Price and Quantity Indicators of Latin American and Caribbean Trade

This document serves as a discussion of the methodology of the Inter-American Bank Integration and Trade Sector (INT) Export and Import External Trade Indices in the context of the greater theoretical and Latin American context. Part One of this document serves as a theoretical review on the best practices and characteristics of the indices. Part Two follows with examples from Latin America on methodologies from national institutes, highlighting Argentina, Colombia and Uruguay. A table in this section also offers a snapshot of the range of years and frequency of the national indices available in the region. Part Three delves into the methodology of the indicators that INT created in 2014 for all Latin American countries with publically available data, explaining not only the data collection and formulas used, but also the method of data correction. Last, the document presents a comparison between INT and other existing indices, highlighting the benefits and drawbacks of the indicators and their products. The analysis concludes that INT indices are comparable to both CEPAL and national methodologies, but have the advantage of being based completely on national data, and as a result fully reflect the prices received and paid for by all national economies.

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OBJECTIVE

Price indices play an important role in macroeconomic monitoring and policymaking by representing the proportionate price changes of goods and services over time. The four major types of price indices include the consumer price index (CPI), the producer price index (PPI), and the export and import price indices.

Specifically, export and import price indices represent the average change in prices of the entirety of goods and services exchanged between a given country and the rest of the world. A popular use of the export and import price indices is for the calculation of the Terms of Trade, the quotient of the export and import indices of a given country with the rest of the world. Importantly, the Terms of Trade represents the development of relative prices and a country's purchasing power of exports to imports. The objective of this document is to present a methodology for import and price indices of the external sector that is comparable across countries and reflects the prices received and paid by countries in international trade.

Part One of this document serves as a Theoretical Review on the best practices and characteristics of the indices. The methods available for data collection and calculation of the import and export price indices are varied, and advantages vary with their use. Part Two follows with examples from Latin America on methodologies from national institutes, highlighting Argentina, Colombia and Uruguay.

Part Three then delves into the methodology of the indicators that INT created in 2014 for all Latin American countries with publically available data, explaining not only the data collection and formulas used, but also how the data was cleaned. Last, the document presents a comparison between INT and other existing indices, highlighting the benefits and drawbacks to the indicators and methodologies used.

The analysis concludes that INT indices are comparable to both CEPAL and national methodologies, but have the advantage of being based completely on national data, and as a result fully reflect the prices received and paid for by the national economies.

1. PART ONE: THEORETICAL REVIEW

There are several international institutional studies dedicated to highlighting best practices behind the creation of import and export price and quantity indexes, most notably those by the United Nations (1977, 1981, 1983, 1991, 1992, 1998, 2005, 2010, among others) and the *Export and Import Price Index Manual* published by the International Monetary Fund in 2009. This discussion uses these publications as main sources and serves to highlight the important notions and outputs of the major indices.[1]

[1] For an in-depth discussion on non-theoretical issues such as the definition of the 'elemental unit' used in the practice of many index calculations, the selection of the sample, the homogenization of unit values, treatment of atypical entries, and more, the reader is highly encouraged to consult the literature referenced throughout the Technical Note, especially the *Export and Import Price Index Manual*, published by the International Monetary Fund and the fruit of a joint effort by the International Monetary Fund, the International Labour Office, the Organization for Economic Co-operation and Development, the Statistical Office of the European Communities, the United Nations Economics Commission for Europe, and the World Bank (2009).

The Theoretical Review features a discussion of the theoretical and practical issues surrounding data collection and calculation of the import and export price indices, two major areas in which the statistician makes decisions that affect the outcome of the indicators.

The section first discusses the alternatives for data sources and the benefits and drawbacks associated with each type. The section then probes Index Number Theory and discusses the concepts behind choosing and applying the variety of index formulas available.

The study divides these indices into two main parts, the Lowe indices and their geometric counterparts, then discussing the interrelations in the outcomes achieved with their application. It sums up the presentation of indices with an introduction of the Symmetric indices. Although the formulas proposed are varied, the list is by no means exhaustive.

The Theoretical Review concludes with the proposal of two methods, the axiomatic and economic approaches, by which to choose the formula, and an introduction on the nature and benefits of the 'Superlative formulas', which both approaches conclude are the optimal equations for the indicators.

1.1 Data Collection

This section introduces the two types of records used for the creation of the indices: disaggregated customs data and import/export establishment survey data. It first describes the data types and then enters into a comparison of advantages and disadvantages to both.

The section concludes that although the most widely used data type is disaggregated customs data, import/export establishment survey data is the optimal source for the indices (IMF 2009, 71-90) and (UN 1981, 5-12). Alternatives such as mirror prices and international commodity prices exist for when neither of the abovementioned options is available.

1.1.1 Customs Data

Disaggregated customs data refers to the information extracted from customs documentation on the entry and departure of goods from national borders. This information may be available at a highly detailed level to the entities that calculate the indices, such as Central Banks and national statistical agencies.

While the details of the data may vary, the minimal variables needed include:

- Product code[2]
- Value of the traded good
- Volume of the traded good
- Trade year
- Direction of trade

Additional variables include product description, the method of departure/arrival, export/import establishment, and partner country. These additional variables may help tailor the indices when it comes to homogenizing the prices and quantities along different periods of time. Furthermore, this data may be of a monthly, quarterly or annual frequency.

Data entries may be aggregated by product category in a given unit of time, by import/exporters, or a combination of variables, depending on the level of detail desired. After the desired aggregations, the quotient of the value and volume of

[2] Product code may vary according to a national, regional, or international nomenclature.

the traded good is used to calculate the price proxy 'unit value,' ($unit\ value = \frac{Value}{Quantity}$). As such, indices based on customs data are usually referred to 'unit value indices'.

1.1.2 Survey Data

Survey data originates from the detailed survey of import and export establishments. Using survey data entails the creation of a database assembled solely for the purpose of import/export price and quantity indices. It requires a constant conversation between the calculating agency and national import/exporter firms that monitors the characteristics of products in each category for changes that might make them non-comparable over time. In order to be comparable, all price-determining characteristics must remain constant over time. Surveyed characteristics include conditions of sale, type of item, purchaser, and transport costs.

1.1.3 Advantages and Disadvantages of Customs and Survey Data

Few question the superiority of establishment data over customs data, as unit value index changes may be due not only to price changes, but also in quality, and their reliability depends on the homogeneity of the items aggregated and compared over time. This in turn relates to how specifically the products are themselves defined. In short, unit value indices work well for the aggregation of identical, homogeneous items, but are biased for the aggregation of different, heterogeneous goods. Their shortcomings with regard to the problems listed here are usually termed 'unit value bias'.

Despite the technical superiority of survey data, institutions tend to use customs data. According a United Nations (2005) publication entitled *National Practices in Compilation and Dissemination of External Trade Index Numbers*, of 77 country respondents from around the world, 95% used customs records as sources for their import and export price indices, and 60% claimed these were the sole source of data. 35% supplemented customs records with non-customs sources, and only 5%, calculated indices from only survey data.

However, a later UN (2007) publication, the *Survey on Country Practice Export Price Indexes,* presents slightly different values. According to the publication, 88.4% of the countries surveyed use customs declarations as the main source of data, with a marked difference between developed and developing economies, of which 55.6% and 97.9% use customs data, respectively. Developed countries also tended to use a wider variety of data sources, including tax information and establishment surveys, allegedly due to the simplification of customs procedures and lack of information there from. In the process of transition from Customs to survey data, some countries use a mix of both types, resulting in a source termed 'hybrid' data.

The prevalence of customs data in the face of its relative theoretical shortcomings suggests that several practical benefits and drawbacks play into the final decision of the statistician. Table 1 below summarizes the benefits and drawbacks to using the two types of data.

TABLE 1 – ADVANTAGES AND DISADVANTAGES OF USING CUSTOMS AND SURVEY DATA

	Advantages	**Disadvantages**
Customs Data	• Unparalleled coverage • Updated and corrected regularly • Relatively easy and affordable conversion to indices	• Exports tend to not be reported as well as imports as the latter are scrutinized for tariffs • There is a lack of control over what is being compared due to broad product categories and limited distinction between contract specifications, if any • Not all products are disclosed, including large products with occasional exchange, like ships and arms • Quantity data comes at varying levels of quality
Survey Data	• Compares homogeneous products with great accuracy	• Difficult to survey the range of importers and exporters available in the Customs Data • Depending on the specificity of the characteristics desired, there is a risk of not being able to compare similar products over time • Creating product categories according to different features requires high level of expertise in different industries, econometrics and statistics as well as the resources to create and maintain it • It is difficult to survey the same importers over time as they are subject to a high turnover, and may even appear for only a specific period or product • There are time-lags between contract agreement (price determination) and the moment of trade

Sources: (IMF 2009, 71-90) and (UN 1981, 5-12)

Despite customs and survey data being the main sources for import and export price indices, alternatives exist. Where an agency lacks the resources to collect survey data but also finds shortcomings in their customs data, they may choose to use these options. Indeed, many countries use a mix of Customs data with the following alternatives: inference of prices for one product group from a similar one, global and mirror prices (the price index calculated by the partner country of the transaction), international commodity prices[3], and producer prices indices (PPI, price changes from output to all consumers, both domestic and foreign). Using each of these alternatives involves a set of assumptions that may or may not hold for a specific industry or country for the use of import and export price indices. However, due to the range of products exchanged, it is common to resort to alternative measures of data collection.

1.2 Index Number Theory

This section explores Index Number Theory and discusses the concepts behind choosing and applying the most widely used index formulas available.

It divides the indices into two main types, the Lowe indices and their Geometric alternatives, eventually discussing the interrelations in the outcomes achieved with their application. The Lowe indices were chosen as the two elemental and recognized Laspeyres and Paasche are derivatives of it. The Geometric indices are appropriate alternatives.

After the discussion on interrelations, we know that the 'true' index is somewhere between Laspeyres and Paasche and that the closest intermediate approximations are the geometric versions of these two. This section thus concludes with an introduction of the Symmetric indices, which have characteristics that tend to offset disadvantages of the aforementioned formulas.[4]

1.2.1 Lowe Indices

One popular class of price indices computes the percentage change of prices between two periods with the total cost of producing a fixed set of product quantities, generally described as a 'basket.'

In principle, any set of goods can serve as the basket. Importantly, the basket year does not have to be restricted to the basket in use in one or other of the two periods being compared. As such, this index has 'hybrid weights', which means that where

$$b = quantity\ reference\ period,$$
$$0 = price\ reference\ period,\ and$$
$$t = index\ year\ period,$$

prices and quantities belong to different periods, 0 and b respectively, but as a requirement, $b \leq 0 \leq t$. For instance, the values may by b=2005, 0=2007 and t=2014.

Table 2 below presents the general Lowe formula.

[3] A key assumption is that there is little to no price discrimination between countries (IMF 2009, 7). In advocating stratification by country of origin/destination, UN (1981) implicitly argues against this as a strategy. But there may be product areas for which this is useful.

[4] Although the formulas proposed are varied, the list is by no means exhaustive. The discussion simply serves to highlight the important notions and outputs of the major indices and the reader is highly encouraged to consult the literature referenced throughout the Technical Note.

TABLE 2 – THE GENERAL LOWE FORMULA

Index	Ratio of Two Value Aggregates	Weighted Arithmetic Average	Weight	Specification	Comments
Lowe	$P_{Lo} = \frac{\sum_{i=n}^{n} p_i^t q_i^b}{\sum_{i=n}^{n} p_i^0 q_i^b}$	$P_{Lo} = \sum_{i=1}^{n} (p_i^t/p_i^0) s_i^{0b}$	$s_i^{0b} = \frac{p_i^0 q_i^b}{\sum_{i=1}^{n} p_i^0 q_i^b}$	• *0* = price reference period • *b* = quantity reference period • *t* = index year period	This index has 'hybrid weights', which means that prices and quantities belong to different periods, 0 and b respectively, but as a requirement, $b \leq 0 \leq t$.

Source: (IMF 2009, 28)

Laspeyres and Paasche are well-known Lowe index derivatives. In them, the weight and price reference periods are b=0 and b=t, respectively. As a result, the Laspeyres price index, $\mathrm{P_L} = \frac{\sum_{i=n}^{n} p_i^t q_i^0}{\sum_{i=n}^{n} p_i^0 q_i^0}$, compares the price and quantity of a basket of goods of the base year 0, to prices in period t and quantities in year 0. On the other hand, the Paasche price index, $\mathrm{P_P} = \frac{\sum_{i=n}^{n} p_i^t q_i^t}{\sum_{i=n}^{n} p_i^0 q_i^t}$, compares the price of year 0 and current quantities t to current prices and quantities of year 0.

In turn, these indices can be written as averages of price ratios. The Laspeyres index can be written as a weighted average of *n* product's present price over base year price ratio, weighted by the share of product *n* over total value in the base period. The Paasche index, on the other hand, can be written as an harmonic average of *n* product's present price over base year price ratio, weighted by share of product *n* over total value in the present period.

Table 3 summarizes the index formulas.

TABLE 3- LASPEYRES AND PAASCHE FORMULAS

Index	Ratio of Two Value Aggregates	Weighted Arithmetic/Harmonic Average	Weight	Specification	Comments
Laspeyres	$P_L = \frac{\sum_{i=n}^{n} p_i^t q_i^0}{\sum_{i=n}^{n} p_i^0 q_i^0}$	$P_L = \sum_{i=1}^{n} (p_i^t/p_i^0) s_i^0$	$s_i^0 = \frac{p_i^0 q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0}$	• 0 = reference period • t = index year period	Requires only prices to be collected on a regular basis.
Paasche	$P_P = \frac{\sum_{i=n}^{n} p_i^t q_i^t}{\sum_{i=n}^{n} p_i^0 q_i^t}$	$P_P = \sum_{i=1}^{n} (p_i^t/p_i^0) s_i^0$	$s_i^0 = \frac{p_i^t q_i^t}{\sum_{i=1}^{n} p_i^t q_i^t}$	• 0 = reference period • t = index year period	Requires both prices and quantities to be collected on a regular basis.

