

The Effects of Revisions to Seasonal Factors on Revisions to Seasonally Adjusted Estimates

The Case of Exports and Imports

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MUCH of BEA's source data contains monthly or quarterly patterns that approximately recur each year. In order to determine what is new or distinctive about economic activity in a particular month or quarter, seasonal adjustments are used to remove the effects of these recurring patterns. Previous BEA studies of revisions to seasonal adjustment factors found that the revisions are relatively large sources of the revisions to gross domestic product (GDP) and its components.¹

This article focuses on the effects of the revisions to the seasonal adjustment factors and the revisions to seasonally unadjusted estimates.² In particular, it looks at the exports and imports recorded in BEA's international transaction accounts—where the use of preliminary source data results in large revisions to the early estimates—and it examines the relative importance of revisions to the underlying seasonally unadjusted data relative to the effects of revisions to seasonal factors.

Seasonal adjustment is a statistical procedure that is used to distinguish seasonal fluctuations from changes in trend growth. It is used, for example to look at the fourth-quarter jump in sales that occurs every year around Christmas and to determine if the increase in any given year is more than the normal Christmas increase and thereby indicative of a strengthening in the economy.

The concept of a “normal” increase is a relative one and can only be judged by reference to some average over recent periods. A string of stronger-than-normal

Christmas sales will therefore change the average used to judge what is normal and the associated seasonal adjustment factors. As a result, one can observe large revisions to seasonally adjusted estimates as they are updated each year to reflect changing seasonal patterns, even if there are no substantial changes in the underlying seasonally unadjusted estimates.

For most components of exports and imports, seasonal factors are calculated by a process that is centered on the year being seasonally adjusted. As a result, the ultimate estimates of seasonal factors depend on both the patterns of the seasonal fluctuations in past years and on the patterns of seasonal fluctuations in future years when the early vintage seasonally adjusted estimates are prepared. Seasonal factors for year y will ultimately depend on both the seasonal patterns in years $y-n$ to y and the seasonal patterns in years $y+1$ to $y+n$. Because future seasonal patterns are unknown—and unforecastable—when the early vintage estimates are prepared, large revisions to seasonal factors that result from the incorporation of data for later years are unavoidable. Finally, the revisions to seasonal factors are not errors, and they can occur with the passage of time, even if no revisions to seasonally unadjusted estimates for a given year—or for preceding years—are made; for example, as seasonal patterns evolve over time, estimates of seasonal factors for year y will change from their initial values.

The principal findings of this article include

- Mean (average) revisions to seasonal adjustment factors for exports and imports of goods and services are of the opposite sign of the revisions to seasonally unadjusted estimates, and they tend to be offsetting.
- Mean absolute revisions to seasonal factors are the principal determinants of the mean absolute revisions to the seasonally adjusted estimates of exports and imports of goods and services.
- Mean absolute revisions to seasonal factors for exports and imports of goods and services can be considerably larger than the revisions to the seasonally unadjusted estimates.

1. Young (1996) reported that “the average absolute revision in quarterly changes in the seasonal factors in the period 1983 to 1988 ... is about one half the size of the total revision (seasonally adjusted) from the current estimates to the latest available estimate of GDP.” Fixler and Grimm (2002) found that mean absolute revisions in seasonal factors in 1987–97 were roughly the same sizes as the corresponding revisions to seasonally adjusted estimates of GDP and seven major components, including exports and imports of goods and services; the revisions examined were from the first annual revision vintage estimates to the third annual revision vintage national income and product accounts (NIPAs).

2. Seasonally unadjusted estimates are also described by BEA as “not seasonally adjusted.”

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The revisions to seasonally unadjusted estimates reflect the incorporation of somewhat different types of data than the revisions to seasonal factors. The revisions to seasonally unadjusted estimates reflect the incorporation of source data that become available after the earlier vintage estimates for a given period are prepared, and they may use new types of source data. In addition, the revisions may incorporate changes in definitions, classifications, and statistical methodology that adapt the economic accounts to changing economic conditions. At more detailed levels, large revisions to seasonally unadjusted estimates may reflect the limitations of the earlier available source data. These types of revisions are all due to improvements in the economic accounts and do not indicate difficulties such as biases or other unreliability. The revisions to seasonal factors may also reflect revisions to the seasonally unadjusted estimates; in this case, revisions to the seasonal factors tend to offset the revisions to seasonally unadjusted estimates and thus hold down the sizes of revisions to seasonally adjusted estimates.

