INSTITUTE OF DEVELOPING ECONOMIES

IDE Discussion Papers are preliminary materials circulated
to stimulate discussions and critical comments

IDE DISCUSSION PAPER No. 795

# Departure Months and Discrepancy in Mirror Trade Data

Kazunobu HAYAKAWA*

August 2020

***Abstract***: This study highlights the role of departure months of shipping and the discrepancies in mirror trade statistics. Specifically, we conjecture that trade values are recorded in different years between export and import statistics when exports leave the port of origin in the latter months of the year because exports arrive at the port of destination in the following year. To empirically examine this hypothesis, we investigate exports from Japan to the world. The study findings show that, first, the import statistics are likely missing in the export year when exports occur in November or December and, second, the probability of such missing statistics is higher when exports occur via the sea. These findings have various implications for empirical analysis in trade.

**Keywords**: Mirror trade data; Discrepancy; Japan

**JEL Classification**: F15; F53

* Senior Research Fellow, Economic Geography Studies Group, Development Studies Center, IDE (kazunobu_hayakawa@ide.go.jp)

The Institute of Developing Economies (IDE) is a semigovernmental, nonpartisan, nonprofit research institute, founded in 1958. The Institute merged with the Japan External Trade Organization (JETRO) on July 1, 1998. The Institute conducts basic and comprehensive studies on economic and related affairs in all developing countries and regions, including Asia, the Middle East, Africa, Latin America, Oceania, and Eastern Europe.

---



---

**INSTITUTE OF DEVELOPING ECONOMIES (IDE), JETRO**
**3-2-2, WAKABA, MIHAMA-KU, CHIBA-SHI**
**CHIBA 261-8545, JAPAN**

# Departure Months and Discrepancy in Mirror Trade Data*

Kazunobu HAYAKAWA#

*Institute of Developing Economies, Japan*

***Abstract***: This study highlights the role of departure months of shipping and the discrepancies in mirror trade statistics. Specifically, we conjecture that trade values are recorded in different years between export and import statistics when exports leave the port of origin in the latter months of the year because exports arrive at the port of destination in the following year. To empirically examine this hypothesis, we investigate exports from Japan to the world. The study findings show that, first, the import statistics are likely missing in the export year when exports occur in November or December and, second, the probability of such missing statistics is higher when exports occur via the sea. These findings have various implications for empirical analysis in trade.

***Keywords***: Mirror trade data; Discrepancy; Japan

***JEL Classification***: F15; F53

## 1. Introduction

Export statistics are not identical to import statistics in the corresponding trade flow for several reasons. There is ongoing debate on such discrepancies in mirror trade statistics (e.g., Sheik, 1974; Yeats, 1978; 1995). According to Trade Map in International Trade Centre,[1] difference in trade systems between countries (e.g., some countries exclude trade in free zones), misclassification of a partner country or a product, confidentiality, the existence of re-exports or transit, and transportation and insurance costs are some reasons for the discrepancies.[2] Guo (2009) highlighted the differences in thresholds for recording international trade and irregularity in the recording of exchange rate fluctuations. Some studies have empirically demonstrated the existence of smuggling (e.g., Carrere and Grigoriou, 2015; Javorcik and Narciso, 2008; 2017; Fisman and Wei, 2004; Mishra et al., 2008). Ferrantino and Wang (2008) highlighted the role of transfer pricing, profit shifting, and

* I would like to thank Kyoji Fukao, Shujiro Urata, Hitoshi Sato, Koichiro Kimura, Satoru Kumagai, Kohei Shiino, and the seminar participants in the IDE-JETRO for their invaluable comments. This work was supported by JSPS KAKENHI Grant Number #17H02530. All remaining errors are ours.

# Author: Kazunobu Hayakawa; Address: Wakaba 3-2-2, Mihama-ku, Chiba-shi, Chiba, 261-8545, Japan. Tel: 81-43-299-9500; Fax: 81-43-299-9724; E-mail: kazunobu_hayakawa@ide-gsm.org.

1 https://www.trademap.org/stFAQ.aspx#li_Answer2_3

2 The United Nations recommend excluding goods in transit from trade statistics: https://unstats.un.org/unsd/tradereport/compliance_MM.asp.

evading capital, which lead to increasing discrepancies. Studies have also examined the discrepancies in mirror trade data (e.g., Federico and Tena, 1991; Makhoul and Otterstorm, 1998; Ferrantino and Wang, 2008).

This study highlights the role of shipping months in the discrepancies in mirror statistics. Trade values are likely recorded in the different years between export and import statistics when exports leave the port of origin in the latter months of the year and arrive at the port of destination the following year.[3] Although recognized as time lag or issue of timing (Hamanaka, 2011; Carrere and Grigoriou, 2015), no studies have empirically examined its significance. The present study addresses this gap by examining Japan's export data. The study focuses on the role of time lag in Japan and excludes the effects of other factors. Given that Japan is a developed and island country, product misclassification and smuggling are rare. To further minimize misclassification in both Japan and partner countries, this study examines the time widow under the common version of harmonized system (HS) nomenclature, that is, 2012 to 2016 under the HS 2012 version. Moreover, to avoid recording goods exported in the previous year as that exported in the current year, this study focuses on country-product pairs exported only to those countries where Japan has no export records in 2012 and 2013. Then, for example, the study confirms whether exports in 2014 can be found in the partner's 2014 import statistics and how such records differ by the month of the first export.

