Real Exports and Real Imports:
Methodology and Tips for Analysis

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Abstract

Real exports and imports compiled and released by the Research and Statistics Department of the Bank of Japan — based on concepts consistent with exports and imports in real GDP — serve as an indicator for measuring the real value of export/import goods, that is adjusted for the effects of price changes. In this latest release, we have made revisions including changes to goods and region classifications so as to reflect structural changes in exports among other factors. We also include an update of the base year of the deflators used for calculating real exports and imports in line with the base year revision of the *Corporate Goods Price Index*. This paper explains these revisions together with the methodologies used to compile the real export/import data. It also provides some useful tips when using the real export/import data in practice.

1. Introduction

The Bank of Japan's Research and Statistics Department compiles data on real exports and imports — in which the effects of price fluctuations are removed — to analyze developments in the goods trade of Japan (Figure 1). Specifically, we prepare two sets of data for real exports and real imports: the main series, which are long-term time series data on real exports/imports (as to world total); and the reference series, which consist of real exports by goods, real exports by region, and real trade balance (% of real GDP). These time-series data on real exports/imports are released in the "Research Data" section on the Bank of Japan website and widely used by those who follow the state of the financial economy (Figure 2).[1]

Figure 1. Real Exports and Real Imports
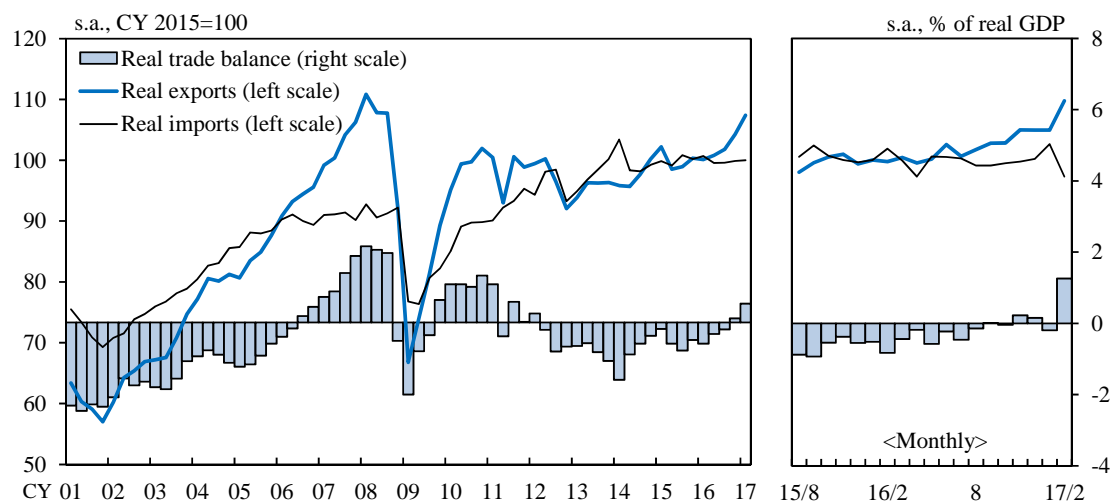
Note: Figures for 2017/Q1 are January-February averages.
   Figures for the real trade balance (as a ratio of real GDP) from January 2017 onward are calculated using real GDP for 2016/Q4.
Source: Bank of Japan, "Developments in Real Exports and Real Imports."

Figure 2. Data Series Released as "Research Data"

Main series (from 1975 onward)	Reference series (from 2000 onward)
Real exports (CY 2015=100)	Real exports by goods (CY 2015=100)
Real imports (CY 2015=100)	Real exports by region (CY 2015=100)
	Real trade balance (% of GDP)

Note: All series are seasonally adjusted monthly data.

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[1] Research Data "Developments in Real Exports and Real Imports" are available on the BOJ website at the following link:

http://www.boj.or.jp/en/research/research_data/reri/index.htm/

Data on real exports and imports — based on the same concepts underlying that of exports and imports in real GDP — serve as an indicator for measuring the real value of export/import goods in which the effects of price changes are removed. These figures, which are released on the same day every month as the provisional release of the *Trade Statistics of Japan* by the Ministry of Finance, are useful in the sense that they can provide more timely information than the GDP statistics that are released after each quarter. We also compile data on real exports broken down by region and by goods — data unavailable in the GDP statistics — to make it possible to analyze developments in Japanese exports, even in terms of regional-level developments in overseas economies and the intra-industry global value chain. This time we have updated the base year of the deflators used for calculating real exports and imports in line with the base year revision of the *Corporate Goods Price Index*. Revisions were also made to reclassify groupings of goods and regions so as to reflect the structural changes in exports among other factors. This paper explains these revisions in conjunction with the methodologies used to compile real export/import data. It also provides some tips for using real export/import data in practice.

The paper is organized as follows. In Section 2, we introduce the detailed methods used to compile the data on real exports/imports available online in the BOJ website as of April 2017.[2] We also explain the revisions made this time. Section 3 provides some tips for analysis referring to actual examples such as comparable indicators.

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[2] We continually revise the methodology, reflecting the availability of source data used for estimation and in response to the economic situation. Therefore, please check the most recent information available on the BOJ website.

2. Compilation Methodologies and Details on Current Revisions

Figures of real exports/imports are calculated by dividing the nominal export/import value of goods released in the *Trade Statistics of Japan* by the BOJ's *Export/Import Price Index*.[3] By dividing the nominal value using the price index, data for real exports/imports represent the movements of export/import values in real terms and are adjusted for the effect of price changes. This concept is the same as that used for estimating real exports/imports of goods in the GDP statistics.

In the following, we provide a detailed description of the methods used for estimating: (i) the main series of real exports and real imports (as to world total; long-term time-series data from 1975 onward) and the reference series, including (ii) real exports by goods (2000 onward), (iii) real exports by region (2000 onward), and (iv) real trade balance (% of real GDP), all of which are released on a monthly basis in the "Research Data" section of the BOJ website. We also explain the seasonal adjustment method and procedures for updating the base year of deflators.

(1) Main series of real exports and real imports (long-term time-series)

The long-term time-series data on real exports are compiled in the following way.