The revisions to seasonally adjusted estimates are driven by the interactions between the two types of revisions—the revisions to the seasonally unadjusted estimates and the revisions to the seasonal factors. If the seasonal factors are unchanged, the revisions to the seasonally adjusted estimates would be entirely due to the revisions to the seasonally unadjusted estimates. Conversely, if the seasonally unadjusted estimates are unchanged, the revisions to the seasonally adjusted estimates would be entirely due to revisions to the seasonal factors. When both the seasonal factors and the seasonally unadjusted estimates are revised, the mean absolute revisions for the seasonally adjusted estimates may be smaller than the mean absolute revisions for either type of revision, may be in between the sizes of the two types, or may be larger than those for either type. The extent to which the revisions to the two types of estimates offset each other or reinforce each other depends on the complex way in which they interact over time.

The revisions to the seasonally adjusted estimates may be disaggregated into revisions to seasonally unadjusted estimates, revisions to seasonal factors, and the interaction term between revisions to the two. In this study, the interaction term is included in the revisions to seasonal factors; that is, the effects of the revisions to the seasonal factors are measured as

Revisions to seasonal factors = revisions to seasonally adjusted estimates less revisions to seasonally unadjusted estimates.

This treatment of the interaction term is arbitrary, but it may be justified on the grounds that without revisions to seasonal factors, the interaction term would be zero. Separate calculations using selected components of exports and imports—not shown here—suggest that the interaction term is generally small relative to the effects of revisions to the seasonal factors alone.³

The measures of imports and exports examined in this article are from the international transactions accounts (ITAs), which are published quarterly by BEA. The estimates are published both on a seasonally adjusted basis and on a seasonally unadjusted basis. They differ somewhat from those published in the NIPAs because of differences in geographical coverage, in the treatment of international flows of gold, and in the definitional treatment of a few components and because of statistical differences due to differences in the timing of the revisions in the ITAs and the NIPAs.⁴

Preparing the Estimates of Exports and Imports of Goods and Services

Timing of the estimates

In the ITAs, two vintages of estimates for a quarter are prepared—the “preliminary” estimates and the “revised” estimates. The preliminary estimates of the ITAs, including those of exports and imports of goods and services, are released in the 3rd month after the end of each quarter. The revised estimates are released 3 months later when the preliminary estimates for the next quarter are released. Each June, revised annual estimates are released along with the revised estimates for the fourth quarter of the previous year and preliminary estimates for the first quarter of the current year. The revised annual estimates incorporate new and revised source data, updated seasonal factors, and the changes in definitions and in estimating procedures that are part of a continuing process to adapt the ITAs to changing economic circumstances and to improve the quality of the estimates. The estimates are revised back as far as is needed to incorporate all of the various types of revisions; for example, as part of the revision

3. For example, the revision (in percent change at annual rate) to the estimate of seasonally adjusted exports of services for the first quarter of 2001 from the revised vintage to the latest estimate is -5.99 percentage points, reflecting revisions of -4.33 percentage points for the seasonally unadjusted estimate and of -1.66 percentage points for the effects of the seasonal factor as calculated here. An alternative calculation using the revision to the seasonal adjustment factor times the value of the revised estimate indicates that its direct effect is -1.27 percentage points, and the interaction term accounts for the remaining -0.39 percentage point.

4. The two sets of estimates are reconciled on an annual basis in NIPA table 4.5 (this table is now table 4.3 in the 2003 comprehensive revision of the NIPAs). Footnotes to that table provide additional descriptions of differences in the two sets of accounts. The ITAs are also referred to as the “balance-of-payments accounts.”

released in June 2002, some portions of the ITAs for 1995–2001 were revised, and other portions were revised for shorter periods; the exports and imports of goods for 1995–2001 were revised, and the exports and imports of services for 1999–2001 were revised.

The data underlying the ITAs come from four major sources: Census Bureau tabulations of merchandise trade flows, BEA surveys, Treasury Department tabulations of reports on international capital movements, and reports by U.S. Government agencies to BEA.⁵ The data are also obtained from a variety of other public and private sources. The Census Bureau tabulates data from administrative documents that exporters and importers are required to file with the U.S. Customs Service; in addition, it provides data that are used as quantity indicators by BEA to estimate freight and port expenditures that are part of “other” transportation services. Data from BEA’s surveys are used to estimate receipts and payments of income on direct investment, “other” services receipts and payments, and private remittances and other transfers. The Treasury Department tabulations are primarily used to estimate financial flows that are not part of goods and services flows. The reports from other U.S. Government agencies engaged in international transactions are required under Office of Management and Budget Statistical Policy Directive Number 19, and the data from these reports are used to estimate foreign military sales and direct defense expenditures, receipts and payments for various services, and some other financial flows. The variety of other sources provide data that is primarily related to “other” services, reconciliation items, and the preparation of real flows.