Source: (IMF 2009, 360-362)

These specifications with respect to the more general Lowe index give Laspeyres and Paasche outputs differing characteristics and data requirements. A well-known benefit to implementing the Laspeyres index is that it requires updates only on price data. As seen in the Laspeyres equation above, after the initial computation, the base period weight remains the same, as the reference, or base period, t=0. Paasche, on the other hand, requires both prices and quantities to be collected on a regular basis.[5]

The stability of base year quantities in the Laspeyres formula makes it relatively simple and cost-effective to compute. The Paasche index, on the other hand, requires both prices and quantities to be calculated on a regular basis. According to the *Export and Import Price Index Manual*, "If detailed data on nominal trade flows are not timely, this is a decisive practical advantage of Laspeyres […] indices over Paasche indices and explains why Laspeyres […] are used much more extensively than Paasche indices" (IMF 2009, 30).

1.2.2 Geometric Indices

[5] In the sense that the usual use of the indices is to deflate values to decompose them into price and quantity effects, the corresponding quantity index is calculated by deflating the original value with the price index for the matching time period. For more information, see Import and Export Price Indices (IMF 2009, 360).

With exception of the original Lowe index, the indices discussed can be converted into geometric indices. The attraction of geometric indices over the non-geometric versions of the Lowe indices lies in their treatment of index value biases. As we shall see in the following section, these indices tend to fall between extremes in outputs of the non-geometric Lowe indices caused by the nature of the formulas themselves.

The Lowe index cannot be converted because the geometric counterparts are not basket indices that measure the ratio between aggregated quantities. Instead, the geometric Laspeyres and Paasche indices measure the weighted geometric averages of the price ratios, differing in the definition of the weight periods *b*, as shown in the table below. Under Laspeyres and Paasche, *b* represents 0 and *t*, respectively. This is shown in Table 5 below.

TABLE 4 – GEOMETRIC LASPEYRES, PAASCHE AND YOUNG FORMULAS

Index	Weighted Arithmetic Average	Weights	Specifications	Comments
Laspeyres	$P_{Geo} = \prod_{i=1}^{n} (p_i^t / p_i^0)^{s_i^b}$	$s_i^b = \frac{p_i^b q_i^b}{\sum_{i=1}^n p_i^b q_i^b}$	b=0	These are not basket indices; they do not measure the ratio between quantity aggregates.
Paasche			b=t	

Source: (IMF 2009, 33)

The main disadvantage of geometric indices for computing agencies is that as they are not basket indices, they are not intuitive to a broad range of potential users of the indices.

1.2.3 Fixed versus Chained weights

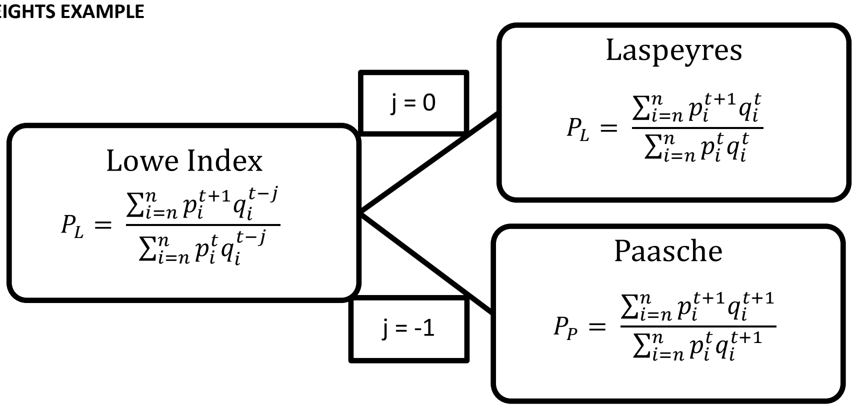
When the weights stay the same over a long period of time, it is important to evaluate the pertinence of the basket over time. Eventually, the weight year must change to account for the natural evolution of products in the trade mix.[6]

An alternative to fixing weights, as shown in the tables above, is to use moving weights. This entails comparing the present time with a certain preceding period. The example below shows the general formula for a yearly moving weighted index with a lag, *j*, pertaining to Laspeyres and Paasche index from a Lowe index where

$\mathrm{b} = \text{quantity reference period} = \mathrm{t} - \mathrm{j}$, and

$\mathrm{t} = \text{index year period} = 0.$[7]

FIGURE 1- CHAINED WEIGHTS EXAMPLE



Source: (IMF 2009, 34)

While moving weights can maintain the basket relevant, there are disadvantages. By definition of the formulas, each index is dependent on a price that came before it. The approach tends to be advantageous where changes are gradual and

[6] The *Import and Export Price Index Manual* (IMF, 2009) gives detailed instructions in Chapter 16 on how this can be done.
[7] Multiplying the indices from 0 to *t*, one can compare any time *t* to period 0

smooth, but tends to exacerbate the disparities between the different index formulas (a topic pertaining to the following section) when changes are abrupt or seasonal.

1.2.4 Interrelations

As mentioned above, Laspeyres and Paasche have different advantages and disadvantages as a result of the placing in time of the price and quantity weights presented above. These placements create systematic and mathematical interrelations between the indices that help determine the optimal index to use.

Let us suppose we take the resident perspective.[8] As residents, theory points to the following behavioral attributes: when prices rise, users shift their consumption away from products that have become relatively more expensive to those that have become relatively cheaper. This behavior is otherwise dubbed the 'substitution effect'.

We take Laspeyres and Paasche as the starting points of our comparison.

As explained, Laspeyres price index, $P_L = \frac{\sum_{i=n}^{n} p_i^t q_i^0}{\sum_{i=n}^{n} p_i^0 q_i^0}$, compares the price and quantity of a basket of goods of the base year 0, to prices in period t and quantities in year 0. Therefore, when $P_t{}^L = 1$, the index implies that the consumer could have consumed the same bundle in the base year 0 as in t.

However, suppose prices rose between 0 and t, and consumers changed their consumption pattern to account for the price changes, moving from costlier options to cheaper ones. In this case, the Laspeyres index does not take substitution effects into account. Therefore, it tends to overestimate price increases.

On the other hand, the Paasche price index, $P_P = \frac{\sum_{i=n}^{n} p_i^t q_i^t}{\sum_{i=n}^{n} p_i^0 q_i^t}$, compares the price of year 0 and current quantities t to current prices and quantities of year 0. When $P_t{}^P = 1$, the consumer in period t can afford the same bundle as in the base period 0. However, as explained above, when prices change, consumers adjust their consumption. Because the Paasche index comparison price is at time 0 instead of t and quantities are in t, it already takes into account consumption changes that occurred after price changes between time t and the base year 0. Therefore, it tends to underestimate price increases.

Following the above discussion, we can posit the following relation:

$$Laspeyres \geq Paasche$$

Of course, these outcomes depend on the products' substitution properties. when cross elasticities of demand are at unity and value shares are constant, geometric Laspeyres and Paasche indices are equal.

The positioning of the Lowe index, where b$\geq 0 \geq t$, and

$$b = quantity\ reference\ period,$$
$$0 = price\ reference\ period,\ and$$
$$t = index\ year\ period,$$

depends on a couple of assumptions, including substitution behavior and a trend of price increases. If indeed substitution effects occur as explained above, and prices tend to rise. Then,

$$Lowe \geq Laspeyres \geq Paasche$$

[8] Throughout the theoretical and practical aspects of this analysis, the point of view from which the discussion emanates is the 'resident' perspective. In other words, the export price index expresses the relative price value of the national country production to the rest of the world, and therefore represents a source of income to the country. The import price index, on the other hand, represents the price that domestic consumers pay for products from abroad. The 'non-resident' perspective would conform the opposite relations. The discussion that follows in this section and the rest of the Technical Note takes on this perspective and the outcomes for the non-resident perspective tend to simply be the opposite of the resident perspective.

Nevertheless, the positioning of the quantity reference period, *b*, is crucial for the relation between Lowe and the other two indices. The difference between Lowe on the one hand, and Laspeyres and Paasche on the other, tends to increase the farther *b* is situated from 0, the price reference period.

Indeed, if we relax the assumption that $b \geq 0 \geq t$ and $0 \geq b \geq t$, where the quantity reference period b is positioned around halfway between 0, price reference period, and *t*, the index year period, the quantities will be representative of both periods and the index will approximate itself the middle of Laspeyres and Paasche. In other words,

$$Laspeyres \geq Lowe \geq Paasche$$

In terms of how geometric indices fare in comparison to the fixed basket indices, we simply take advantage of the properties of averages, where it is stated that in any positive numbers (which indices always are), the arithmetic average (Laspeyres) is larger than or equal to the geometric average. At the same time, the geometric average is greater than or equal to the harmonic average (Paasche). These inequalities are true when all inputs are equal.

$$Laspeyres \geq Geometric\ Laspeyres \geq Geometric\ Paasche \geq Paasche$$

From this discussion, it is important to take into account that although the geometric Laspeyres does not require more inputs than the arithmetic Laspeyres, it is still situated between Paasche and Laspeyres. This is important for those institutions that do not have access to timely quantity data but would like to minimize the bias that results from the inherent natures of the formulas.

1.2.5 Symmetric Indices

From the previous discussion, we know that the 'true' index is somewhere between Laspeyres and Paasche and that the closest intermediate approximations are the geometric versions of these two. The study previously also mentioned that neither formula is by definition 'better' than the other. Presumably, a 'combination' index that values both Laspeyres and Paasche equally would tend to neutralize the substitution effects previously discussed. As such, a group called the 'symmetric' indices balance biases, and do so in different ways. The most applied symmetric indices are: Fisher, Walsh and Tornqvist.

Table 6 summarizes their specifications.

TABLE 5 – COMMON SYMMETRIC INDEX FORMULAS

Index	Formula	Description
Fisher	$P_F{}^t = \sqrt{P_L{}^t * P_P{}^t}$	The geometric average of Laspeyres and Paasche indices.
Walsh	$P_W = \frac{\sum_{i=1}^{n} p_i^t \sqrt{q_i^t * q_i^0}}{\sum_{i=1}^{n} p_i^0 \sqrt{q_i^t * q_i^0}}$	The quantity weights are geometric averages of the quantities in both periods. As opposed to using arithmetic averages, the quantities are given equal weight.
Törnqvist	$P_T = \prod_{i=1}^{n} (p_i^t / p_i^0)^{\sigma_i}$	The geometric average of the price relatives weighted by the arithmetic average of the revenue shares in the two periods, $\sigma_i = \frac{s_i^t + s_i^0}{2}$.

Source: (IMF 2009, 358-384)

1.3 Discussion: How to Pick an Appropriate Formula

This section draws upon two methods[9] under which to evaluate the previously-mentioned indices for practical use. These two methods and a short description are found below:

[9] The *Import and Export Index Manual* (IMF, 2009) presents one additional method, the stochastic approach. For a thorough explanation of the three methods see Chapters 17 and 18 of that publication.

- **Axiomatic/test approach:** The main assumption of the axiomatic approach is that there is a list of properties that are most favorable for an index and the index that satisfies the greatest number of tests proving these characteristics is the fittest.
- **Economic approach:** The economic approach uses optimization behavior to formulate a favored theoretical formula to use as a model from which to identify the best practical index. A new classification of formulas, the 'superlative indices', stems from this approach.

This discussion concludes that neither approach is all-encompassing. It also establishes that while the axiomatic approach biases towards arithmetic indices, as opposed to geometric indices, and ultimately the Fisher equation, the economic approach advocates using a 'superlative' index, which Fisher also is.
If Fisher is unattainable due to data requirements, as discussed in the previous sections, the second-best option is the geometric Laspeyres. However, as also outlined in the previous sections, the geometric formulas may not be very intuitive to the general public. This could undermine the purpose of the index in the first place.

1.3.1 Axiomatic approach

As mentioned above, an important assumption under the axiomatic approach is that there are desirable properties that any index should have and that these properties are testable. Importantly, aptness may change according to the final use of the indices, and the list presented in this Theoretical Review is by no means exhaustive. Instead, it presents an example of how to rank indices on an axiomatic basis.

Table 7 below presents the most popular axioms.

TABLE 6- AXIOMATIC APPROACH TESTS

	Topic	Test	Property	Proposed by	Formula
1	N/A	Positivity Test	The price index and its constituent vectors of prices and quantities should be positive.	Eichhorn & Voeller (1976)	$P(p^0,p^1,q^0,q^1)$>0
2	N/A	Continuity Test	The price index and its constituent vectors of prices and quantities should be a continuous function of its arguments.	Fisher (1922)	$P(p^0,p^t,q^0,q^t)$
3	N/A	Identity/Constant Prices Test	If the price of every commodity is identical in both periods, then the price index should equal unity, no matter what the quantity vectors are.	Laspeyres (1871), Walsh (1901), Eichhorn & Voeller (1976)	$P(p\ \ ,p\ \ ,q^0,q^1) = 1$
4	N/A	Fixed-Basket/Constant Quantities Test	If quantities are constant during the two periods so that $q^0 = q^1 \equiv q$ then the price index should equal the value generated by trading the constant basket in period 1, $\sum_{i=1}^{n} p_i^1 q_i$, divided by the value generated by trading the basket in period 0, $\sum_{i=1}^{n} p_i^0 q_i$.	Willard Fisher (1913)	$P(p^0,p^1,q\ \ ,q\ \ ) = \frac{\sum_{i=1}^{n} p_i^1 q_i}{\sum_{i=1}^{n} p_i^0 q_i}$
5	Homogeneity	Proportionality in Current Prices Test	If all prices in period t are multiplied by the positive number λ, then the new price index should be λ times the old price index.	Walsh (1901), Eichhorn & Voeller (1976), Vogt (1980)	$P(p^0,\lambda p^1,q^0,q^1) = \lambda P(p^0,\lambda p^1,q^0,q^1)\ when\ \lambda > 0$
6		Inverse Proportionality in Base-Period Prices Test	If all period 0 prices are multiplied by the positive number λ, then the new price index is 1/λ times the old price index.	Eichhorn & Voeller (1976)	$P(\lambda p^0,p^1,q^0,q^1) = \lambda^{-1} P(p^0,p^1,q^0,q^1)\ when\ \lambda > 0$
7	Homogeneity/Invariance	Invariance to Proportional Changes in Current Quantities Test	If current-period quantities are multiplied by the number λ, then the price index remains unchanged.	Vogt (1980)	$P(p^0,p^1,q^0,\lambda q^1) = P(p^0,p^1,q^0,q^1)\ when\ \lambda > 0$
8		Invariance to Proportional Changes in Base Quantities Test	If base-period quantities are multiplied by the number λ, then the price index remains unchanged.	Vogt (1980)	$P(p^0,p^1,\lambda q^0,q^1) = P(p^0,p^1,q^0,q^1)\ when\ \lambda > 0$
9	Invariance/ Symmetry	Commodity Reversal Test	The price index should remain unchanged if the ordering of the commodities is changed.	Fisher (1922)	$P(p^{0*},p^{1*},q^{0*},q^{1*}) = P(p^0,p^1,q^0,q^1)$
10		Commensurability Test	The price index does not change if the units in which the commodities are measured are changed.	Jevons (1963), Pierson (1896), Fisher (1911)	
11		Time Reversal Test	If all the data for the two periods are interchanged,	Pierson (1896), Walsh	$P(p^0,p^1,q^0,q^1) = 1/P(p^1,p^0,q^1,q^0)$