(i)   First, the total value of nominal exports in the *Trade Statistics of Japan* is subdivided into groupings of goods depending on their characteristics. Specifically, it is broken into eight item groups based on the principal commodity items provided in the provisional release of the *Trade Statistics of Japan* (Figure 3 [1]).[4]

(ii)   The value of real exports is calculated by dividing the nominal export value of each group with the price index (deflator), which is selected from the *Export Price Index* so as to correspond with each group (Figure 3 [1]).[5]

(iii)   The total value of real exports is derived by adding up the value of real exports of the eight item groups; the value is then seasonally adjusted and indexed at 100 using the CY2015 average.[6]

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[3] For compiling the *Corporate Goods Price Index*, the Bank of Japan's Research and Statistics Department collects data on prices with fixed qualities for goods transacted among companies. Three sets of indexes comprise the *Corporate Goods Price Index*: the *Producer Price Index*, *Export Price Index*, and *Import Price Index*; they are also used as source data for deflators in the GDP statistics.

[4] In the revised release of the *Trade Statistics of Japan*, detailed breakdown data for commodities with a 9-digit code (among which the first six digits are based on the internationally-standard Harmonized System Code) are included. On the other hand, only the major series of commodity data called "principal commodity item" (in which each item is comprised of some more detailed commodities) are released in the provisional figures.

[5] Since an index corresponding to "foodstuff" does not exist in the *Export Price Index* in the current base, "food and beverages" in the *Producer Price Index* is substituted for this index (Figure 3 [1]).

Figure 3. Item Groups in "Real Exports and Imports (main series)"

(1) Exports

Principal commodity item in "Trade Statistics"	EPIs (2015 base) used as corresponding deflator
Foodstuff	Beverages & foods (PPI)
Textile yarn, Fabrics	Textile products
Chemicals	Chemicals & related products
Iron and steel products Nonferrous metals Manufactures of metals	Metals & related products
Machinery Scientific, optical inst.	General purpose, production & business oriented machinery
Electrical Machinery	Electric & electronic products
Transport Equipment	Transportation equipment
Others (residuals)	Other primary products & manufactured goods

(2) Imports

Principal commodity item in "Trade Statistics"	IPI (2015 base) used as corresponding deflator
Foodstuff	Beverages & foods and agriculture products for food
Fabrics Clothing, etc.	Textiles
Mineral fuels	Petroleum, coal & natural gas
Chemicals	Chemicals & related products
Machinery Scientific, optical inst.	General purpose, production & business oriented machinery
Electrical Machinery	Electric & electronic products
Transport Equipment	Transportation equipment
Others (residuals)	Lumber & wood products and forest products Metals & related products Other primary products & manufactured goods

Note: EPIs and IPIs are in yen terms. PPI Beverages & foods used as the corresponding deflator for "foodstuff" of real exports excludes consumption tax. Deflator for "others" of real imports is calculated as the weighted average of three indices using their shares in IPI as weights.

Sources: Ministry of Finance, "Trade Statistics"; Bank of Japan, "Corporate Goods Price Index."

Real imports are also derived by subdividing the total value of nominal imports in the *Trade Statistics of Japan* into eight item groups and then deflated using corresponding deflators (from the *Import Price Index*) for each group (Figure 3 [2]).

Exports/imports are deflated in the GDP statistics in the same way, but with a higher degree of detail, with each divided into approximately 400 items. The estimating procedure for grouping in our real exports/imports is simple and rough relative to the GDP statistics. Nevertheless, the main series of real exports/imports have their advantages in analyzing the trade activities of the Japanese economy for three reasons: (i) the long-term time-series data are able to be compiled using the value of nominal exports/imports in the *Trade Statistics of Japan* and the corresponding *Export/Import Price Index* that can be obtained from 1975 onward;[7,8] (ii) they can provide more timely information than the GDP statistics, since they are compiled on a monthly basis; and (iii) they basically trace movements in exports and imports of goods in the GDP statistics (Figure 8; details will be discussed later on this paper).

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[6] i.e. Our real exports/imports are based on Laspeyres volume index.

[7] Figures for the trade value based on principal commodity items in the *Trade Statistics of Japan* are available from 1988 onward. Those for the value of nominal trade for 1988 forward — which are used as source data for real exports/imports — are estimated retroactively by recalculating items.

[8] The current GDP statistics are estimates based on the new international standard, the SNA 2008; retroactive data for figures before 1994 are not released. Even in the former base, the SNA 1993, data only start from 1980.

(2) Real exports by goods

To capture the detailed features of Japan's exports in recent years, data for real exports by goods are compiled based on a goods classification which is subdivided even further than the above-mentioned main series (Figure 4). However, mainly due to data limitation, these data have been compiled and released for only a relatively recent period (2000 onward).

The goods classification of real exports rearranges principal commodity items — those from the preliminary release of the *Trade Statistics of Japan* — into groups of similar items. They are arranged into the following five categories: (i) *Intermediate goods*, such as iron and steel products, chemicals, etc.; (ii) *motor vehicles and related goods* including cars and motor vehicle parts; (iii) *IT-related goods*, which includes cellular phones, computers, digital home appliances, precision machinery as well as their parts; (iv) *capital goods*, excluding motor vehicles and related goods and IT-related goods; and (v) *others* (Figure 4).

To analyze export trends in a timely fashion, data for real exports by goods are also compiled using the goods classification based on principal commodities available at the time of the provisional release of the *Trade Statistics of Japan*. It should be noted, however, that the goods classifications are not strictly defined. A power-generating machine for instance — which belongs to the *motor vehicles and related goods* category — may include engines for motor vehicles on the one hand, but may also include turbines for generators.

Figure 4. Goods Classification in "Real Exports by Goods"