Seasonal adjustments

Most exports and imports of goods and services in the ITAs are seasonally adjusted. The exceptions for measures in this study are noted below.

BEA and the Census Bureau work together to seasonally adjust the estimates of exports and imports of goods at the five-digit-end-use-commodity category level, which is the most detailed level of end-use classification available. BEA adjusts the estimates of most components services for seasonality at the most detailed level available by type of service; the exports and imports of royalties and license fees and the exports and imports of “other” services are adjusted at the aggregate levels.

Two seasonal adjustment strategies are commonly used by various government agencies. Regular seasonal adjustments use seasonal factors that are based on sea-

sonal factors for prior years, and for adjusting the estimates for the current year, the seasonal adjustments use either the seasonal factors for the previous year or an average of the seasonal factors for the 2 previous years. Concurrent seasonal adjustments are redone each period (quarter or month), using all the estimates up to and including the current period to calculate the seasonal factor for the current period. Ultimately, the seasonal factors for a given year use data for a number of years before and after the year for which the seasonal factors are being estimated.

Seasonal patterns change gradually.⁶ Thus, rather complex methods have been developed to deal with these changes and other complicating factors. At present, the most widely used seasonal adjustment method is the X-12 ARIMA program developed at the Census Bureau.⁷ This method uses a statistical analysis to calculate how the seasonal pattern of a time series has changed recently and how it might be expected to change further over the coming year. Thus, in contrast to the revisions to seasonally unadjusted estimates, which are revised in response to changes in the measures for each quarter, revisions to seasonal factors result from changes in measures for quarters over a number of years.

BEA’s seasonal adjustment methodology typically projects seasonal factors for the current year that are based on data for prior years and using the X-12 ARIMA program. To adjust the estimates for the current year, BEA estimates the seasonal factors each spring, incorporating the most recent seasonally unadjusted data for the period that extends to the end of the previous year.

Seasonal factors continue to be revised as additional data become available. Ultimately, seasonal factors for each year are calculated from seasonally unadjusted data for a period that is centered on that year, and seasonally unadjusted estimates for a number of preceding years and subsequent years are used to calculate the seasonal factors; the number of years depends on the strategy followed by the agency doing the seasonal adjustment. In addition to the revisions to the seasonal factors generated by this process, the seasonal factors for the exports and imports at the levels examined in this article may also change because of changes in the relative weights of more detailed components if these components have different seasonal patterns. Finally, the seasonally adjusted estimates for each year are ad-

5. For a more extensive discussion of the data sources, see U.S. Bureau of Economic Analysis (1990).

6. As seasonal factors change, their effects sum to 100 percent for each year for which the estimates are being seasonally adjusted.

7. In addition to X-12 ARIMA, similar programs—such as X-11 and X-11 ARIMA—are sometimes used. They all are designed to take into account special factors that affect seasonal patterns, such as the number of business days in a period or the date of Easter.

justed to match the annual totals for the seasonally unadjusted estimates.

Estimates and their sources

The estimates used in this article are from two ITA tables: “Table 1. U.S. International Transactions” and “Table 2. U.S. Trade in Goods.”⁸ In addition to the measures examined in this study, these tables contain more detailed estimates. The latest estimates are available on BEA’s Web site at <www.bea.gov>.

This article examines the revisions to the quarterly estimates of exports, and imports of goods and services for the period 1990–2000. The revisions to the estimates of exports and imports of goods and their six major components are also examined for 1990–2000. The revisions to exports and imports of services and their seven major components are examined for 1992–2000. The beginning years were chosen because the latest estimates for earlier years have not been subject to the same sets of revisions as the estimates for later years.⁹ However, the latest estimates for years in the sample periods do not always incorporate the same source data or methodologies. The ending year, 2000, was chosen to balance the desirability of large sample sizes against the likelihood of further revisions to the seasonal factors.

Revisions to Seasonal Factors and to Seasonally Adjusted and Seasonally Unadjusted Estimates

The revisions evaluated in this study are the revisions from the preliminary and revised current quarterly estimates to the latest estimates. In order to avoid the distortions associated with the increasing size of exports and imports over time, the estimates are expressed in percent changes at annual rates, and the revisions are measured in percentage points. The use of annual rates means that the estimates are about four times larger than the changes at quarterly rates.