	Topic	Test	Property	Proposed by	Formula
			then the resulting price index should equal the reciprocal of the original price index.	(1901), Fisher (1911)	
12		Quantity Reversal Test	If the quantity vectors for the two periods are interchanged, then the price index remains invariant.	Funke & Voeller (1988)	$P(p^0,p^1,q^0,q^1) = (p^0,p^1,q^1,q^0)$
13		Price Reversal Test	If the price vectors for the two periods are interchanged, then the quantity index remains invariant.	Diewert (1992)	$\frac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0} / P(p^0,p^1,q^0,q^1) = \frac{\sum_{i=1}^{n} p_i^0 q_i^1}{\sum_{i=1}^{n} p_i^1 q_i^0} / P(p^1,p^0,q^0,q^1)$
14	Mean Value	Mean Value Test for Prices	The price index lies between the highest and the lowest price relatives.	Eichjorn & Voeller (1976)	$\min_i \frac{p_i^1}{p_i^0} : i = 1, \dots, n) \le P(p^0,p^1,q^1,q^0) \le \max_i \frac{p_i^1}{p_i^0} : i = 1, \dots, n)$
15	Mean Value	Mean Value Test for Quantities	The quantity index lies between the highest and the lowest quantity relatives.	Diewert (1992)	$\min_i \frac{q_i^1}{q_i^0} : i = 1, \dots, n) \le \frac{(\frac{V^1}{V^0})}{P(p^0,p^1,q^0,q^1)} \le \max_i \frac{q_i^1}{q_i^0} : i = 1, \dots, n)$
16	Mean Value	Paasche and Laspeyres Bounding Test	The price index lies between the Laspeyres and Paasche indices.	Bowley (1901) & Fisher (1922)	
17	Monotonicity	Monotonicity in Current Prices Test	If the only change is that any period t price is increased, then the price index must increase.	Eichorn & Voeller (1976)	$P(p^0,p^1,q^0,q^1) < P(p^0,p^2,q^0,q^1)$ $if\ p^1 < p^2$
18	Monotonicity	Monotonicity in Base Prices Test	If period 0 price increases, then the price index must decrease.	Eichorn & Voeller (1976)	$P(p^0,p^1,q^0,q^1) > P(p^2,p^1,q^0,q^1)$ $if\ p^0 > p^2$
19	Monotonicity	Monotonicity in Current Prices Test	If any period 1 quantity increases, then the implicit quantity index Q that corresponds to the price index P must increase.	Vogt (1980)	$Q(p^0,p^1,q^0,q^1) < Q(p^0,p^1,q^0,q^2)$ $if\ q^1 < q^2$
20	Monotonicity	Monotonicity in Current Quantities Test	If any period 0 quantity increases, then the implicit quantity index Q must decrease.	Vogt (1980)	$Q(p^0,p^1,q^0,q^1) < Q(p^0,p^1,q^2,q^1)$ $if\ q^0 < q^2$

Source: (IMF 2009, 390-396)

The Fisher equation is the only index that fulfills all axiomatic tests. it is generally considered the optimal index for this reason. Additionally, of the twenty axiomatic tests above, some are considered more important than others. The two next best indices are Laspeyres and Paasche, although they fail Test 11, or the Time Reversal Test.

As shown in Table 8 below, the Time Reversal Test stands out as an important failure to the Laspeyres and Paasche indices. It posits that whether period 0 or t is chosen as the base period, the index should not change. While the Laspeyres and the Paasche indices fail this text, Fisher does not.

Table 8 below summarizes the axiomatic result of the main indices discussed in this text.

TABLE 7- RESULTS OF AXIOMATIC APPROACH FOR LASPEYRES, PAASCHE, FISHER, WALSH AND TORNQVIST FORMULAS

Test	Laspeyres	Paasche	Fisher	Walsh	Tornqvist
1					
2					
3					
4					
5					
6					
7					
8					
9					

Test	Laspeyres	Paasche	Fisher	Walsh	Tornqvist
10	Light grey	Light grey	Light grey	Light grey	Light grey
11	Dark grey	Dark grey	Light grey	Light grey	Light grey
12	Dark grey	Dark grey	Light grey	Light grey	Dark grey
13	Dark grey	Dark grey	Light grey	Dark grey	Dark grey
14	Light grey	Light grey	Light grey	Light grey	Light grey
15	Light grey	Light grey	Light grey	Light grey	Dark grey
16	Light grey	Light grey	Light grey	Dark grey	Dark grey
17	Light grey	Light grey	Light grey	Light grey	Dark grey
18	Light grey	Light grey	Light grey	Light grey	Dark grey
19	Light grey	Light grey	Light grey	Dark grey	Dark grey
20	Light grey	Light grey	Light grey	Dark grey	Dark grey

Notes: Dark grey: fails the test; Light grey: passes the test
Source: (IMF 2009, 390-396)

As mentioned above, the axiomatic approach is one example of how to choose an index, but it has shortcomings. Its conclusion relies on the assumptions that these tests reveal the most desirable properties of indices. A shortcoming is that depending on the preferred outcomes of the index, the list of tests could be considered 'arbitrary' (IMF 2009, 386).

Additionally, many of the tests are biased towards arithmetic indices while some, as the Törnqvist, are geometric indices. In fact, the Fisher equation owes its fame to the axiomatic approach, which Fisher was actually instrumental in developing (IMF 2009, 44).

Last, depending on the specific use of the index, it is important to note the extent to which one index fails a desired test as opposed to the number of tests that it fails.

1.3.2 Economic approach

Unlike the axiomatic approach, the economic approach departs from the purely mathematical and incorporates assumptions about the behaviors of the agents involved, which affect production activity in one of two ways (IMF 2009, 413-443):

- Export producers act to maximize profit, shifting their relative production from relatively cheaper goods to those that are relatively dearer; and,
- Importers act to minimize costs, shifting their consumption from relatively dearer goods to those that are relatively cheaper.

The implications of the economic approach highlight drawbacks in the typical Laspeyres and Paasche formulas that the axiomatic approach does not cover, namely the complete omission of substitution behavior among economic agents. Unlike the purely mathematical axiomatic approach, the economic approach does not treat quantities and prices as independent of one another. The economic approach would be irrelevant in the case of products whose production or consumption cannot change in the analyzed time period. However, for practical purposes of the construction of an index, identifying these products would not be a straightforward task. Apart from highlighting substitution bias, the economic approach aims to identify the theoretical formula that would best account for the agent's optimizing behavior so as to pinpoint the practical formula(s) that best satisfy the requirements.

In order to isolate the confounding factors that might affect final production/consumption from price changes, this approach makes certain assumptions. From the point of view of producers, the approach assumes the producer has fixed technology and inputs over the period analyzed, in other words the producer has a fixed-input output price index.[10]

The exporter can change output mix as a result of price increases (or decreases) between period 0 and 1, but must do with the same technology and inputs as period 0. The ratio of period 1 and 0 revenues now incorporate only the effects of price changes in production.

Note that these production quantities may not be observed in real data. They are generated from a given period's fixed technology production function and input level, using assumptions of maximizing behavior and dictated by relative prices. Importantly, from this approach, the goods basket in the numerator and denominator, as compared to that of the Laspeyres index, would not be exactly the same. Although the quantities are hypothetical, practical indices can be scrutinized for their proximity to the theoretical ideal.

Comparing the formulas from the theoretical economic approach to the practical ones of Laspeyres and Paasche reveals an interesting relationship. Given price increases and the profit maximizing optimizing behavior of a producer, the theoretical index will be either equal to or greater than the Laspeyres formula. This is because the producer has the possibility of, at worst, producing the same set of commodities as in period 0. The Laspeyres is therefore the lower bound of the theoretical economic index. On the other hand, the Paasche index will be the higher bound to the theoretical economic index. The theoretical output price index based on period 1 technology and inputs will increase by less than the Paasche index.

It follows that if fixed period 0 technology and primary inputs (Laspeyres) is the lower bound and fixed period 1 technology and primary inputs (Paasche) is the higher bound of the ideal index under the economic approach, then indices situated midway between these would be a potential useful approximation of the optimal theoretical index.

1.3.2.1 Superlative indices

From the theoretical discussion above follows a class of indices, the Superlative Indices, made up of those that existed well before the definition of Superlative Indices, which was pioneered by Diewert in his 1976 paper entitled "Exact and superlative index numbers".

According to the definition, an index is superlative if it is equal to a theoretical price index whose functional form is 'flexible'. A functional form is flexible if it can approximate an arbitrary technology to the second order. In other words, the technology by which inputs are converted into output quantities and revenues is described in a manner that is realistic of a wide range of forms.[11]

Importantly, the definition relates the Superlative indices to technologies represented by flexible functional forms, of which the three most widely-used are: translog, generalized Leontieff and normalized quadratic functions.

Specifically, a homogeneous quadratic production, or utility function, is flexible and corresponds to the Fisher Index. A homogeneous quadratic is a flexible functional form that can provide a second-order approximation to other twice-differentiable functions around the same point. This implies that the Fisher Index is likely to provide a close approximation to the unknown theoretical index.

An index number formula that is exactly equal to a theoretical one based on an underlying aggregator function that is flexible is also a superlative index. It follows that any quadratic mean of order r is a superlative index as long as $r \neq 0$.

The equivalent of the Fisher, Walsh, Törnqvist indices are expressed below in the form of quadratic means in Table 9.

[10] Or a fixed-output input price index, for importers
[11] (IMF 2009, 42)

TABLE 8 – SUPERALTIVE INDICES FORMULAS

Superlative Indices	Quadratic mean of order r	Weights	Specifications	Comments
Fisher	$P = \frac{\sqrt[r]{\sum_{i=1}^{n} s_i^0 (\frac{p_i^t}{p_i^0})^{r/2}}}{\sum_{i=1}^{n} s_i^t (\frac{p_i^o}{p_i^t})^{r/2}}$	$s_i^b = \frac{p_i^b q_i^b}{\sum_{i=1}^{n} p_i^b q_i^b}$	r=2	For low absolute values of r, the differences between the indices are negligible. As r increases, the indices tend to ascribe more weight to extreme price relatives.
Walsh			r=1	
Törnqvist			r→0	

Source: (IMF 2009, 43-44)

1.4 Summary

Customs data is the most widely used data type for the creation of import and export price indices. However, due to product heterogeneity in the most disaggregated levels of typical customs data, import/export establishment survey data is considered superior. Nevertheless, there are a range of drawbacks associated to survey data, including breadth of coverage and cost. On the other hand, alternatives such as mirror prices and international commodity prices can be applied when neither of the abovementioned options is available.

Index number theory provides us with various choices of formulas, including, but not limited to, those introduced in the discussion above. The text embarked upon the Lowe indices (including Paasche and Laspeyres), as well their geometric alternatives.

From the discussion on the interrelation between the indices, there is no reason to prefer the Laspeyres over the Paasche index, or the other way around, as their biases are essentially mirror images. The upside to the Laspeyres index, however, is that it requires repeated data on prices only, instead of both prices and quantities for every new period, and this may be a decisive factor in the decision regarding which to use. To be used as an input for these indices, the data must not only be available, but also clean of errors, a product that requires significant resources and expertise.

Regardless of the formula used, weights should be updated on a regular basis, and, where possible, symmetrical indices provide an alternative that tends to neutralize the biases inherent in Laspeyres and Paasche indices.

The axiomatic and economic approaches to choosing an index formula provide frameworks from which to evaluate the different formulas. Neither approach is all-encompassing, and while the axiomatic approach biases towards arithmetic indices and, in conclusion, the Fisher equation, the economic approach advocates using a superlative index, which Fisher also is.

Therefore, theory would indicate the use of the Fisher index where possible. Given the relation between the indices discussed, if a superlative index is not feasible, due to data limitations, the geometric Laspeyres would be the second-best option. Nevertheless, as mentioned, institutions may wish to steer clear of the geometric formulas because they may not be intuitive to the general public.

2. Part Two: Official Latin American Import/Export Price Indices

Following the Theoretical Discussion, Part Two presents a broader view of where Latin America stands in the creation of the import and export price and quantity indices. The first section presents a table of the national methodologies that are publically available for the region. The second section provides perspective on the creation of the indices through the presentation of three national methodologies that exemplify the array of variances in the region.

2.1 National Methodologies

The table summarizes the national methodological literature on unit value and quantity indices by country with respect to the issues discussed throughout this document, including data sources and the formulas applied. It also offers a snapshot of the range of years and frequencies of the indices available. Most of the information regards only the most recent of methodologies. Where possible, historic methodology is included in the table, as is the case with Bolivia.

The table shows that most countries use a hybrid of international commodity prices and customs data as well as either chained Laspeyres or Paasche indices as the main formulas. Most Base years range from early to mid-2000's and the indices are available at a monthly or quarterly frequency. Last, national statistics agencies or central banks tend to compute the indices.