Principal commodity item in "Trade Statistics"		Inter-mediate goods	Motor vehicles and related goods	IT-related goods	Capital goods	Others	EPIs (2015 base) used as corresponding deflator
Foodstuff						X	Others deflator*
Raw materials						X	Others deflator*
Mineral fuels						X	Petroleum products
Chemicals		X					Chemicals & related products, Silicon wafers, Plastic films & sheets (except plastic polarizing films), Plastic laminates
Manufactured goods	Iron and steel products	X					Iron & steel
	Nonferrous metals	X					Nonferrous metals
	Manufactures of metals	X					Metal products, Tools for machines
	Non-metallic mineral ware	X					Ceramic, stone & clay products (excluding Artificial graphite electrodes)
	Other manufactured goods (residuals)					X	Others deflator*
Machinery	Power generating machine		X				Engines, Internal combustion engines for motor vehicles & parts, Internal combustion diesel engines for marine vessels, Outboard motors, Aircraft engine parts
	Computer and units, Parts of computer			X			Electronic computers & computer equipment
	Metalworking machinery				X		Metal forming machinery, Metal cutting machine tools
	Pump and centerifuges				X		Pumps & compressors, Motor vehicle air conditioner parts
	Construction machines				X		Machinery & equipment for construction and mining (excluding Construction cranes)
	Mechanical handling equip.				X		Industrial trucks & parts, Construction cranes
	Heating or cooling machine				X		Household electric equipment, Refrigerating appliances
	Other machinery (residuals)				X		General purpose machinery, Production machinery
Electrical machinery	Semiconductors. etc			X			Diodes & rectifying devices, Transistors, Integrated circuits, Photoelectric converter devices, Crystal oscillators, Solar batteries, Piezoelectric ceramic devices & filters
	Visual apparatus, Audio apparatus, Parts of audio, visual app.			X			Electric & electronic products
	Electrical power machinery				X		Transformers for electronic equipment, Generators, Motors, Power transformers
	Telephony, Telegraphy			X			Communications equipment
	Electrical Measuring			X			Electrical meters & measuring instruments
	Electrical Apparatus			X			Electric & electronic products
	Other electrical machinery (residuals)			X			Electric & electronic products, Electric tools, Artificial graphite electrodes
Transport equipment	Motor vehicles		X				Passenger cars, Buses, Trucks
	Parts of motor vehicles		X				Motor vehicle parts (excluding Internal combustion engines for motor vehicles & parts and Motor vehicle air conditioner parts)
	Motorcycles, Autocycles		X				Motorcycles
	Ships				X		Transportation equipment
	Other transport equipment (residuals)					X	Others deflator*
Others	Scientific, Optical inst.			X			Business oriented machinery, Display devices, Plastic polarizing films, Frames for spectacles & ophthalmic focus lenses
	Others (residuals)					X	Others deflator*

Note: Deflators based on some EPIs are calculated as weighted averages of the indices using their shares in EPI as weights. The "others deflator" consists of other primary products and manufactured goods (excluding ceramic, stone and clay products and petroleum products), photosensitive materials, iron and steel scrap, copper and copper alloy scrap, aircraft parts (except engines), bicycle parts, and textiles.

Source: Ministry of Finance, "Trade Statistics."

The definitions used for goods classification of real exports are revised on an ongoing basis in response to structural changes in Japan's exports as well as those of source data (in the *Trade Statistics of Japan* and *Export Price Index*). In the current revision, we have moved electronic components, such as electrical apparatus as well as batteries, both previously included in *capital goods and parts,* into the *IT-related goods* category, reflecting that fact that they have come to serve more for IT-related purposes (Figure 5). As a result of this rearrangement, *capital goods and parts* have been renamed *capital goods*. Although semiconductor production equipment also serves for IT-related purposes, here it is classified as *capital goods*.[9]

Figure 5. Revision to Goods Classification of "Real Exports by Goods"

	Principal commodity item in "Trade Statistics"			
	Machinery	Electrical machinery	Others	
"Capital goods and parts" before revision	Metalworking machinery Construction machines Heating or cooling machine Pump and centerifuges Mechanical handling equip. Other machinery	Electrical power machinery	Ships	"Capital goods" after revision
	Parts of Computer	Parts of audio, visual app. Electrical measuring Electrical apparatus Others (Batteries and accumulators, etc.)		"IT-related goods" after revision
"IT-related goods" before revision	Computers	Visual apparatus Audio apparatus Semiconductors, etc. Telephony, Telegraphy	Scientific, Optical inst	

Note: Other machinery includes semiconductor production equipment.
Source: Ministry of Finance, "Trade Statistics."

Data for exports by goods — consistent with the method used for the main series — are compiled using the following two steps.

(i)   The value of nominal exports is deflated for each principal commodity item in the *Trade Statistics of Japan*, using the deflator that corresponds with each item selected from the *Export Price Index* (Figure 4).

(ii) The value of real exports for each principal commodity item is aggregated according to the goods classification defined in Figure 4 and seasonally adjusted; the value is then indexed with the base-year average (CY2015) set at 100.

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[9] In Figure 5, semiconductor production equipment is included in "other machinery," which is derived by subtracting major commodities from machinery (as figures up until 2007 are not released, it is not isolated as an independent item in our calculation).

(3) Real exports by region

Similar to real exports by goods, data by region are compiled using information at the country and region levels available in the provisional releases of the *Trade Statistics of Japan*.[10] Countries and regions are classified into five groups — "United States," "EU (European Union),"[11] "China," "NIEs, ASEAN, etc." and "Others" — as shown in Figure 6.

Figure 6. Region Classification in "Real Exports by Region"

Region classification		Countries and regions
United States		-
EU		Germany, France, Italy, Spain, Netherlands, United Kingdom, Poland, Hungary, Czech Republic, Greece, etc.
Asia		-
	China	-
	NIEs, ASEAN, etc.	Republic of Korea, Taiwan, Hong Kong, Singapore, Thailand, Malaysia, Indonesia, Philippines, Vietnam, India, Bangladesh, etc.
Others		Mexico, Brazil, Russia, Middle East, Africa, Australia, etc.

Note: As of April 2017.
Source: Ministry of Finance, "Trade Statistics."

The Ministry of Finance plans to stop the release of "NIEs" data currently included in the provisional release of the *Trade Statistics of Japan* as of its April figures (due for release in May 2017). Data for real exports/imports include categories at the regional level for "NIEs" and "ASEAN4," but with data for "NIEs" no longer obtainable from the provisional releases of the *Trade Statistics of Japan*, we have taken out these two categories and instead introduced a new one called "NIEs, ASEAN, etc.," which is derived by excluding "China" from "Asia" (figures have been released in this new classification from April 2017).

Real exports by region are compiled by aggregating real exports by goods for each country and region. Details of the procedure are as follows.

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[10] In the provisional release of the *Trade Statistics of Japan*, only the export values by principle commodity of major countries and regions are provided (data are not available for all countries).

[11] In the *Trade Statistics of Japan*, the member countries of EU include only those of when the trade took place. This means that when a new country becomes a member (such as the case with Hungary which joined the union in May 2004), the export value to the EU rises from the month the new country joined the EU and onward, while exports to others — calculated as residuals — decrease their value at the same amount.

(i)   The value of nominal exports of each principal commodity for each country and region is estimated in real terms using deflators for exports by goods.[12]

(ii)   The real export value of each principle commodity is aggregated according to the goods classification defined in real exports by goods at the country and region level, and then seasonally adjusted respectively.

(iii)   Finally, the real export value (seasonally adjusted) by goods is aggregated for each country and region, and then indexed with the base-year average (CY2015) set at 100.

