country Input-Output (ICIO) Tables published by the OECD, the World Input-Output Tables (WIOT) published by the World Input-Output Database (WIOD) project, and the Eora Multi-region Input-Output Database (Eora MRIO).

The studies based on the above two approaches have revealed a trend of rising foreign value-added content in international trade flows and the resulting implications for trade policies. Johnson and Noguera (2016) find that value-added exports are falling relative to gross exports, which means that double-counting is increasingly more common in trade flows. This is consistent with increased GVC activity. Hummels, Ishii, and Yi (2001) show that vertical specialization has grown about 30 percent and accounts for about one-third of the growth in trade from about 1970 to 1990.

In recent years, more than half of global manufacturing imports are intermediate goods and more than 70 percent of global services imports are intermediate services (OECD, 2013). This is relevant because tariffs (and other trade costs) have a higher impact on the cost of GVC activity. Each time an intermediate input crosses an international border as part of the production process, the input incurs trade costs. As first observed by Yi (2003), trade costs are compounded when intermediate goods cross borders multiple times to complete the production process. Rouzet and Miroudot (2013) demonstrate that small tariffs can add up to a significant sum by the time a finished product reaches its consumers. Other trade costs such as non-tariff measures also have such accumulative effect on downstream products.

What the literature indicates the trends in GVCs mean for trade flows, generally, are two-fold. First, with the growth of GVC activity, gross value of trade flows will continue to be larger than the value of final goods that cross borders. Second, trade policy designed with respect to gross trade flows could have the potential to be overly restrictive or even impose costs indirectly on domestic production. Trade-in-Value Added thus provides a supplementary, relevant reference for evaluating the economic effect of trade policies.

In this paper, we introduce the North American Trade-in-Value Added (NA-TiVA) project, a trilateral, multiyear initiative that aims to produce a regional TiVA database that maps the value chains connecting Canada, the United States, and Mexico. Furthermore, we introduce and discuss the project's deliverables, the agencies involved, how the NA-TiVA project complements other ongoing TiVA initiatives around the world, the technical framework for producing a regional inter-country input-output table for the NA region, and the value of this work to resolving open policy questions within international trade.

Ongoing TiVA Initiatives

Currently there are three major ongoing global and regional TiVA projects that are related to the North America TiVA project. They are the World Input-Output database (WIOD), OECD-WTO TiVA, and APEC TiVA initiatives.

The World Input-Output database (WIOD): The official WIOD project ran from May 1, 2009 to May 1, 2012, as a joint effort of eleven European research institutions. It was funded by the European Commission. Under the official WIOD project, the accounting framework and methodologies of constructing the TiVA databases, as well as the first version of the World Input-Output database were developed. The database was officially launched in April 2012. Since then, two additional versions of WIOD databases, namely the 2013 and 2016 Releases, were published. The 2016 Released database covers 28 EU countries and 15 other major economies in the world for years 2000-2014 with 56 industries.

The OECD-WTO TiVA database: The Organization for Economic Cooperate and Development (OECD) and World Trade Organization (WTO) undertook a joint initiative on TiVA in 2013. Since then, two versions of TiVA databases have been released (2013 and 2015 release). The 2015 release of OECD-WTO TiVA database covers 61 countries and 13 regions, with 34 industries, for years 1995, 2000, 2005, 2008-2011.

APEC TiVA initiative: In 2014, APEC economic leaders endorsed the APEC TiVA database initiative, a four-year project co-led by China and the United States. Under this project, an APEC TiVA database would be constructed by the end of 2018, covering 21 APEC economies.

Each of these three major global and regional TiVA initiatives include Canada, Mexico, and the United States. In the light of this, why is there still a need for constructing the NA TiVA database? What kind of additional value can the NA TiVA project bring to this global and regional network of TiVA initiatives?

The NA-TiVA project was motivated by regional statistical developments and continuous improvements in compiling TiVA databases. The 2003 Mexican input-output table distinguishes trade flows by domestic producers and production undertaken in Maquiladoras, a tax-free, tariff-free special processing zone, which allowed the estimates of separate production coefficients and thus TiVA measures for these two distinctive zones in Mexico (Koopman, Powers, Wang, and Wei, 2010; De la Cruz, Koopman, Wang, and Wei, 2011). The government of Canada further highlighted the importance and relevance of global value chains in the publication of a book assessing the impact and implication of GVCs (Foreign Affairs and International Trade Canada, 2011); and as of the 2015 edition of the OECD's ICIO tables, Mexico is broken out as Mexico Global Manufacturers and Mexico Non-Global Manufacturers. This NA TiVA project builds off of these developments.

Constructing inter-country input-output tables, or so called TiVA databases, requires the harmonization of national supply-use tables (SUTs) or input-output tables (IOTs) as well as bilateral trade statistics from different countries. However, the data produced by countries often vary greatly in the level of detail and differ in industry and product classifications. Thus, the more

countries are included in a global or regional TiVA project, the higher level of aggregation would be required for the purpose of harmonization. With only three countries involved, it is feasible for the NA TiVA database to include more products and sectors than other global and regional TiVA projects.

Moreover, other factors, such as all three countries adopt the same industry and product classifications (e.g. using the North American Industry Classification System (NAICS)), and produce SUTS at similarly detailed levels, would ensure the compatibility of data components, and thus lead to better quality of the resulting NA TiVA database.

Finally, the NA TiVA project could synthesize the ongoing trilateral trade statistics reconciliation effort and produce better-quality balanced bilateral trade data to feed into other global and regional TiVA initiatives. One of the key inputs for constructing TiVA databases is balanced bilateral trade statistics. However, countries rarely report symmetric bilateral trade statistics—one country's reported exports rarely equals its trading partner's reported imports, and vice versa. To reconcile such asymmetries to produce balanced bilateral trade statistics, joint effort by both trading countries is warranted, including investigating the causes of asymmetries at detailed product level and making corresponding adjustment mechanically. However, global and regional TiVA initiatives often have to consider an incredible number of country pairs, making such an elaborate reconciliation practice rather infeasible. Thus, global and regional TiVA initiatives often turn to economic modelling to balance bilateral trade statistics which could be applied in a systematic way to all countries. Although such approach can be mathematically sound, the resulting data often require additional scrutiny, validation, and adjustment, as they do not always reflect the reality accurately. Canada, Mexico, and the United States have ongoing bilateral trade reconciliation. This NA TiVA project provides additional motivation and framework for this effort.

The History, Scope, and Major Objectives of the NA TiVA Initiative

In October 2014, the representatives from the United States, Canada, and Mexico met and kicked off the idea of constructing the NA TiVA database at a UN conference in Mexico. The main objective of this project is to construct the NA TiVA database by 2021 covering three NA countries with more detailed industry and firm information, and to improve the quality of TiVA measures for the value chains in the NA region.

The NA-TiVA project involves eight government agencies across the three NA countries: for Canada, Statistics Canada (STATCAN) and Global Affairs Canada; for Mexico, Instituto Nacional de Estadística y Geografía (INEGI) and Banco de Mexico; and for the United States, the Bureau of Economic Analysis (BEA), the U.S. Census Bureau (CENSUS), the U.S. International Trade Commission (USITC), and the Office of the U.S. Trade Representative (USTR).

In addition, because the resulting NA-TiVA database would be eventually integrated into the OECD-WTO TiVA database to improve the quality of information on the North American region, participants of the NA-TiVA project regularly meet with OECD representatives to harmonize TiVA database compilation methodologies, exchange data to synthesize the effort and ensure consistency across countries, and discuss best practices. Other international organizations, such as United

Nations Statistics Division (UNSD), and WTO, are often consulted as well for national account and trade statistics related issues.

Under the NA-TiVA initiative, three parallel work streams have been established: The trade in goods and services reconciliation team, which is tasked to produce balanced bilateral trade statistics for goods and services; the SUT team, whose goal is to harmonize the national SUTs and compile the regional NASUTs and NAIOTs; and the White Paper team, the goal of which is to produce documentation that outlines the conceptual methodology, identifies major technical issues, describes policy applications of a NA-TiVA initiative, and details project outputs as well as future work.

Section II

Overarching Conceptual Methodology and Major Technical Issues[1]

Lin Jones

[1] The author would like to acknowledge significant input from Nadim Ahmad, Fabienne Fortanier (OECD), and Jianqin Yuan (China State Information Center) during the two-month onsite training and collaboration at the OECD Headquarters in Paris from January-March 2017, especially in the overarching methodology framework and three flow charts.

This section describes the overarching methodology framework, identifies major technical issues that need to be addressed, and proposes a three-stage flow charts and corresponding steps as the general guideline for constructing the NA TiVA databases.

The Overarching NA-IOT Methodology Framework

Underlying the NA TiVA databases are the NA input-output tables (NAIOTs). There are two types of NAIOTs that can be constructed, each with its own advantages as well as limitations.[2]

Table II-1. NAIOTs with endogenous Rest of World (RoW)

	Intermediate Use				Final Demand				Output
	Canada (c)	**Mexico (m)**	**USA (u)**	**RoW**	**Canada (c)**	**Mexico (m)**	**USA (u)**	**RoW (row)**	
Canada (c)	$ID^{c}_{i,j}$	$IM^{c,m}_{i,j}$	$IM^{c,u}_{i,j}$	$IM^{c,row}_{i,j}$	FD^{c}_{i}	$FM^{c,m}_{i}$	$FM^{c,u}_{i}$	$FM^{c,row}_{i}$	O^{c}_{i}
Mexico (m)	$IM^{m,c}_{i,j}$	$ID^{m}_{i,j}$	$IM^{m,u}_{i,j}$	$IM^{m,row}_{i,j}$	$FM^{m,c}_{i}$	FD^{m}_{i}	$FM^{m,u}_{i}$	$FM^{m,row}_{i}$	O^{m}_{i}
USA (u)	$IM^{u,c}_{i,j}$	$IM^{u,m}_{i,j}$	$ID^{u}_{i,j}$	$IM^{u,row}_{i,j}$	$FM^{u,c}_{i}$	$FM^{u,m}_{i}$	FD^{u}_{i}	$FM^{u,row}_{i}$	O^{u}_{i}
RoW (row)	$IM^{row,c}_{i,j}$	$IM^{row,m}_{i,j}$	$IM^{row,u}_{i,j}$	$ID^{row}_{i,j}$	$FM^{row,c}_{i}$	$FM^{row,m}_{i}$	$FM^{row,u}_{i}$	FD^{row}_{i}	O^{row}_{i}
Value-added	V^{c}_{j}	V^{m}_{j}	V^{u}_{j}	V^{row}_{j}					
Output	O^{c}_{j}	O^{m}_{j}	O^{u}_{j}	O^{row}_{j}					

Source: author's modification from Nadim Ahmad's "Creating Global Input-output tables," 2017

With this approach, RoW would be treated as a single economy, and its supply use tables (SUTs) and other "national" data would be estimated. The resulting NASUTs and NAIOTs include the input-output relationships between RoW and other countries at sector/product level.

Using this type of NAIOTs, trade between RoW and the NA countries is differentiated for intermediate and final uses. As a result, domestic value that initially is embodied in intermediate goods/services exports to RoW but eventually returns home can be captured.

[2] Modified from Nadim Ahmad's "Creating Global Input-output tables," 2017.

Table II-2. NAIOTs with exogenous RoW

	Intermediate Use			Final Demand			Exports[3]	Output
	Canada (c)	**Mexico (m)**	**USA (u)**	**Canada (c)**	**Mexico (m)**	**USA (u)**	**ROW (row)**	
Canada (c)	$ID^{c}_{i,j}$	$IM^{c,m}_{i,j}$	$IM^{c,u}_{i,j}$	FD^{c}_{i}	$FM^{c,m}_{i}$	$FM^{c,u}_{i}$	$FM^{c,row}_{i}$	O^{c}_{i}
Mexico (m)	$IM^{m,c}_{i,j}$	$ID^{m}_{i,j}$	$IM^{m,u}_{i,,j}$	$FM^{m,c}_{i}$	FD^{m}_{i}	$FM^{m,u}_{i}$	$FM^{m,row}_{i}$	O^{m}_{i}
USA (u)	$IM^{u,c}_{i,j}$	$IM^{u,m}_{i,j}$	$ID^{u}_{i,j}$	$FM^{u,c}_{i}$	$FM^{u,m}_{i}$	FD^{u}_{i}	$FM^{u,row}_{i}$	O^{u}_{i}
Imports from ROW	$IM^{row,c}_{i,j}$	$IM^{row,m}_{i,j}$	$IM^{row,u}_{i,j}$	$FM^{row,c}_{i}$	$FM^{row,m}_{i}$	$FM^{row,u}_{i}$		
Value-added	V^{c}_{j}	V^{m}_{j}	V^{u}_{j}					
Output	O^{c}_{j}	O^{m}_{j}	O^{u}_{j}					

Source: author's modification from Nadim Ahmad's "Creating Global Input-output tables," 2017

The second approach treats RoW as exogenous, and assumes exports to RoW are for final use only. It does not differentiate exports to RoW between intermediate and final uses, and it does not require the estimation of input-output relationships between countries and RoW. However, as a result, domestic value embodied in intermediate exports to RoW and eventually returned home could not be separately estimated and captured.