TABLE 10- SUMMARY OF NATIONAL METHODOLOGIES

Region	Country	Data				Index					Time			Agency
		Data Source				Formulas: Price Index (Quantity Index)			Weights					
		Intl Commodity Prices	Customs	Survey	Producers	Laspeyres (Paasche)	Paasche (Laspeyres)	Fisher	Fixed weights	Chain-weighted	Base Year	Availability	Highest Frequency Available	
South America	Argentina	■	■				■			■	2004	1986-present	Monthly	Instituto National de Estadística y Censos
	Bolivia		■			■				■	1980/1990	1990-present	Quarterly	Instituto Nacional de Estadística de Bolivia
	Brazil [i]	■	■					■		■	2006	1996-present	Monthly	Fundação Centro de Estudos do Comércio Exterior
	Chile		■			■				■	2003	1996-present	Quarterly	Banco Central de Chile
	Colombia		■		■		■			■	2005	2000-2011	Monthly	Departamento Administrativo Nacional de Estadística
	Ecuador	Based on US price indices									2000	1993-present		Banco Central de Ecuador
	Paraguay	N/A												
	Peru	■	■				■			■	2002	2001-present	Monthly	Instituto Nacional de Estadística e Informática
	Uruguay		■				■			■	2005	2005-2014	Monthly	Banco Central de Uruguay
	Venezuela	N/A												
Central America	Costa Rica	N/A												
	Dominican Rep.	N/A												
	El Salvador‡	■	■				■			■				Banco Central de la Reserva del Salvador
	Guatemala†		■				■						Monthly	Instituto Nacional

Region	Country	Data				Index					Time			Agency
		Data Source				Formulas: Price Index (Quantity Index)			Weights		Base Year	Availability	Highest Frequency Available	
		Intl Commodity Prices	Customs	Survey	Producers	Laspeyres (Paasche)	Paasche (Laspeyres)	Fisher	Fixed weights	Chain-weighted				
														de Estadística
	Honduras	N/A												
	Mexico†												Monthly	Banco de México
	Nicaragua										2006	2006-present	Monthly	Banco Central de Nicaragua
	Panama	N/A												
Caribbean	Bahamas	N/A												
	Belize	N/A												
	Barbados†[β]												Monthly	Barbados Statistical Service
	Guyana													
	Haiti†												Monthly	Institut de Statistique et d'Informatique
	Jamaica†[β]												Annual	The Statistical Institute of Jamaica
	Suriname	N/A												
	Trinidad and Tobago	N/A												

Notes: [β] Uses Laspeyres for both price and quantity indices.

Sources: Information from official methodological notes detailed in the References unless the source is unavailable and indicated below.

[i] (Guimarães, Eduardo, et al. 2007)

‡ (Banco Central de Reserva de El Salvador 2010)

† (United Nations 2005)

2.2 Three National Examples

This section provides perspective on the creation of import and export price indices in Latin America and the Caribbean through the presentation of three national methodologies. These different methodologies exemplify the array of variances in the region pertaining to the following international standards in the creation of import and export price and quantum indices (IMF 2009):

- Definition of the elemental units, defined as a group of homogeneous products that can be compared over time
- Selection of the sample
- Homogenization of unit values
- Treatment of atypical values and volatility
- Definition of aggregation and classification of elemental units for the application of formulas.

2.2.1 Argentina

The Argentine National Institute of Statistics and Census (INDEC) calculates unit value price indices using the Paasche formula and deflates values, resulting in a Laspeyres quantity index. Indices are available on a quarterly frequency starting in 1993. In 2013, INDEC announced that it had reviewed its methodology and spliced previous indices to the new base year of 2004. As of early 2015, the publication of its new methodology was still underway.

The INDEC marks a distinction between products that do not tend to change over time and those that do, namely consumer durables and capital goods. A change in unit value in the latter group of products may reflect not only a change in price, but also in quality. As such, INDEC takes some price information from major exporting countries of these products.

According to international standards, the INDEC import and price indices are made up of 'elemental units', defined as a group of homogeneous products that can be compared over time (IMF 2009, 231-247). In the case of Argentina, INDEC determines elemental units using the national commodity nomenclature at its most detailed level broken up further by trading country. Where possible, customs data is prioritized. However, where customs data is not available or is considered sub-optimal, INDEC uses price information from major exporting countries. Detailed explanations regarding the aggregations can be found in the INDEC methodological note.

Apart from the determination of elemental units and aggregation into groups of products where necessary, INDEC refines the data. Two factors help decide which products are included: first, the coverage of all chapters in the national nomenclature and second, the degree of variation of the unit values of the products.

The first step is to identify those HS chapters (referring to the 2-digit level of the Harmonized system) that made up 85-90% of trade over the period 1986-1994. INDEC then keeps products that are at least 1 million USD in value. Elemental units are subsequently chosen according to a set of two consecutive tests: the first relating to the representativity of products over time, and the second with the heterogeneity of unit values.

To ensure representativity over time, INDEC keeps those elemental units that make up 80% of a given chapter in every year. After this pre-selection, INDEC applies a test for homogeneity. The underlying assumption is that heterogeneous elemental units have the most volatility because they include products with different qualities and characteristics.

In order to filter out volatile (heterogeneous) products, INDEC uses a higher coefficient of variation ($COV = \frac{Standard\ deviation}{Arithmetic\ mean}$) of elemental units compared to the equivalent group in international markets as the cut-off mark. If no equivalent is found in the international market, then the coefficient of variation cut-off is that of the corresponding HS chapter.

In terms of imports, the coefficient of variation cut off is calculated differently. The product/country combination is rejected if the annual coefficient of variation of unit values doubles the quarterly coefficient of unit values in the years 1986-1994.

When these tests for volatility are done, if 80% of a given the chapter is not covered, then INDEC discards the whole chapter for use by unit values and uses international instead. The following Table 11 summarizes the distribution of data originating from Customs versus price data from major partner countries for the years 1993-1995 as outlined in the national methodological note.

TABLE 11- CUSTOMS (UNIT VALUE) VERSUS INTERNATIONAL PRICES, ARGENTINA

	Unit Values	International Prices
Imports	41 chapters	7 chapters
Exports	38 chapters	6 chapters

Source: INDEC

After emending the data, INDEC applies formulas in a series of aggregations pertaining to the Paasche price formula. Readers are encouraged to consult Annex 1 for the specific formulas applied.

2.2.2 Colombia

The Colombian National Department of Statistics (DANE) and the National Taxation and Customs Department (DIAN) provide data to the Central Bank of Colombia for the calculation of a unit value and quantity indices of international trade using a chained Paasche and corresponding Laspeyres price and quantity formulas, respectively. The base year is 2005 and indices are available starting from the year 1995 in monthly frequency (Garavito, Aaron, et al. 2011).

As outlined for the case of Argentina, the Central Bank follows international standards in the definition of the elemental unit, the selection of the sample, and the homogenization of atypical values and volatility. The elemental units are compiled at the 10-digit national nomenclature level and month and year, aggregating partner country, type of transport and import/export establishment.

In order to avoid lack of representativity and prevalence over time, the Central Bank excludes some elemental units before the volatility tests. First, in order to ensure representativity, the Central Bank retains elemental units that cover more than 90% of total import and export transactions. If less than 77% of the value by HS chapter-level remains, the Central Bank adds from those that are otherwise excluded. In terms of prevalence over time, those elemental units that were traded for more than three years during the 1995-2010 period, or have been traded at a 'significant' level over the most recent years, are retained. This first filter includes 95% and 96% of total exported and imported value, respectively.

Within these elemental units, atypical values can throw off the sample and suggest more variability than actually occurs. The Central Bank identifies the elemental units to be excluded by calculating the standard deviation of unit values with respect to the modified mean of the items in the same elemental unit. Under the assumption of a normal distribution, this modified mean excludes extreme unit values within the elemental unit. Specifically, the Central Bank replace unit values outside two standard deviations by the modified mean of the group. In most cases, the replacement of unit values according to the modified mean decreased the volatility of the sample. However, where it did not improve the volatility, the Central Bank kept the original values.

Additionally, with the exception of some elemental units deemed homogeneous in all cases, such as crude oil, coal, coffee and bananas, the Central Bank implemented further volatility tests. Those unit values that fell outside of three standard deviations of the arithmetic mean are replaced with the arithmetic mean of the six adjacent periods.

In the last step of data cleansing, products are pooled by chapter instead of elemental units. The Central Bank then calculates the coefficient of variation of the monthly percentage variation. With exceptions for some specific products, those values that fall 30% above or below the median are considered volatile and the corresponding product is excluded. The final sample comprises on average 93% and 89% of total exported and imported value, respectively.

The Central Bank of Colombia also uses an alternative data source, the surveys of the producer price indices, for a second version of the same indices. The formula used is a fixed weight chained Fisher index (Banco de la República de Colombia 2011).

2.2.3 Uruguay

The Central Bank of Uruguay (BCU) calculates monthly unit value and quantity deflators using the Paasche formula and a base year of 2005 for a three month moving average centered in the reference period (t), a proxy for the index in period (t) Banco Central de Uruguay 2012).

As is the case with Argentina, BCU removes some capital goods from the original sample replaces them with international unit values because some products with in the same tariff line are heterogeneous and unit values from customs declarations might reflect changes in composition of the goods rather than changes in prices. The raw data used contains the following variables: product code following the MERCOSUR nomenclature, values (FOB or CIF), volumes, importer/exporter and trading country.

The first step is neutralizing unit values with excessive variation. Entries are grouped at the MERSOSUR 10-digit level. They are ordered and separated into quartiles. All those values that satisfy either of the equations below are dropped.

$$Q_1 - 1.5(Q_3 - Q_1) > x$$

$$Q_1 + 1.5(Q_3 - Q_1) < x$$

With the products that remain, BCU creates elemental units with the combination of 10-digit product code, partner country, and import/export establishment. Given this breakdown, the BCU calculates the price index for each elemental unit using Paasche, the base being the same month a year earlier, and the present period (t) being the sum of three months centered at (t).

Nevertheless, the elemental units are then subject to another filter to eliminate any possibility of heterogeneity. Specifically, the BCU deletes a maximum of 20% of elemental units whose indices are different than the median of all those who share the same 2-digit chapter.

With this sample, the BCU recalculates the index with a 'new' elemental unit, a combination of the same 10-digit product code and partner country.

There are then three steps to expand the scope of the elemental units included. The assumption is that the elemental units that were excluded in the prior steps would have had a similar growth rate as those that remained. The BCU takes the average estimated change for those that were included in the final index, and extrapolates that growth rate to those elemental units left out, then aggregating from 10 to 8 and later 6 digits. There result is a yearly Paasche price index with a moving base at the Harmonized System 6-digit product level and partner country.

At this point, it is possible to construct the index by country or by group of countries. The total is also possible by aggregating the sub- indices.

3. Part Three: INT Indices and Comparison

Part Three presents the INT methodology for price and quantity indices. It also compares them to other indices of the region calculated by CEPAL and national methodologies.

The first section describes that into preliminary data adjustment and methodology used, culminating with an explanation of the mechanism used to correct data of faulty entries. The discussion also highlights the fact that due to the source of the data, INT indices are preliminary estimations for an average of two years.

The second section introduces CEPAL's methodology and then compares INT indices with it for all countries that both methodologies cover. This section then compares two specific countries: Brazil and Bolivia, chosen for evidencing issues associated to the importance of the quality and nature of the underlying data, regardless of the methodology.

As it is not possible to compare the wide range of national methodologies in the same fashion as the CEPAL and INT comparison, the section then compares INT indices with the national indices of those countries whose methodologies were highlights in Part II: Argentina, Colombia and Uruguay.

The discussion helps uncover a general concurrence between both INT and CEPAL indices as well as INT and national indices, despite the differences in methodologies. This analysis therefore sets INT as a comparable index, one that has the advantage of being based solely on the data individual countries report for their goods, which may be different from international prices.

3.1 Data Sources and Methodology

The Integration and Trade Sector of the Inter-American Development Bank hosts INTrade, a database that compiles national data and in-house trade indicators pertaining to Latin America and the Caribbean. In its 2014 version of the yearly Integration and Trade Monitor publication, *Facing Headwinds: Trade Policies to Support a Trade Recovery in the Post-Crisis Era*, INT published a first version of the price and quantity indicators for all countries in Latin America. These indices have the particularity of being the only indices calculated on a large scale for all the countries with available customs data for Latin America and the Caribbean using the same methodology, therefore allowing them to be compared.

The countries included in the current methodology[12]:

- Argentina
- Bolivia
- Brazil
- Chile
- Colombia
- Costa Ric
- El Salvador
- Ecuador
- Guatemala
- Guyana
- Honduras
- Jamaica
- Nicaragua
- Paraguay
- Peru
- Uruguay

With the compilation of customs data disaggregated by partner country and product, the INTrade database lends itself well to the use of unit value indices to create the price and quantity indices for the region. As presented in the 2014 Integration and Trade Monitor, INT presents the international commerce transactions for the above countries over the period of 2002-present.

[12] Mexico and Venezuela were calculated using mirror prices as declarations are not up to date.

In most cases, INTrade data includes the following variables:

- Product number in HS code (at the 8 or 10 digit level)
- Product description
- Trade direction (either import or export)
- Trade partner[15]
- Transport mechanism[13]
- Trade Year
- Value [14]
- Volume[16]

Depending on the country, the HS code may have been at the 8 or 10 digit level, while the highest disaggregation according to the international HS standard is 6-digits. Depending on the quality of the data and product classification over the years, countries had varying margins of error at different aggregations of the HS code. This methodology aggregates the first four digits of the HS code to make it possible to apply one methodology to all countries.[17]

Additionally, chapters 00 (existent only at the national level and used for exceptional/non-traditional, one-time goods), 77 (reserved for possible future use), 98 (special classification provisions) and 99 (temporary legislation; temporary modification, etc.) were excluded from the calculation because of the heterogeneity of the products destined to those chapters.

The base year was selected after a careful consideration. The base year must be recent but also comparable to the first years of the index. This ensures that the products and their quantities are comparable to most years and within the time period of 2002-present. The base year must also benefit from stability and a lack of immediately preceding or proceeding crises. This is especially in commodity prices, as per the major exports of the region.

Within the index time frame and the context of Latin American and Caribbean trade, 2002 and 2008 were inappropriate due to their proximity to international and regional crises. The years 2003-2007 and 2010-2012 remained. 2005 was chosen both for its use as a base year in other institutional and national indices (implying the ability of comparing INT indices to them), as well as for its stability.[18]

Due to the limitations of needing updated price and quantity data for Paasche and the lack of intuitiveness of the geometric indices, the formulas used was a simple Laspeyres index for prices and the equivalent Paasche for quantities.

Unit value index : Laspeyres, fixed base, unchained, $P_t{}^L = \frac{\sum_i p_t^i * q_0^i}{\sum_i p_0^i * q_0^i}$.

Quantity index: Deflate the value with the unit value index, equivalent to Paasche, fixed based, unchained, $Q_t{}^L = \frac{\sum_i p_t^i * q_t^i}{\sum_i p_t^i * q_0^i}$.