(4) Real trade balance (% of real GDP)

Real trade balance (% of real GDP) is compiled by dividing the difference between real exports and real imports both denominated by the 2015 price by real GDP (seasonally adjusted) for the quarter that includes the month concerned. If the real GDP figure is yet to be released, real GDP of the most recent quarter is used for the months.[13]

(5) Seasonal adjustments

Real exports/imports provide only seasonally adjusted data.[14] This is because the original figures (non-seasonally adjusted) include seasonality which makes it difficult to capture trends in trade activities. For instance, during the New Year holidays in January, the Golden Week holidays in May, and the *Bon* holidays in August, production lines at companies tend to stop, resulting in a slowdown in export activity (Figure 7). In order to assess underlying movements of real exports/imports, we need to analyze data without this seasonality.

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[12] Since indexes by country and region are not released for the *Export Price Index* (except for automobiles to North America), the value of exports by goods for each country and region is deflated using the deflators by commodity as to world total.

[13] The real trade balance matches the nominal trade balance at the time of the base year.

[14] Specifically, we use the X-12-ARIMA, a software package developed by the U.S. Census Bureau for seasonal adjustment.

Figure 7. Seasonality in Real Exports

(1) Real Exports (SA and NSA)	(2) Seasonal Factors of Real Exports
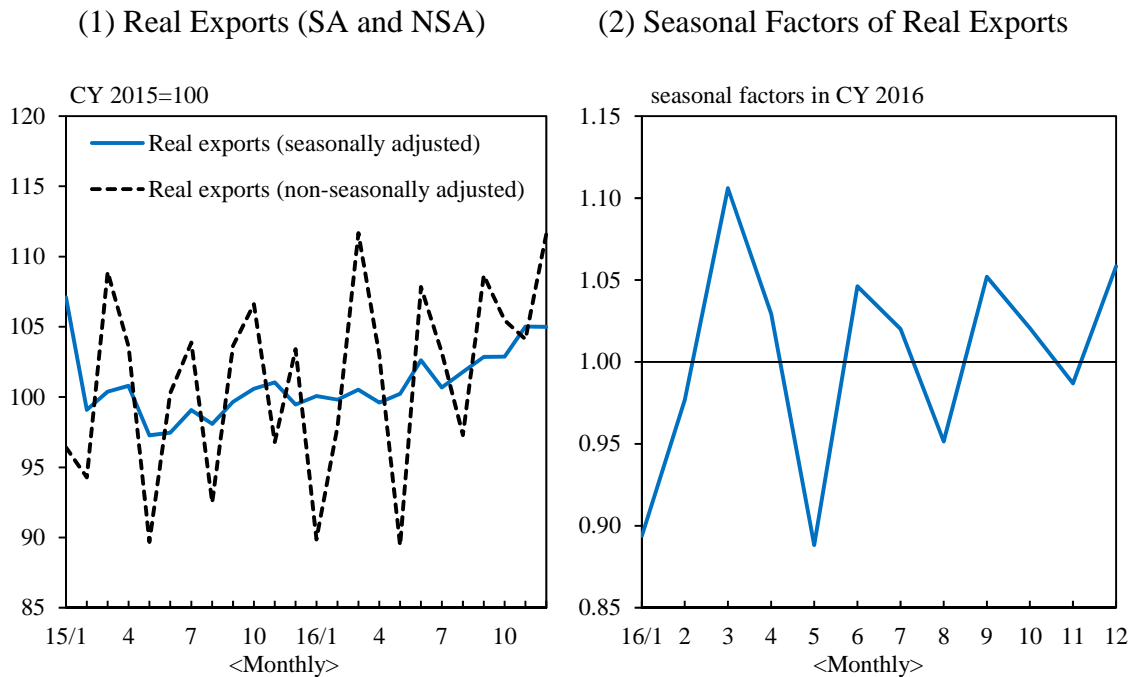
Seasonally adjusted figures are re-estimated each year to reflect new data accrued over time. In practice, we recalculate these figures around April each year following the release of the revised figures for the previous calendar year of the *Trade Statistics of Japan*. For the period up until the next update (basically for one whole year), seasonally adjusted figures are calculated using expected seasonal factors.

Seasonal factors that demonstrate a stable pattern can be easily estimated, although it is difficult to estimate factors such as the Lunar New Year, which changes every year depending on the cycle of the moon. This will be discussed in more detail in Section 3 (7).

(6) Treatment of the rebasing of the *Export and Import Price Indexes*

The *Export/Import Price Index* — used as source data for deflators of real exports/imports — is updated once every five years. When rebasing the *Export/Import Price Index*, commodities are abolished or revised based on their export/import weights in the base year; source data of series for real exports/imports are taken out, while the new series are established with the increased availability of source data. As a result, revisions are also applied to data on real exports and imports for those series that correspond as deflators and for updating the base year of deflators, following the rebasing of the *Export/Import Price Index*.

In April 2017, in line with the rebasing of the *Export and Import Price Index* in February, we revised the series that are used as deflators for real exports/imports and updated the base year from 2010 to 2015.[15]

Following updates to the base year of deflators, historic data have also been recalculated retroactively. The long-term time-series data on real exports/imports are produced by connecting figures of real exports/imports of each base year (figures prior to seasonal adjustments) with the link series. Since the span of the time-series data is relatively short, real exports by goods and by region are calculated using the fixed-base-year method (currently 2015 prices).

3. Tips for Analyzing Real Export/Import Data

In this section, we discuss some tips for analyzing real export/import data in practice by presenting specific examples including comparisons with related statistics.

(1) Comparison with real exports in GDP statistics

Data for exports in the GDP statistics, unlike those for our real exports, covers not only goods but also services.[16] When looking in terms of goods, however, both the *Trade Statistics of Japan* and *Export Price Index* are used as source data respectively, and therefore, fundamentally show similar movements in trade activity on a real-value basis (Figure 8).[17]

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[15] The base year for deflators of real exports and imports are updated after close examination following the base year revision of the *Export/Import Price Index*. Consequently, for a period up until the next update, data on real exports and imports are compiled — on the basis of the former *Export/Import Price Index* — by using deflators that are produced by linking the monthly figures of the newly based *Export/Import Price Index*.

[16] Services exports have tended to grow in recent years on the back of increased inbound demand boosted by foreign visitors and the rise in industrial and property license fees received by Japanese companies as a result of their further production shifts to overseas sites. For more information on this, see Mera, et. al. (2013), Osada et al. (2015), and Bank of Japan (2017).