The second approach may be preferable when a) data for estimating input-output relationship between countries at a detailed sector/product level are available and b) examining inter-country production at such detailed level is desirable, however, c) estimating input-output relationship for RoW at such detailed level proves to be infeasible, or the accuracy of the estimation could suffer and thus is undesirable.

One of the major advantages from the NA TiVA initiative is that all three NA countries use similar classification systems with high quality statistics, which allow the construction of the NA TiVA database at more detailed product and industry levels than any other ongoing global and regional TiVA initiatives. To preserve this advantage without losing the quality, constructing NAIOTs with exogenous RoW might be the suitable choice. For more detailed discussion on the NA IOT, please see Section IV.

The Basic Underlying Data

Conceptually, constructing NAIOTs is not complicated. The basic underlying idea is to link three NA countries' *national supply-use tables* with *bilateral trade statistics* through *import use matrices* to derive the data required to build inter-industry-country input-output relations.

To construct NASUTs and NAIOTs, the following data need to be derived from the above three datasets:[4]

- *A domestic transactions matrix*, ID^{k}_{ij}, showing the value of domestically produced intermediate consumption in basic prices[5] for country *k* used by domestic industry *j* of output produced by domestic industry *i*.

[3] Assuming exports to ROW are all for final demand.
[4] Modified from Nadim Ahmad's "Creating Global Input-output tables," 2017.

- *An import transaction matrix*, $IM^{k}_{i,j}$, showing the value of imported intermediate consumption at CIF price for country *k*, used by domestic industry *j* of output produced by foreign industry *i* located abroad.
- *A column of domestic final demand,* FD^{k}_{i}, showing the value at basic prices of domestic final consumption (by households, non-profit institutions serving households, and government) for country *k*, as well as fixed capital (including investment and changes in inventories) of output produced by domestic industry *i.*
- *A column of imported final demand*[6]*,* FM^{k}_{i}, showing the value at CIF price of imported final consumption (including by households, non-profit institutions serving households, and government) for country *k*, as well as fixed capital (including investment and changes in inventories) of output produced by foreign industry *i* located abroad.

  Note: for both FD^{k}_{i} and FM^{k}_{i}, separate columns for each final demand category are in principle available.
- *Bilateral trade matrices*[7]*, in 'free on board' (f.o.b) prices,* $X^{s,r}_{i} = M^{s,r}_{i}$, showing the value of exports in FOB price sent by industry *i* in sourcing country *s* to receiving country *r.* Or, in other words, because bilateral trade data is coherent[8], it equals to the value of imports by receiving country *r* from industry *i* in sourcing country *s.*
- *A vector of gross output by industry,* O^{k}_{j}, at basic prices, and *value-added*[9], V^{k}_{j}, by industry for country *k*, where $O^{k}_{j} = \sum_{j} ID^{k}_{i,j} + FD^{k}_{j} + E^{k}_{j}$ and $V^{k}_{j} = O^{k}_{j} - \sum_{i} (ID^{k}_{i,j} + IM^{k}_{i,j})$.

  With the data listed above, to produce a NAIOT, the additional work needed to be done is to disaggregate $IM^{k}_{i,j}$ and FM^{k}_{i} into $IM^{s,r}_{i,j}$ and $FM^{s,r}_{i}$, by industry *i* in sourcing countries *s*, as follows

$$IM^{s,r}_{i,j} = M^{s,r}_{i} / (\sum_{world=c,m,u,\,row} M^{s,world}_{i}) * IM^{r}_{i,j} \quad (I)$$

$$FM^{s,r}_{i} = M^{s,r}_{i} / (\sum_{world=c,m,u,\,row} M^{s,world}_{i}) * FM^{r}_{i} \quad (II)$$

  $IM^{s,r}_{i,j}$: imported intermediate by industry *j* in receiving country *r* from industry *i* in sourcing country *s*;

  $M^{s,r}_{i}$: total imports by receiving country *r* from industry *i* in sourcing country *s*;

  $\sum_{world=c,m,u,row} M^{s,world}_{i}$: the world's total imports from industry *i* in sourcing country *s*;

  $IM^{r}_{i,j}$: total imported intermediate by industry *j* in receiving country *r* from foreign industry *i* located abroad;

  FM^{r}_{i}: total imported final demand in receiving country *r* from foreign industry *i* located abroad.

  If bilateral trade could be broken down into end-use categories of intermediates (I), capital goods (K), and goods for final consumption (C), they can be rewritten as

$$IM^{s,r}_{i,j} = IM^{s,r}_{i} / (\sum_{world=c,m,u,row} IM^{s,world}_{i}) * IM^{r}_{i,j} \quad (III)$$

$$FM^{s,r}_{i} = M^{s,r}_{i} - IM^{s,r}_{i} \quad (IV)$$

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[5] Basic prices

[6] Note: that for both FD^{K}_{i} and FM^{K}_{i}, separate columns for each final demand category are typically also available.

[7] Note: for simplicity, no re-exports are assumed in this exposition.

[8] Note: it means there are no asymmetries.

[9] Note: because intermediate consumption and gross output are measured at basic prices, the derived measure of value-added shown above, for ease of exposition, therefore includes taxes paid and subsidies received on any intermediate consumption.

$IM^{s,r}_i$: total intermediate imports by receiving country *r* from industry *i* in sourcing country *s*;

$\sum_{world=c,m,u,row} IM^{s,world}_i$: the world's total intermediate imports from industry *i* in sourcing country *s*.

Although the underlying conceptual methodology of constructing NAIOTs is simple, in practice, there are quite a few technical data issues that need to be addressed.

Major Technical Issues

- Major technical issues in harmonizing national input-output accounts
  Several data compatibility issues in the three countries' national I-O accounts require harmonization before they could be linked together.

  - *Incompatible classification systems*

    Canada, Mexico, and the United States jointly developed the North American Industry Classification System (NAICS) in 1997 to allow for a high level of comparability among the North American countries. Since then, NAICS has been the basis of these three countries' economic and business statistics, including national I-O accounts. As a result, the compatibility issue in industry classification has been minimized.

    Since 2003, the three countries also began to work on developing the North American Product Classification System (NAPCS) as the united classification system for products produced in the North America. However, the adoption of NAPCS in these three countries varies. Currently, the United States and Mexico still use a NAICS-based product classification system by mapping source data into the NAICS system. The implementations of NAPCS in both countries are a few years away. Canada, on the other hand, has implemented NAPCS based product classification system for its 2009–2013 SUTs, but used the Standard Industrial Classification (SIC) and NAICS based classification systems for SUTs from previous years.

  - *Various industry/product detail levels and available years*

    The United States publishes the 1997-2015 time series SUTs at 71 industry and 72 product levels. Estimates at more detailed level (389 industries and 387 products) are only available for the benchmark years, which are compiled every five years in years ending in 2 and 7, corresponding to the occurrence of the U.S. Economic Census. The last benchmark year data available is 2007; and the next benchmark year data (2012) is expected to be published in the fall of 2018.

    Canada produces annual benchmark SUTs based on annual surveys. Currently it has SUTS for 1961-2013. The most recent SUTs (2009-2013) have 230 industries and 490 products. The SUTs from earlier years (e.g. 1997-2008) have up to 300 industries and 700 products.

Mexico compiles SUTs every five years in years ending in 3 and 8. Currently, Mexico has SUTs for years 2003, 2008, and 2013. Its 2003 SUTs have 79 industries and products (3 digit at the NAICS 2002); its 2008 and 2013 SUTs have 262 industries and products (4 digit at the NAICS 2007). (Note: for the purpose of the APEC and NA TiVA projects, Mexico put additional resources and effort to produce the 2012 SUTs, which was completed in September of 2017.)

- *Different currency and unit value*

  The United States reports its national I-O account data in millions of U.S. dollars. Canada reports its national I-O account data in thousands of Canadian dollars. Mexico reports its national I-O account data in millions of Mexican Pesos.

  Before any harmonization between these national I-O account data takes place, to address the above data compatibility issues, it is necessary to define the standard NA TiVA industry and product classifications at the most detailed feasible levels, at standard currency, for all years.

- Major technical issues in balancing bilateral trade statistics

  Trade statistics are another crucial input for constructing NAIOTs. However, some inherent issues in trade data would require additional actions before they could be used. These issues include reconciling discrepancies in bilateral merchandise trade statistics; estimating missing bilateral services trade statistics; and aligning balanced external trade statistics to national account trade data.

  - *Reconciling discrepancies in bilateral merchandise trade statistics*

    Although the three countries maintain detailed merchandise trade statistics and they are compatible at the 6 digit Harmonized System (HS) level, one country's reported import or export values rarely equal its trading partner's reported export or import values at either the aggregate or detailed product level. A number of factors could contribute to such asymmetries in bilateral merchandise trade statistics, including valuation differences for exports and imports[10], re-exports, misclassifications, or under-reporting. Reconciling discrepancies and balancing bilateral merchandise trade statistics are required before merchandise trade statistics could be used in the NA TiVA database construction.[11]

[10] The United States reports exports on free alongside (FAS) value basis, and imports at custom value, plus information on freight and insurance. Canada reports both exports and imports on free on board, or FOB basis. Mexico reports exports at FOB basis while imports on cost, freight, and insurance, or CIF basis, with an adjustment at total so it's FOB.

[11] Section III provides more detailed information on reconciling the asymmetries in bilateral merchandise trade statistics in the three NA countries.

- *Estimating missing bilateral services trade statistics*

  Compiling detailed bilateral services trade statistics is challenging. Internationally, there are substantial differences across countries in the availability and level of detail in reported bilateral services trade data. Currently, the United States publishes services trade statistics with the world, as well as roughly 88 trading partners by country or region. Most of U.S. bilateral services trade statistics are reported by the Balance of Payment and International Investment Position Manual (BPM) major categories;[12] in some cases, more detailed data are available by the extended Balance of Payments (EBOP) classifications.[13] In the case of U.S. reported bilateral services trade with Canada and Mexico, about 9 major BPM6 categories[14] and 39 sub-categories are available.

  Canada publishes services trade statistics with the world, as well as roughly 80 trading partners by country or region. In the case of Canada reported bilateral services trade with the United States and Mexico, three major categories are available (travel, commercial services, transportation and government services).

  The Central Bank of Mexico reports Mexican services trade statistics with the world for 8 categories: maintenance and repair services, transport, travel, insurance and pension services, financial services, charges for the use of intellectual property, telecommunications, and other services.[15] In addition, using surveys, the Bank of Mexico reports bilateral travel services trade with Canada and the United States.

- Major technical issues in linking trade statistics with national input-output accounts

  - *Harmonizing product classifications*

    Products in merchandise trade statistics are classified by the Harmonized Commodity Description and Coding Systems, also known as the Harmonized System (HS). Products in services trade statistics are classified by either the BPM or EBOPS classifications. Products

[12] BPM is published by IMF, providing guidance to IMF member countries on the compilation of balance of payments and international investment position data. It was first published in 1948, and has gone through several revisions since. The latest revision, BPM6, was released in 2009, to reflect the changes introduced in the System of National Accounts 2008 (SNA2008). BPM6 proposes 12 major services categories. Source: IMF.
[13] EBOPS, the further breakdown of major BMP services categories, is introduced by the Manual on Statistics of International Trade in Services (MSITS). MSITS is published by the Interagency Task Force on Statistics of International Trade in Services (TFSITS) under the United Nations Statistical Commission, with representatives from various international organizations and leading economies in the world. The first edition of MSITS was released in 2002, and the latest revision was published in 2010.Thus, there are two versions of EBOPS: EBOPS 2002 and EBOPS 2010. Source: the United Nation Trade Statistics Branch.
[14] U.S. reported services trade statistics with Canada and Mexico don't include manufacturing services; construction; and person, cultural, and recreational services.
[15] http://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=1&idCuadro=CA410&accion=consultarCuadroAnalitico&locale=en. However, Banco de Mexico foes not display information for the following on its website: charges for the use of intellectual property, telecommunications, and maintenance and repair services.

in national I-O accounts are classified by either NAICS or NAPCS based product classification systems. Thus, harmonizing these three data sets in product classification is required before linking them through import use matrices.

