

Adjustment of U.S. Merchandise Trade Data  
For Price Change

Prepared by Foreign Trade Division  
U.S. Bureau of the Census  
March 2004

## Introduction

The U.S. Census Bureau (Census) introduced a new constant dollar series (2000 = 100) in the April 2003 release of the FT900, “*U.S. International Trade in Goods and Services*”. The fixed-weighted series, published since 1990, was discontinued at that time. This paper explains the chained Fisher methodology, its benefits, and where additional information on the chained Fisher methodology can be found.

Census adopted the new chained Fisher methodology to improve the quality of the data series and restore the consistency of the Census Bureau’s constant dollar (real) data with the Bureau of Economic Analysis’s (BEA) National Income and Product Accounts (NIPA), as required by the Omnibus Trade and Competitiveness Act of 1988. The chained Fisher methodology improved the quality of the series by eliminating the substitution bias, that is, the tendency of fixed-weighted series to misstate growth as one moves further from the base year. This tendency reflects the fact that the commodities, for which output grows rapidly, tend to be those for which prices increase less than average or decline. Elimination of the substitution bias was the driving force behind BEA’s adoption of the chained Fisher methodology.<sup>1</sup>

The Fisher index consists of two components, the Paasche and Laspeyres indexes. The Paasche index uses weights based upon the month for which the index is calculated. The Laspeyres index is base-weighted, so the quantity of the previous month provides the weights. The primary weakness of the Paasche and Laspeyres indexes is the substitution bias. The chained Fisher methodology brings the two indexes together in the form of a geometric mean and chains the data back to the base period, thereby minimizing the substitution bias.

The new real dollar series is available in Exhibits 10 and 11 of the monthly FT900. Historical data from 1994-2000 and the 2002 Final Revisions (Exhibits 9, 9a, and 10) are available on the Foreign Trade Website (<http://www.census.gov/foreign-trade/www/>). Census plans to develop and maintain a minimum of 10 years of chain-weighted dollar data.

## Methodology

The chained Fisher methodology uses fixed-weighted deflators to estimate the price (p) of each good and fixed-weighted real dollars (seasonally adjusted current dollar value ÷ deflator) to estimate the quantity (q). The first step is to calculate Paasche, Laspeyres, and Fisher indexes for all import and export end-use categories (for example: import and export feeds, foods, and beverages; import and export industrial supplies and materials; and import and export capital goods) for each processing month and year based upon the prior processing month:

---

<sup>1</sup> Landefeld, J. Steven and Robert P. Parker. “Preview of the Comprehensive Revision of the National Income and Product Accounts: Bea’s New Featured measures of Output and Prices”. *Survey of Current Business* (July 1995): 1-38.

$$Paasche\ Quantity\ Index_{C,t} = \frac{\sum_e p_{e,t} * q_{e,t}}{\sum_e p_{e,t} * q_{e,t-1}}$$

$$Laspeyres\ Quantity\ Index_{C,t} = \frac{\sum_e p_{e,t-1} * q_{e,t}}{\sum_e p_{e,t-1} * q_{e,t-1}}$$

In the equations, t = the current processing month and year,

t-1 = the prior processing month,

C = the import or export aggregated category,

p<sub>t</sub> = deflator for 5-digit commodity e in time period t, and

q<sub>t</sub> = seasonally adjusted current dollar value for 5-digit commodity e in time period t divided by deflator for 5-digit commodity e in time period t.

$$Fisher\ Quantity\ Index_{C,t} = \sqrt{Paasche\ Quantity\ Index_{C,t} * Laspeyres\ Quantity\ Index_{C,t}}$$

These month-to-month Fisher indexes are then chained together from the first time period (t<sub>1</sub>) to create a chain type index with base period t<sub>1</sub>:

$$Chain\ Type\ Quantity\ Index_{C,t} = Fisher\ Quantity\ Index_{C,t} * Chain\ Type\ Quantity\ Index_{C,t-1}$$

The Chain Type Quantity Index for base period t<sub>1</sub> is set equal to 1. The Chain Type Quantity Index is then adjusted to the desired base year (currently 2000) by dividing by the average Chain Type Quantity Index for the base year (BYR):

$$Fisher\ Chained\ Quantity\ Index_{C,t} = \frac{Chain\ Type\ Quantity\ Index_{C,t}}{Average\ Chain\ Type\ Quantity\ Index_{C,BYR}}$$

The Fisher Chained Quantity Index and base year Average Current Dollar Value are used in calculating the real value in chain-weighted dollars:

$$Real\ Value_{C,t} = Fisher\ Chained\ Quantity\ Index_{C,t} * Average\ Current\ Dollar\ Value_{C,BYR}$$