[17] The *Balance of Payments Statistics* — used as source data for the GDP statistics — have a gap in data for January 2014 due to revisions of methodology made to comply with the IMF's sixth edition of the *Balance of Payments and International Investment Position Manual* (changes in concept, etc.). It should be noted that the gap observed in the first quarter of 2014 has not been adjusted in the GDP statistics as well, see Cabinet Office (2014a, b).

Figure 8. Real Exports in the GDP Statistics

s.a., CY 2011=100
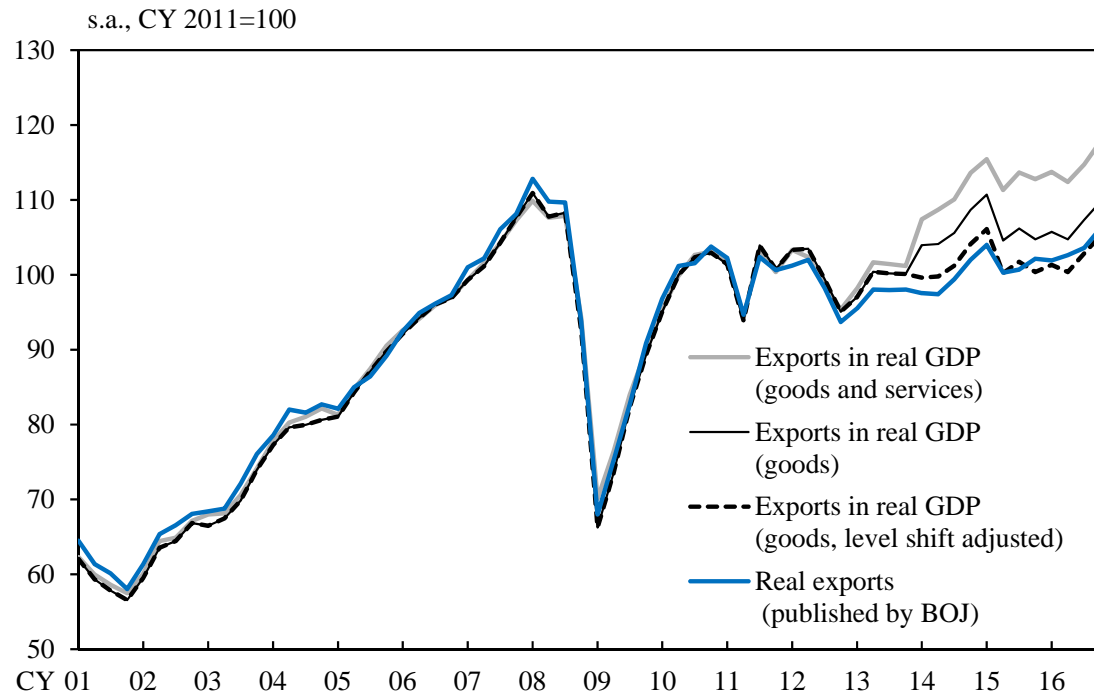
Note: Figures for exports in real GDP are CY2011 base. Figures for exports in real GDP (goods, level shift adjusted) are estimated by adjusting for the level shift due to a revision to the source statistics in 2014/Q1.

Sources: Cabinet Office, "National Accounts"; Bank of Japan, "Developments in Real Exports and Real Imports."

Although the concepts underlying their methodologies are the same, figures for our real exports and those in the GDP statistics are not exactly so. Some reasons can be given to explain this difference: since in the GDP statistics (i) the *Balance of Payments Statistics* — a secondary statistics made from the *Trade Statistics of Japan* — is used as source data, meaning that it uses a different criteria for the range and timing to record its value;[18] (ii) as mentioned previously, data are deflated to the detail, categorized into around 400 items;[19,20] and (iii) seasonal adjustment is performed on a quarterly basis with the retroactive revision performed at the time of each release.

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[18] For example, in the *Trade Statistics of Japan*, exports are recorded at the FOB value (Free on Board: excludes freight, insurance, etc.) and imports at the CIF value (Cost, Insurance and Freight: includes the cargo itself as well as freight and insurance), whereas in the *Balance of Payments Statistics*, both exports and imports are recorded at the FOB value. In the *Balance of Payments Statistics*, the export/import value of items that are not regarded as economic activity in the given term — such as re-exports/re-imports, calligraphic works/paintings and antiques, etc. — are excluded; transfers of property rights are collected and recorded independently. For more information, see International Department, Bank of Japan (2016), Cabinet Office (2017), etc.

[19] "Around 400 items" is derived from the number of items defined by the commodity flow method used to estimate GDP; it also includes services items (about 300 items for commodities alone). In the GDP statistics, in cases where deflators corresponding to the commodity breakdown are not available in the *Export/Import Price Index*, the *Producer Price Index* or the unit price of exports/imports in *Trade Statistics of Japan* is used to substitute this. For details, see Cabinet Office

(2) Comparison with trade volume index of the *"Trade Statistics of Japan"*

Similar to our real export/imports, the volume index released in the *Trade Statistics of Japan* is also an indicator measuring exports/imports in which the effects of "price" changes are removed. When comparing real exports and the export volume (Figure 9 [1]), movements are similar in the short run, while their long-run trends show two distinct movements. This is because "prices" used as the deflator for real exports/imports are based on a quality-adjusted "price index," whereas the deflator for the volume index uses the "unit price index" which is not adjusted for changes in the quality of goods. This means that data for real exports/imports enable us to detect changes in the value-added amounts of traded goods, which cannot be traced by the volume index.

We consider here a case in which automobile exporters saw the unit price for exports (average unit price per car) rise due to enhanced fuel efficiency of exported eco-friendly cars, while the total number of exported cars remained unchanged. In this case, the volume index obviously remains unchanged since the export volume (number of cars) has not changed. On the other hand, the rise in the unit price accompanying the improved quality (when the improved quality alone is added on to export prices) means that the "price index" remains unchanged. As a result, real exports — calculated by dividing the nominal export value with the "price index" — reflect the increase in value-added brought on by improved fuel efficiency (Figure 9 [2]).[21]
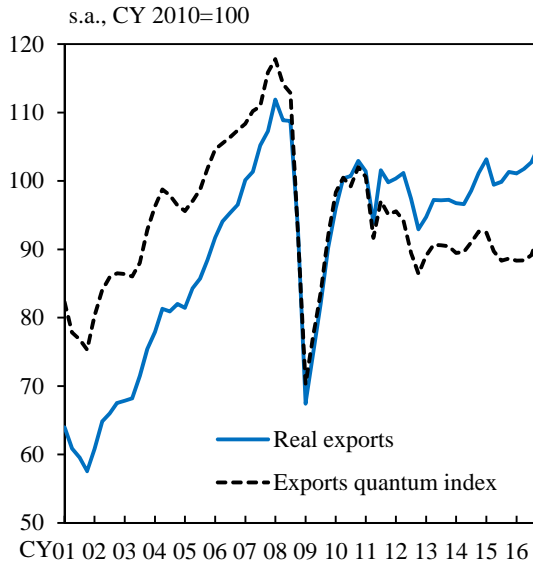

(2017).