The study findings are summarized as follows. First, import statistics are likely missing when exports occur in November or December. Specifically, trade values remain zero in importing countries when Japan exports in the latter months of the year. Second, such results are found at both HS six-digit and four-digit levels. The HS six-digit level decreases not only the number of study observations but also the possibility of misclassification. Third, similarly, these findings are observed when importers include both developing and developed countries despite that misclassification is less likely in developed countries. Finally, misclassification is more likely in the import statistics, especially when exporting by the sea, although no apparent differences were found in the results according to the distance from Japan. The result in sea transportation is consistent because sea transportation takes longer than air transportation.

This study adds empirical evidence to the discrepancies in the mirror trade data. Although several studies exist, none have empirically shown the valid role of shipping timing in the discrepancies. Moreover, this study follows Bernard et al. (2017), which demonstrated that the firm-level export growth rate in the first export year is significantly associated with the month when firms start exporting. Specifically, they showed that firms starting exports at the end of the year have a higher export growth rate from the first to the second year and called this "partial-year effects." While they focus on the effects on the

---

[3] For example, it takes about two months to ship from Japan to the UK by sea.

gradual growth rate, this study highlights the difference in trade values between import and export statistics.

This study is presented as follows. Section 2 provides the empirical framework to examine the role of shipping months in the discrepancies in the mirror data. Section 3 presents the estimation results, and section 4 concludes by discussing various implications of the findings to the empirical analysis in trade.

## 2. Empirical Framework

This section explains the empirical framework to examine the role of shipping months in the discrepancies in the mirror data. In this simple empirical model, an indicator variable ($Y$) is regressed on dummy variables ($\mathbf{D}$) in the first month when a country exports product $p$ to country $c$ in year $t$. Specifically, it is given by

$$\Pr\left(Y_{cpt} = 1 | \mathbf{D}_{cpt}, \mathbf{u}\right) = \Phi\left(\mathbf{D}'_{cpt}\boldsymbol{\beta} + \mathrm{u}_c + \mathrm{u}_p + \mathrm{u}_t\right),$$

where $Y$ is 1 if country $c$ does not report any imports (i.e., missing) of product $p$ from Japan in year $t$, and a value of 0 otherwise. Among the dummy variables, for example, the December dummy takes a value of 1 if it is the month of the first export in year $t$. Import statistics are missing when exporting in the latter months. Thus, positive and larger estimates are expected in the dummy variables for the later months. We control for importer fixed effects ($\mathrm{u}_c$), product fixed effects ($\mathrm{u}_p$), and year fixed effects ($\mathrm{u}_t$). Probit method is used to estimate this model.

The fixed effects are expected to control for various elements. Besides the effect of the time lag, the magnitude of discrepancies varies by countries. For example, as mentioned earlier, smuggling may occur in developing countries with poor institutions. Therefore, smuggling leads to missing import statistics. Moreover, freight costs are obviously higher in shipping to distant countries. Regardless of shipping months, the magnitude of the discrepancy is affected by these factors. However, this effect changes the difference in magnitude between the import and export statistics rather than increase in missing import statistics. Nevertheless, freight costs should also vary across products based on products' fragility, size, or weight. Furthermore, compared with homogeneous or primary products such as agricultural goods or mineral products, differentiated, secondary, or highly processed products can be misclassified. Moreover, the change in oil prices over the years affects the magnitude of the discrepancies through the changing freight costs. To control for these differences, importer, product, and year fixed effects are introduced.

This study chooses Japan as the exporting country. Thus, the export statistics are obtained from the Customs of Japan. To identify the first month of exports, the monthly export data are used. The import statistics are derived from a typical data source, that is, the UN Comtrade, on a yearly basis. The products are defined at an HS four-digit and six-digit levels. The six-digit level analysis presents better results but includes the effects of misclassification of product category on the discrepancies. Such a possibility is rare in the four-digit level analysis, but the number of study observations also decreases. Thus, both levels are tried in this estimation. The study years include 2014, 2015, and 2016, all of which follow the HS 2012 version. To avoid considering shipping in 2013 and arriving in 2014 as shipping and arriving in 2014, we restrict the study country-product pairs only to those where no exports are observed in the export statistics in both 2012 and 2013. Therefore, we exclude observations where positive exports are observed in the previous year.

In the later analyses, the study observations are split based on various dimensions. First, this model is regressed for high-income and low-income importers separately. In this classification of importing countries, the income classification in 2015 defined by the World Bank is used. Countries are categorized as high-income countries if classified so by the World Bank. Otherwise, countries are classified into low-income countries. Second, the study observations are categorized based on the transportation mode, that is, air or sea, which can be identified in export statistics, in this case, Japan's export data. Finally, the validity of the hypothesis is examined based on the distance from Japan. This is addressed by introducing its interaction term with the dummy variables of the first month. However, this approach not only loses the degree of freedom resulting from including 24 variables (i.e., 12 dummy variables and 12 interaction terms) but also yields the multicollinearity issue. Thus, an approach of sample splitting is adopted using 10,000 km (i.e., almost median distance) as a threshold. The data on distance are obtained from the Centre d'Études Prospectives et d'Informations Internationales (CEPII) website.