3.2.1 Selection Procedures

Due to the nature of the formulas used, items without quantity data available for any year, were dropped. Additionally, to create an index with representativity of relevant trade, all items with a value of less than US$ 1 million were excluded.

As suggested by relevant literature, the data was purged for errors, "subject to the need to provide broad representation, unit value indices that exhibit exceptional price changes should be excluded" (IMF 2009, 73).

[13] Variable not used in this version of the indicators
[14] To homogenize units, we converted value data to thousands of USD, where necessary.
[15] Variable not used in this version of the indicators
[16] To homogenize units, we converted quantity data to thousands of kilos, where necessary.
[17] Amendment as of March 2015: all HS codes that suffered official changes to Harmonized System classification are converted to a common denomination.
[18] As discussed in Part I: Theoretical Review, the base year must be changed to reflect the traded products over time. As of March 2015, 2010 was selected as base year.

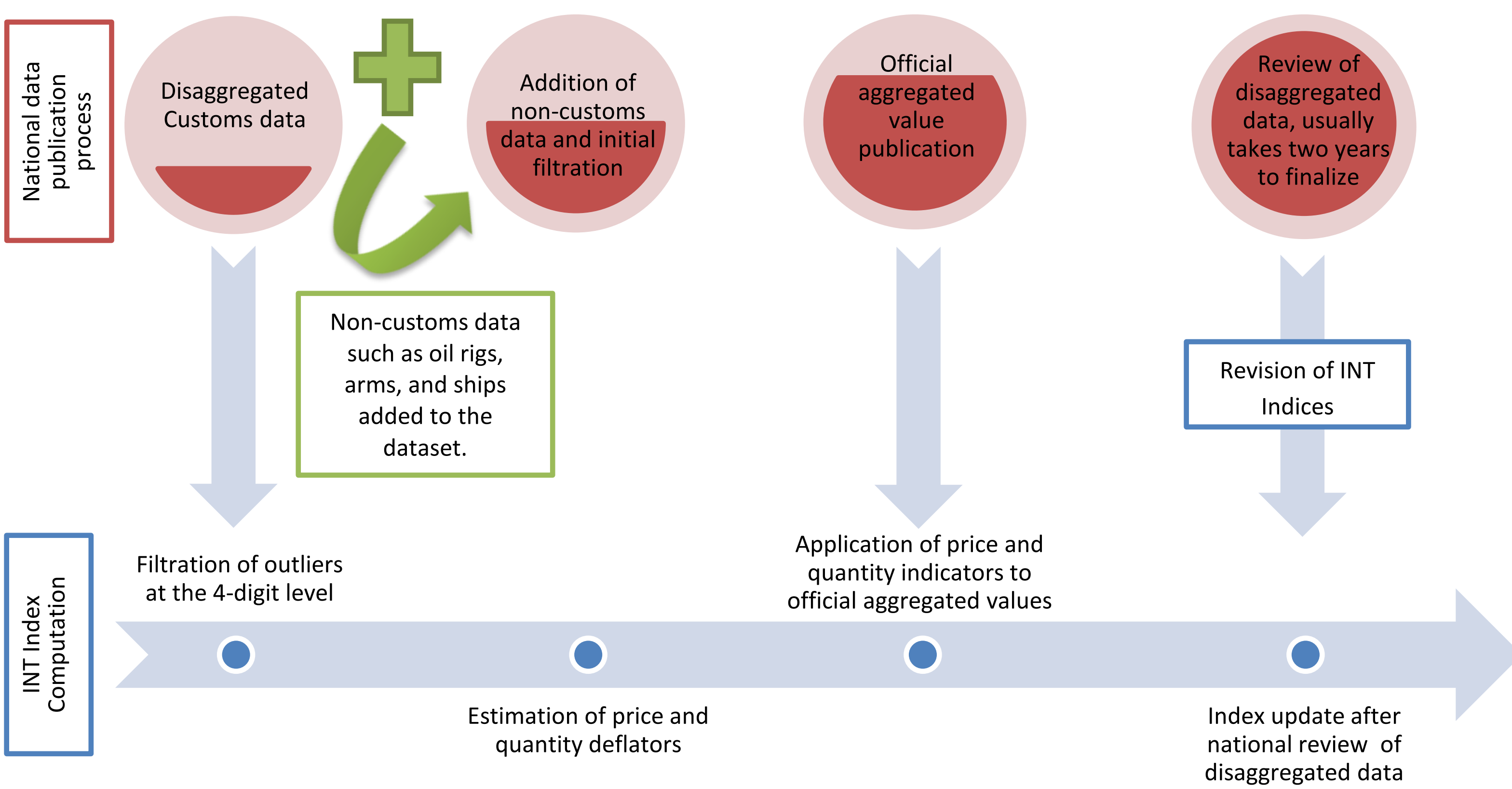
In years with important discrepancies, we searched for errors in the database to correct unit errors, mostly due to the faulty inscription of values at customs. Once the 'problem year' was identified, the methodology tried to find which specific product(s) caused the anomaly. It was usually straightforward to tell if there was a mistake in the units used, for instance, kilograms instead of tons. Every 'problem product'[19] was analyzed. Where there was a clear mismatch of decimal points the error was fixed by dividing or multiplying by the relevant unit of 10. However, where it was not possible to tell why the value or volume was incorrect compared to the entire data series, the specific year-product-direction of trade combination was eliminated.

3.2 Use of Indices

The creation and application of price and quantity indices outlined here fits within a parallel processes led by national statistical and customs agencies.

Figure 1 below depicts the national data preparation process (above) alongside INT unit value and quantity index computation (below).

FIGURE 2- PROCESSES OF DATA PUBLICATION AND REVISION



Due to the fact that some INTrade data is composed of primary data from customs offices, the data can lack the initial filtration done in national accounts offices. To neutralize the potential effects of errors in INT primary data, it is necessary to deflate the official aggregated values with the computed price and quantity index ratios. Additionally, due to the ongoing

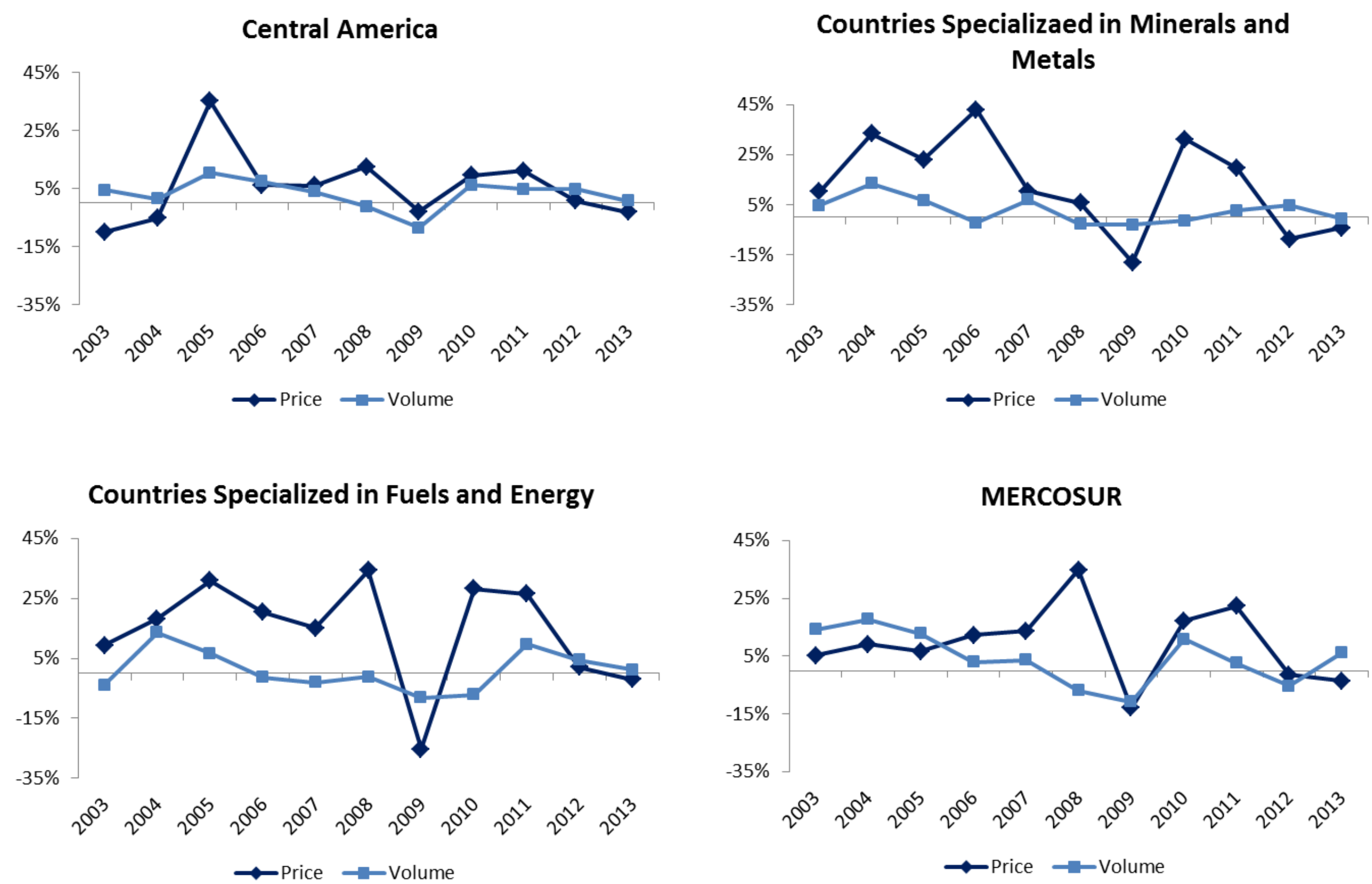
[19] Defined as a product where the quantity (price) index of a particular product in one year fell or increase significantly compared to its general path.

national revision of data of usually two years, depending on the country source, indices published for recent years serve as estimations and are subject to revisions and updates by INT.

Using aggregate values, it is possible to group countries by regions or primary exports, as was done in the *2014 Integration and Trade Monitor*.

Figure 3 below exemplifies this aggregation.

FIGURE 3- EVOLUTION OF PRICES AND VOLUMES OF LATIN AMERICAN EXPORTS - (ANNUAL GROWTH RATES, 2003-2013)



Note: Central America includes Costa Rica, El Salvador, Honduras, Guatemala and Nicaragua. Countries specialized in minerals and metals include Chile and Peru. Countries specialized in fuel and energy include Bolivia, Colombia, Ecuador, and Venezuela. MERCOSUR excludes Venezuela.

While using disaggregated national customs data for a broad section of the Latin American region gives INT an upper hand in the creation of import/export price and quantity indices, there are drawbacks associated to the method. As mentioned earlier, the fact that national agencies review data for a substantial amount of time, generally two years, makes recent INT indices estimative in nature.

For this reason, the quality of the data is of vital importance to the dependability and pertinence of the indicators over time. In this way, despite filtration of atypical values, the quality of the indices depends in large part in the quality of the data.

3.3 Comparison of Methodology Results

New indices, when others exist, are of little consequence unless evaluated and deemed appropriate for practical use. This section presents INT indices as compared to indices of the region calculated by CEPAL and national methodologies.

The first section introduces CEPAL's methodology and then compares INT indices with it for all countries that both methodologies cover. This section then culminates with the comparison of two specific countries: Brazil and Bolivia, chosen for evidencing issues associated to the importance of the quality and nature of the underlying data, regardless of the methodology.

As it is not possible to compare the wide range of national methodologies in the same fashion as the CEPAL and INT comparison, the second section compares INT indices with the national indices of those countries whose methodologies were highlights in Part II: Argentina, Colombia and Uruguay.

The discussion helps uncover a general concordance between both INT and CEPAL indices as well as INT and national indices, despite the differences in methodologies. This analysis therefore sets INT as a comparable index, one that has the advantage of being based solely on the data individual countries report for their goods, which may be different from international prices.

3.3.1 CEPAL versus INT

As explained above, this version of the INT indices are simple, non-chained indices of the Laspeyres and Paasche type at the 4-digit HS level. However, the simplicity of the methodology is an important facilitator in applying the index to all Latin American countries that publish data based on customs declarations. In turn, this allows an accurate comparison between countries.

In order to evaluate INT methodology thoroughly, we must have sufficiently large comparative datasets. We use CEPAL indices because the entity publishes widely-used price and quantity import and export indices for the region with the same methodology for all countries.

3.3.1.1 CEPAL's Methodology

CEPAL uses 2005 as its base year and the Paasche index as the formula for its price index. It calculates unit value indices from its database, BADECEL and in some cases, national sources as well as international commodity prices. Quantity indices are simply the result of deflating values with the Paasch price indices.

Importantly, CEPAL compares a list of selected products, or baskets, that reflect the import/export makeup of trade in different periods, which are 1970-1989 and 1990-2004.