- *Align merchandise trade statistics with national accounts*

  Merchandise trade statistics cover goods "which add to or subtract from the stock of materials resources of a country by entering (imports) or leaving (exports) its economic territory." Thus, merchandise trade statistics capture the physical movements of goods across borders. Most of these international movements of goods pass through the customs administration of the exporting and importing countries, and are subject to customs procedures. Therefore, the main source for merchandise trade statistics is customs records.[16]

  Merchandise trade statistics are usually the main data source for goods trade in national accounts, in addition to other data sources such as administrative data, and surveys of traders. However, since national accounts are balance of payment (BoP) based, which requires the change of economic ownership of goods between residents and nonresidents, additional adjustment to source data are commonly needed to account for coverage, timing, valuation, and classification that do not meet BoP guidelines.[17]

  In addition, merchandise trade statistics and national accounts data are usually compiled by different statistical agencies. Sometimes two data sets differ in their geographical coverage. For instance, the U.S. SUTs and national account data exclude the U.S. territories, such as Puerto Rico and the U.S. Virgin Island. Yet, U.S. merchandise trade statistics include these two U.S. territories. Thus, it is necessary to adjust all three countries' merchandise trade statistics to be aligned with the U.S. national accounts' geographical coverage first, before carrying out any bilateral merchandise trade statistics reconciliation exercises. For detailed discussions on merchandise trade statistics adjustment, please see section III.

- *Aligning different price valuations*

  In national accounts, data usually are reported in one of the following three price concepts: the basic price, the producer's price, and the purchaser's price. These price concepts reflect different valuations concerning whether specific underlying price components, such as taxes and subsidies, and trade and transport margins, are included.[18] Merchandise trade

[16] UNSD, International Merchandise Trade Statistics, Compilers Manual, Rev. 1, 2013.
[17] IMF, *Balance of Payments and International Investment Position Manual, sixth edition (BPM6)*, 2009.
[18] The basic price is "the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale; it excludes any transport charges invoiced separately by the producer."
The producer's price is "the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT, or similar deductible tax, invoiced to the purchaser; it excludes any transport charges invoiced separately by the producer."

statistics are usually reported in either free on board (fob) or cost, insurance and freight (cif) value. Import use matrices are usually reported in cif, which is the equivalent of the basic price for imported products.

Since TiVA calculation seeks to capture the ultimate input-output economic relationships across multiple countries, building NAIOTs at the basic price would be the apparent choice, which would allow us to evaluate the contributions of margin sectors, such as wholesale and transport, to global value chains, while minimize any distortions that could arise from tax and subsidy policies of each country imposes. However, the concept of the basic price at the international setting is different from the national setting. For instance, cif value is considered as the equivalent to the basic price for imported goods at the national setting, but at the international setting, since cif contains international transport and insurance, as well as the domestic margins and net taxes from the exporting countries, it can no longer be treated as the basic price. The similar consideration is extended to fob value as well, as it contains exporting countries' domestic margins and net taxes. Thus, to construct ICIO tables at the basic prices, international transactions require additional price adjustments. For detailed discussions on price adjustment, please see section IV.

General Workflow and Methodologies of Constructing TiVA Databases

To address the major technical issues listed above, this section outlines the general workflow and the underlying methodologies to construct the NAIOTs. It is based upon the eight-step approach developed by the OECD to create a coordinated global input-output table, while taking into account the alignment with the APEC TiVA database methodology. The proposed workflow and methodologies serve as the general guideline to construct the NASUTs and NAIOTs, as we should allow flexibility and freedom for revisions during the implementation. The OECD's overall conceptual framework is applied to constructing an ICIO with endogenous RoW. As discussed under "The Overarching NA-IOT Methodology Framework," there is an advantage of constructing NAIOTs with exogenous RoW, and thus is preferred by this NA TiVA project. Therefore, in our exercises, we only need to derive the input-output relations between the three NA economies without concerning such relations with RoW.

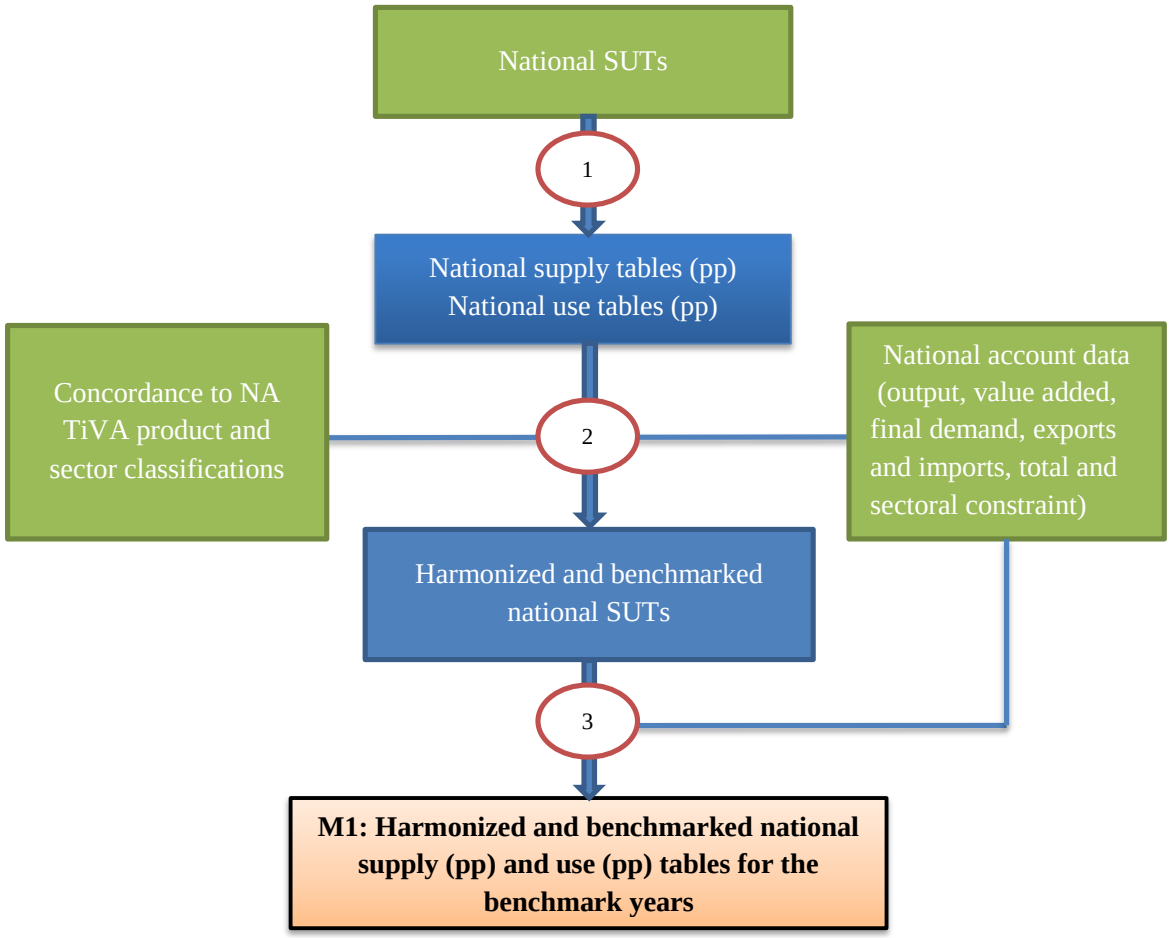
Stage one: harmonize and benchmark national SUTs (Figure II-1)

1. Estimate SUTs at purchaser's price (PP) if not available; and adjust the 2008 SNA based SUTs to the 1993 SNA based concept of processing trade and merchanting, if applicable;

The purchaser's price is "the amount paid by the purchaser, excluding any deductible VAT or similar deductible tax, in order to take delivery of a unit of a good or service at the time and place required by the purchaser; the purchaser's price of a good includes any transport charges paid separately by the purchaser to take delivery at the required time and place."
Source: OECD, "Glossary of Statistical Terms"

2. Harmonize SUTs (PP) to the NA TiVA industry and product Classifications and benchmark with the national account data of the corresponding years (exports, imports, output, value added, final demand, margins, taxes):
    i. Estimate national account constraints at the NA TiVA standard industry/product level[19];
    ii. Harmonize SUTs to the NA TiVA industry and product Classifications with national account constraints;
    iii. If feasible, evaluate the treatment of re-exports in SUT compilation. In principal, economies should include re-exports in imports and exports in SUTs;
3. For non-benchmark year SUTs, update them with the benchmark year national accounts data;

Figure II-1: Harmonize and benchmark national SUTs at purchaser's prices



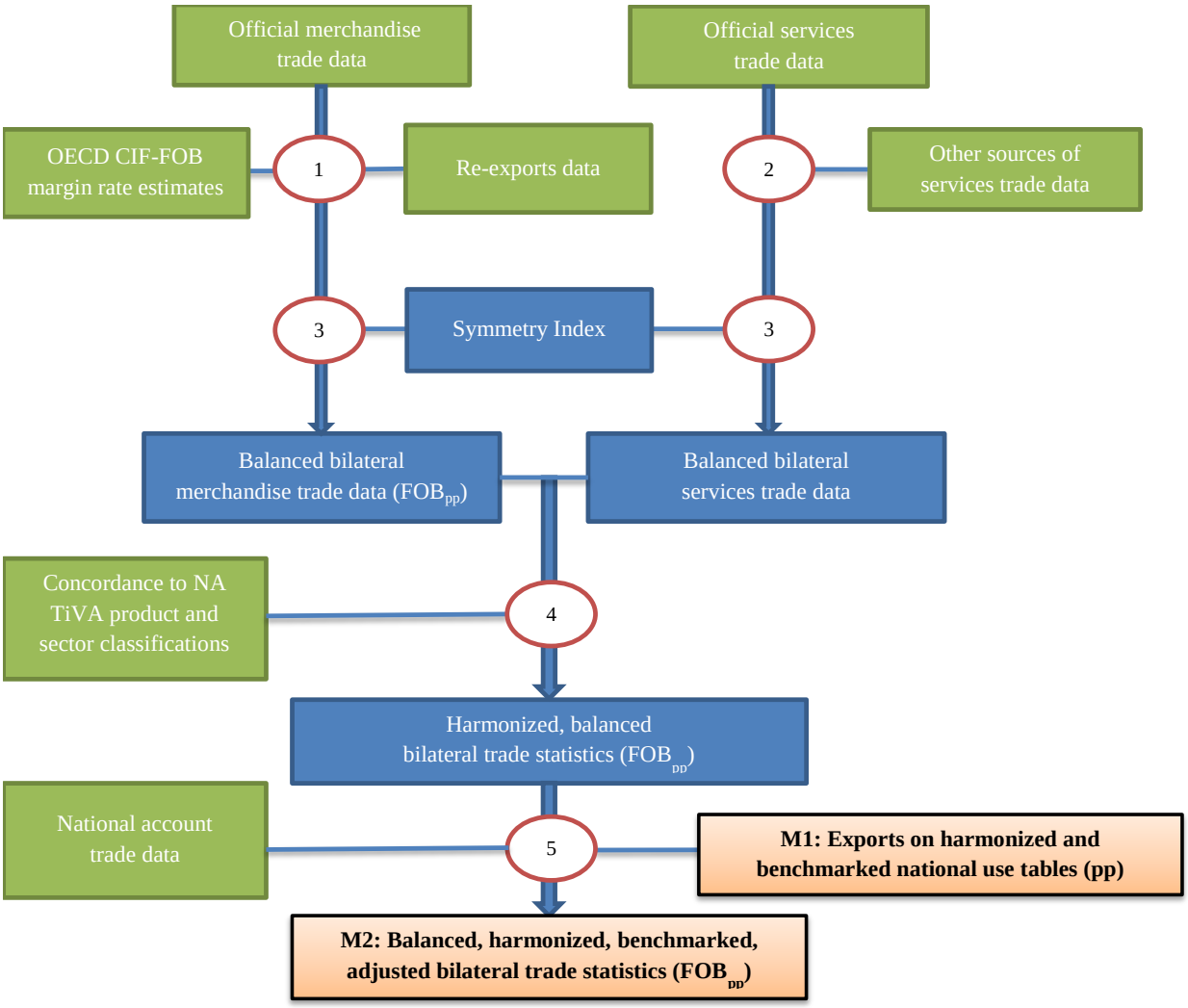
Stage two: prepare and process trade statistics (Figure II-2)

[19] It should be stressed that countries may not be able to offer information with a high degree of granularity due to confidentiality, statistical infrastructure or some other restrictions.

1. For merchandise trade statistics, convert import value to the same FOB_{pp} price, harmonize geographical coverages, and adjust for re-exports if such data are available;
2. Use official services trade data, as well as other sources of services trade data to estimate missing bilateral services trade data;
3. Determine the final step to balance bilateral merchandise and services trade statistics. If applicable, estimate the Symmetric Indices for each reporting NA economies as exporter and importer based on the reconciled trade statistics, and use them as the weight to generate balanced bilateral trade statistics (note: the Symmetric Indices for merchandise and services trade would be estimated separately);
4. Harmonize balanced trade statistics to the NA TiVA product classifications; Step 3 and 4 could be completed simultaneously or separately.
5. If applicable, adjust product exports in balanced trade statistics to be aligned with product exports in use tables introducing known adjustments to harmonize with national accounts concepts and introduce a column reflecting unallocated exports reflecting differences between SUT exports by product and the equivalent estimates derived from the alignment steps above. Adjust product imports of corresponding trading partners' accordingly and impose these within the import column - introducing, in turn, an item for unallocated imports.