Finally, before reporting the estimation results, an overview of the seasonality of Japan's exports during 2012–2016 is presented. Figure 1 depicts monthly exports to the world, which are rescaled such that the value in January becomes 1 in each year. The year 2015 does not show dramatic export growths compared with the other years because the level of exports in each month moves just around their level in January. Observing the over-month changes, increase in exports from January is seen. After hitting the first peak in March, exports decrease in April, which is the first month in the Japanese fiscal year, and in May, which has the longest holiday period. Subsequently, the exports start to increase but decrease in August, that is, the summer holiday season. Another decrease can be found in November, although the reason is unclear. Overall, some amounts of exports can be observed every month, although some fluctuation over the months is observed.

=== Figure 1 ===

In Figure 1, an overview of aggregated exports (i.e., the sum of exports over products and countries) was considered. Examination of the seasonality of exports shows that exports of some products are concentrated in a specific month. To check this possibility, Table 1 shows the number of country-product pairs according to the number of months with positive exports. The product is defined at an HS six-digit level. Table 1 indicates that most of the pairs appear in either only one month or every month. The relatively large numbers can also be found in the pairs where exports are observed in two months. Specifically, significant numbers of the pairs appear only in one or a few months. Thus, if a systematic difference exists in the mirror data discrepancy according to export months, several cases suffer from the effects of the time lag on the discrepancy in the mirror data.

=== Table 1 ===

## 3. Empirical Results

This section reports the estimation results in terms of marginal effects. The estimation results at an HS six-digit level are shown in column "Six" in Table 2. In all the estimations, January is a base month in the dummy variables of the first month. The results show the significantly positive and relatively large coefficients for dummy variables of the months in the fourth quarter (i.e., 10–12). While the coefficients for the other months are estimated to be approximately 0.02, they are 0.03 in October, 0.07 in November, and 0.14 in December. Similar results can be found at an HS four-digit level, reported in column "Four." Owing to the aggregation, the number of observations decreases to one-third. While the coefficient for October is insignificant, the dummy variables for November and December still have significantly positive coefficients. Thus, import statistics are more likely missing when exporting from the latter months of the year. In the analyses below, we focus on the estimation at an HS six-digit level.

=== Table 2 ===

Next, the model for low-income and high-income importers is estimated separately. Misspecification and smuggling occur in developing countries. Although the inclusion of country fixed effects controls for this effect on the *average* probability of missing in each country, this effect varies across months within a year. Considering that such an effect is small in high-income importers, the model for low-income and high-income importers is estimated separately. The results are shown in column "Importer's income" and are qualitatively similar to those in column "Six." The trade values in the import statistics are likely to be zero when exporting from the latter months of the year. Thus, the study hypothesis is empirically valid even after controlling for some other effects by focusing on trade between developed countries. Nevertheless, such a time-lag effect can also be found in low-income importers.[4]

The model is estimated for the cases of sea and air transportation. Since export by sea takes longer than by air, the study hypothesis is expected to be more valid in the exports by sea transportation. Specifically, we estimate for the study observations where the exports by air are positive and those by sea are positive separately. This grouping is not mutually exclusive. If the observations for exports by both air and sea are positive, they are included in both cases. However, such cases are few. The results are shown in column "Mode" in Table 3. The sum of observations for sea and air modes is similar to the number in column "Six" in Table 2. The results in sea transportation are consistent with our expectation. When exporting in December by sea, the probability of missing becomes 21% higher than when exporting in January. In air transportation, the coefficients for the dummy in the former months are also significantly positive, perhaps because the time lag between the departure and the arrival in the case of air transportation (i.e., between exporting and importing) is minimal.

=== Table 3 ===

Based on the similar motivation to estimate by transportation mode, the model is estimated for geographically close importers and distant importers separately. Namely, because shipping to distant countries is time-consuming, we expect that our hypothesis is more valid when examining for distant importers. Thus, using 10,000 km from Japan as a cutoff, we group the study import countries. The results are shown in column "Distance." Again, the results for distant importers are consistent with the hypothesis because the dummy variables for the middle months in the year also have significantly positive coefficients in the case of nearby importers. Nevertheless, the difference based on the distance is unclear compared with that between air and sea transportations. Given that land transportation is not available in Japan's trade, geographical distance does not lead to large differences in the effects of the time lag on the discrepancies compared with the transportation mode (i.e., sea versus air).

Thus far, this study has investigated the discrepancy in terms of extensive margin (i.e., missing). Such discrepancy may also occur in terms of the intensive margin, which is defined as

$$\ln Export_{cpt} - \ln Import_{cpt}.$$

*Export* and *Import* represent trade values of product $p$ in year $t$ in the exporting country statistics and the importing country statistics, respectively. In this variable, observations are excluded if country $c$ reports zero imports. By aggregating the monthly export statistics up

[4] We also categorize importing countries according to the efficiency of customs clearance process, but the results are similar to those reported here. The results are available in Table A2 in Appendix.

to a yearly level, *Export* is computed.[5] The data on *Import* are obtained from the UN Comtrade. By replacing the dependent variable with this indicator, the following model is estimated.

$$\ln Export_{cpt} - \ln Import_{cpt} = \mathbf{D'}_{cpt}\boldsymbol{\gamma} + \mathrm{u}_c + \mathrm{u}_p + \mathrm{u}_t + \epsilon_{cpt}.$$

This model is estimated by the ordinary least square (OLS) method. The trade value in the import statistics is underestimated compared with that in the export statistics when exporting in the latter months. Thus, positive and larger coefficients for the month dummy are expected in this estimation.

