Working Party on International Trade in Goods and Trade in Services Statistics

MEXICAN EXPORT AND IMPORT UNIT VALUE INDICES

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For discussion of the methodology used for detecting outliers and generating Unit value indices in Mexico.

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Methodological note

Export and import price indices are useful for the analysis of foreign trade statistics. Besides being used as deflators, they provide information for the measurement of competitiveness of the economy, for the analysis of international prices trends, for the estimation of price-elasticities and to calculate future domestic inflation. For these reasons, and due to the lack of export and import price surveys to firms, a methodology was developed to estimate export and import unit value indices for the Mexican economy. These indices will serve to approximate the behavior of the export and import prices.

The unit value indices were estimated with information contained in custom declarations, in which goods are classified with the codes of the Harmonized Commodity Description and Coding System (HS). This classification system has been modified three times: in 1997, 2002 and 2007. To make this information compatible throughout time, it would be necessary to build equivalence tables for each version. However, changes made to the 1997 version were so large that it was impossible to build an equivalence table for that version. Therefore, the estimated unit value indices start in July 1997, month in which the changes occurred.

Transactions classified into Chapters 98 and 99 of the HS were omitted from the calculation. This is because these chapters are used by Customs Authorities to register special trade movements, which cannot be identified or classified. The value of both chapters represented, in the case of exports, less than one per cent of the total, while for imports represented approximately 4 per cent.

Likewise, items ending with “99” were removed because they refer to goods classified as “The rest” in each subheading. About 38 per cent of imports and 28 per cent of exports have items ending with “99”.

In order to identify and remove outliers observations, the information was broken down for each item by firm, and each firm by country. This allowed us to have a set of unit values for each item, and detect the outliers through the analysis of the distribution of those unit values.

The detection of outliers was performed using nonparametric methods that take into account the distribution of unit values of each item. These methods require a minimum number of observations;

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1 This system of classification of goods is numerical and consists of pairs of digits. The first pair is called "Chapter" (hs2), by adding another pair is called "Heading" (hs4) by adding a third pair forms a "Sub Heading" (hs6), and finally, having four pairs of digits is an "Item" (hs8). It should be noted that there is also a classification name as "Section", which is the aggregate of several Chapters.

2 Henceforth we called "operation" to the combination item-firm-country.

3 Using the outlier detection methodology exposed by Anitori, Paola and Maria S. Causo (2008).
therefore, those items with less than ten operations in a month were omitted\(^4\). These operations represent 8.3% of the exports value and 12.9% of imports.

To identify items with more than 100 operations was applied the Quartile Method or Asymmetric Fence Method (AFM). On the other hand, outliers of items with less than 100 operations were detected with the Mean Absolute Deviation (MAD)\(^5\) method. In both cases, the logarithms of the unit values were used because it has been proved that the log-transformation improves the outlier detection method by reducing the Type I Error (observations that are not outliers but the method would detect as such)\(^6\).

For items with more than 100 operations, according to the AFM, an observation was considered outlier if one of the following conditions is satisfied:

\[
\begin{align*}
q_1 - u_{ih}^i > k_{AFM} \cdot \max(q_2 - q_1, c | q_2 |) \\
u_{ih}^i - q_3 > k_{AFM} \cdot \max(q_3 - q_2, c | q_2 |)
\end{align*}
\]

where \(u_{ih}^i\) is the logarithm of the unit value of transaction \(i\) - import or export by firm and country - classified into the item of the HS; \(q_1\), \(q_2\) and \(q_3\) respectively correspond to the first, the second (median), and the third quartiles of the population distribution of log unit values of trade transactions; \(k_{AFM}\) and \(c\) are parameters of the method, which determine how restrictive the outlier detection method is. Several parameters were tested and when \(c = 0.05\) and \(k_{AFM} = 1\) the resulting indices performed properly\(^7\), and in addition, it was not necessary to eliminate from the calculations a large number of operations.

For items with 100 or less transactions in a month, an observation was considered an outlier if the following conditions are satisfied simultaneously:

\[
\begin{align*}
| u_{ih}^i - q_2 | > k_{MAD} \cdot MAD_{ih} \\
| u_{ih}^i - q_2 | > A \cdot | q_2 |
\end{align*}
\]

where \(A = 0.1\) and \(k_{MAD} = 2\).

Trade operations that represented at least 30 per cent of trade of an item were not eliminated, despite the methods described above could identify them as outliers. This was done because excluding these transactions could diminish the sample representativeness and bias the estimation. The average number of operations that would have been removed each month without this exception was 155.

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\(^4\) The item ‘27090001’ of the exports, which correspond to crude oil, was not considered in this filter. This is due to a monthly statistical reconciliation with Pemex.

\(^5\) The AFM is inefficient when the number of observations is too small, considering that it is based on the distribution of the data. See Thompson and Sigman (1999).