   Note: Step 3, 4 and 5 could be completed simultaneously or separately, depending on the methodologies and balancing models used.

Figure II-2: Prepare and process trade statistics



Stage three: integrate national SUTs with balanced trade statistics to produce NASUTs and NAIOTs (Figure II-3)

1. Estimate use tables at "quasi basic price" (the price excludes domestic margin and taxes but includes import duties and/or other import specific taxes) and generate margin/net tax matrices for later use in step 7;
    i. Combined with other available data, estimate domestic margin and net tax matrices (excluding import duties and other import specific taxes);
    ii. Return domestic margins and net taxes embedded in intermediate and final uses to the corresponding margin sectors and tax rows;
2. Break down use tables into domestic use tables at basic price and import use tables at CIF *'special purchaser's price'* (CIF_{pp}: CIF+ import duties or other import specific taxes);
    i. Convert national import data to CIF_{pp} by adding import duties and/or other import specific taxes;

ii. Assign national import with broad end use categories;

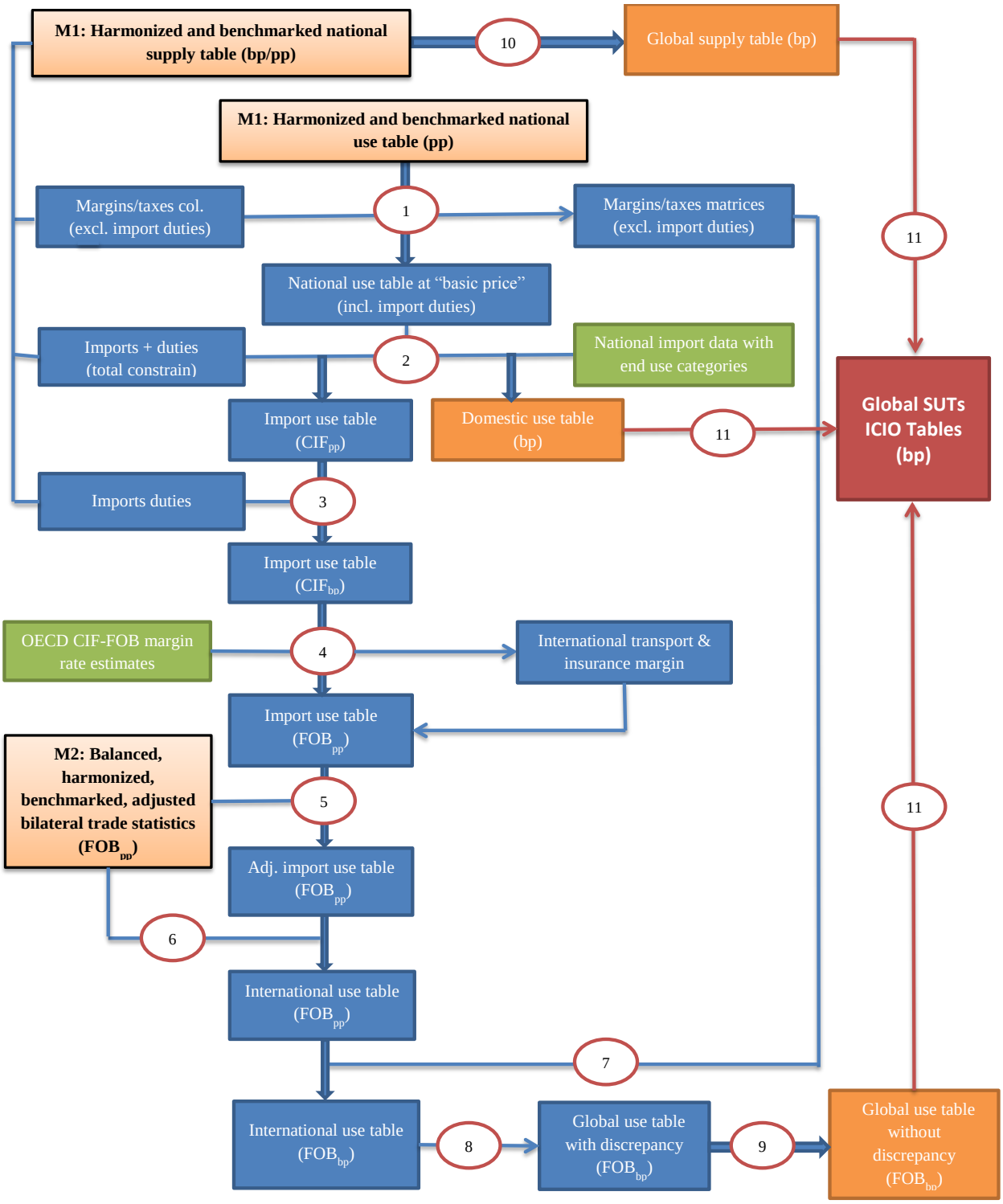
iii. Estimate import use tables at CIF_{pp};

iv. Derive domestic use tables at basic price;

3. Estimate import use tables at CIF *'special basic price'* (CIF_{bp}) and return import related taxes to the corresponding tax rows;
4. Apply CIF-FOB margin rates to estimate import use tables at FOB purchaser's price (FOB_{pp}); return international insurance and freight embedded in CIF price to a separate row in the import use table;
5. Adjust product imports in import use tables to be aligned with product imports in harmonized, benchmarked, adjusted, balanced trade statistics;
6. Apply the shares of trading partners by product and end use to generate international use tables at FOB_{pp};
7. Apply corresponding trading partners' domestic margin and net taxes rate to estimate international use tables at FOB basic price (FOB_{bp});
8. Compile NA use tables at basic price with global trade discrepancy;
9. Eliminate global trade discrepancy to produce balanced NA use tables;
10. Produce NA supply tables at basic price;
11. Convert NASUTs into symmetric industry-by-industry NAIOTs at basic prices.

Note: Step 5 and 6 could be carried out separately or simultaneously, depending on the balancing methodology and model used.

Figure II-3: Integrate SUTs and trade statistics to construct NAIOTs



Section III

Reconciliation of North American Merchandise Trade

Anthony Peluso

This section attempts to compare "mirror" trade data for goods, where the value of country A's imports from country B are compared to the value of country B's exports to country A. These data are compiled using customs declarations filed by importers and exporters. While the transaction values should be the same, regardless whether they are recorded by the importer or the exporter, this isn't the case in practice.

In the case of goods, the discrepancies in the data reported by the two trading partners arise for a variety of reasons, the dominant one being re-exports. Re-exports occur when a country exports to another country goods that are not grown, extracted or manufactured in the country of the exporter. The U.S. may re-export goods of Canadian origin to Mexico, for example. As importers and exporters may not have the same knowledge of the origin of the commodity, or of its ultimate destination, the trading partners may not necessarily attribute the transaction to each other, but to a third country instead. Each trading partner's total imports or exports will remain unchanged, but the countries of attribution will change, and consequently so too will bilateral trade.

The section examines other causes for discrepancies in trade data for goods, particularly each country's treatment of data sources, processes and concepts:

- sources of data
- data validation
- availability of country of destination and consignment for exports
- treatment of U.S. geography
- treatment of freight and insurance
- release schedules for revised data
- revisions to reported data
- treatment of confidential and low-value transactions
- treatment of processing services

For each of the six comparisons of mirror data (three countries, each with imports and exports), a methodology is presented for data reconciliation. The asymmetries are concentrated in certain commodities, suggesting commodity-specific differences in the treatment of transactions between importers and exporters.

It is necessary to emphasize that the information from the reconciliation of trade data is not official but complementary that comes through experimental methods to adjust and reduce the asymmetries. The reconciliation of bilateral asymmetries is one of the key steps for the TiVA database construction. Therefore, these exercises must be thought and done in the short and long run. On the one hand, we should have some outcomes and a general adjustment in the near term. On the other hand, in the long-term, we have to continually revise and refine the methodology by considering the changes in the trade patterns. By following this, we will ensure to have better quality data to fulfill the SUTs and IOTs regional tables.

This exercise is part of a broader initiative called North American Trade in Value-Added (NA-TiVA). The NA-TiVA project will be based on continental supply-use tables,[20] with each North American

[20] Supply-use tables balance the supply (imports and production) and use (intermediate use, personal expenditures, investment, government expenditures and exports) of commodities in the economy. In

country individually represented. To construct these supply-use tables, it is necessary to capture bilateral trade flows for goods and services, as well as trade between North American countries and extra-continental trading partners. At the very least, a geographically consistent continental supply-use table requires geographically consistent trade flows, with which to capture each country's contribution to the value added of traded goods and services.

This section reports on the work and conclusions of the reconciliation of North American trade in goods. It begins with a summary comparison of data on bilateral trade in goods and a quick review of some of the key concepts that are likely to explain differences between mirror data. It provides a comparative review of the three countries' concepts, data collection processes, compilation processes, validation processes, and dissemination and revision policies, for goods. A more detailed examination of the data for goods is presented, with an attempt at explaining differences. A few goods are examined in greater detail still before drawing conclusions and making recommendations.

Trade in goods

From a customs perspective (as opposed to balance-of-payments perspective), goods are traded when they cross from one economic territory (usually a country) into another. With some exceptions, customs agencies are the sources of these transactions, as importers and exporters file import and export declarations with customs agencies.

There are two parties to an international customs transaction: the exporter, who is selling the commodity, and the importer, who is buying it. In the customs world, the two parties are located in different economic territories and file, with their respective customs agencies, the export and import declarations. Since each transaction involves a value, a buyer and a seller, it is expected that the buyer (importer) and the seller (exporter) would report the same values to their respective customs agencies, and imports and exports as reported by the respective customs or statistical agencies would be equal.

In the customs world, the geography of the transaction is attached to the uninterrupted journey of the commodity.[21] This journey starts in the **country of origin** and ends in the country of import, or of **final destination**. The **country of consignment**, in the case of imports, is the last country to have ownership of the commodity before that ownership is transferred to the importer. On the export side, the country of consignment is the first country to take ownership of the commodity once it leaves the exporting country.

The respective customs agencies may not necessarily report the same journey. The importing country as a rule has better information on the origin, as the country of origin determines the tariff rate that is applied to the commodity and that will be collected as duty by the importing country's

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particular, they describe how value-added is generated for various commodities or within certain sectors of the economy.

[21] Here and in the text that follows, concepts and definitions are drawn from the United Nations 2010 publication *International Merchandise Trade Statistics: Concepts and Definitions* – IMTS (2010) for short).

revenue agency. On the other hand, it is quite difficult for the exporting country to know a priori the last country of destination of each export, and therefore the country of destination is not reported accurately in all the cases. For example, a Canadian importer would report accurately (as there is closer monitoring of imports) a commodity as being an import from Mexico if that commodity originated in Mexico (country of origin) and was then shipped to the U.S. (country of consignment) before entering Canada. The Mexican exporter, however, might only be aware of the country of final destination based on its records, (i.e., the information provided by the main importer), and might report the importing country (the country of consignment, as opposed to country of final destination) as the U.S. instead of Canada. In this case, Canada would report greater imports from Mexico than Mexico reports exports to Canada. However, Mexico would show greater exports to the U.S. than the U.S. would show as imports from Mexico. A reconciliation of this data would lead to the same trade values reported by each of the three countries, though there would be a reallocation of Mexico's exports by country of (final) destination in this case. However, it is not necessarily the exporter's lack of information regarding the country of final destination that leads to a misattribution of the country of import. Another cause for the discrepancy is re-exports.

Re-exports

Goods that are imported and then subsequently exported without substantial transformation usually are classified as **re-exports**. These are goods that originate in a country other than the exporting country, with the commodity's journey being delayed in the exporting country, but without the commodity being substantially transformed before being sent on as an export. An example would be goods that are imported into the U.S. from Mexico in a container, repackaged and then shipped to the final destination in Canada. Or where goods imported from Canada are put into U.S. storage or into a U.S. mixing centre, before being exported to Mexico. Indeed, re-exported goods may spend a good deal of time (even years!) before being sent on, so that the country from which the good was initially exported would have little idea of the country of final destination at the time it was reporting its export.

Re-exports can also originate in the country of destination, where the importing country attributes the country of origin to itself. An example might be goods that were originally exported and returned unsold to the original country of export. This type of trade is identified by the importing country as **re-imports** and counts towards its total imports.

When reporting customs export data, statistical agencies countries add up re-exports and **domestic exports**, i.e., those originating in the exporting country. Re-exports are different from goods **in transit**,[22] which are not subject to duties in the country of transit (i.e., transshipment) but are simply traversing it uninterrupted. In-transit goods, unlike re-exports, are not included in the trade numbers.