[20] The GDP statistics adopt the chain-indexed formula whose weights are updated every year to calculate deflators, while the weights for real exports (long-term time series) are revised only every five years. This difference tends to create a slight gap between the two trends with the difference in time from the base year.

[21] In recent years, large cars such as SUVs have begun to increase their share in the profile for motor vehicle exports, leading to a rise in the unit price of exports (average unit price per car). For the case where the share of high value-added cars rises, the increase in value-added brought on by the increased share of large cars is considered as an increase in real exports since the price index — which collects prices with the quality fixed — is kept unchanged (Figure 9 [2]). For rising value-added of export goods, see *BOJ Reports & Research Papers* (2007) and BOX 1 in the *Outlook on Economic Activity and Prices* (January 2017).

Figure 9. Trade Volume Index in the Trade Statistics

(1) Real Exports and Exports Quantum Index   (2) Motor Vehicle Exports
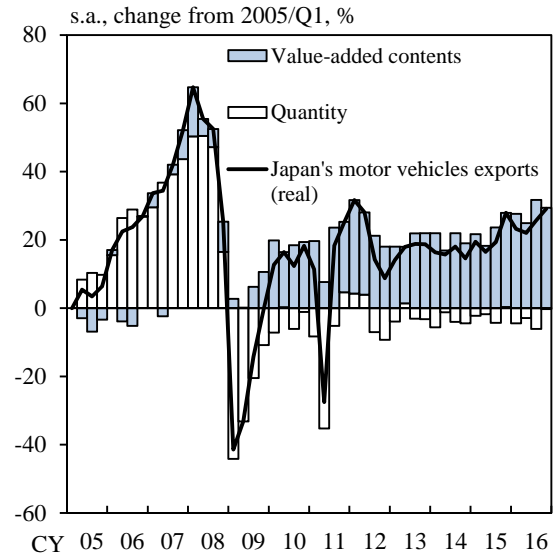
Note: The quantum index is 2010 base.
Sources: Ministry of Finance, "Trade Statistics"; Bank of Japan, "Developments in Real Exports and
          Real Imports."

**(3) Usage of data on exports by region and by goods**

In general, the impact of developments in overseas final demand and other factors should be taken into account when analyzing developments in real exports. Therefore, data on real exports by region allow us to analyze the impacts of economic developments in the importing countries or regions on Japan's real exports. By using data on real exports by goods, we can analyze the impact of the changes in global demand for each goods on Japan's real exports as well as differences in their responsiveness to the foreign exchange rate.

For example, exports of "IT-related goods" show movements similar to global semiconductor shipments which track cyclical fluctuations of global IT-related demand (Figure 10 [1]). Exports of "capital goods" are driven by global demand for business fixed investment, moving in parallel with the developments in machinery orders from overseas (Figure 10 [2]). We compile and release data on exports by region and by goods to provide grounds to employ a multi-faceted approach.
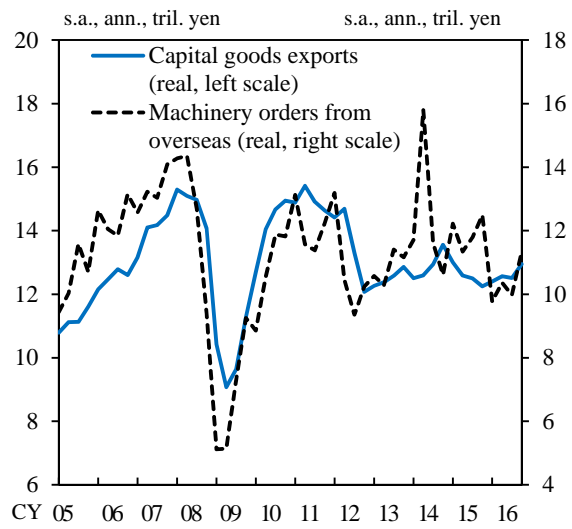
15

Figure 10. Japan's Exports by Type of Goods

(1) IT-Related Goods Exports
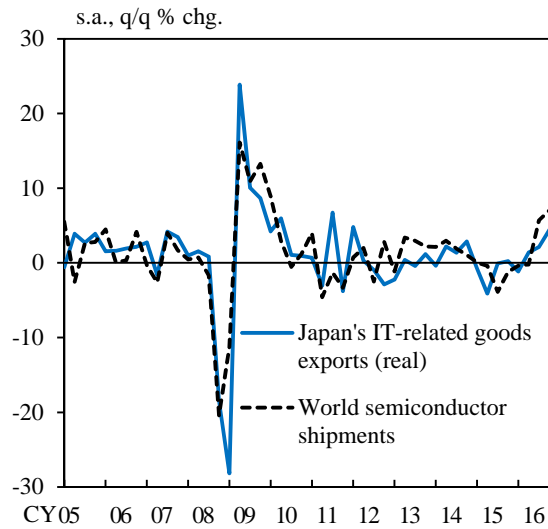
(2) Capital Goods Exports

Sources: Bank of Japan, "Developments in Real Exports and Real Imports"; World Semiconductor
Trade Statistics (WSTS); Cabinet Office, "Machinery Orders."

### (4) Export deflator by region

The deflator for real exports by region can be derived by back calculation using the nominal export value and real export value by region.[22] However, the *Export Price Index* — the source data for real exports by goods — does not release figures at the country or region level. Therefore, it is worth noting that the difference in movements of the export deflators by region only depends on differences in the share of goods by region and thus, does not reflect differences in the price-setting behavior taken by exporting companies against countries or regions.

(5) Real Trade Balance

Changes in the real trade balance as a ratio of real GDP (Figure 11) more or less captures the contribution of goods trade to real GDP growth rate. As mentioned above, as data on real exports/imports are provided in a timely manner and obtainable on a monthly basis, they are deemed useful for short-term forecasting of GDP.