\(^7\) Although different values were tested for \(k_{MAD}\) parameter, the value of this parameter was set to 1, which is exactly the same used by Anitori et al. (2008).
After the outlier detection process described above, unit value time series were built. By exploring the paths of these series, some operations were assumed as outliers in the final calculations. Transactions detected in this final filter were exceptional and represented approximately 0.4 per cent in the total value of imports and exports.

Finally, the information from which indices were calculated represented in average 55 per cent of total monthly exports and 43 per cent in the case of imports. The value of the exported transactions included in the estimation of the export unit value index was 136,431 millions of dollars in 2009, while for imports were 103,072 millions.

Elementary unit values were calculated from aggregated data by item:

\[
UV_{hs}^{m,t} = \frac{\sum_{i \in hs} P_{i}^{m,t} Q_{i}^{m,t}}{\sum_{i \in hs} Q_{i}^{m,t}}
\]

where \(UV_{hs}^{m,t}\) is the unit value of the item \(hs\) in month \(m\) of year \(t\); \(P_{i}^{m,t}\) is the imported or exported value of transaction \(i\) of item \(hs\) in month \(m\) of year \(t\); and \(Q_{i}^{m,t}\) the imported or exported volume registered of transaction \(i\) of item \(hs\) in month \(m\) of year \(t\).

The next step consisted in obtaining unit value indices each month. In other words, the ratio between the unit value in month \(m\) and the average unit value of the base period\(8, UV_{hs}^{0}\).

\[
UVI_{hs}^{m,t} = \frac{UV_{hs}^{m,t}}{UV_{hs}^{0}}
\]

To calculate the elementary indices, Unit Value Indices were treated as a price ratio in the standard index formulas. Using the Laspeyres, Paasche and Fisher price index formulas, the Sub Heading indices are:

\[
L_{hs6} = \sum_{hs8 \in hs6} UVI_{hs8}^{m,t} \cdot s_{hs8}^{0}
\]

where, \(s_{hs8}^{0} = \frac{P_{hs8}^{0} Q_{hs8}^{0}}{\sum_{hs8 \in hs6} P_{hs8}^{0} Q_{hs8}^{0}}\)

\[
P_{hs6} = 1 / \left(\sum_{hs8 \in hs6} (UVI_{hs8}^{m,t})^{-1} \cdot s_{hs8}^{m,t}\right)
\]

where, \(s_{hs8}^{m,t} = \frac{P_{hs8}^{m,t} Q_{hs8}^{m,t}}{\sum_{hs8 \in hs6} P_{hs8}^{m,t} Q_{hs8}^{m,t}}\)

\[
F_{hs6} = \sqrt{P_{hs6} \cdot L_{hs6}}
\]

For the estimation of elementary indices, it was considered only the subset of items with value in both, the month for which the index is being calculated and the base period. Consequently, such sub sets are different each month and \(s_{hs8}^{0}\) is not necessarily equal in every month.

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8 Price reference period may be a month or a year; it could also remain constant or be the price of the previous year.
Afterwards, elementary indices were weighted for higher aggregation levels (headings, chapters and sections).

The Fisher index at Section level of the Harmonized System is:

\[ F_s = \sum_{h \in s} w^b_{hs} \cdot F_{hs} \]

where, \( w^b_{hs} = \frac{P^b_{hs}Q^b_{hs}}{\sum_{h \in s} P^b_{hs}Q^b_{hs}} \)

The weight vector \( w^b_{hs} \), may not be the same each month because the indices calculation include only Sub Headings with value in both, the estimated month and the reference year \( b \).

The year 2005 was selected as the reference period for prices and weights because within the range period, the year 2005 has more stability and less internal and external shocks. It is important to notice that for the weights used in calculating aggregate indices only fractions of Chapters 98 and 99 were excluded.

Finally, weighting the resulting indices from the aggregation by section we obtain the overall index. Moreover, the final index would be the same if it is built from other levels of aggregation, whether section, chapter or heading.

\[ F = \sum_s w^b_s \cdot F_s \]

where, \( w^b_s = \frac{P^b_sQ^b_s}{\sum_s P^b_sQ^b_s} \)

The following graphs present the Unit Value Indices of Exports and Imports, Total and Excluding Petroleum, as well as Terms of Trade.
As an element of evaluation, comparisons between U.S. Export and Import Price Indices and Mexican Imports and Exports Unit Values were done. The following chart shows the comparison between the Mexican Export Unit Values Index and the U.S. Import Price Index. As shown, there is a similarity between these two indices.
The comparison between the Mexican Imports Unit Values Index and the U.S. Exports Price Index shows that both trajectories are similar.  

The share of Mexican Exports to the United States in the total of Mexican Exports was 80.6% in 2009, while the share of Mexican Imports from the U.S. in the total of Mexican Imports stood at 47.9%. For this reason, it may be that the similarity between the Mexican Exports Unit Value Index and the U.S. Imports Prices Index is higher than in the case of the Mexican Imports Unit Value Index and the U.S. Exports Price Index.
REFERENCES


Lutero, G. and M. Mariniy (2008). “Direct vs. Indirect Forecasts of Foreign Trade Unit Value Indices”, ISTAT.