Table 4 shows the results for the intensive margin. Those at an HS six-digit and four-digit level are reported in column "HS digit." The results are contradictory. All coefficients are estimated to be negative rather than positive. Some of them are even significant. These results remain unchanged even when estimating high- and low-income importers separately, as shown in column "Importer's income." The negative coefficients may be a result of the absolute magnitude of *annual* exports being larger when starting to export from the earlier months. Given that the import statistics underestimate the trade value in each month, the magnitude of discrepancies is accumulated over months and larger when starting in the early months.[6] In either case, the effects of time lag on the discrepancies appear significant in terms of extensive margin.[7]

=== Table 4 ===

## 4. Concluding Remarks

This study examined the role of departure months of shipping in the discrepancies in mirror trade statistics by focusing on exports from Japan to the world. Consequently, the study found that the import statistics are likely missing in the export year when exporting in November or December. Furthermore, the probability of such missing statistics becomes higher especially when exporting by sea and not by air. These findings have various implications for empirical analysis in trade. Several studies have used the ratio of these mirror data as a proxy for transportation costs (e.g., Baier and Bergstrand, 2001; Hummels

[5] We convert Japanese yen to US dollars by using the monthly average of exchange rates available in the Bank of Japan.

[6] Although we control for the effects of freight and insurance costs on the average discrepancy over month, these may create significant coefficients if freight and insurance costs differ across months. However, at least from Japan to the Netherlands and the United States in 2014, no clear differences are found in freight costs (20-feet container) across months. The figure of those costs is available in the Appendix.

[7] The results for intensive margin according to the transport mode and the distance from Japan are available in Table A1 in the Appendix.

and Lugovskyy, 2006) or the extent of smuggling as listed in the introductory section. However, these findings indicate that their ratio depends on not only these elements but also the seasonality of exporting and the product characteristics that affect transportation mode. Moreover, the study results imply that, compared with the value in export statistics, the value in import statistics is underestimated in the export year and overestimated in the following year. These effects might be offset if goods constantly trade every year, and the annual data are used, as claimed in Hamanaka (2011). Nevertheless, caution is recommended when mixing import and export statistics (e.g., for the purpose of increasing the number of study observations) because what the year indicates differs between the two statistics. This mix might be problematic, especially when those trade data are liked with other variables (e.g., GDP). Undoubtedly, this issue is serious when examined at a monthly level.

## References


**Baier, S. and Bergstrand, J.**, 2001, The Growth of World Trade: Tariffs, Transport Costs, and Income Similarity, *Journal of International Economics*, 53(1): 1-27.

**Carrere, C. and Grigoriou, C.**, 2015, Can Mirror Data Help to Capture Informal International Trade?, Working Papers P123, FERDI.

**Federico, G. and Tena, A.**, 1991, On the Accuracy of Foreign Trade Statistics 1909-1935; Morgenstern Revisited, *Explorations in Economic History*, 28: 259-273.

**Ferrantino, M. and Wang, Z.**, 2008, Accounting for Discrepancies in Bilateral Trade: The Case of China, Hong Kong, and the United States, *China Economic Review*, 19(3): 502-520.

**Fisman, R. and Wei, S.**, 2004, Tax Rates and Tax Evasion, Evidence from Missing Imports, *Journal of Political Economy*, 112(2): 471-496.

**Guo, D.**, 2009, Mirror Statistics of International Trade in Manufacturing Goods: The Case of China, UNIDO Research and Statistics Branch, Working Paper 19/2009.

**Hamanaka, S.**, 2011, Whose Trade Statistics are Correct? Multiple Mirror Comparison Techniques: A Test of Cambodia, *Journal of Economic Policy Reform,* 15(1): 33-56.

**Hummels, D. and Lugovskyy, V.**, 2006, Are Matched Partner Trade Statistics a Usable Measure of Transportation Costs?, *Review of International Economics*, 14(1): 69-86.

**Javorcik, B. and Narciso, G.**, 2008, Differentiated Products and Evasion of Import Tariffs, *Journal of International Economics*, 76(2): 208-222.

**Javorcik, B. and Narciso, G.**, 2017, WTO Accession and Tariff Evasion, *Journal of Development Economics*, 125(C): 59-71.

**Makhoul, B. and Otterstrom, S.**, 1998, Exploring the Accuracy of International Trade Statistics, *Applied Economics*, 30(12): 1603-1616.

**Mishra, P., Subramanian, A., and Topalova, P.**, 2008, Tariffs, Enforcement, and Customs Evasion: Evidence from India, *Journal of Public Economics*, 92(10-11): 1907-1925.

**Sheik, M.**, 1974, Underinvoicing of Imports in Pakistan, *Oxford Bulletin of Economics and Statistics*, 36(4): 287-296.

**Yeats, A.**, 1978, On the Accuracy of Partner Country Trade Statistics, *Oxford Bulletin of Economics and Statistics*, 40(4): 341-361.

**Yeats, A.**, 1995, Are Partner-country Statistics Useful for Estimating "Missing" Trade Data? Policy Research Working Paper 1501. Washington DC: World Bank.