- *Trans-shipment and in-transit goods*

[22] In-transit goods, since they are transiting free of duty, are subject to regulations governing the access and temporary storage of the container or the vehicle carrying the commodity. In the Mexican case, the goods in transit are not included in the Merchandise Trade Statistics of Mexico.

- More generally, goods that may not be formally in transit but that are simply transported through a third country without interruption should be removed from trade, i.e., not count as exports or imports, according to the UN's *International Merchandise Trade Statistics: Concepts and Definitions*. However, these numbers seem to be included only by the U.S. and Canada customs agencies, though this may not cause any discrepancies as all three countries are consistent with each other in their treatment of this type of trade.
- Since there are no appreciable tariffs within NAFTA, carriers that might otherwise ship a good in transit oftentimes will ship normally (filing import and export documents with the country of trans-shipment) to avoid the administrative burden and possible delays required to ship in-transit. This overstates continental trade numbers but does not affect trade balances of the trading countries.
- In summary, the misallocation of the country of final destination may be attributable to the lack of information regarding the country of final destination, or to the presence of re-exports. Other errors in classification (the inclusion of trade that is, in all but name, in transit, or trade that may have been in transit but for the absence of tariffs) may inflate the trade numbers (both imports and exports) of the country of transshipment, and lead to the misattribution of country of import; they have no bearing on trade balances, however.

Table III-1 shows how re-exports figure in the reconciliation of trade numbers: country A is reporting its exports to country B, and country B is reporting its imports from country A, where country A is the country of origin. Line 1 is the starting point for the calculation of NAFTA country A's exports to NAFTA country B. For the purpose of the reconciliation exercise, A's exports should be domestic exports only. To arrive at that number, country A's re-exports originating in NAFTA country C (line 2) and those originating in non-NAFTA countries (line 3) should be subtracted. To those numbers should be added exports from A to B that A is not recording in its trade statistics. That trade would be re-exports of goods originating in country A but that are being re-exported by the third NAFTA country (line 4) or being re-exported by a non-NAFTA country (line 5) to country B. Once all of the calculations have been performed for lines 1 to 5, the total should be the same, in theory, as line 6.

Table III-1: Accounting for re-exports in reconciling trade number

Line	Operation	Trade type and geography	Source of data within NAFTA
1	Initial	Total exports of NAFTA country A to NAFTA country B	Country A's export data
2	Subtract	A's re-exports to B of goods originating in B (re-imports)	Country A's export data
3	Subtract	A's re-exports to B of goods originating in NAFTA country C	Country A's export data[23, 24]

[23] U.S. does not identify re-exports by country of origin, including those from Mexico.
[24] Mexico does not include re-exports in any flow.

4	Subtract	A's re-exports to B of goods originating in non-NAFTA countries	Country A's export data
5	Add	Country C's re-exports to B of goods originating in A, or *Country B's imports from C of goods originating in A*	Country C's export data / *Country B's import data*
6	Add	Non-NAFTA country's re-exports to B of goods originating in Country A, or *Country B's imports from non-NAFTA countries of goods originating in A*	Not available *Country B's import data*
7	Final	B's imports from country of origin A	Country B's import data

This calculation is different if country B is reporting its imports from country A where country A is the country of most recent consignment, i.e., the last country of ownership before the commodity enters country B. In that case, steps 4 and 5 are omitted.

For lines 5 and 6, country A's import data is proposed as a substitute for re-export data provided by country C, or by non-NAFTA countries. This substitution is an approximation: there is no reason, from a reporting perspective, for re-exports from country A to country B to be conceptually identical to B's imports from country A via third countries.

Returning to the concept of imports based on country of origin, the importance of each line depends on whether the NAFTA countries are contiguous or once removed. For contiguous countries (for example Mexico's imports from the U.S.), lines 2 and 3 (U.S. re-exports to Mexico of goods originating in Canada, and U.S. re-exports to Mexico of goods originating in non-NAFTA countries) are more important. For countries once removed (for example Mexico's imports from Canada), line 4 (the U.S.'s re-exports to Mexico of goods originating in Canada) is more important.

The geography of attribution is the most obvious cause for discrepancies in mirror data, but not the only one. It and other causes will be taken up in the next section.

Before proceeding, it should be noted that Canada and the U.S. have in place an agreement such that one country's data on imports from the other country are provided to the other country as that country's data on exports to the first: Canada's imports from the U.S. are provided to the U.S., just as the U.S. provides its imports from Canada to Canada. This has the effect of eliminating most of the discrepancies between what importers and exporters report.

We present next some summary numbers for each of North-bound (Table III-2) and South-bound (

Table **III-3**), where M represents imports, and X exports and all values are expressed in U.S. dollars.

The numbers are raw, not having been subject to the adjustments suggested in table III-1. Nevertheless, they do admit of some observations. The overall North-bound trade numbers between Mexico and the U.S. seem to be in broad agreement. Canadian-Mexican trade, however, is reported very differently by the two countries, though total values are a small percentage of North-bound trade overall. The numbers reported by Canada and the U.S., respectively, for their bilateral North-bound trade, appear quite different. This is all the more surprising since both sets of data are based on a single source: import documents filed with the Canadian customs agency. This difference suggests a large presence of U.S. re-exports to Canada of goods of non-US origin.

The numbers for South-bound trade suggest similar issues. Again, Canada-Mexico trade is small, but the discrepancies in each country's reporting of South-bound trade are large. Canada-U.S. trade is in broad agreement, pointing to few re-exports from Canada to the U.S. as an explanation. As was the case of U.S. re-exports to Canada in North-bound trade, the excess of U.S. exports to Mexico reported by the U.S. over U.S. imports reported by Mexico suggest sizable U.S. re-exports to Mexico.

Table III-2: Trade Numbers for North-Bound Trade, 2014 , in US$ millions

	Value (US$ millions)		Value (US$ millions)		Value (US$ millions)	Total Trade Value (US$ millions)
MEX X to USA	318,681	MEX X to CAN	10,714	USA X to CAN	312,371	641,767
USA M from MX	296,856	CAN M from MX	26,071	CAN M from US	251,814	574,741
Difference	21,825		-15,357		60,557	67,026

Source: UN Comtrade

Table III-3: Trade numbers for South-bound trade, 2014, in US$ millions

	Value (US$ millions)		Value (US$ millions)		Value (US$ millions)	Total Trade Value (US$ millions)
CAN X to USA	364,959	CAN X to MX	5,111	USA X to MEX	240,247	610,318
USA M from CAN	354,172	MEX M from CAN	10,045	MEX M from USA	195,858	560,074
Difference	10,788		-4,934		44,390	50,243

Source: UN Comtrade

Sources of data asymmetries

This section takes up some of the reasons, other than re-exports, why there may be asymmetries between imports and exports as reported by the two trading partners.

For example, Canada uses non-customs data for some of its trade in energy products (see

Table for more detail), but most of these data are passed on to the U.S. for the U.S. to use as its imports from Canada, with one exception: Statistics Canada draws its petroleum export data from Canada's National Energy Board, whereas the U.S. gets its data on petroleum imports from Canada from its own customs data. In addition, Mexico draws on PEMEX for data on crude oil.

Table III-4: Sources of data

	CAN	MEX	USA
	Trade in hydrocarbons and electricity, both exports and imports, are from surveys All other imports and exports to the U.S. are based on CAN customs documents All other exports to the U.S. are based on U.S. customs documents	The information source of international merchandise trade is the customs declaration, in addition to the administrative records supplied by the state oil company (PEMEX) which are only for crude oil	Imports of electricity and natural gas from Canada Imports from customs documents electronically and on paper) Exports to Canada from Canada's import data Exports to countries other than Canada from the Electronic Export Information (EEI) through Customs Estimates for low valued transactions on Imports and Exports generated by Census
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

Filers, customs brokers typically, do make mistakes in reporting values; as a result, customs agencies have to identify and correct customs filings for errors. These errors may also be made to commodity classification, which also affect the analysis of trade asymmetries, as well as to other fields such as quantities, mode of transportation, etc. If both the exporting and importing customs agencies for the same transaction use different thresholds for reviewing transactions, then there may be discrepancies in the numbers reported should one filer make changes and the other not for the same transaction.

If the importer subsequently submits an amendment to the original customs filings, where the importer makes a correction to the original value or HS code filed with the customs agency, and the exporter submits no amendment, then a discrepancy will emerge.

This discrepancy is minimized between Canada and the U.S., as the custodian of the import data has the final say over the reported value for a transaction. However, the other country may make changes to other fields in the transaction, including the HS code, again with implications for trade asymmetries.

Table III-5: Data validation

	CAN	MEX	USA
	Data are first subject to / port vs. province of import), and to determine whether transaction is "in trade" (e.g., repairs excluded) Transactions over $1 million CDN (and smaller, for agricultural commodities), reviewed separately, for geography among other things High level review process, including geography of X or M	In the statistical generation process are identified customs operations which are part of the international merchandise trade, in agreement with the IMTS recommendations and also some validators are applied to identify inconsistencies between the fields or values out of range Transactions over 300 million Mexican pesos (approximately 22.5 million US Dollars) are analyzed. Considering the historical behavior of the series if an atypical data is identified, the information is consulted directly with the enterprises	Transactions are edited for quantities, shipping weight, transportation information, duty (imports), trade act information (imports), and charges (imports). We identify non-statistical transactions before editing Edit failures are resolved by analysts. High level commodity verification review
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

One gap in customs data occurs on the export side where, typically, only one country is provided, either the country of consignment (the first country to take ownership of the export) or the country of final destination. Even at that, the country of final destination may not be known with much certainty.

Table III-6: Availability of country of destination and country of consignment for exports[25]

	CAN	MEX	USA
	Only Country of Consignment Available	Available information by country destination for exports and by country of origin for imports. At the same time, records are available by registry purchaser and seller country	Imports has country of export and country of origin. Exports has country of destination
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

One source of asymmetry is rather simple to tackle: the treatment of U.S. geography. As mentioned in the previous section, whereas Canada and Mexico treat Guam, Puerto Rico and the U.S. Virgin Islands as economic territories separate from the U.S., the U.S. considers them to be part of the U.S. for customs reporting purposes. For the sake of the homogeneity in the reconciliation process, staff from the national account and statistical agencies of the three countries agreed to treat Puerto Rico and the American Virgin Islands as part of the Rest of the World. However, it is important to note that this approach is only for the NA-TiVA analysis: it will result in experimental, not official, statistics and will not change how the statistical agencies of each country consider Puerto Rico and the American Virgin Islands.

Table III-7: Treatment of U.S. geography

	CAN	MEX	USA
	U.S. territory does not include Guam, Puerto Rico and the U.S. Virgin Islands	The international merchandise trade statistics considers Puerto Rico and the Virgin Islands as independent economic territories from the U.S.	U.S. territory includes Guam, Puerto Rico and the U.S. Virgin Islands Separate trade between U.S. territories as non-contiguous trade
Proposed Adjustment			Exclude U.S. territories from bilateral trade data and include them in ROW.

Sources: INEGI, Statistics Canada and U.S. Census Bureau

According to table III-8, re-exports as reported by NAFTA countries can explain most of the asymmetries. However, the country of origin of the re-exports have to be reported in order to

[25] This information is for analysis purposes only.

reconcile the data. Unfortunately, re-exports are unavailable for Mexico, and country of detail is not provided for the U.S. Country detail, though compiled by Statistics Canada, was not made available for this exercise for all of the years under consideration. More detail is presented in table III-8.

Table III-8: Treatment of re-exports

	CAN	MEX	USA
	On CAN export forms, the country of origin is reported. If this country is different from CAN, its value less than 1.5 times its value at import, and it remains within the same 6-digit HS code, then it is a re-export from that country. Otherwise, it is a domestic export.	Mexico does not include re-exports	We extract a domestic/foreign indicator on the Electronic Export Information (EEI) provided by the exporter, no additional information for foreign export country of origin.
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

There are a number of bases for valuing trade, the most common one being Free on Board, or FOB. The valuation refers to marine transport (on inland waterways or at sea), where the value of the merchandise on board the ship in the port of export includes the value of the merchandise itself as well as the freight and insurance up to that point, but nothing beyond. The notion of Free Alongside Ship (FAS) is similar, although the costs of loading the merchandise onto the ship and clearing them for export are excluded. The Cost, Insurance and Freight (CIF) valuation, adds to FOB the costs of insuring and transporting the merchandise to the port of import.

For commodities being transported by i) motorway, or by ii) rail and pipeline, the valuations Free Carrier (FCA) or Delivered at Frontier (DAF), respectively, capture the cost of delivering the merchandise to the frontier of the exporting country; they are akin to the concept of FOB.

According to IMTS (2010), countries should report imports on a CIF basis and exports on an FOB basis. All three NAFTA partners report both exports and imports on an FOB basis, though the U.S. makes imports available on a CIF basis as well.