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[22] Since data for real exports by region which we release are seasonally adjusted with the base year (2015) indexed at 100, the nominal export value used as the denominator for the calculation also needs to be seasonally adjusted and indexed at 100 with the 2015 average.

Figure 11. Real Trade Balance and Contribution of Net Exports to GDP Growth Rate
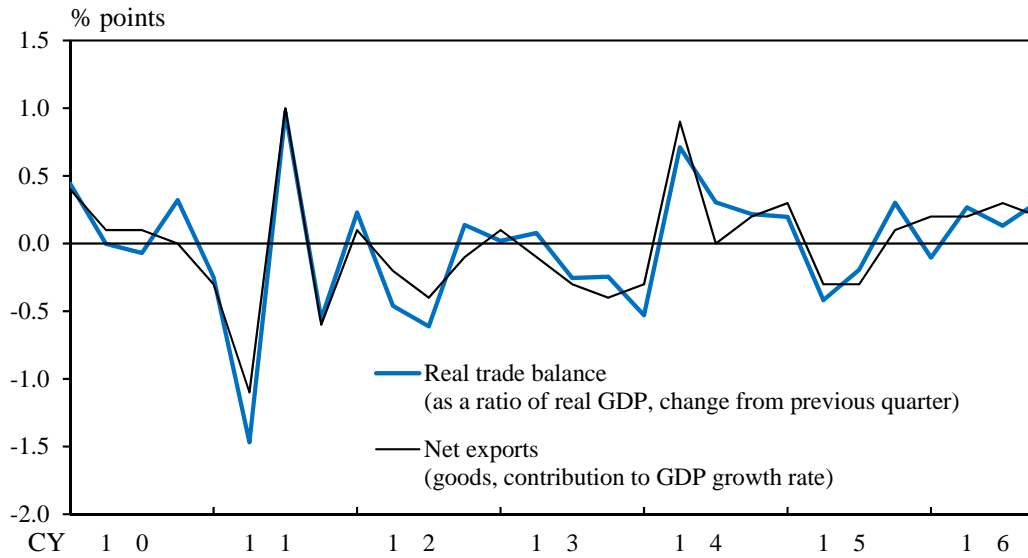
Sources: Bank of Japan, "Developments in Real Exports and Real Imports"; Cabinet Office,
   "National Accounts."

(6) Case: Large fluctuations in the foreign exchange rate

Large fluctuations in the foreign exchange market tends to lead to data for real
exports/imports overestimating actual developments when the yen is appreciating, and
vice versa when it is depreciating.

When declaring exports/imports to customs, companies are required by law to convert
the export/import value denominated in foreign currency into yen terms using the
officially announced rate of foreign exchange ("Foreign Exchange Rate Provided by
Regulation of Ministry of Finance," hereafter customs exchange rate). The *Trade
Statistics of Japan* collects and releases the export/import value compiled using this
yen-converted value. However, the customs exchange rate lags behind the market
exchange rate (telegraphic transfer middle rate of banks) — which is used to convert
contract-currency-based price data into yen terms in the *Export/Import Price Index* —
by two weeks (Figure 12).[23] Therefore, since the rate of foreign exchange used for the
numerator and denominator in the calculation is different, data on real exports/imports
may differ from the actual movements.

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[23] The 2-week lag of the customs exchange rate arises due to practical reasons. The export/import
declaration form that is submitted to customs and used as the source data of the *Trade Statistics of
Japan* must be completed ahead of customs clearance. The applied rate of exchange is officially
announced in advance reflecting the time required for filling this form. The announcement is
conferred by Article 1 of the Order for Enforcement of Customs Tariff Act.

Figure 12. Exchange Rate (Customs Exchange Rate and Market Exchange Rate)
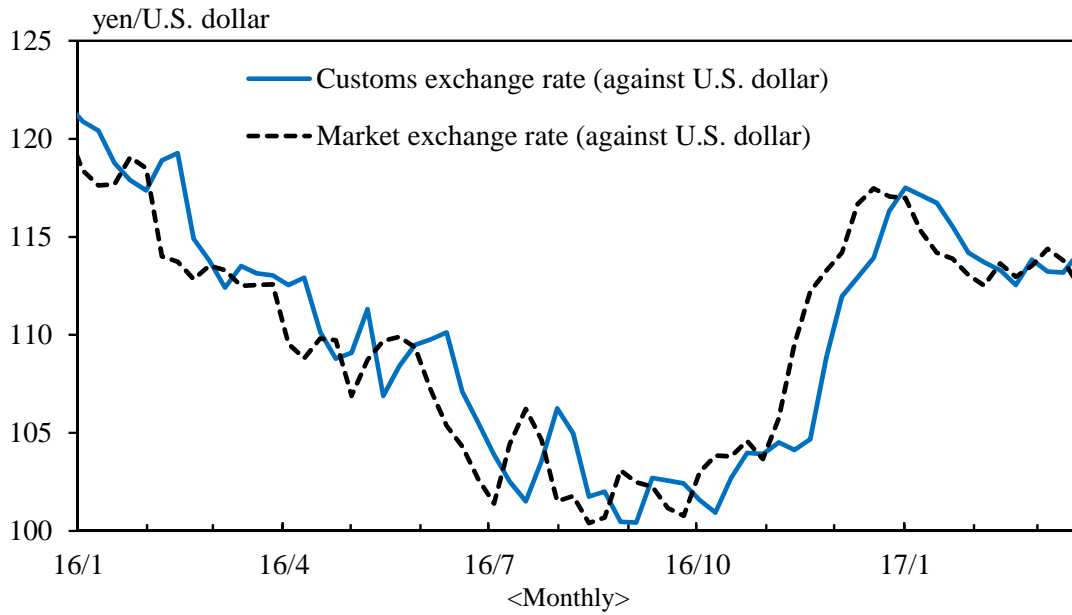
Sources: Japan Customs, "Foreign Exchange Rate Provided by Regulation of Ministry of Finance provided by article 4-7 of customs Tariff Law"; Bloomberg

In order to adjust real exports for the effects of the difference between the two exchange rates (the difference at the time of exchange), the value of nominal exports is divided again by the customs exchange rate to calculate contract-currency-based nominal exports and then reconverted into yen terms using the market exchange rate. The formula below shows that real exports (non-adjusted) can be distorted in proportion to the customs-based effective exchange rate and the market-based effective exchange rate.[24]

$$REX = \frac{EX^{yen}}{Edef} = REX_{adj} \times \frac{e_{customs}}{e_{actual}} \quad \left(\because REX_{adj} \equiv \frac{EX^{yen} \times \frac{e_{actual}}{e_{customs}}}{Edef} \right)$$

where *REX*, *EX*, *Edef*, and *e* denote real exports, nominal exports, export deflator, and exchange rate, respectively.