3.3.1.2 Index Comparison: CEPAL versus INT

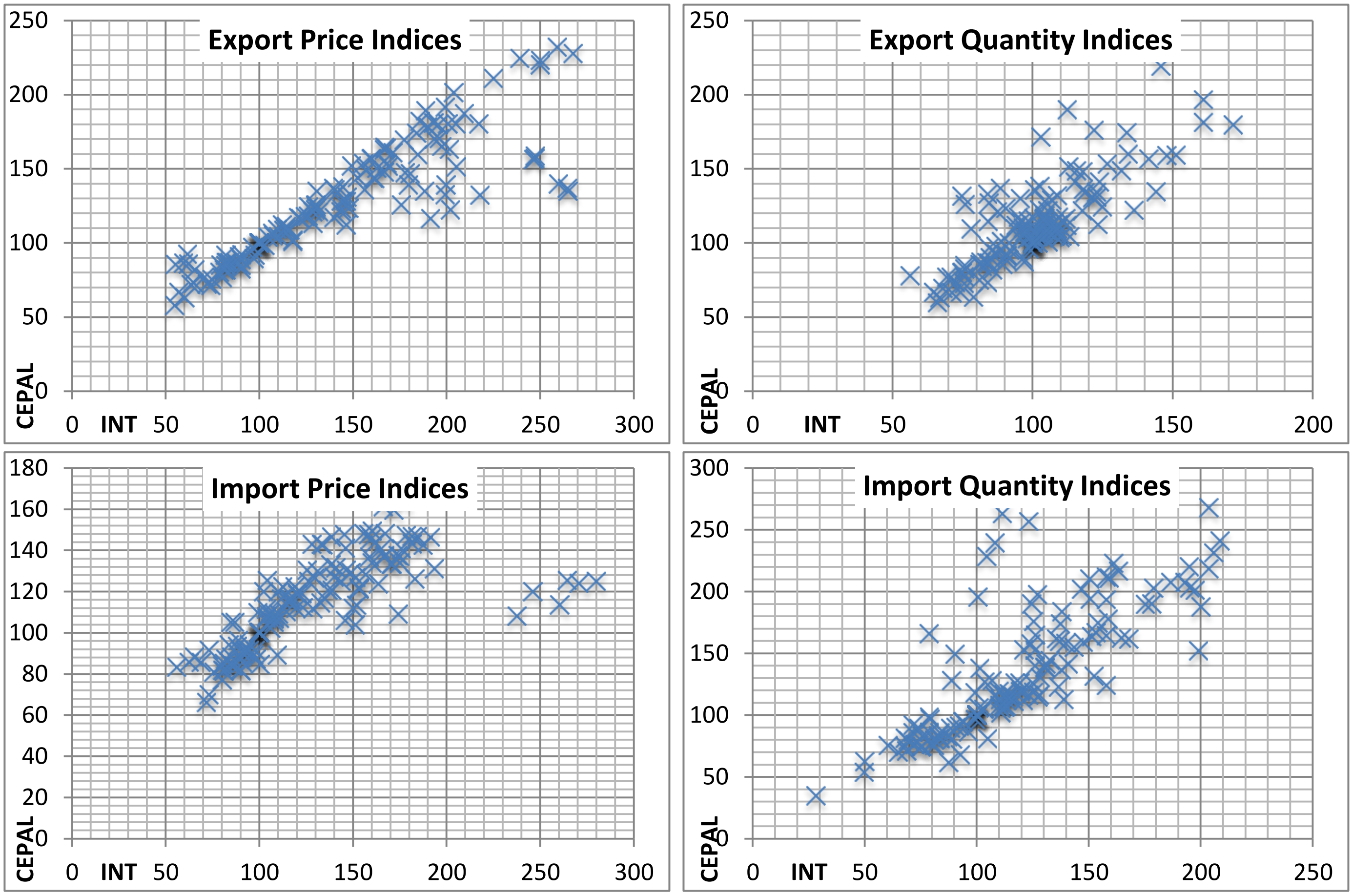
When comparing indices, it is important to keep in mind that there is not one 'correct' method, and instead a group of preferred data treatments and a group of appropriate formulas. Nevertheless, parting from the assumption that indices represent an objective reality, the preferred outcome is similar indices despite different methodologies.

The cross-plots in Figure 3 of the original indices[20], reveal general concordance between the CEPAL and INT indices, both when compared by type of index (top left and top right) and by direction of trade (bottom left and bottom right).[21]

[20] Unweighted by value as explained in section 3.2

[21] Annex 3 shows the INT, CEPAL and national indices (where available) for the countries for which INT published indices.

FIGURE 3 – INT AND CEPAL INDICES CROSSPLOTS



The following Table 12 summarizes the Coefficients of correlation for the indices between INT and CEPAL. The coefficient of correlation ranges from -1 to 1, and 1 indicates perfect correlation.

TABLE 12- COEFFICIENT OF CORRELATION, INT VERSUS CEPAL INDICES

Coefficient of correlation		
	Prices	Quantity
Exports	0.89	0.80
Imports	0.71	0.80

A reason for the greater discrepancy between the price of imports compared to exports may be that in the case of the Latin American and Caribbean region, imports tend to be more heterogeneous than exports. As a result, we may be witnessing the effects of unit value bias, where depending on the make-up of the groups compared at the most disaggregated level, indices vary.

3.3.1.2 CEPAL versus INT, Examples

The broad cross plot above is helpful in understanding the range, concordance and discrepancies between the two methodologies. However, looking closely at countries as examples can help reveal matters that are otherwise undetectable.

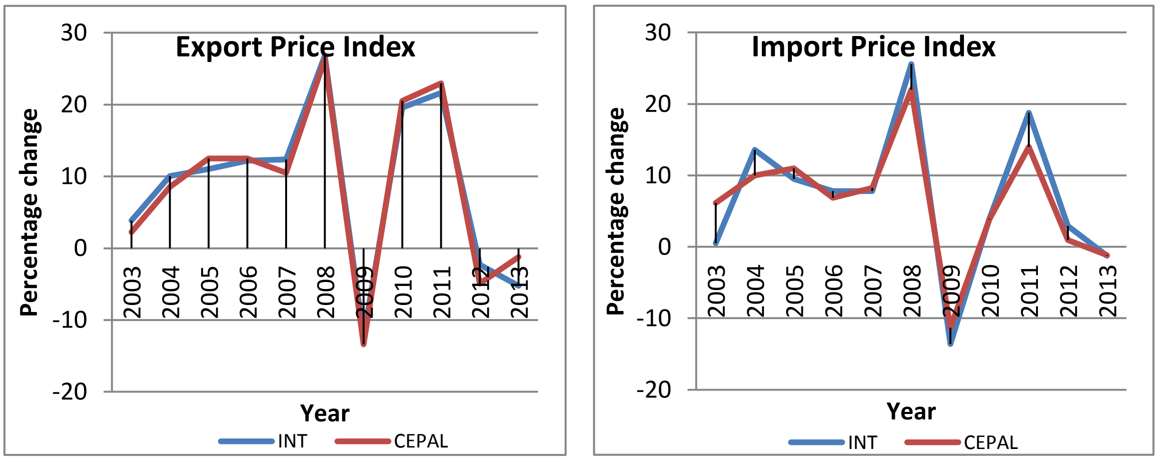
This section highlights two countries, Brazil and Bolivia, from which different questions arise given an analysis of the import and export price indices.

3.3.1.2.1 Brazil

Brazil's primary export and import customs data is preliminary and open to adjustments for a period of two and five years, respectively. However, INT methodology closely resembles the output of CEPAL. The implicit conclusion is that the INT methodology, despite using preliminary primary data, may be just as applicable as CEPAL methodology.

Figure 5 below traces the percentage changes in the indices for Brazil.

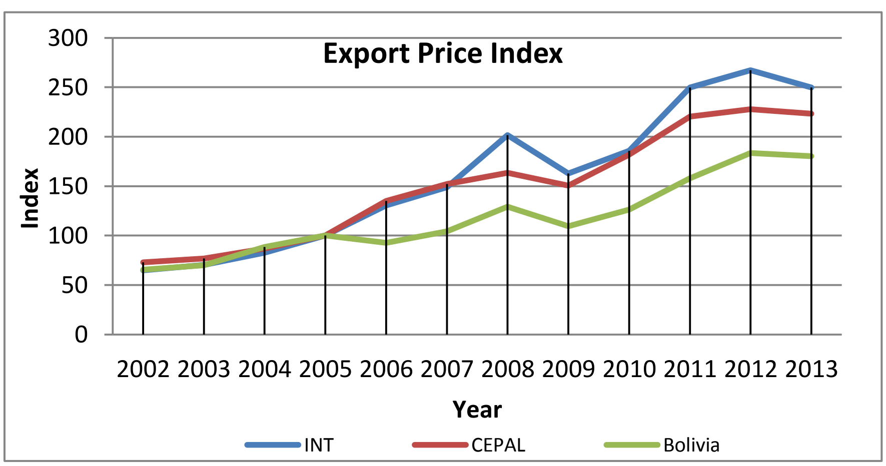
FIGURE 5 – COMPARISON INT-CEPAL, BRAZIL



3.3.1.2.2 Bolivia

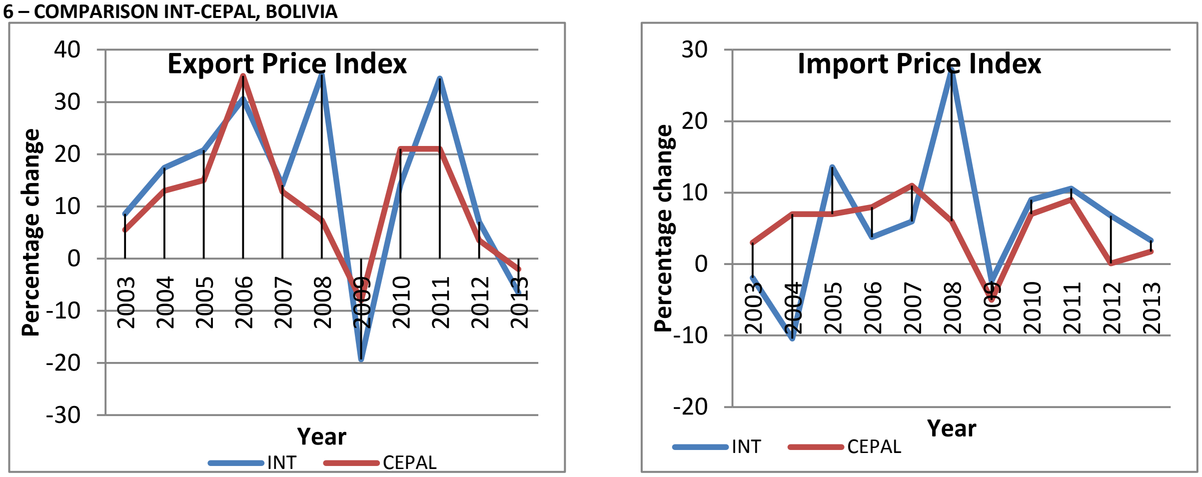
Additionally, while a mismatch between INT and CEPAL indices may be due to erroneous preliminary data, it is at times due to perhaps to differences between international commodity prices and those received by the exporting country. One such situation could be case seen as a spike in all indices for the year 2008 for Bolivia that can be witnessed in Figure 4 below, which incorporates the index published by the Bolivian Statistics Institute.

FIGURE 4: BOLIVIA PRICE EXPORTS INDEX



While international commodity prices are generally reflective of those used in national accounts, national customs records may tell a different story. Figure 6 below shows import and export price indices percentage changes for further detail.

FIGURE 6 – COMPARISON INT-CEPAL, BOLIVIA



In conclusion, INT indices are widely comparable to CEPAL's. Additionally, it is important to note that INT uses national data instead of a mix of data. As a result, it's possible to compare all countries in the region while at the same time taking into account the prices actually received and paid for by the said economies.

3.3.2 Index Comparison : National versus INT

Part II of this document highlighted the range of methodologies Central Banks and Statistics Offices tend to use to make national import and export price and quantity indices.

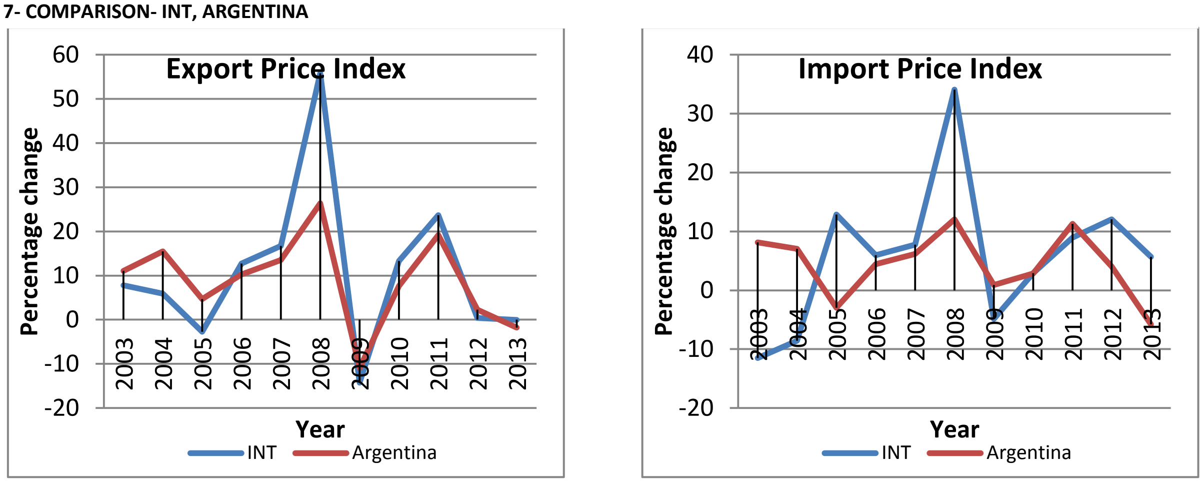
Due to the diversity of the processes, it is unreasonable to compare INT methodology with all of the region's indices at the same time. However, this section showcases the national indices of those countries that were studied in depth in Part II: Argentina, Colombia and Uruguay. The following subsections analyze the direction of variation of the national and INT indices.

3.3.2.2.1 Argentina

INT indices tend to coincide with Argentina's national indices. The export price index (Figure 7, left) shows only two years of discordance in the direction of change, 2005 and 2013. On the other hand, the import price index (Figure 7, right) shows five years of discordance. Three of these years are concentrated in the beginning of the series, between the years 2002-2005. Additionally, there is a discordance in the year of the global recession, 2009, as well as 2013.

Due to the fact that data is preliminary for two years after initial publication, both INT and national indices are subject to change for the years of 2012 and 2013. The remaining differences, especially those at the beginning of the series, are likely cause by the difference in base years (2004 and 2005, national and INT, respectively). Additionally, as clear from the discussions above, they may be caused by the differences in the correction and interpretation of errors in the data.