Table 1. Number of Country-product Pairs according to the Number of Months with Positive Exports

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| 1 | 27,752 | 28,008 | 28,621 | 28,214 | 28,145 |
| 2 | 12,166 | 12,313 | 12,725 | 12,813 | 12,637 |
| 3 | 7,831 | 7,920 | 8,083 | 8,341 | 8,273 |
| 4 | 5,820 | 5,860 | 6,100 | 6,199 | 5,921 |
| 5 | 4,802 | 4,827 | 4,872 | 5,065 | 4,961 |
| 6 | 4,036 | 4,108 | 4,185 | 4,315 | 4,181 |
| 7 | 3,782 | 3,832 | 3,911 | 3,854 | 3,830 |
| 8 | 3,430 | 3,578 | 3,654 | 3,725 | 3,580 |
| 9 | 3,476 | 3,612 | 3,564 | 3,531 | 3,706 |
| 10 | 3,864 | 3,808 | 3,910 | 3,988 | 4,016 |
| 11 | 5,056 | 4,967 | 5,113 | 5,200 | 5,155 |
| 12 | 24,855 | 25,670 | 26,462 | 26,775 | 26,685 |

*Source*: Japan's Customs

*Note*: The product is defined at an HS six-digit level.

Table 2. Estimation Results

| | HS digit | | Importer's income | |
|---|---|---|---|---|
| | Six | Four | Low | High |
| Month = 2 | 0.002 | -0.024 | 0.008 | 0.050* |
| | [0.018] | [0.028] | [0.027] | [0.031] |
| Month = 3 | 0.013 | 0.021 | 0.006 | 0.028 |
| | [0.017] | [0.028] | [0.026] | [0.029] |
| Month = 4 | 0.026 | 0.02 | 0.060** | 0.01 |
| | [0.017] | [0.028] | [0.026] | [0.029] |
| Month = 5 | 0.028 | 0.019 | 0.043 | 0.043 |
| | [0.018] | [0.030] | [0.027] | [0.031] |
| Month = 6 | 0.026 | 0.01 | 0.032 | 0.036 |
| | [0.018] | [0.028] | [0.026] | [0.031] |
| Month = 7 | 0.028 | 0.029 | 0.038 | 0.054* |
| | [0.018] | [0.029] | [0.026] | [0.031] |
| Month = 8 | 0.004 | 0.021 | 0.042 | -0.056* |
| | [0.018] | [0.030] | [0.027] | [0.029] |
| Month = 9 | 0.013 | 0.009 | 0.000 | 0.033 |
| | [0.018] | [0.030] | [0.027] | [0.031] |
| Month = 10 | 0.033* | 0.022 | 0.034 | 0.058* |
| | [0.018] | [0.029] | [0.027] | [0.031] |
| Month = 11 | 0.070*** | 0.124*** | 0.097*** | 0.067** |
| | [0.019] | [0.032] | [0.027] | [0.032] |
| Month = 12 | 0.138*** | 0.143*** | 0.159*** | 0.166*** |
| | [0.018] | [0.031] | [0.025] | [0.031] |
| Number of obs | 31,480 | 10,337 | 16,202 | 10,736 |
| Log pseudolikelihood | -14722.5 | -4472.8 | -7224.9 | -5151.9 |

*Notes*: The dependent variable is an indicator variable that takes a value of 1 if an importing country does not report any imports, and 0 otherwise. We estimate our model as the Probit model and report the marginal effects. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. The square brackets denote the robust standard errors. The product is defined at an HS six-digit level in column "HS Six-digit" and at an HS four-digit level in column "HS Four-digit." In all specifications, we control for importer fixed effects, product fixed effects, and year fixed effects. The product is defined at an HS six-digit level in column "Importer's income." "High" includes importing countries that are categorized into a high-income group in the classification by the World Bank. Otherwise, countries are classified as "Low."

Table 3. Estimation Results according to the Transport Mode and Distance

| | Mode | | Distance | |
|---|---|---|---|---|
| | Sea | Air | < 10,000 | > 10,000 |
| Month = 2 | -0.02 | 0.058** | 0.017 | 0.038 |
| | [0.026] | [0.027] | [0.022] | [0.044] |
| Month = 3 | -0.004 | 0.036 | 0.017 | 0.02 |
| | [0.025] | [0.026] | [0.021] | [0.043] |
| Month = 4 | 0.015 | 0.060** | 0.026 | 0.038 |
| | [0.026] | [0.027] | [0.021] | [0.041] |
| Month = 5 | 0.026 | 0.057** | 0.043* | 0.043 |
| | [0.027] | [0.028] | [0.022] | [0.045] |
| Month = 6 | 0.046* | 0.023 | 0.047** | -0.007 |
| | [0.026] | [0.027] | [0.022] | [0.041] |
| Month = 7 | 0.014 | 0.067** | 0.037* | 0.069 |
| | [0.026] | [0.028] | [0.022] | [0.043] |
| Month = 8 | 0.025 | 0.025 | -0.002 | 0.071* |
| | [0.027] | [0.028] | [0.023] | [0.043] |
| Month = 9 | 0.008 | 0.031 | 0.045** | -0.024 |
| | [0.027] | [0.027] | [0.022] | [0.043] |
| Month = 10 | 0.057** | 0.013 | 0.042* | 0.079* |
| | [0.027] | [0.027] | [0.023] | [0.042] |
| Month = 11 | 0.145*** | 0.046 | 0.091*** | 0.101** |
| | [0.027] | [0.029] | [0.023] | [0.043] |
| Month = 12 | 0.214*** | 0.110*** | 0.150*** | 0.142*** |
| | [0.025] | [0.028] | [0.022] | [0.044] |
| Number of obs | 15,689 | 13,853 | 20,840 | 7,421 |
| Log pseudolikelihood | -7114.2 | -6123.5 | -9817.9 | -3029.2 |