The examination of the revisions uses two summary statistics—mean revision and mean absolute revision. In addition, mean absolute changes for the latest seasonally adjusted estimates are shown in order to allow the reader to compare the summary statistics with these average changes. The mean revision is the average of the revisions:

$$MR = \frac{\Sigma(L - E)}{n}$$

where *E* is the percentage change in the earlier quarterly estimate, *L* is the percentage change in the later

estimate—typically the latest estimate—and *n* is the number of quarters in the sample period for which the summary statistic is calculated.

Because revisions can be positive or negative and thus may offset each other, it is useful to also look at the mean absolute revision (that is, the mean revision without regard to sign). The mean absolute revision is the average of the absolute values of the revisions:

$$MAR = \frac{\Sigma|L - E|}{n}$$

Exports and imports of goods and services

Mean revisions and mean absolute revisions for exports and imports of both goods and services for 1990–2000 are shown in table 1. In addition, in the last column of the table, mean absolute changes in the latest estimates of the seasonally adjusted flows are shown so that the sizes of the average revisions can be compared with the sizes of the average changes. The mean revisions for all three types of estimates—seasonally adjusted, seasonally unadjusted, and (the effects of) seasonal factors for both vintages—are small in comparison with the mean absolute changes in the latest seasonally adjusted estimates. All the mean revisions for the seasonally unadjusted estimates of both exports and imports are positive, but all the mean revisions due to seasonal factors are negative. Thus, the two types of revisions tend to offset each other. The net effect of the revisions to the two types of estimates is that the mean revisions for the seasonally adjusted estimates are positive for exports and negative for imports. (The mean revisions for the seasonally unadjusted estimates and those for the seasonal factors are additive in deriving mean revisions to the seasonally adjusted estimates.)

The mean absolute revisions for the seasonally adjusted estimates of both exports and imports are larger than the mean absolute revisions for either the

Table 1. Revisions From Preliminary and Revised Estimates to Latest Estimates of Quarterly Changes in Exports and Imports of Goods and Services, 1990–2000
[Percentage points at annual rates]

	Mean revision		Mean absolute revision		Mean absolute change ¹
	Preliminary	Revised	Preliminary	Revised	Latest
Exports of goods and services					
Seasonally adjusted	0.38	0.26	3.47	3.23	8.96
Seasonally unadjusted	0.81	0.38	1.94	1.57	.....
Seasonal factors	-0.44	-0.12	3.42	3.07	.....
Imports of goods and services					
Seasonally adjusted	-0.08	-0.17	2.39	2.22	10.22
Seasonally unadjusted	0.10	0.02	1.75	1.57	.....
Seasonal factors	-0.17	-0.19	2.00	1.88	.....

8. Ten other ITA tables provide additional information.

9. The latest estimates in this study are those available in March 2003.

1. Mean of the absolute values of changes from quarter to quarter.

seasonally unadjusted estimates or the seasonal factors. The mean absolute revisions for the seasonal factors are larger than those for the seasonally unadjusted estimates. Thus, the revisions to the seasonally unadjusted estimates augment the revisions to seasonal factors in determining the revisions to the seasonally adjusted estimates.¹⁰

The mean absolute revisions for the revised seasonally adjusted estimates of exports and imports are both about 0.2 percentage point smaller than those for the preliminary estimates; this result suggests that the revised estimates are more accurate. In addition, the mean absolute revisions for both the revised seasonally unadjusted estimates and the revised seasonal factors are also smaller than the preliminary estimates.

Exports and imports of goods

The mean revisions and mean absolute revisions for exports and imports of goods for 1990–2000 are shown in table 2. The results are broadly similar to those shown in table 1. The mean revisions are small in comparison with the mean absolute changes; the mean absolute revisions for seasonally adjusted estimates are larger than those for either the seasonally unadjusted estimates or the seasonal factors, and the mean absolute revisions for the revised estimates are smaller than those for the preliminary estimates. However, the mean revisions for the seasonal factors are nearly as large as the mean revisions for the seasonally adjusted estimates of exports of goods and larger than the mean revisions for the seasonally adjusted estimates of imports of goods. Similarly, the mean absolute revisions for the seasonal factors are about four times as large as those for the seasonally unadjusted estimates. Thus,

10. In contrast, Fxler and Grimm (2002, 19) found that the revisions to seasonal factors were found to offset the effects of the revisions to seasonally unadjusted estimates of GDP and most of its major components, and the mean absolute revisions to the seasonally adjusted estimates were smaller than those to either the seasonally unadjusted estimates or the seasonal factors for all GDP components except imports.