Unfortunately, the concept of freight, as reported on a customs document, may be different from that used in reporting customs-based trade data. For example, the Canadian Border Services Agency reports freight from the starting point of the journey, sometimes referred to as the **point of direct shipment**, up to the destination. The U.S. includes this freight when reporting its exports to Canada. The U.S. provides with its customs information the cost of freight from point of direct shipment in Canada to the Canada-U.S. border crossing, which Statistics Canada includes in the value of its exports. As a result, when the Canada and the U.S. are reconciling trade data, removing freight puts both sets of data on an equal footing.

Table III-9: Treatment of freight and insurance

	CAN	MEX	USA
	X and M with U.S. are reported FOB to the port of exit or to the border crossing.	Exports and imports are quantified in FOB basis There is an estimation of CIF value for total imports	Exports and Imports – FAS
Proposed Adjustment	For trade with U.S., remove freight from point of direct shipment to border crossing for over-land transportation.		

Sources: INEGI, Statistics Canada and U.S. Census Bureau

Brokers continuously make revisions to their previous filings. As corrections are made to data, they are released according to a schedule. For more recent months and years in particular, different statistical agencies may be releasing different vintages of data. For example, Canada may release its revised export data for the previous year in March of the current year, while the U.S. won't release that data until June of the current year.

Table III-10: Release schedule for revised data

	CAN	MEX	USA
	Revised data for the previous year (Y-1) released in Jan-Mar of current year, then quarterly thereafter, including December. Revised monthly data for Y-2 and Y-3 are available with December release of current year.	Final data for the previous year (Y-1) is published 7 months following the end of the reference year Revised monthly data is published 40 days after the close of the reference month. The revision of the information is carried out on May of each year	Published revised data for Y-1, Y-2, and Y-3 annually in June of each year. Publish notable previous month revisions in our monthly press release
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

Furthermore, revisions can go back years, and amount to hundreds of millions of dollars on transactions. While these and other revisions to trade numbers are relatively small, they can take

on greater importance if analysis is being done at the commodity level for which late filing is more prevalent.

Discrepancies can arise if one country's revision period goes back further than its trading partner's, so that one country can take on corrections in its trade data while the other country can't. Here Canada and the U.S. make revisions going back 3 years, although Canada will go back an extra 6 months in history (the difference between June and December) owing to the staggered release dates.

Table III-11: Revisions to reported data

	CAN	MEX	USA
Period of revision	Revisions are made to years Y-1, Y-2 and Y-3, and are reported in December release of the current year.	Revisions are often made to years Y-1 to Y-4, the period is according to the information sources updates, mainly by the state oil company (PEMEX)	Revisions are made to years Y-1, Y-2 and Y-3, and are reported in June release of the current year.
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

Transactions can, at the importer or exporter's request, be suppressed if the information is thought to provide sensitive commercial information on the importer or exporter. This may be handled in a number of ways: by assigning the transactions to a single stand-alone HS code for the whole of trade (as Canada does), or aggregating the transactions to a higher-level HS code.

As a result, the treatment of suppressed information can cause asymmetries in two ways: if one is keeping HS commodities within the same family (though at a more aggregate level) while the other is not; and if only one of the exporter or the importer asks for the information to be suppressed.

Low-value transactions also can cause inconsistent data. They may or may not be assigned to a separate, stand-alone code. Differences among statistical agencies in where they place this code can lead to asymmetries. Or, different statistical agencies may have their own value thresholds below which a transaction is considered to be of low-value; and hence, different valuations of trade by HS code.

Table III-12: Treatment of confidential and low-value transactions

	CAN	MEX	USA
Treatment of confidential data	Confidential data are suppressed by keeping all information except HS code, and reassigning HS code 9901	Confidential information is aggregated into higher level codes	• Combine several 10 digit HS codes into higher level codes to avoid disclosure: recode the commodity code • Suppress shipping weight and quantities: recode transportation information
Treatment of low-value transactions	All transactions below CDN 2.5k are assigned to code 9901	All transactions are assigned according to their corresponding code	
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

Treatment of processing services presents a problem when reconciling trade data. Processing takes place when value is added to an import that is subsequently exported. There are no standard thresholds, in IMTS (2010) for example, separating normal re-exports, where some handling and transformation can take place, from processed goods.

There exist criteria such as whether the exported good no longer falls within the same six-digit HS category as the imported good, or whether the value of the exported good is beyond a certain multiple of the value when it was first imported for processing.

Processing can lead to trade asymmetries when the unprocessed good as exported by the first country, is processed by a second country, that subsequently exports the good at a higher value than it paid for the import. Clearly the value reported by the final importer will be greater than that reported by the first exporter.

It is unclear how much of this processing actually occurs in North America. What evidence there is of Canada-U.S. processing (of crude oil refining, gold refining and pharmaceuticals, for example) involves an export whose HS code is different at the six-digit level from the goods that were imported as inputs to processing. In this case, the asymmetry created by processing is minor.

Table III-13: Treatment of processing services

	CAN	MEX	USA
	The capture of processing activity is not clear across data sources All processing services remain in merchandise trade.	The custom declaration does not allow to identify and record of the processing services They are included in the international merchandise trade statistics	
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

Table III-14: Attribution of country of control of importer and exporter

	CAN	MEX	USA
	Business identifiers for exporters and importers are linked to a business registry, which provides country of control of business entity.	There is no information available that allows to identify the country that controls the export or import flows	N/A
Proposed Adjustment			

Sources: INEGI, Statistics Canada and U.S. Census Bureau

Methodologies for reconciliation of goods

In this section we take up each of the methodologies adopted bilaterally to reconcile mirror data. The format is similar to that of

Table **III-1**, where the exports appear in the first line of the table and the imports in the last. Unlike

Table **III-1**, however, the before-last line is not equal to the last line, owing to trade asymmetries. In the tables that follow, the before-last line is actually equal to the asymmetry so that, when added to all of the values above it, it is equal to the last line.

Table III-15: U.S. Exports to Mexico / Mexican Imports from U.S.

Line	Operation	Trade type and geography
1	Initial	U.S. exports to Mexico
2	Subtract	U.S. re-exports to Mexico of non-U.S. goods
3	Add	Mexican imports from Canada of goods of U.S. origin
4	Add	Mexican imports from non-NAFTA countries of goods of U.S. origin
5	Variance	Asymmetry
6	Final	Mexican imports from U.S.

Table III-16: Mexican Exports to U.S. / U.S. Imports from Mexico

Line	Operation	Trade type and geography
1	Initial	Mexican exports to the U.S.
2	Subtract	Mexican exports to the U.S. via Canada
3	Subtract	Mexican export to the U.S. via non-NAFTA country
4	Variance	Asymmetry
5	Final	U.S. imports from Mexico

Table III-17: U.S. Exports to Canada / Canadian Imports from U.S.

Line	Operation	Trade type and geography
1	Initial	U.S. exports to Canada
2	Subtract	U.S. exports to Canada of goods originating in Canada.
3	Subtract	U.S. exports to Canada of goods originating in Mexico
4	Subtract	U.S. exports to Canada of goods originating in non-NAFTA countries
5	Subtract	Inland freight to U.S.-Canada border of goods of U.S. origin exports to Canada
6	Add	Canadian imports from Mexico of goods of U.S. origin
7	Add	Canadian imports from non-NAFTA countries of goods of U.S. origin
8	Variance	Asymmetry
9	Final	Canadian imports from U.S.

Table III-18: Canadian Exports to U.S. / U.S. Imports from Canada

Line	Operation	Trade type and geography
1	Initial	Canadian exports to U.S.
2	Subtract	Canadian exports to U.S. of goods not originating in Canada
3	Subtract	Inland freight to Canada-U.S. border for Canadian exports of Canadian origin
4	Variance	Asymmetry
5	Final	U.S. imports from Canada

Table III-19: Canadian Exports to Mexico / Mexican Imports from Canada

Line	Operation	Trade type and geography
1	Initial	Canadian exports to Mexico (of Canadian and non-Canadian origin)
2	Add	Mexican imports from U.S. of goods of Canadian origin
3	Add	Mexican imports from non-NAFTA countries of goods of Canadian origin
4	Variance	Asymmetry
5	Final	Mexican imports from Canada

Table III-20: Mexican Exports to Canada / Canadian Imports from Mexico

Line	Operation	Trade type and geography
1	Initial	Mexican exports to Canada
2	Add	Canadian imports from U.S. of goods of Mexican origin
3	Add	Canadian imports from non-NAFTA countries of goods of Mexican origin
4	Variance	Asymmetry
5	Final	Canadian imports from Mexico

Section IV

Anatomy of the North American Use Table for use in Trade in Value Added (TiVA) Analysis

Gabriel Medeiros and Jeffrey Young

The North American TiVA Use table is a three country Use table with an exogenous rest-of-the-world (ROW) sector. Like all Use tables, it can be subdivided into 3 sections: intermediate inputs, final uses, and value added. However two of these sections, notably intermediate inputs and final uses, differ greatly from a single country Use table.[26]

Table IV-1. Mock NA-TiVA Use Table

	Intermediate Inputs			Final Uses		
	Canada	Mexico	US	Canada	Mexico	US
Canada						
Mexico						
US						
ROW						
VA						

The intermediate inputs section can be further partitioned into the three countries along the columns, and the three countries plus the ROW along the rows, for a total of twelve sub-sections. Each of these twelve subsections has the same product structure. The industry structure is determined by column country, and each country potentially can have a different industry structure.

The final uses section is likewise partitioned into three countries along the columns, and three countries plus the ROW section along the rows, for a total of twelve sub-sections. Unlike a single country Use table, the final use categories underlying each country in the North American TiVA table consist of personal consumption expenditures, business investment and inventory change, government expenditures and investment, and exports and imports to ROW.

Interpreting values along a row in the North America Use table:

The main diagonal section intermediate inputs show row country's intermediate inputs sourced from itself. This section is further subdivided into purchasing industries and products purchased. The main diagonal section of final uses shows row country's final use purchases sourced from itself. This section is further subdivided into final use categories and purchased products. This section further includes exports to the ROW.

[26] Refer to Section II for additional discussion on this topic.

The off-diagonal section of intermediate inputs show row country's exports purchased by the column country as intermediate inputs. The exports shown here do not include exports purchased by final users. This section is further subdivided into purchasing industries and products purchased. The off-diagonal section of final uses shows exports of row country to the remaining two countries. The exports shown here include only those exports purchased as final uses by the column country. Exports purchased as intermediate inputs are shown in the intermediate inputs section. This section is further subdivided into final use categories and purchased products.

The sum of a row element corresponds to row country's gross output of a given product. This is because the row exhausts all possible uses for a country's production, and it excludes imports to the row country.

The intermediate inputs section shows rest-of-the-world exports purchased by the column country as intermediate inputs. It is further subdivided into purchasing industries and products. The final uses section shows exports by the ROW purchased by column country as final uses. In addition, this section also includes overall imports from the ROW to the three countries, regardless of whether those imports were used as intermediate inputs or final uses. The imports have the sign opposite of the exports. The sum of the row elements in the rest of the world row add up to zero. This is because exports from the ROW to the three countries are exactly offset by the value of imports of the three countries from the ROW.

The value added row consists of returns to labor, capital, and government from production. It can be further subdivided into value added components by producing industry. The sum of the value added row equals the sum of final uses.

Interpreting values along a Column in the North America Use table:

The individual elements of the columns headed by intermediate use share the same interpretation as described above. The sum of the column corresponds to gross output in a given country. This gross output is further subdivided by producing industry.

The individual elements of the columns head by final use share the same interpretation as described above. The sum of all three country final use columns together equals the sum of the value added row. The sum of a given country final use column equals personal consumption plus investment and inventory change plus government consumption and investment plus net exports to the rest of the world.

On Valuation of Transactions in the Use table

For simplicity, transactions are taken to meant a cell value in the use table. For intermediate inputs and final uses, they can also be understood as an exchange where a good or service leaves and establishment.

Use tables transactions are commonly valued using three broad approaches: purchaser prices, producer prices, and basic prices. Purchaser prices and producer prices are closely related, and vary not in total, but in composition. Transactions valued at purchaser prices assign to a given transaction the full value of what purchasers paid, inclusive of any unit taxes and distributive services required to acquire the good or service. So for example, in purchaser prices distributive services are not separately identified, but included in the value of the merchandise purchased. Producer prices in contrast value transactions based on what producers receive from the purchaser. In producer prices, the value of merchandise transactions exclude distribute services, which are identified as being purchased in a separate transaction by the purchaser.

Basic prices differ from purchaser and producer prices in total, but share similarities with producer prices in composition. Basic price transactions are producer price transactions, but altered so that they exclude any tax, and include any subsidy, on each unit sold as a consequence of that unit's sale or production.