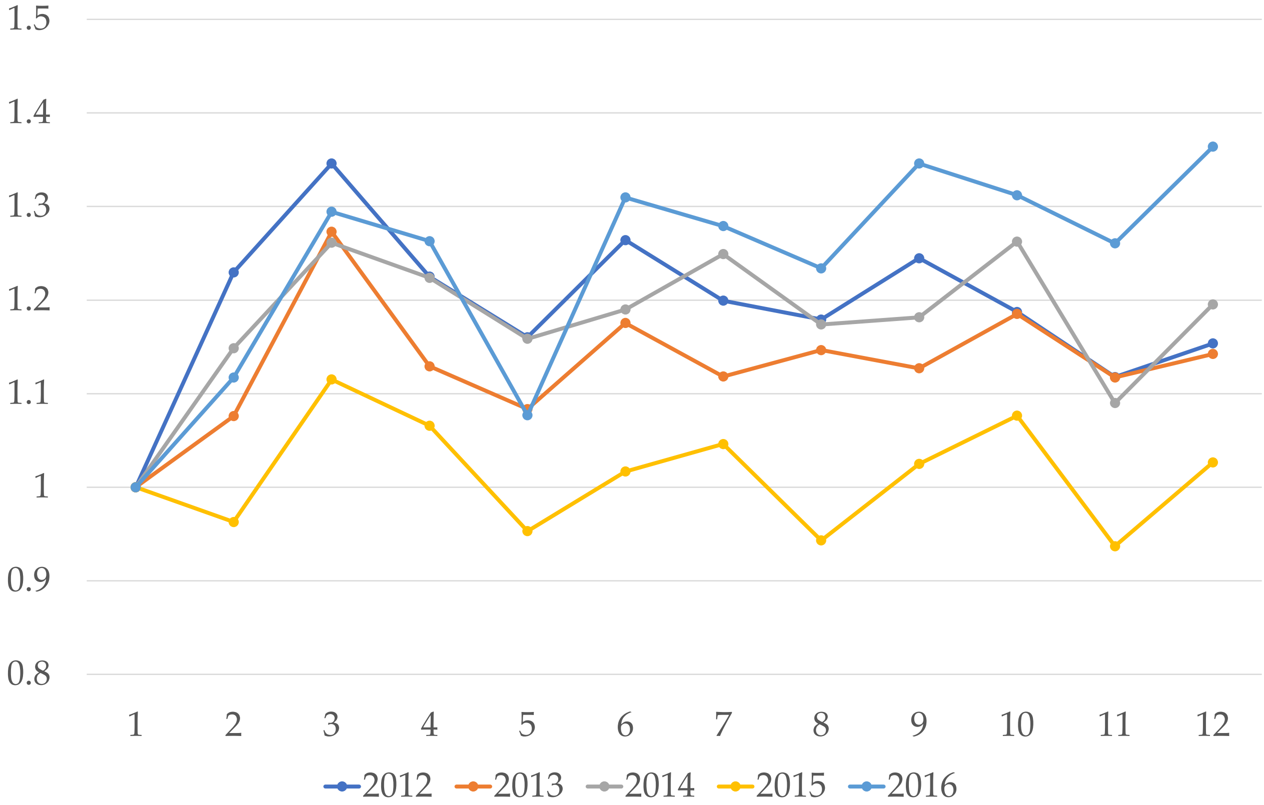
*Notes*: The dependent variable is an indicator variable that takes a value of 1 if an importing country does not report any imports, and 0 otherwise. We estimate the model as the Probit model and report the marginal effects. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. The square brackets denote the robust standard errors. In all specifications, we control for importer fixed effects, product fixed effects, and year fixed effects. The product is defined at an HS six-digit level. "Sea" ("Air") includes the observations where exports by sea (air) are positive. "Distance" indicates the geographical distance between Japan and an importing country (kilometers).