Table 2. Revisions From Preliminary and Revised Estimates to Latest Estimates of Quarterly Changes in Exports and Imports of Goods, 1990–2000

[Percentage points at annual rates]

	Mean revision		Mean absolute revision		Mean absolute change ¹
	Preliminary	Revised	Preliminary	Revised		Latest
Exports of goods					
Seasonally adjusted.....	-0.57	-0.23	5.03	4.58	9.63
Seasonally unadjusted.....	-0.03	-0.03	1.17	1.01	
Seasonal factors.....	-0.54	-0.20	4.64	4.23	
Imports of goods					
Seasonally adjusted.....	-0.16	-0.28	2.41	2.28	10.96
Seasonally unadjusted.....	0.03	0.09	0.90	0.67	
Seasonal factors.....	-0.19	-0.36	2.30	2.18	

1. Mean of the absolute values of changes from quarter to quarter.

the revisions to seasonal factors contribute heavily to revisions to the seasonally adjusted estimates.

The revisions for exports of goods disaggregated into five components and a residual “not elsewhere classified” are shown in table 3.¹¹ The mean revisions are generally small and negative and are primarily due to the revisions to the seasonal factors. An exception is a positive mean revision for the revised estimates of exports of automotive vehicles, engines, and parts; for these estimates, a positive mean revision for the seasonally unadjusted estimates more than offsets the negative mean revision for seasonal factors. Like the revisions to total exports of goods, the mean absolute revisions for the seasonally adjusted estimates of the exports of the five components are larger than those for either the seasonally unadjusted estimates or the seasonal factors, which augment each other. The mean absolute revisions for the seasonal factors are also much larger than those for the seasonally unadjusted estimates.

The revisions for imports of goods disaggregated into the same five components as for exports are shown in table 4. The mean revisions—which again are small—are negative for most of the seasonally adjusted estimates and for all of the seasonal factors, and

11. The “not elsewhere classified” grouping is a catchall that is small, and its components have changed over time. As a result, it is not included in the discussion of either exports or imports of goods.

Table 3. Revisions From Preliminary and Revised Estimates to Latest Estimates of Quarterly Changes in Exports of Goods by Major Component, 1990–2000

[Percentage points at annual rates]

	Mean revision		Mean absolute revision		Mean absolute change
	Preliminary	Revised	Preliminary	Revised		Latest
Foods, feeds, and beverages					
Seasonally adjusted.....	-2.45	-1.73	13.39	12.66	18.12
Seasonally unadjusted.....	-0.18	0.4	2.42	2.27	
Seasonal factors.....	-2.27	-2.14	13.03	12.53	
Industrial supplies and materials					
Seasonally adjusted.....	-0.83	-0.14	3.2	2.87	13.49
Seasonally unadjusted.....	-0.41	0.09	1.52	1.06	
Seasonal factors.....	-0.42	-0.24	2.97	2.59	
Capital goods, except automotive					
Seasonally adjusted.....	-0.82	-0.11	9.28	8.53	12.53
Seasonally unadjusted.....	-0.08	0.06	1.51	1.05	
Seasonal factors.....	-0.74	-0.18	8.61	7.89	
Automotive vehicles, engines, and parts					
Seasonally adjusted.....	-0.94	0.37	11.3	10.6	16.79
Seasonally unadjusted.....	-0.13	1.17	5.2	4.09	
Seasonal factors.....	-0.81	-0.8	10.51	9.34	
Consumer goods					
Seasonally adjusted.....	-0.8	-0.36	7.86	7.49	10.15
Seasonally unadjusted.....	-0.22	0.13	1.75	1.51	
Seasonal factors.....	-0.58	-0.49	7.2	7.08	
Not elsewhere classified					
Seasonally adjusted.....	1.32	-7.59	26.16	23.29	19.96
Seasonally unadjusted.....	3.56	-5.95	26.55	23.99	
Seasonal factors.....	-2.24	-1.64	5.13	5.19	

they are positive for most of the seasonally unadjusted estimates. The mean absolute revisions for the seasonally adjusted estimates are larger than those for all of the seasonally unadjusted estimates and larger than those for the seasonal factors for three of the five components. The mean absolute revisions for the seasonal factors are substantially larger than those for the seasonally unadjusted estimates for four components, but for industrial supplies and materials, the revisions for the seasonal factors are about the same size as those for the unadjusted estimates.

For both the exports and imports of goods, the mean absolute revisions for the revised estimates of all the components and for all three types of estimates are smaller than the revisions for the preliminary estimates. This result suggests that the revised estimates are more accurate. In addition, the finding that the mean absolute revisions for the seasonal factors are considerably larger than those for the seasonally unadjusted estimates—and typically nearly as large as those for the seasonally adjusted estimates—indicates that the incorporation of additional years of data in determining the seasonal factors plays a major role in the revisions to the seasonally adjusted estimates.