Based on the above, looking at the impact of exchange rate fluctuations on real exports, for instance, when the yen appreciated as in early 2016 (Figure 13), the market-based exchange rate saw its yen appreciate faster than the customs exchange rate causing an overestimation in real exports. In contrast, real exports are underestimated when the yen depreciates. When looking at the growth rate, real exports, to begin with, exhibit a

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[24] The effective exchange rates are calculated using the transaction share by contract currency as weights. A slight difference in the distortion is present between exports and imports as the weights are not the same (see Iijima and Osada [2008]; available in Japanese only).

higher growth rate than its actual rate when the yen is appreciating, although the growth rate lowers subsequently. Particularly in times when the yen's exchange rate turns from appreciation to depreciation, or vice versa, fluctuations in real exports tend to become larger.

Figure 13. Timing of Conversion of Currency and Real Exports

(1) Conceptual Diagram
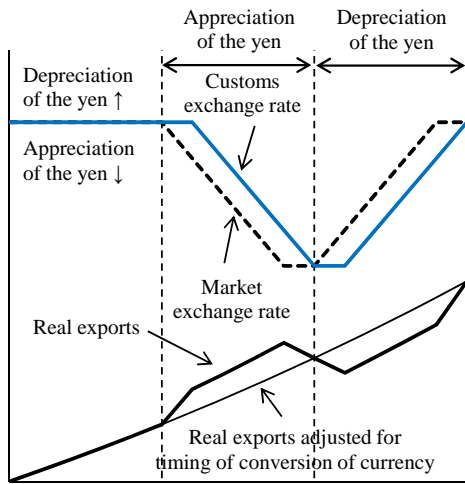
(2) Actual Impacts
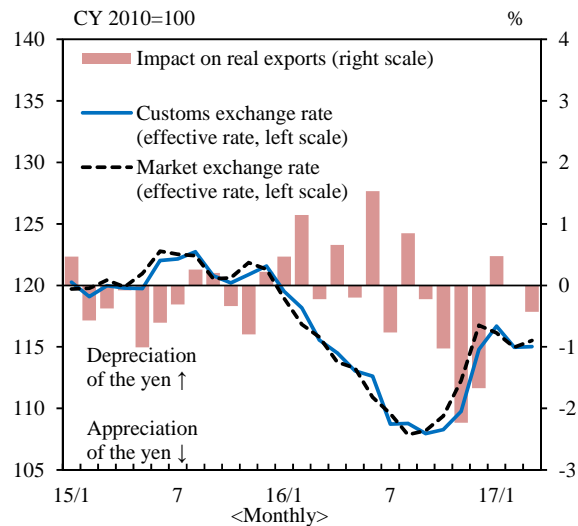
Sources: Japan Customs, "Foreign Exchange Rate Provided by Regulation of Ministry of Finance provided by article 4-7 of customs Tariff Law"; Bloomberg

This characteristic can also be found in real exports/imports in the GDP statistics, but since GDP statistics are produced by calculating figures on a quarterly basis, the impact stemming from the 2-week lag is smaller than the data for real exports/imports on a monthly basis.

(7) Impact of the Lunar New Year holidays in Asian countries

The lunar New Year holidays in Asian countries, especially in China, have a significant impact on Japan's trade activity as they stop production activity for about a week as well as the clearance process at many customs offices throughout the period in those countries. So in order to assess the export/import trend, it is preferable that the effects of the Lunar New Year holidays are excluded from the data by using methods such as seasonal adjustments. For the following reasons, however, we do not include the Lunar New Year factor in the seasonal adjustment process. First, there is the issue of the Lunar New Year holidays falling on a different date every year. Real exports to China tend to show different fluctuations depending on the timing of the holidays (Figure 14).[25]

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[25] Since the procedure usually used for seasonal adjustments removes only seasonal fluctuations that exhibit a stable pattern observed in each month, the effects of the Lunar New Year cannot be removed as the holidays may extend to the following month depending on their timing. Although

Second, since this culture of celebrating the holidays is also shared among other Asian countries outside China, the timing of holidays and the way they celebrate may differ depending on the country. This means that the impact on trade activity also varies and thus proves difficult to measure the magnitude of its impact using just a simple method.

As a result, it is appropriate to assess the effects of the Lunar New Year on real exports using the January-February average rather than adjusting for its factor using statistical methods.[26],[27]

Figure 14. Real Exports to China around Lunar New Year Holidays

s.a., m/m % chg.

	Lunar New Year Holidays in China	Lunar New Year in Late January				Lunar New Year in mid-February			
		Dec. (prev. year)	Jan.	Feb.	Mar.	Dec. (prev. year)	Jan.	Feb.	Mar.
CY 2001	Jan. 24-30	▲1.5	4.0	5.4	▲7.5				
2002	Feb. 12-18					▲4.5	22.1	▲11.9	10.6
2004	Jan. 22-28	6.8	2.5	2.0	▲5.2				
2007	Feb. 18-24					▲0.6	10.3	▲10.6	6.6
2009	Jan. 25-31	▲15.6	▲11.4	9.2	8.8				
2010	Feb. 13-19					2.7	9.6	▲11.3	9.0
2012	Jan. 22-28	▲0.7	▲5.1	7.9	▲2.4				
2015	Feb. 18-24					▲0.7	10.8	▲22.6	13.9
2017	Jan. 27-Feb. 2	3.5	▲3.3	13.7					

Source: Bank of Japan, "Developments in Real Exports and Real Imports."

this seasonality might be eliminated by measuring the effects using a simple dummy variable for the month in which the holidays fall, it is not possible to perform an estimation due to the fact that the Lunar New Year holidays continue over a long stretch of time and that the timing of their impact on trade is uncertain. For instance, Sakuyama (2015) claims that real exports to China for the January-February period tends to show various patterns depending on the timing, whether it be in the period before or after February 8. We do not employ this approach as a simple dummy variable may distort the seasonally adjusted estimates to a large extent.

[26] Imports tend to decline in the month following the Lunar New Year, while they have a tendency to increase subsequently two months after.

[27] Cases are similar for the Easter holidays in the United States and Europe as well as the Ramadan in Islamic societies, although their impact on Japan's exports is comparatively smaller than the above-mentioned Lunar New Year holidays.

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