Table 4. Estimation Results for the Intensive Margin

| | HS digit | | Importer's income | |
|---|---|---|---|---|
| | Six | Four | Low | High |
| Month = 2 | -0.112 | -0.368* | -0.063 | -0.158 |
| | [0.087] | [0.219] | [0.139] | [0.133] |
| Month = 3 | -0.091 | -0.431** | -0.047 | -0.108 |
| | [0.084] | [0.210] | [0.135] | [0.132] |
| Month = 4 | -0.178** | -0.237 | -0.211 | -0.145 |
| | [0.086] | [0.217] | [0.139] | [0.133] |
| Month = 5 | -0.144* | -0.242 | -0.329** | -0.029 |
| | [0.087] | [0.225] | [0.135] | [0.141] |
| Month = 6 | -0.131 | -0.486** | -0.132 | -0.11 |
| | [0.087] | [0.214] | [0.139] | [0.136] |
| Month = 7 | -0.160* | -0.423* | -0.022 | -0.211 |
| | [0.088] | [0.223] | [0.141] | [0.136] |
| Month = 8 | -0.217** | -0.575** | -0.12 | -0.417*** |
| | [0.089] | [0.239] | [0.140] | [0.136] |
| Month = 9 | -0.217** | -0.457** | -0.228 | -0.258* |
| | [0.088] | [0.223] | [0.139] | [0.143] |
| Month = 10 | -0.321*** | -0.325 | -0.191 | -0.325** |
| | [0.087] | [0.230] | [0.144] | [0.133] |
| Month = 11 | -0.397*** | -0.393* | -0.302** | -0.501*** |
| | [0.093] | [0.235] | [0.145] | [0.148] |
| Month = 12 | -0.210** | -0.138 | -0.094 | -0.337** |
| | [0.093] | [0.251] | [0.147] | [0.142] |
| Number of obs | 19,126 | 3,597 | 8,805 | 8,804 |
| R-squared | 0.3365 | 0.3941 | 0.4054 | 0.4292 |

*Notes*: The dependent variable is the log-difference in trade values between the export and the import country statistics. The model is estimated using the OLS method. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. The square brackets denote the robust standard errors. The product is defined at an HS six-digit level in column "HS Six-digit" and at an HS four-digit level in column "HS Four-digit." The product is defined at an HS six-digit level in column "Importer's income." "High" includes importing countries categorized into a high-income group in the classification by the World Bank. Otherwise, countries are classified as "Low." In all specifications, we control for importer fixed effects, product fixed effects, and year fixed effects.

Figure 1. Seasonality of Japan's Total Exports




*Source*: Japan's Customs

*Note*: We rescale exports so that the value in January becomes 1.

## Appendix. Other Tables and Figures

Table A1. Other Results for the Intensive Margin

| | Mode | | Distance | |
|---|---|---|---|---|
| | Sea | Air | < 10,000 | > 10,000 |
| Month = 2 | -0.166 | -0.204* | -0.049 | -0.258 |
| | [0.127] | [0.123] | [0.108] | [0.183] |
| Month = 3 | -0.041 | -0.15 | -0.142 | 0.02 |
| | [0.125] | [0.122] | [0.102] | [0.182] |
| Month = 4 | -0.349*** | -0.098 | -0.099 | -0.192 |
| | [0.126] | [0.125] | [0.106] | [0.183] |
| Month = 5 | -0.234* | -0.107 | -0.115 | -0.209 |
| | [0.131] | [0.127] | [0.108] | [0.187] |
| Month = 6 | -0.188 | -0.173 | -0.012 | -0.193 |
| | [0.129] | [0.127] | [0.110] | [0.178] |
| Month = 7 | -0.163 | -0.201 | -0.189* | -0.078 |
| | [0.130] | [0.130] | [0.109] | [0.185] |
| Month = 8 | -0.304** | -0.207 | -0.197* | -0.336* |
| | [0.134] | [0.130] | [0.112] | [0.190] |
| Month = 9 | -0.224* | -0.262** | -0.253** | -0.104 |
| | [0.133] | [0.125] | [0.111] | [0.183] |
| Month = 10 | -0.379*** | -0.355*** | -0.228** | -0.366** |
| | [0.130] | [0.125] | [0.110] | [0.180] |
| Month = 11 | -0.322** | -0.488*** | -0.456*** | -0.193 |
| | [0.145] | [0.131] | [0.116] | [0.196] |
| Month = 12 | -0.107 | -0.453*** | -0.202* | -0.332* |
| | [0.146] | [0.128] | [0.115] | [0.193] |
| Number of obs | 9,418 | 9,516 | 13,161 | 4,723 |
| R-squared | 0.4121 | 0.3890 | 0.3680 | 0.4841 |