Exports and imports of services

The revisions for exports and imports of services for 1992–2000 are shown in table 5. The mean revisions for the seasonally adjusted estimates are positive, but

Table 4. Revisions From Preliminary and Revised Estimates to Latest Estimates of Quarterly Changes in Imports of Goods by Major Component, 1990–2000
[Percentage points at annual rates]

	Mean revision		Mean absolute revision		Mean absolute change
	Preliminary	Revised	Preliminary	Revised		Latest
Foods, feeds, and beverages					
Seasonally adjusted.....	-0.29	-0.43	5.12	5.08	10.75
Seasonally unadjusted.....	0.05	0.04	0.71	0.55	.....
Seasonal factors.....	-0.35	-0.47	5.4	5.41	.....
Industrial supplies and materials					
Seasonally adjusted.....	0.17	0.24	2.92	2.71	21.26
Seasonally unadjusted.....	0.35	0.54	2.51	2.03	.....
Seasonal factors.....	-0.18	-0.3	2.36	2.3	.....
Capital goods, except automotive					
Seasonally adjusted.....	-0.46	-0.24	2.74	2.63	12.48
Seasonally unadjusted.....	-0.37	0.54	1.07	0.78	.....
Seasonal factors.....	-0.09	-0.3	2.41	2.47	.....
Automotive vehicles, engines, and parts					
Seasonally adjusted.....	-0.90	-0.24	7.76	7.64	14.58
Seasonally unadjusted.....	-0.46	-0.18	2.26	1.53	.....
Seasonal factors.....	-0.44	-0.06	7.71	7.18	.....
Consumer goods					
Seasonally adjusted.....	0.01	-0.03	5.77	5.5	11.27
Seasonally unadjusted.....	0.38	0.24	1.08	0.95	.....
Seasonal factors.....	-0.37	-0.27	5.82	5.74	.....
Not elsewhere classified					
Seasonally adjusted.....	-2.08	-2.96	15.99	15.88	17.44
Seasonally unadjusted.....	-0.18	-0.88	3.62	2.48	.....
Seasonal factors.....	-1.90	-2.08	15.12	15.33	.....

small relative to the mean absolute changes; however they are larger than those for the exports and imports of goods (table 2). These positive mean revisions are primarily due to upward revisions to the seasonally unadjusted estimates.

The mean absolute revisions for the seasonally adjusted estimates are smaller than those for the seasonally unadjusted estimates but are larger than those for the seasonal factors. Thus, in contrast to the seasonally adjusted estimates exports and imports of goods, the revisions for the seasonal factors partly offset those for the unadjusted estimates. The mean absolute revisions for the seasonally adjusted estimates of the exports of services are roughly the same size as those for exports of goods, but those for the imports of services are about twice the size of those for the imports of goods. The mean absolute revisions for seasonally unadjusted estimates of exports and imports of services are both much larger than those of exports and imports of goods.

The revisions to exports of services disaggregated into seven components are shown in table 6. Two of the components—transfers under U.S. military agency sales contracts and miscellaneous U.S. Government services—are judged to not have seasonal patterns and are not seasonally adjusted. Both the mean revisions and the mean absolute revisions for these components are large in comparison with those for all exports of services, but the components are quite small relative to all the exports of services and are not further discussed.

The mean revisions for most estimates of the other five components are small relative to the mean absolute changes. The mean revision for the preliminary estimates of royalties and license fees, however, is more than half the size of the mean absolute change. The mean absolute revisions for the seasonally adjusted estimates are nearly as large as the mean absolute changes, and the mean absolute revision for the preliminary estimates for passenger fares is slightly larger.

Table 5. Revisions From Preliminary and Revised Estimates to Latest Estimates of Quarterly Changes in Exports and Imports of Services, 1992–2000
[Percentage points at annual rates]

	Mean revision		Mean absolute revision		Mean absolute change
	Preliminary	Revised	Preliminary	Revised		Latest
Exports					
Seasonally adjusted.....	1.75	1.11	4.39	4.22	6.71
Seasonally unadjusted.....	1.75	0.68	4.87	4.94	.....
Seasonal factors.....	0.00	0.43	2.14	2.07	.....
Imports					
Seasonally adjusted.....	0.69	0.70	4.89	4.61	7.76
Seasonally unadjusted.....	1.21	0.54	6.38	6.38	.....
Seasonal factors.....	-0.52	0.16	3.98	3.80	.....