FIGURE 7- COMPARISON- INT, ARGENTINA

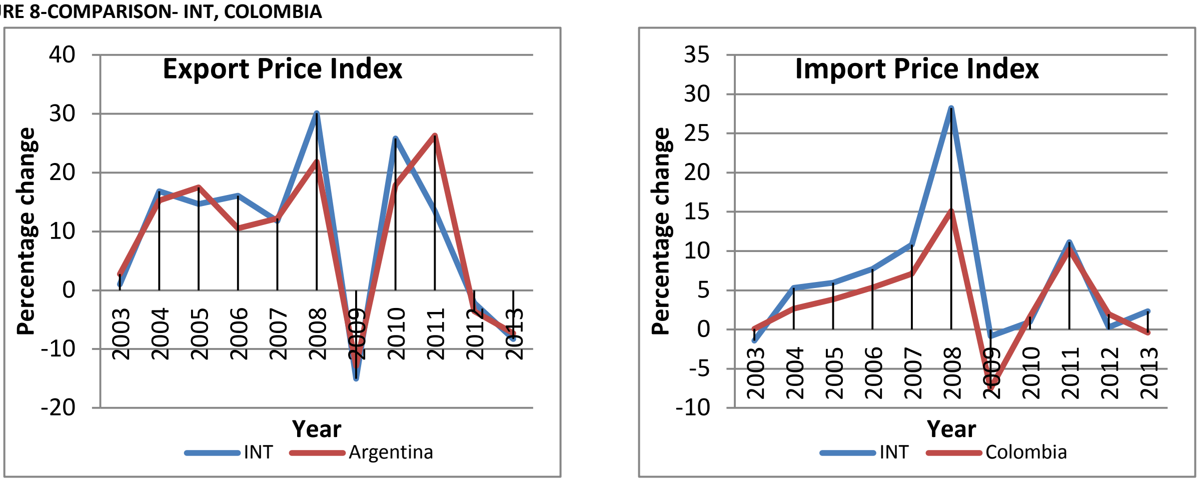


3.3.2.2.2 Colombia

More so than in the case of Argentina, Colombian national indices tend to coincide with INT indices. In fact, in terms of the direction of variation, the export price index (Figure 8, left) has no year of discordance. In terms of the import price index (Figure 8, right), the only years of discordance are at the beginning and end of the series, in 2003 and 2013. One cause of the general concurrence of the indices that was not applicable above is the unity of the base years, 2005.

As above, the last two years of data are estimations that national agencies revise. Therefore, the difference in the year of 2013 can be discounted. The reason behind the difference in variation of 2003 is unclear, but there is general concordance despite the differences in the methodologies.

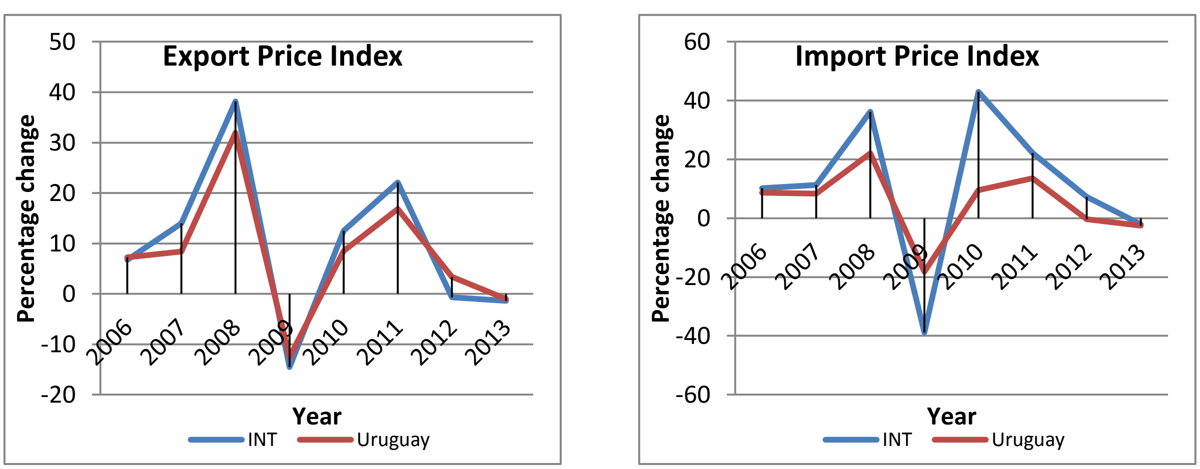
FIGURE 8-COMPARISON- INT, COLOMBIA



3.3.2.2.3 Uruguay

Similar to the case of Colombia, Uruguay shares the base with INT and this aids the similarity of the output of the indices despite the broad difference in the methodologies applied by the institutions. In this example, neither the export price index (Figure 9, left) nor the import price index (Figure 9, right) carry years of discordance. Nevertheless, there is less room for error because national Uruguay indices following this methodology are only available starting in 2005 and the national series is three years shorter than in the above comparisons.

FIGURE 9- COMPARISON- INT, URUGUAY



The analysis of Argentina, Colombia and Uruguay helped show that INT indices are comparable to the national examples despite the variations in the methodologies. An upside to the INT indices is that, unlike different national indices, they can be compared as a result of the homogeneity methodology applied to all.

CONCLUSIONS

The Integration and Trade Sector of the Inter-American Development Bank hosts INTrade, a database that compiles national data and in-house trade indicators pertaining to Latin America. In its 2014 version of the yearly Monitor publication, *Integration and Trade Monitor 2014, Facing Headwinds: Trade Policies to Support a Trade Recovery in the Post-Crisis Era,* INT published a first version of price and quantity indicators for all countries in Latin America with data available on INTrade. These indices have the particularity of being the only indices calculated on a large scale for all the countries with available customs data for Latin America and the Caribbean using only national source and with the same methodology. These characteristics allow different national indices to be compared.

Customs data is the most widely used data type for the creation of import and export price indices. However, due to product heterogeneity in the most disaggregated levels of typical customs data, import/export establishment survey data is considered superior. To be used as an input for these indices, the data must not only be available, but also free of errors, a product that requires significant resources and expertise. Alternatives exist for when neither option is available.

Index number theory provides us with various choices of formulas. The text covered the Lowe indices (including Paasche and Laspeyres), as well as their geometric alternatives. There is no reason to prefer the Laspeyres over the Paasche index, or the other way around, as their biases are equally relevant. The upside to the Laspeyres index, however, is that it requires updating only prices, instead of both prices and quantities for every additional period, and this may be a decisive factor in the decision of which to use. Regardless of the formula used, weights should be updated on a regular basis, and, where possible, symmetrical indices provide an alternative that tends to neutralize the biases inherent in Laspeyres and Paasche indices.

Theory would indicate the use of a superlative index where possible. Given the relation between indices discussed, if a superlative index is not possible, due to data requirements, the geometric Laspeyres would be the second-best option. Nevertheless, many institutions may steer clear of the geometric formulas as they may not be very intuitive to the general public.

Part Three presents INT index methodology and compares INT indices with others. The discussion highlights the fact that due to the source of the data, INT indices are preliminary estimations for an average of two years, but perhaps longer. It then compares all INT indices for the region with those of CEPAL, which use a different methodology. A discussion of two examples, Brazil and Bolivia, showcase similarities and differences in the products of the different methodologies, as well as possible reasons behind both. Last, the discussion compares national indices for three selected countries: Argentina, Colombia and Uruguay and finds general concordance with the indices.

The analysis concludes that INT indices are comparable to both CEPAL and national methodologies, but have the advantage of being based completely on national data, and as a result fully reflect the conditions of the national economy.

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ANNEX 1: ARGENTINA METHODOLOGY FORMULA DETAILS

In aggregating the products for the application of the Paasche and Laspeyres formula, individual products were aggregated into four additional levels where possible.

Moving chain weights elemental unit index is:

$$I_{ijt} = \frac{p_{ijt}}{P_{i(j-1)t}} * I_{i(j-1)t}$$

Where i= product; t= year; j= quarter

Additionally, the weight is:

$$w_{N_k j}{}^{t} = \frac{v_{N_{k+1} j}{}^{t}}{\sum_{N_k} N_{k+1} j^{t}} * 100$$

Where k=0,1,2,3,4 and is the level of aggregation in ascending order; v=value in USD

The index at every level but 1 is:

$$IP_{N_k j}{}^{t} = \left(\sum_{N_{k+1}} IP_{N_{k+1} j}{}^{t^{-1}} * w_{N_{k+1} j}{}^{t}\right)^{-1} * 100$$

The final unit value index is:

$$IP_{j}{}^{t} = \left(\sum_{N_1} IP_{N_1 j}{}^{t^{-1}} * w_{N_1 j}{}^{t}\right)^{-1} * 100$$

Where

$$P_P{}^{t} = \frac{\sum_{i=n}^{n} p_{ij}^{t}\, q_{ij}^{t}}{\sum_{i=n}^{n} p_{ij}^{0} q_{ij}^{t}} * 100$$

$$= \frac{100}{\sum_{i=n}^{n} p_i^{0} * \frac{q_{ij}^{t}}{\sum_{i=n}^{n} p_{ij}^{t} q_{ij}^{t}}} = \left[\sum_i \left(\frac{p_{ij}^{t}}{p_i^{0}}^{-1} * \frac{p_{ij}^{t} * q_{ij}^{t}}{\sum_{i=n}^{n} p_{ij}^{t} q_{ij}^{t}}\right)\right] * 100 = \left(\sum_i^{n} (I_{ij}^{t})^{-1} * w_{ij}^{t}\right)^{-1} * 100$$

ANNEX 3: FINAL INTA, CEPAL AND NATIONAL INDICES

The following table displays all openly-available indices for the countries that INT calculated using the methodology.

Country	Direction of Trade	Trade Year	Quantity Index			Price Index		
			INT	CEPAL	National	INT	CEPAL	National
Argentina	E	2002	70.7	77.0	95.3	90.1	82.5	77.9
		2003	75.7	82.8	100.1	97.1	89.6	86.5
		2004	83.5	86.9	100.1	102.8	98.5	99.9
		2005	100.0	100.0	111.7	100.0	100.0	104.6
		2006	101.8	106.2	116.7	112.7	108.6	115.3
		2007	104.8	114.4	123.7	131.6	121.2	130.9
		2008	84.0	114.5	122.5	205.0	151.4	165.4
		2009	77.9	109.4	109.3	175.7	125.9	147.3
		2010	84.4	127.2	124.4	199.1	132.6	158.6
		2011	83.7	133.0	128.6	246.3	156.5	189.0
		2012	75.8	126.2	120.1	247.2	158.8	193.3
		2013	74.5	131.7	124.4	247.0	157.2	189.9
	I	2002	28.0	34.8	44.4	109.4	89.3	86.4
		2003	49.5	53.9	66.6	96.9	89.3	93.4
		2004	83.7	81.0	100.1	88.6	96.4	100.0
		2005	100.0	100.0	118.6	100.0	100.0	97.0
		2006	111.9	116.6	133.7	106.0	102.4	101.3
		2007	130.7	141.4	163.6	114.2	110.2	107.6
		2008	126.1	164.7	186.6	153.1	121.5	120.6
		2009	88.6	128.4	142.7	145.7	106.0	121.6
		2010	125.2	176.2	199.6	149.9	112.0	125.1
		2011	150.3	210.3	243.7	163.3	123.9	139.2
		2012	124.5	190.2	227.0	183.0	126.2	144.8
		2013	127.0	198.0	235.8	193.4	131.1	136.4
Bolivia	E	2002	66.7	63.0	N/A	64.9	72.9	N/A
		2003	72.4	73.5	N/A	70.5	77.0	N/A
		2004	90.7	88.1	N/A	82.8	87.0	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	109.6	103.5	100.0	130.6	135.0	100.0
		2007	110.3	104.6	102.8	149.0	152.3	112.8
		2008	115.1	141.2	104.3	201.6	163.5	139.7
		2009	111.8	116.6	84.7	162.7	150.4	118.1
		2010	124.8	124.4	98.6	185.7	182.0	136.3
		2011	122.7	134.2	98.3	249.8	220.3	170.8
		2012	133.5	174.3	107.0	267.4	228.0	198.3
		2013	160.8	181.5	117.2	249.9	223.4	194.8
	I	2002	71.5	86.1	N/A	100.2	84.8	N/A
		2003	72.3	76.1	N/A	98.3	87.3	N/A
		2004	87.0	82.6	N/A	88.1	93.5	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	116.5	111.1	100.0	103.8	108.0	100.0
		2007	136.3	123.0	110.5	109.9	119.9	101.3
		2008	157.8	164.5	112.1	139.8	127.1	118.9
		2009	143.2	154.9	126.4	136.5	120.7	104.6
		2010	158.6	178.0	137.8	148.8	129.2	114.8
		2011	205.6	231.6	166.4	164.6	140.8	121.9
		2012	208.4	241.4	165.3	175.7	140.9	129.5
		2013	203.5	267.9	160.2	181.5	143.4	129.7
Brazil	E	2002	64.4	66.7	64.2	78.8	80.1	68.3
		2003	75.3	77.1	74.3	81.8	81.9	71.5
		2004	90.7	91.7	88.5	90.0	88.9	79.3
		2005	100.0	100.0	96.8	100.0	100.0	88.9
		2006	103.5	103.5	100.0	112.2	112.5	100.0
		2007	107.4	109.2	105.5	126.0	124.3	110.5
		2008	104.0	106.5	102.9	159.8	157.1	139.6
		2009	91.6	95.1	91.8	140.1	136.0	120.9
		2010	101.7	104.1	100.6	167.5	164.0	145.7
		2011	105.8	107.3	103.5	203.8	201.7	179.5
		2012	101.1	107.0	103.2	199.1	191.7	170.7
		2013	108.2	108.1	106.3	188.7	189.4	165.2
	I	2002	75.5	83.2	71.7	80.0	77.2	72.1
		2003	81.1	80.1	69.1	80.4	81.9	76.6
		2004	93.6	94.8	81.7	91.3	90.1	84.2
		2005	100.0	100.0	86.1	100.0	100.0	93.6
		2006	114.7	116.1	100.0	107.8	106.9	100.0
		2007	140.6	141.7	122.0	116.2	115.7	108.2
		2008	153.2	166.6	143.6	145.9	141.1	131.9
		2009	130.4	138.6	119.3	126.0	125.2	117.2