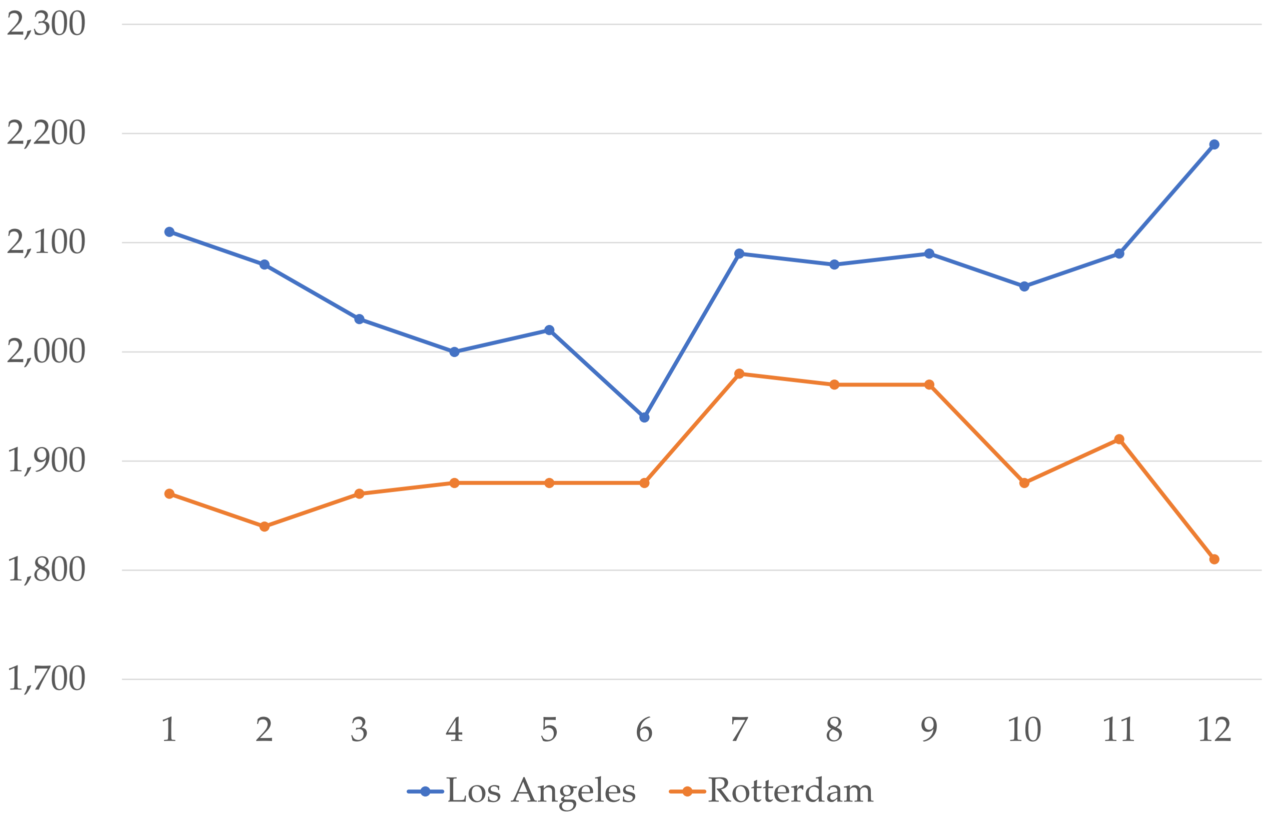
*Notes*: The dependent variable is the log-difference in trade values between the export and the import country statistics. The model is estimated using the OLS method. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. The square brackets denote the robust standard errors. The product is defined at an HS six-digit level. "Sea" ("Air") includes the observations where exports by sea (air) are positive. "Distance" indicates the geographical distance between Japan and an importing country (kilometers). In all the specifications, we control for importer fixed effects, product fixed effects, and year fixed effects.

Table A2. Results according to Importer's Customs Efficiency

| | Extensive | | Intensive | |
|---|---|---|---|---|
| | Low | High | Low | High |
| Month = 2 | -0.040** | 0.018 | -0.112 | -0.157 |
| | [0.020] | [0.019] | [0.136] | [0.109] |
| Month = 3 | 0.004 | 0.014 | -0.09 | -0.13 |
| | [0.019] | [0.018] | [0.133] | [0.109] |
| Month = 4 | 0.035* | 0.006 | -0.237* | -0.166 |
| | [0.019] | [0.018] | [0.140] | [0.110] |
| Month = 5 | -0.027 | 0.032* | -0.152 | -0.11 |
| | [0.020] | [0.019] | [0.134] | [0.115] |
| Month = 6 | 0.012 | 0.024 | -0.221 | -0.219* |
| | [0.019] | [0.019] | [0.138] | [0.113] |
| Month = 7 | -0.013 | 0.039** | -0.144 | -0.224** |
| | [0.019] | [0.019] | [0.143] | [0.109] |
| Month = 8 | -0.005 | 0.011 | -0.025 | -0.329*** |
| | [0.020] | [0.019] | [0.142] | [0.114] |
| Month = 9 | -0.03 | 0.038** | -0.193 | -0.242** |
| | [0.020] | [0.019] | [0.137] | [0.112] |
| Month = 10 | -0.004 | 0.034* | -0.241* | -0.391*** |
| | [0.019] | [0.019] | [0.141] | [0.113] |
| Month = 11 | 0.032 | 0.075*** | -0.270* | -0.497*** |
| | [0.020] | [0.020] | [0.149] | [0.121] |
| Month = 12 | 0.067*** | 0.104*** | -0.247 | -0.064 |
| | [0.019] | [0.020] | [0.154] | [0.123] |
| Number of obs | 17,328 | 16,884 | 7,609 | 10,959 |
| Log pseudolikelihood | -11852.3 | -10913.4 | | |
| R-squared | | | 0.0012 | 0.0029 |

*Notes*: The dependent variable in the extensive margin is an indicator variable that takes a value of 1 if an importing country does not report any imports, and 0 otherwise. That in the intensive margin is the log-difference in trade values between the export and the import country statistics. The model is estimated using the Probit model in the extensive margin and the OLS in the intensive margin. In the probit estimation, we report the marginal effects. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. The square brackets denote the robust standard errors. The product is defined at an HS six-digit level. In all specifications, we control for importer fixed effects, product fixed effects, and year fixed effects. "High" includes the importing countries that have the logistics performance index higher its median value among our study observations. The data on the logistics performance index are obtained from the World Development Indicators. The higher index implies the higher efficiency of the customs clearance process. The rest is classified as "Low."

Figure A1. Freight Rates for 20-feet Containers from Yokohama in 2014 (USD)




*Source*: Container Freight Rate Insight (Drewry).