For most of the components, the mean absolute revisions for the seasonally adjusted estimates are smaller than those for the seasonally unadjusted estimates and larger than those for the seasonal factors; thus, the revisions to the seasonal factors partly offset the revisions to the seasonally unadjusted estimates. However, the two vintages of estimates of royalties and license fees have mean absolute revisions for the seasonally adjusted estimates that are slightly larger than those for the other two types.

The revisions for imports of services disaggregated into seven components are shown in table 7. Like exports of services, two components—direct defense expenditures and miscellaneous U.S. Government services—are not seasonally adjusted. The mean revisions for the two components are similar in size to those for all the imports of services, but the mean absolute revisions are considerably larger. These components are small relative to all the imports of services, and they are not further discussed. The mean revisions for the other five components are small relative to the corresponding mean absolute changes.

A closer examination of two components—travel and passenger fares—illustrates one of the complex ways that the revisions to seasonally unadjusted estimates interact with the revisions to seasonal factors. The mean revisions for seasonally unadjusted estimates of travel have large negative values, while the mean revisions for the seasonal factors for travel have large positive revisions, illustrating an offsetting rela-

tionship. Yet, while the seasonally unadjusted passenger fares have large positive values, it is only the mean revision for the seasonal factors for the preliminary estimates of passenger fares that has an opposite sign. The mean revision for the revised estimates of the seasonal factors for passenger fares is positive, and it adds to the positive mean revision for the seasonally unadjusted estimates.

The mean absolute revisions for the seasonally adjusted estimates of four components are roughly as large as the mean absolute changes. For most components, the mean absolute revisions for the seasonally adjusted estimates are smaller than those for the seasonally unadjusted estimates and larger than those for the seasonal factors; like the exports of services, the revisions to the seasonal factors partly offset the revisions to the seasonally unadjusted estimates. However, the mean absolute revisions for the seasonally adjusted estimates for the two vintages of estimates of “other transportation” and for the revised estimates of royalties and license fees are slightly larger than those for the unadjusted estimates.

As with goods, the mean absolute revisions for the revised estimates of both exports and imports of services and their components are all smaller than those for the preliminary estimates. This result also may be interpreted as the increase in accuracy. In addition, the mean absolute revisions for the seasonally unadjusted services components are all larger than those for the seasonal factors, in contrast to those for the goods components.

Table 6. Revisions From Preliminary and Revised Estimates to Latest Estimates of Quarterly Changes in Exports of Services by Major Component, 1992–2000

[Percentage points at annual rates]

	Mean revision		Mean absolute revision		Mean absolute change
	Preliminary	Revised	Preliminary	Revised	Latest
Transfers under U.S. military agency sales contracts.....	7.95	8.74	31.49	28.49	39.30
Travel.....					
Seasonally adjusted.....	1.90	2.07	8.66	8.35	10.63
Seasonally unadjusted.....	1.33	0.12	11.83	11.46	.....
Seasonal factors.....	0.57	1.95	8.10	8.28	.....
Passenger fares.....					
Seasonally adjusted.....	-0.97	0.73	11.55	8.76	8.84
Seasonally unadjusted.....	-0.32	-1.18	14.86	12.09	.....
Seasonal factors.....	-0.65	1.92	9.33	7.81	.....
Other transportation.....					
Seasonally adjusted.....	-1.71	-1.14	5.22	4.10	9.04
Seasonally unadjusted.....	-1.61	-0.71	8.05	6.52	.....
Seasonal factors.....	-0.09	-0.43	4.56	3.76	.....
Royalties and license fees.....					
Seasonally adjusted.....	5.82	2.88	10.56	8.43	10.96
Seasonally unadjusted.....	3.68	2.17	9.95	7.28	.....
Seasonal factors.....	2.14	0.71	7.21	5.86	.....
Other private services.....					
Seasonally adjusted.....	2.58	0.23	6.78	5.51	8.24
Seasonally unadjusted.....	2.34	-0.11	7.37	5.31	.....
Seasonal factors.....	0.24	0.34	3.20	2.72	.....
U.S. Government miscellaneous services.....	47.44	29.47	106.05	95.24	159.54

Table 7. Revisions From Preliminary and Revised Estimates to Latest Estimates of Quarterly Changes in Imports of Services by Major Component, 1992–2000

[Percentage points at annual rates]