Generally speaking, the way transactions are valued does not change between a single country and a multi-country table. The exception to this is imports. In a single country table, the basic price of imports is the total cost incurred in bringing the good or service to the domestic port. In a sense, the domestic port is considered the producer of the good or service. Any distributive services required to bring a good or service to the domestic port is part of the basic value of that import In a multi-country table, however, the basic price of imports will depend on the source of those imports. For imports from countries that are exogenous to the table, the valuation will mirror the single country valuation of imports. For imports from those countries that are endogenous to the table, the basic value of imports will separately identify the distribute services required to transport the good to the domestic port from the value accrued to the merchandise itself.

The distinction between imports from countries endogenous as opposed to exogenous remains when considering producer prices, which again separately identify distributive services from the value of merchandise. In purchaser prices, however, there is no difference in valuation based on the source of imports, since in purchaser prices distributive services are included in the value of the merchandise transactions.

Diagram VI-1. Import valuation

Basic price - multi country (foreign country, foreign factory)

plus: distributive services and taxes from foreign factory to foreign port

= Foreign port value of imports (foreign country, foreign port).

plus: distributive services and insurance from foreign port to domestic port

= Domestic port value of imports (domestic country, domestic port). This is equivalent to a single country basic price valuation of imports.

On Valuation of Value Added Transactions

There is no difference in the value added transactions between producer and purchaser price valuations. For both, value added is equal to industry output in producer prices, less intermediate inputs in either producer or purchaser prices. Value added in basic prices is equal to industry output in basic prices, less intermediate inputs in either producer or purchaser prices.

Valuation of the NA-TiVA tables for Input-Output analysis

In a make and use framework, both the output and the intermediate inputs need to be valued in the same basis in order to compute input-output tables. Of the three broad valuation approaches discussed earlier in this section, basic prices are generally used in TiVA analysis. If the NATIVA takes this approach, the end goal for this project becomes generating both a Make table in basic prices, and a Use table where intermediate transactions are in basic prices.

A consequence of having intermediate inputs in basic prices, while still maintaining identities between production and purchases, the Use table requires that Final Use transactions also be valued in basic prices. Basic price final uses differs in total from National Accounts GDP estimates in that they exclude unit taxes and include unit subsidies on each good or service sold.

In order to maintain production and purchase identities, Value Added transactions have a novel valuation. These value added transactions are valued as basic price value added plus the difference between producer and basic price intermediate inputs.

On the Industry and Product Structure of the NA-TIVA Use Table

Regional TiVA Use Tables are assembled by country column. Looking at Table 1 as an example, Canadian data, coupled with reconciled exports, will be used to create data for the Canada column. Likewise, Mexico and US data will each be used, coupled with reconciled export data, to create data for the Mexico and US columns respectively. This applies to both intermediate inputs and final uses.

A consequence of this is that the product structure embedded in the rows of the Use table needs to be harmonized across the different countries in order to build a NaTIVA table. Without this harmonization of products, the column countries pieces do not assemble together. However, because each column country is assembled roughly independently of one another (once harmonization of trade data occurs), each country's industries and final use categories need not be harmonized in order to assemble a NaTIVA table. Harmonizing the industry structure may aid cross country comparisons, but it is not required in order to assemble the NaTiVA Use Table. The assembly of these tables is discussed in depth in the next section.

Assembling the NA-TiVA Use Table

Assemble, for each of the three endogenous countries in the NA-TIVA model:

D: Domestic Intermediate Inputs in Basic Prices

Matrix of products purchased by industries as inputs to production sourced from domestic producers.

Fd: Domestic Final Uses in Basic Prices

Matrix of products purchased by final users sourced from domestic producers.

I: Unreconciled Imported Intermediate Inputs in Basic Prices.

Matrix of products purchased by industries as inputs to production sourced from foreign producers.

Fi: Unreconciled Imported Final Uses in Basic Prices

Matrix of products purchased by final users source from foreign producers.

V: Value Added

Matrix of Value Added components by industry. This matrix is valued such that for each industry, D + I + V is equal to basic price output for that industry. Conceptually, Value Added in this framework in equal to basic price Value Added plus the difference between producer and basic price intermediate inputs.

Bx: Bilateral Exports Reconciled in Basic Prices

Vectors of product exports from endogenous country to endogenous country, reconciled so that corresponding imports from partner country equal these exports.

These starting points are unrealistic because trade data reconciliation will not occur at basic prices. There are also conceptual differences between the reconciled trade data and the national accounts trade data. Furthermore, the difference between imports in basic prices for a single country as opposed to a multi-country table that were referenced in section 2.3 has been elided. In addition, source data limitations that may prevent countries from submitting the above data. These considerations will be addressed later in this document.

Given these starting points, the first step is to partition out the unreconciled Imported Intermediate Inputs in Basic Prices, *I,* and the Unreconciled Imported Final Uses in Basic Prices, *Fi*, to the different countries in the model and the rest-of-the-world (ROW) category.

Absent any additional source data, the common approach is to parcel out *I* proportionately based on the share of reconciled imports to overall imports. So for example, if country A imports 100 of a product in total, and reconciled imports assign 10 of that product total to country B, then 10% of

the purchases in both *I* and *Fi* for that particular product are assigned to country B. Repeating this process for each product and country pair allows us to parse out *I* and *Fi* to their foreign sources.

At the end of this process, for example, the data in *I* and *Fi* for the US has been parceled into *I_Mexico*, the US intermediate input transactions sourced from Mexico, *Fi_Mexico*, the US final use transactions sourced from Mexico, as well as *I_Canada* and *Fi_Canada*. The Intermediate Inputs sourced from the ROW, as well as the final uses sourced from the ROW can be calculated residually. Continuing the example, *I_ROW*, the US intermediate input transactions sourced from the ROW, can be calculated as *I - I_Mexico - I_Canada*. Likewise, *Fi_ROW* can be calculated as *Fi - Fi_Mexico - Fi_Canada*. Calculating the imports sourced from the ROW residually preserves the National Accounts import totals, while utilizing the reconciled bilateral trade estimates.With imports fully partitioned and in agreement with National Accounts totals, what remains is to adjust exports to ROW so that export totals also agree with National Accounts totals. This adjustment can also be calculated residually as product exports totals less reconciled bilateral product export totals. This adjustment is included in the ROW exports found in section *F*.[27]

Table IV-2. Example: Partitioning I and Fi, coupled with Domestically Sourced D, F, and V

	Intermediate Inputs	Final Uses
	US	US
Canada	I_Canada	Fi_Canada
Mexico	I_Mexico	Fi_Mexico
US	D	F
ROW	I_ROW	Fi_ROW
VA	V	

Once this process is completed, we can assemble the various partitions of *I* and *Fi*, as well as sections *D, F,* and *V* into a format resembling Table IV-2 above. The various Table IV-2 formats from each country are then further assembled into the multi-country NaTiVA Use table format found in Table VI-1.

[27] Calculating ROW export and imports residually can result in values with the wrong sign. For example, ROW imports can be positive if bilateral imports by product exceed import totals by product. Likewise, ROW exports can be negative if bilateral exports by product exceed export totals by product. This is a low probability event in the NA-TiVA.

Issue: Reconciliation of Bilateral Trade Data does not occur in Basic Prices

The process outlined in Section 4.1 is predicated on the reconciliation of bilateral trade data occurring at Basic prices. The trade data however will not be reconciled at Basic prices, but instead likely reconciled at Freight on Board or Foreign Port Value valuations. This valuation is akin to a producer price, but assuming that the foreign port is the producer. In this valuation, the distributive services and insurance associated with transporting the good from the foreign port to the domestic port are identified separately from the merchandise itself. The distributive services and taxes related to transporting the good from the foreign factory to the foreign port are embedded in the value of merchandise imports/exports. It is these distributive services related to shipment from the foreign factory to the foreign port that need to be addressed here.

Additional data required to resolve this issue:

Ideally, countries would provide, in addition to the basic price exports specified in 4.1, distributional service and tax matrices that link basic price exports to purchaser price exports. If these are not available, the matrices from a neighboring country can be used as proxies to provide rates to partition distributive services from the export value.[28]

Issue: Basic Price Valuation for Imports differs in Single Country vs. Multi-Country

This topic was first discussed in section 2.1, and is related to the topic discussed in section 4.2 below. In a single country model, the basic price valuation of imports treats the domestic port as the producer of the good. In a multi-country model, for those countries endogenous to the model, the basic price valuation of imports treats the foreign factory as the producer of the good. The difference between these two concepts includes both the insurance and freight required to ship the good from the foreign port to the domestic port, as well as the distributive services required to take the good from the foreign factory to the foreign port.

The two stages of adjustments, foreign factory to foreign port, and foreign port to domestic port, are best dealt with separately. This is because data for the adjustment from foreign port to domestic port generally resides with the importing country, while data for the adjustment from foreign factory to foreign port generally resides with the exporting country. Thus before partitioning the unreconciled import matrix *I,* two adjustments should be made, one to the unreconciled import matrix, and one related to the reconciled bilateral export data.

Prior to the partition of the unreconciled import matrices *I* and *Fi,* the insurance and freight required for transport from the foreign port to the domestic port needs to be excised from the value of merchandise imports. Corresponding adjustments are made to imports of insurance and freight products to offset the changes in merchandise import values. The value of imports purchased by each industry and final use category should remain unchanged, but the composition should differ, with merchandise imports lowered by the amount of insurance and freight adjusted.

[28] If a country can only provide purchaser price Use table data, then distributive services and tax matrices tables need to be estimated for the entire economy, not just exports.

With the adjustments outlined above, the unreconciled import matrices *I* and Fi are essentially at a foreign port or freight on board valuation. As discussed in section 4.2, it is at this valuation that the export data will be reconciled. It is at this valuation that the reconciled bilateral trade data will be used to compute shares to partition the import matrices *I* and *Fi* as discussed in section 4.1. The logic here is that the data being used to partition the matrix should have a similar valuation to the data in the matrix itself. After the matrices *I* and *Fi* are partitioned into endogenous country tables and the ROW tables, then adjustments to the endogenous country tables should be made to covert their valuation from a freight on board or foreign port value to a multi-country basic price valuation.

These adjustments are made using the distributive service and tax rate matrices from section 4.2. The rates from section 4.2 are used to excise distributive services and taxes from merchandise imports. The distributive services excised are offset as imports of distributive services. The taxes excised are offset, but not in imports, but in the Value Added of the purchasing industry.[29]

Additional data required to resolve this issue:

There are two datasets required for the adjustments outlined in section 4.3: one related to adjustments from foreign port value to multi-country basic prices, and one related to adjustments of foreign port value to domestic port value. The data required for the adjustment from foreign port value to multi-country basic prices is the same as outlined in section 4.2.1. Insurance and freight charges related to shipping data from foreign ports to domestic ports are required for the second adjustments. Countries either provide these freight and insurance charges by product imported. In the absence of this data, rates of such charges from neighboring country can be used to estimate these values.

Issue: Conceptual differences between National Accounts trade data and Bilateral Trade Data

The harmonized trade data undergoes a number of adjustments, besides the valuation adjustments described in 4.2, in the process of being incorporated into Use tables. Since these adjustments are a source of discrepancy between the reconciled bilateral trade data and the Use table trade data, these adjustments need to be separately identified. Note that these adjustments include both the adjustments made by the exporting country, and the adjustments made by the importing country. These adjustments, as well as the adjustments resulting from the trade reconciliation process, are outlined in Diagram IV-2. Diagram 2 shows how each of these adjustments helps bridge various datasets.

Diagram IV-2. Example: Bridge Between Bilateral Trade Datasets between Mexico and the US.

[29] Recall that the valuation of Value Added in the multi-country framework where intermediate inputs and output are in basic prices is equal to basic price value added plus the difference between producer price and basic price intermediate inputs. Thus the value added includes all the unit taxes paid on intermediate input transactions.

Imports to the US from Mexico, National Accounts basis

less: Conceptual adjustments made by the US on imports

= Imports to the US from Mexico, Harmonized Trade Basis

less: Reconciliation adjustments on imports

= Reconciled bilateral trade data, Harmonized Trade Basis

plus: Reconciliation adjustments on exports

= Exports from Mexico to the US, Harmonized Trade Basis

plus: Conceptual adjustments made by Mexico on exports

= Exports from Mexico to the US, National Accounts basis.

The process for computing the NATiVA Use table outlined in section 4.1 assumes that the only differences between the bilateral trade data on a National Accounts basis are the reconciliation adjustments.[30] Section 4.1 does not account for the conceptual adjustments needed to bridge the harmonized trade data and each country's respective national accounts trade data.

The fundamental problem, if we continue the example in Diagram 2, is that the trade data in the NATiVA Use table cannot be simultaneously consistent with both the Imports to the US from Mexico, as reported by the US, and the exports from Mexico to the US, as reported by Mexico. Adjusting the reconciled harmonized trade data to the US National Accounts concept results in one set of numbers, and adjusting the reconciled harmonized trade data to the Mexican National Accounts concept results in another set of numbers. The proposed solution is to pick one concept, and where necessary add adjustment records so that accounting identities hold.