		2010	178.0	189.9	163.5	131.0	130.0	121.7
		2011	186.4	207.4	178.0	155.6	148.2	139.1
		2012	178.9	202.7	174.0	160.2	149.6	140.4
		2013	194.7	220.2	189.0	158.2	147.8	138.8
Chile	**E**	2002	80.8	74.8	N/A	54.7	57.9	N/A
		2003	85.6	81.8	78.6	60.0	63.1	42.7
		2004	98.7	96.0	90.3	81.0	82.0	56.7
		2005	100.0	100.0	92.4	100.0	100.0	70.4
		2006	100.5	102.5	95.9	144.4	138.0	96.0
		2007	108.5	109.6	102.2	157.0	149.0	104.0
		2008	100.6	104.0	100.0	166.8	147.8	100.0
		2009	99.5	105.2	97.1	130.2	125.6	88.5
		2010	99.1	104.0	96.9	166.6	162.9	113.7
		2011	100.8	108.0	100.9	195.3	179.7	125.1
		2012	105.1	109.6	103.1	177.1	169.5	117.2
		2013	107.6	113.5	106.7	171.2	161.0	111.4
	I	2002	87.4	61.9	N/A	55.6	83.2	
		2003	92.5	68.0	44.1	62.4	85.7	69.6
		2004	104.7	81.3	52.8	72.9	91.7	74.5
		2005	100.0	100.0	64.9	100.0	100.0	80.9
		2006	138.7	112.9	73.1	86.8	105.3	84.9
		2007	152.4	131.8	85.3	99.1	109.9	88.9
		2008	198.8	152.0	100.0	104.0	125.3	100.0
		2009	157.6	124.2	80.6	84.7	105.3	84.6
		2010	167.7	161.8	105.7	103.7	111.6	89.2
		2011	200.0	187.7	122.9	112.3	122.3	96.8
		2012	197.4	201.2	131.5	118.8	122.3	97.0
		2013	194.8	203.2	132.9	119.7	119.7	94.9
Colombia	**E**	2002	74.6	79.9	N/A	73.9	71.3	86.41
		2003	81.9	84.1	N/A	74.6	75.6	88.8
		2004	90.6	91.2	N/A	87.2	87.0	102.36
		2005	100.0	100.0	N/A	100.0	100.0	120.26
		2006	99.0	106.3	N/A	116.1	109.0	132.93
		2007	108.9	112.3	N/A	129.8	125.4	149.15
		2008	104.1	116.9	N/A	168.9	151.7	181.71
		2009	106.7	129.0	N/A	143.5	121.3	158.29
		2010	104.1	128.0	N/A	180.6	146.8	186.58
		2011	131.6	148.7	N/A	204.9	180.6	235.67
		2012	141.3	156.7	N/A	200.5	180.6	227.27
		2013	151.2	159.4	N/A	183.8	174.1	210.68
	I	2002	64.9	70.1	N/A	91.0	85.6	89.39
		2003	67.8	74.7	N/A	89.7	88.2	89.47
		2004	82.7	83.6	N/A	94.4	94.3	91.86
		2005	100.0	100.0	N/A	100.0	100.0	95.4
		2006	114.3	117.6	N/A	107.7	105.0	100.52
		2007	130.5	138.4	N/A	119.3	111.8	107.66
		2008	121.0	153.1	N/A	153.0	121.9	123.91
		2009	101.1	137.9	N/A	151.7	113.4	114.56
		2010	124.1	157.5	N/A	153.2	121.3	116.44
		2011	150.5	194.4	N/A	170.3	133.4	128.33
		2012	159.1	211.3	N/A	170.8	133.3	130.87
		2013	157.8	211.7	N/A	174.8	134.1	130.36
Ecuador	**E**	2002	67.8	69.5	N/A	72.0	72.3	N/A
		2003	74.8	80.4	N/A	80.1	76.6	N/A
		2004	87.0	92.9	N/A	65.5	82.0	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	103.8	107.6	N/A	120.7	117.0	N/A
		2007	96.6	110.4	N/A	145.5	128.7	N/A
		2008	100.3	116.5	N/A	184.6	159.6	N/A
		2009	94.0	112.0	N/A	143.9	122.9	N/A
		2010	94.8	117.5	N/A	177.6	147.5	N/A
		2011	90.2	123.6	N/A	189.7	178.4	N/A
		2012	95.5	130.0	N/A	193.0	181.1	N/A
		2013	100.6	135.9	N/A	217.0	180.3	N/A
	I	2002	74.9	74.4	N/A	81.0	85.2	N/A
		2003	75.5	75.0	N/A	82.0	87.4	N/A
		2004	78.8	86.3	N/A	94.5	91.7	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	110.1	107.8	N/A	105.0	109.0	N/A
		2007	116.3	115.2	N/A	111.4	116.6	N/A
		2008	125.8	140.0	N/A	140.6	131.8	N/A
		2009	106.7	128.2	N/A	132.6	114.7	N/A
		2010	135.5	161.9	N/A	143.4	125.0	N/A
		2011	137.1	174.1	N/A	166.8	137.5	N/A
		2012	137.8	183.8	N/A	173.9	137.5	N/A
		2013	146.6	202.0	N/A	174.8	137.3	N/A
Guatemala	**E**	2002	84.6	90.2	N/A	88.5	85.7	N/A

		2003	84.3	96.7	N/A	55.0	85.7	N/A
		2004	88.6	101.0	N/A	61.5	92.6	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	103.4	106.1	N/A	107.5	105.0	N/A
		2007	110.8	114.9	N/A	114.3	111.3	N/A
		2008	109.1	117.4	N/A	129.9	122.4	N/A
		2009	104.8	113.0	N/A	125.9	118.3	N/A
		2010	105.2	121.8	N/A	146.3	128.3	N/A
		2011	118.6	134.1	N/A	160.7	143.7	N/A
		2012	118.0	136.3	N/A	156.1	135.8	N/A
		2013	123.7	141.1	N/A	146.6	131.2	N/A
	I	2002	74.1	89.5	N/A	90.2	81.7	N/A
		2003	71.3	92.2	N/A	86.3	84.2	N/A
		2004	78.7	98.7	N/A	92.3	91.7	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	110.6	105.9	N/A	103.7	107.0	N/A
		2007	113.4	111.8	N/A	114.9	115.6	N/A
		2008	112.3	106.5	N/A	125.2	130.6	N/A
		2009	93.7	94.9	N/A	117.1	116.2	N/A
		2010	103.0	104.8	N/A	129.4	126.7	N/A
		2011	120.7	112.1	N/A	133.0	143.1	N/A
		2012	127.2	114.7	N/A	128.0	143.1	N/A
		2013	125.2	118.6	N/A	133.8	142.9	N/A
Honduras	**E**	2002	80.9	85.7	N/A	59.4	86.6	N/A
		2003	84.4	86.7	N/A	62.0	85.7	N/A
		2004	86.8	97.9	N/A	81.8	91.7	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	105.5	100.5	N/A	104.4	104.0	N/A
		2007	107.9	104.9	N/A	109.5	109.2	N/A
		2008	113.1	104.1	N/A	124.2	117.9	N/A
		2009	96.9	87.2	N/A	113.8	109.7	N/A
		2010	101.8	100.1	N/A	130.2	123.9	N/A
		2011	97.9	102.8	N/A	155.5	153.7	N/A
		2012	136.2	122.2	N/A	141.5	134.2	N/A
		2013	122.7	131.1	N/A	128.4	121.1	N/A
	I	2002	67.9	81.6	N/A	89.5	82.1	N/A
		2003	83.3	85.9	N/A	84.4	84.9	N/A
		2004	79.0	97.1	N/A	97.6	91.7	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	110.6	102.4	N/A	108.2	109.0	N/A
		2007	127.9	116.4	N/A	116.2	116.6	N/A
		2008	119.4	119.1	N/A	160.0	134.1	N/A
		2009	99.3	96.5	N/A	134.9	116.7	N/A
		2010	100.7	106.0	N/A	156.6	128.4	N/A
		2011	108.0	115.8	N/A	181.3	146.8	N/A
		2012	99.1	118.4	N/A	184.2	146.8	N/A
		2013	123.1	116.5	N/A	159.9	145.9	N/A
Nicaragua	**E**	2002	78.9	63.6	N/A	82.0	86.9	N/A
		2003	83.8	73.4	N/A	84.0	86.9	N/A
		2004	96.6	89.8	N/A	90.4	92.2	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	112.1	111.9	N/A	110.0	104.4	100.0
		2007	117.7	121.7	N/A	115.2	108.6	101.4
		2008	121.2	130.5	N/A	139.8	117.3	111.4
		2009	123.2	112.4	N/A	128.6	113.2	113.9
		2010	144.0	134.5	N/A	147.7	123.3	119.1
		2011	147.8	159.0	N/A	179.5	139.4	132.4
		2012	171.4	179.8	N/A	199.5	139.4	136.0
		2013	160.9	196.7	N/A	188.1	134.9	134.9
	I	2002	79.5	77.1	N/A	81.1	81.3	N/A
		2003	83.2	81.5	N/A	85.2	84.2	N/A
		2004	92.2	91.4	N/A	92.3	90.9	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	112.9	107.6	N/A	110.7	107.0	100.0
		2007	119.7	120.1	N/A	123.0	112.4	110.3
		2008	116.9	126.1	N/A	151.3	127.0	132.4
		2009	110.3	112.7	N/A	128.4	111.7	129.2
		2010	124.8	126.0	N/A	138.6	120.7	134.9
		2011	132.7	144.4	N/A	158.7	136.9	145.8
		2012	147.5	159.1	N/A	166.7	136.9	149.2
		2013	136.8	159.6	N/A	145.3	147.8	147.1
Paraguay	**E**	2002	56.0	78.0	N/A	90.0	84.9	N/A
		2003	69.3	77.1	N/A	97.5	91.8	N/A
		2004	75.8	84.9	N/A	117.8	101.0	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	87.3	121.2	N/A	117.7	102.0	N/A
		2007	102.5	138.2	N/A	146.3	112.2	N/A

		2008	112.8	151.3	N/A	217.6	132.4	N/A
		2009	88.3	137.0	N/A	191.4	116.5	N/A
		2010	121.9	176.3	N/A	202.0	122.3	N/A
		2011	112.2	189.9	N/A	264.4	137.0	N/A
		2012	102.8	171.7	N/A	259.5	139.8	N/A
		2013	145.6	219.2	N/A	264.7	134.9	N/A
	I	2002	49.9	62.5	N/A	68.7	85.6	N/A
		2003	68.7	71.2	N/A	65.1	88.2	N/A
		2004	96.2	86.6	N/A	83.6	94.3	N/A
		2005	100.0	100.0	N/A	100.0	100.0	N/A
		2006	103.5	127.0	N/A	151.1	104.0	N/A
		2007	90.2	149.5	N/A	174.0	109.2	N/A
		2008	100.4	195.7	N/A	245.9	120.1	N/A
		2009	78.6	166.1	N/A	237.4	108.1	N/A
		2010	104.2	228.8	N/A	260.2	113.5	N/A
		2011	123.0	256.9	N/A	270.6	124.2	N/A
		2012	108.0	239.6	N/A	264.2	125.4	N/A
		2013	111.2	263.1	N/A	279.7	124.9	N/A
Peru	**E**	2002	74.0	66.6	N/A	56.7	66.7	N/A
		2003	75.3	72.6	N/A	63.3	72.1	N/A
		2004	81.3	87.0	N/A	82.0	84.7	N/A
		2005	100.0	100.0	N/A	100.0	100.0	64.3
		2006	91.4	100.2	N/A	139.5	136.9	87.7
		2007	95.5	103.3	N/A	159.4	156.6	100.0
		2008	104.8	108.5	N/A	166.8	164.6	103.8
		2009	97.2	107.8	N/A	152.4	144.0	90.6
		2010	93.6	109.4	N/A	209.3	187.2	118.2
		2011	98.2	114.7	N/A	258.9	232.2	143.7
		2012	104.2	118.6	N/A	239.0	224.5	140.5
		2013	95.8	114.1	N/A	224.8	211.1	132.8
	I	2002	81.0	75.6	N/A	75.6	80.9	N/A
		2003	89.1	80.7	N/A	80.0	84.2	N/A
		2004	88.1	89.3	N/A	90.3	90.9	N/A
		2005	100.0	100.0	N/A	100.0	100.0	74.9
		2006	114.4	114.3	N/A	107.7	107.5	95.9
		2007	137.8	136.6	N/A	120.3	118.7	100.0
		2008	151.1	163.7	N/A	161.6	143.8	89.1
		2009	128.2	130.6	N/A	138.0	133.2	86.9
		2010	164.5	162.6	N/A	138.2	146.6	105.2
		2011	175.2	189.7	N/A	166.2	161.3	112.8
		2012	192.8	207.4	N/A	176.9	164.0	110.5
		2013	203.5	218.7	N/A	171.7	159.7	105.3
Uruguay	**E**	2002	65.9	59.7	N/A	79.2	85.3	N/A
		2003	71.0	66.4	N/A	89.1	91.0	N/A
		2004	89.2	85.7	N/A	96.3	97.3	N/A
		2005	100.0	100.0	100.0	100.0	100.0	100.0
		2006	108.7	109.4	108.5	106.8	106.6	107.2
		2007	103.9	116.0	113.2	121.7	116.5	116.2
		2008	102.3	122.2	112.6	168.2	153.8	153.4
		2009	108.7	132.0	117.5	143.7	128.3	134.1
		2010	117.8	148.1	134.7	161.7	143.7	145.5
		2011	115.5	148.7	135.7	197.4	165.2	170.0
		2012	126.5	153.5	144.5	196.1	170.7	175.7
		2013	133.9	160.1	151.7	193.3	170.1	173.9
	I	2002	60.3	75.4	N/A	71.6	66.2	N/A
		2003	69.3	79.8	N/A	72.9	70.0	N/A
		2004	90.6	90.2	N/A	84.8	88.3	N/A
		2005	100.0	100.0	100.0	100.0	100.0	100.0
		2006	109.7	119.5	113.7	110.2	109.2	108.7
		2007	119.1	126.3	122.4	122.6	119.1	117.8
		2008	139.7	158.2	161.8	167.0	148.3	143.9
		2009	125.8	152.9	150.6	102.1	120.1	117.7
		2010	154.0	174.9	171.3	146.1	130.4	128.9
		2011	157.6	193.6	188.7	178.4	147.3	146.4
		2012	161.0	223.2	205.7	191.3	146.6	145.9
		2013	163.3	216.5	210.8	187.3	142.6	142.2

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Bolivia	http://www.ine.gob.bo/indice/general.aspx?codigo=50201
Brazil	http://www.funcexdata.com.br/
Chile	http://www.bcentral.cl/estadisticas-economicas/series-indicadores/index_se.htm
Colombia	http://www.banrep.gov.co/es/indice-terminos-intercambio
Ecuador	N/A
Guatemala	N/A

Honduras	N/A
Nicaragua	http://www.bcn.gob.ni/estadisticas/sector_externo/comercio_exterior/indices_comercio/index.php
Paraguay	N/A
Peru	https://estadisticas.bcrp.gob.pe/estadisticas/series/anuales/terminos-de-intercambio
Uruguay	http://www.bcu.gub.uy/Estadisticas-e-Indicadores/Paginas/Intercambio-Comercial-.aspx