	Mean revision		Mean absolute revision		Mean absolute change
	Preliminary	Revised	Preliminary	Revised	Latest
Direct defense expenditures.....	-1.05	0.10	12.52	9.36	14.46
Travel.....					
Seasonally adjusted.....	-0.71	0.06	7.93	7.60	7.62
Seasonally unadjusted.....	-2.17	-1.73	15.61	16.02	.....
Seasonal factors.....	1.46	1.79	13.80	14.57	.....
Passenger fares.....					
Seasonally adjusted.....	1.99	5.07	11.27	9.02	10.90
Seasonally unadjusted.....	3.40	3.83	15.87	14.02	.....
Seasonal factors.....	-1.41	1.23	10.96	10.73	.....
Other transportation.....					
Seasonally adjusted.....	0.45	-0.39	4.79	4.40	10.31
Seasonally unadjusted.....	0.66	-0.07	4.71	3.32	.....
Seasonal factors.....	-0.22	-0.32	3.86	3.77	.....
Royalties and license fees.....					
Seasonally adjusted.....	14.08	9.94	27.52	25.80	40.26
Seasonally unadjusted.....	14.83	9.08	29.28	25.23	.....
Seasonal factors.....	-0.74	0.85	11.47	9.21	.....
Other private services.....					
Seasonally adjusted.....	-7.04	1.89	21.15	11.19	19.69
Seasonally unadjusted.....	-12.19	2.57	27.13	11.70	.....
Seasonal factors.....	5.15	-0.68	9.81	3.53	.....
U.S. Government miscellaneous services.....	0.45	-0.77	15.35	12.83	22.39

The meaning of the sizes of revisions

Each year, BEA revises its estimates to incorporate statistical and methodological changes and changes in definitions and classifications. BEA implements these improvements as part of a continuing effort to address gaps in coverage, to refine estimation techniques, and to conform more closely with international classification guidelines.¹²

The effect of improvements increases the sizes of revisions. As explained by Young (1996),

An improvement in the current estimates results in a permanent decrease in revision size. Improvement in both the current and latest available estimates results in little change. Improvement that is introduced...into the (then) latest available estimates as is often the case, results in an increase in revision size for a period of years until the improvement is also reflected in the current estimates.

Thus, the ongoing process of introducing improvements into the estimates of exports and imports of services is likely to be a major source of revision to the seasonally unadjusted estimates. As a result, the relatively large mean absolute revisions for services reflect the improvements to the estimates. An example of the effects of improvements in the services flows may be seen by comparing the mean revisions for the seasonally unadjusted estimates of exports of services in table 5 with the mean revisions for the seasonally unadjusted estimates of exports of goods in table 2; the mean revisions for services are much larger (and of the opposite sign) than the mean revisions for goods.

Conclusions

In general, the effects of the revisions to seasonal factors on mean absolute revisions for the seasonally adjusted estimates of exports and imports generally do not simply add to the effects of the revisions to the seasonally unadjusted estimates. The revisions to the seasonally unadjusted estimates result from revisions to the estimates for a quarter, whereas revisions to the seasonal factors result from revisions to the seasonally unadjusted estimates for many quarters that are spread over a number of years. Revisions, however, may also result from improvements to the estimating process. As a result, large revisions do not necessarily indicate poor reliability, and small revisions do not necessarily indicate good reliability.

12. The improvements are described in an article about revisions to the international transactions accounts that is published each July in the *SURVEY OF CURRENT BUSINESS*. For a summary of the many improvements to BEA's data on international services, see Whichard and Borga (2002, 54–56).

The mean absolute revisions for seasonally adjusted estimates of the exports and imports of all goods and services and of goods alone are larger than those for either the seasonally unadjusted estimates or the seasonal factors. The mean absolute revisions for the seasonal factors are typically larger than those for the seasonally unadjusted estimates and are nearly as large as those for the seasonally adjusted estimates. A review of the revisions to the components of exports and imports of goods reinforces this finding. The revisions to seasonal factors are the principal determinants of the revisions to the seasonally adjusted estimates and are about half as large as those to the seasonally adjusted estimates of exports and two-thirds as large as those to imports.

The mean absolute revisions for seasonally adjusted estimates of both exports and imports of services are generally larger than those for seasonal factors but are smaller than those for seasonally unadjusted estimates. The effects of the revisions to seasonal factors are nearly as large as the revisions to seasonally adjusted estimates of exports and imports of goods and services. The mean revisions of the two types of revisions are of the opposite sign, and the revisions tend to offset one another.

Revisions to seasonal factors thus play a mixed role. They play a major role in revisions to exports and imports of goods, and they augment the effects of revisions to the seasonally unadjusted estimates. The revisions play a somewhat smaller role in revisions to exports and imports of services, and they tend to offset the effects of revisions to the seasonally unadjusted estimates.

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