The import matrices *I* and *Fi* from each country are the foundational elements in the process outlined in section 4.1. It is by partitioning these tables that the bulk of the data needed for the multi-country use table is generated. Retaining *I* and *Fi* in total, as well as partitions of those matrices, implies that the bilateral trade data presented in the NATiVA Use table is largely on a National Accounts basis from the importing country.

If we consider what this implies by column, each column element is on the same National Accounts basis, and thus the column sum should equal that country's corresponding gross output. However, the data for each row element is not in the same basis. Thus in order for the row sum to equal that country's gross output, a vector of adjustments records by product need to be inserted in each row to offset any conceptual differences. These adjustment records are best shown as separate from any other records for clarity, and reside as a separate column in final uses.

[30] Since the ROW exports and imports are computing residually, the reconciliation adjustments are embedded in the ROW. The assumption implicit in this is that the reconciliation adjustments reflect a mischaracterization of either the source or destination in the trade data.

Table IV-3. Conceptual Basis for each Row Element of the NaTIVA and Adjustment Column, Sample for Canada

	Intermediate Inputs			Final Uses			
	Canada	Mexico	US	Canada	Mexico	US	Trade Adjustments
Canada		On Mexico National Accounts basis	On US National Accounts basis	*Includes reconciling adjustments	On Mexico National Accounts basis	On US National Accounts basis	Conceptual Differences in Bilateral trade

The purpose of these adjustment records is to ensure that the row sum of the NATiVA table equals gross output for the corresponding country. For the example outlined in table IV-3, and following the terminology from Diagram 2, these Trade Adjustments will equal the conceptual adjustment made by Canada on its exports to Mexico, plus the Conceptual adjustments made by Canada on its exports to the US, less the conceptual adjustments made by Mexico on its imports from Canada, less the conceptual adjustments made by the US on its imports from Canada.

In addition to including this Trade Adjustment column in the final uses section of the table, one further change is required to the process outlined in sections 4.1 and 4.3. Section 4.1 outlines how import matrices *I* and *Fi* are partitioned using bilateral import shares relative to total imports. Section 4.3 outlines how adjustments need to be made when calculating bilateral import shares due to valuation differences. The purpose of the adjustments discussed in 4.3 was to ensure all data was as similar as possible. Given that section 4.4 outlines further conceptual differences, these further conceptual differences need to be accounted for prior to calculating the shares used to partition the import matrices.

Additional data required to resolve this issue:

Ideally for each bilateral trade pair, each country will present the set of conceptual adjustments needed to bridge the harmonized trade data to their national accounts concepts. If this is not available, the next best solution is the set of conceptual adjustments needed to bridge the total balance of trade. The total could then be apportioned to bilateral trade based on shares. If this data is not available, then the total conceptual difference can be calculated residually as gross output less estimated intermediate inputs and final uses.

Issue: Lack of Data

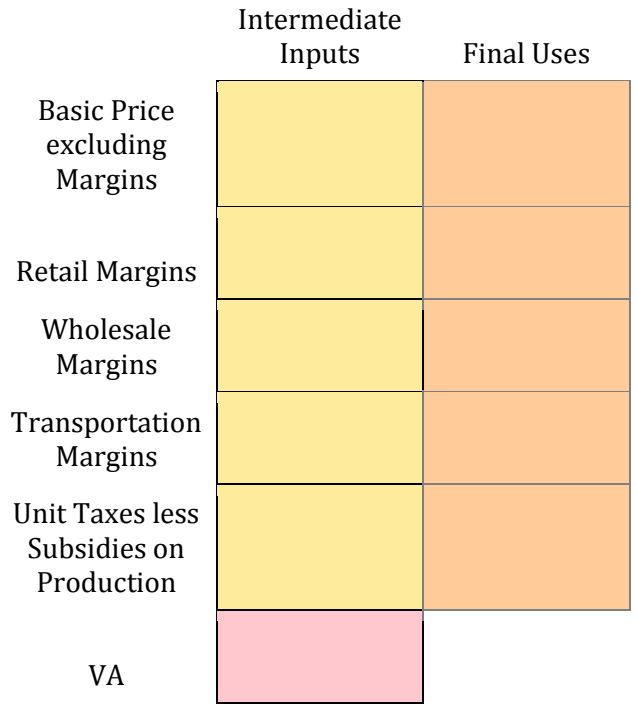
Import Matrices *I* and *Fi* are not available.

If import matrices are not available, then they can be estimated based on import totals and a single country use table in basic prices. This involves apportioning imports based on shares of purchases relative to domestic supply. The underlying logic behind this process is that absent any additional

information, shares of overall import purchases by industry and final use category should match overall shares of purchases relative to the total supply available for purchase.

Domestic supply is calculated by product as equal to gross output, less exports, less imports, less inventory change. Purchase of each product by various industries and final use categories (excluding exports, imports, and inventory change) is drawn directly from Use table values. Import totals by product to be apportioned are also drawn directly from Use table values.4.5.2 Use Table Data not available in Basic Prices

Table IV-4. Additivity of Basic Price, Distributive Service Matrices, and Unit Taxes less Subsidies Matrix



Suppose for example that a country can provide the Use table only in purchaser prices. Then a series of margin matrices need to be estimated that convert the entire Use table from purchaser prices into basic prices. The number of such margin matrices may vary, depending on the level of detail available on the production of various types of distributive services, as well availability of data on unit taxes on production and unit subsidies. Conceptually these margin matrices will encompass retail margins, wholesale margins, transportation margins, as well as a matrix of unit taxes less subsidies.

Table IV-4 outlines the various matrices necessary to bridge basic prices and purchaser prices. These tables can be estimated based on a balancing process - such as a simple RAS algorithm. Row total for the various matrices can be drawn from a supply or make table in basic prices, and from the Use table for Value Added. Column totals are drawn from the purchaser price Use table. Initial values for each cell and each matrix can be estimated using similar matrices from other countries.

Section V

Policy Application and Implications

Ross Hallren and Heather Wickramarachi

The Policy Applications and Implications of the NA TiVA database[31]

Inter-Country Input-Output tables (ICIOs) map out production the linkages across industries and between countries. These data form the informational basis for simulation and econometric models used to investigate the impact of policy changes with both direct and indirect effects. These indirect effects are the secondary, tertiary, etc impacts of policy changes. Only by understanding and quantifying the connections within an economic system, can analysts try to estimate the indirect effects, which in many cases are larger than the direct impacts of policy changes. We review the use of ICIO data in several common applications: trade, trade-in-value added, and labor. We highlight the gains in insight resulting from utilizing ICIO data, versus information that ignores and or fails to capture the international cross-industry connections.

Despite its limitations, the available ICIO data allow for inquiry in a number of relevant policy areas: analysis of global bilateral trade imbalances in gross and value-added terms; the costs and benefits of trade protectionism, country of origin rules, and trade dispute resolution; trade, growth, and employment; pollution production and consumption; and global impacts of regional disasters and economic crises (OECD). The NA-TiVA project aims to produce a detailed 106 industry database for 2005, 2012, and 2013. The database will sort industries by NAICS 3 digit classifications, with some 4 digit NAICS industry breakouts. This database will have more detail than the OECD's ICIO tables and cover more recent years. The data will allow analysts to all of policy areas above, except pollution production and consumption because the NA-TiVA database will not include greenhouse gases.

Within the realm of trade policy analysis, two factors, rising trade volumes as a share of GDP and increased internationalization of production chains, have increased the need for data collection that captures the architecture of global value chains and specifically identifies where value is added and who consumes it (Feenstra, 1998). Vertical specialization of production chains, the use of imported intermediate inputs to produce export goods, accounted for 30% of the growth of OECD countries' exports from 1970-1990 (Hummels, et al., 2001). Despite the increase in gross exports, the domestic value added content in exports fell by 10 percentage points worldwide, 20 percentage points in manufacturing, from 1970-2009, due primarily to declines in trade frictions (Johnson and Noguera, 2016).

Given these changes in global value chains architectures, gross trade data can paint a different picture about the economic connections between countries. For example, gross bilateral trade balances frequently diverge from value-added bilateral trade balances (Johnson and Nogueara, 2012; OECD TiVA Database, 2016). Also, gross trade data cannot capture the cumulative costs of trade barriers accrued along the global value chain, and these cumulative tariffs are often significantly larger than import weighted nominal tariff rates (Rouzet and Miroudot, 2013). This is

[31] It is important to remember that TiVA statistics are experimental statistics. While TiVA statistics are essential for understanding the economic relationships between countries and industries, policymakers should use TiVA information with traditional, official statistics.

particularly meaningful with respect to non-tariff barriers. Their nominal impact may be small, but their cumulative effective ad-valorem equivalent may be quite large.

The impact of trade on labor markets is another area that can be more fully addressed by using TiVA type data. Linking jobs data to TiVA indicators can illuminate the share of employment embodied in exports, as well as highlight the extent to which jobs and wages supported by exports are impacted by linkages between sectors. And by decomposing the value of imports or exports into the contribution of each economy, we can begin to understand where jobs are being created.

Several studies have looked at the relationship between global value chains and employment. A recent assessment of global value chains on jobs and productivity by the OECD shows that a large share of employment in OECD and partner countries relies on foreign demand and that this share has increased since 1995 (OECD, 2102). Further, TiVA statistics allow us to understand the jobs embodied in exports, specifically the industry of origin, and the authors find that the share of employment in exports is significantly higher when indirect jobs, predominantly in the service sector, are taken into account. Additional analysis of employment and exports through TiVA type data include decomposing jobs embodied in gross exports by partner country, decomposing jobs by skill level (the author finds that in all countries, except Denmark, there is a shift towards higher skill jobs in exports), and decomposition based on business function (R&D, engineering, marketing, production).

Timmer et al. (2014) use the World Input-Output Database (WIOD) to estimate the number of jobs directly and indirectly related to the production of final manufacturing goods. Jiang and Milberg (2013) decompose the labor content of a country's trade into five components (imports, exports, export content in imports, import content of exports, and the intermediate content of exports)[32] to capture the labor effects of GVCs. Using the WIOD, the authors are able to compute the employment created in each of the five components in OECD and partner countries from 1995-2009. They find that the demand for final goods generated 538 million jobs, while GVC related trade generated 88 million.[33] Expanding this literature, Cali et al. (2016) create a labor content of exports database, which comprises data on the labor value added and the job content of exports, to decompose the contribution of jobs and wages to exports through direct and indirect components.

TiVA type data can also influence how we think about competitiveness. Typically, competitiveness is measured by shares in the world export market, but this does not take into account intermediate inputs and is thus becoming a less informative measure. The now ubiquitous IPod example highlights that while a country (China) may have a large share of the export market, its value added may be small. Thus countries that are considered to be most competitive in traditional terms, are often less competitive in value added terms (Ceglowski, 2015). In this sense, it will be important to study the conditions that make a country to pass through low value added activities to the higher ones by considering that developed countries focus their presence in high value added activities

[32] The latter three are considered GVC related trade by the authors.
[33] The countries with the largest GVC related trade labor demand are Germany, the United States, China, the Netherlands, and France.

while developing countries usually are doing lower value added activities (Gereffi & Fernandez-Stark 2016).

Several studies have focused on competitiveness and trade in value added. Timmer et al. (2013) measures the competitiveness of EU industries by their GVC income,[34] which takes into account the value added of both foreign and domestic final demand. They find that gross exports overestimate competitiveness in industries dependent on imports of intermediate goods. In an assessment of employment and wages in these industries, they find that in most European countries a rise in jobs related to GVCs has not necessarily translated into a rise in real wages.

Kiyota et al. (2016) assesses the competitiveness of industries within Asia, from 1995-2011, also measuring competitiveness in terms of GVC income. Specifically, they examine the effect changes in production of final goods have on skill demand. They find that manufacturing competitiveness is increasing in three countries: China, India, and Indonesia, while decreasing in Japan, South Korea, and Taiwan. In contrast to Timmer et al. (2013), they find that a rise in jobs related to GVCs is correlated with a rise in real income.

While a large share of trade is intra-firm trade, with parent companies exporting and importing to and from foreign affiliates alongside investment, quantifying the direct and indirect effects of foreign direct investment on GVCs is only just now picking up steam. Being able to integrate FDI statistics with TiVA indicators would allow researchers to understand just how much domestic value added is being generated by domestic firms, versus foreign-owned firms.

Finally, Barrios et al. (2011) and Javorcik (2004) analyze the spillovers in the horizontal and vertical linkages in the GVCs. Additionally, they investigate how these changes in the patterns of trade can lead to an economic and social upgrading, provided adequate policies that enforce the development in the developing countries (Gereffi & Fernandez-Stark, 2016; Lee & Gereffi, 2015).

[34] The value added of industries in producing the final good

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