### Source of Deflators

Most of the deflators used in the calculation of the new chain-weighted series are from the U.S. Import Price Indexes (MPI) and U.S. Export Price Indexes (XPI), published by the Bureau of Labor Statistics (BLS). Census generally uses the most detailed Import and Export Price Index

categories (usually a 3- or 5-digit end-use code) available with the following exceptions:

- Census uses the Producer Price Indexes, produced by BLS, to deflate imports and exports of non-monetary gold; railway transportation equipment; civilian aircraft; spacecraft, excluding military; vessels, excluding scrap; commercial vessels, other; marine engines, parts; exports of semi-conductors; and precious metals, other
- Census uses a combination of import, export, and producer price indexes to deflate imports and exports of computers and computer accessories
- Census also uses import trade data to calculate unit value indexes in order to deflate imports of petroleum and electricity.

Census uses an overall implicit Fisher index, excluding volatile commodities, to deflate ‘Other Goods’. This category consists of import and export minimum value shipments; import military aircraft and parts thereof; other military equipment; U.S. goods returned and re-imports; export military-type goods; miscellaneous domestic exports and special transactions; and undocumented exports to Canada. Petroleum, computers, computer accessories, and semi-conductors are excluded from the calculation of the import implicit deflator, while computers, computer accessories, and semi-conductors are excluded from the export calculation.

### Comparing Fixed- and Chain-Weighted Methodologies

The fixed-weighted and chain-weighted methodologies use the same data, but in different ways. The advantage of the fixed-weighted constant dollar series is its simplicity. The fixed-weighted value is a simple division of the seasonally adjusted current dollar value for each end-use category by the appropriate deflator. The value for each published category is obtained by summing the deflated values for each 5-digit end-use code in that category. This methodology has several disadvantages. The selection of the base year can significantly affect the month-to-month changes, so that estimates of growth can change significantly when a fixed-weighted series is rebased. This methodology also is affected by substitution bias. The fixed-weighted method does not allow for goods to be substituted for one another when relative prices change; it assumes that changes in price do not affect the amount of goods purchased.

One obvious difference between the fixed-weighted and chain-weighted methodologies is that the chain-weighted dollars are not additive. For example, the sum of the six principal end-use categories for imports in Exhibit 10 does not sum to total imports. The ‘residual difference’ between the sum of the categories and the total will vary from month-to-month. These residuals are displayed in each exhibit. As the chain-weighted dollars move further from the base year, the residuals tend to become larger.

In contrast to the fixed-weighted, the chained Fisher methodology minimizes substitution bias. This methodology compares each month to the previous month, weighting those changes by the

importance of each good in both periods, and chaining back to the base period. Changes in the goods traded are incorporated very quickly into the deflators, thereby minimizing substitution bias, and rebasing does not affect month-to-month changes.

### BEA and Census Real Dollars

It is important to note that the real dollar values produced by Census and BEA will still differ. The two agencies present the data in different forms. The data published by BEA each quarter is presented on an annualized basis, using quarterly chaining. Census uses monthly chaining and publishes monthly real dollars. However, the largest differences result from underlying differences between the Census and NIPA current dollar data.

The NIPA figures are presented on a balance of payments basis, which includes adjustments to the merchandise trade data for valuation and coverage differences. The NIPA exclude the repairs of goods, developed motion picture film, electricity, and military type goods; all of which are covered under the services accounts. In addition, imports into and exports from the U.S. Virgin Islands and Puerto Rico are excluded from the NIPA as are exports of non-monetary gold. The BEA makes some additional adjustments for timing and other coverage differences.

### References

For further information on Census procedures for adjusting merchandise trade data for price change contact the Special Projects Branch, Foreign Trade Division, U.S. Department of Commerce, U.S. Census Bureau, Washington, D.C. 20233, phone (301)763-3251, fax (301)457-2104.

For information about the NIPA and the deflators used by BEA, contact the National Income and Wealth Division, U.S. Department of Commerce, Bureau of Economic Analysis, 1441 L Street NW, Washington, D.C. 20220 or refer to the following articles on their website, <http://www.bea.gov>:

Landefeld, J. Steven and Robert P. Parker. "Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA's New Featured Measures of Output and Prices". Survey of Current Business (July 1995): 31-38.

Landefeld, J. Steven and Robert P. Parker. "BEA's Chain Indexes, Time Series, and Measures of Long Term Economic Growth". Survey of Current Business (May 1997): 58-68.

Seskin, Eugene P. and Robert P. Parker. "A Guide to the NIPA's". Survey of Current Business (March 1998): 26-68.

For information about the BLS International Price Indexes, contact the International Price Division, Bureau of Labor Statistics, U.S. Department of Labor, Washington, D.C. 20212, (202)691-7101.