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Keywords: Export regulation; Trade; Japan
JEL classification: F15; F53

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The Impact of the U.S.-China Conflict and the Strengthening of Export Controls on Japanese Exports

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Abstract

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1. Introduction

Export control regulations take center stage among trade policy measures following the outbreak of the U.S.-China trade war. In the initial phase of this war, i.e., 2018 and 2019, the main measure was the imposition of additional bilateral tariffs between the U.S. and China. Initiating the trade war, the U.S. started raising tariffs on imports from China in 2018. This first step was followed by three further phases of tariff increases.[1] In retaliation, China also imposed various tariffs on an array of imports from the U.S. In the next stage of the war, the main measure changed from tariffs to export control regulations. In August 2018, the U.S. strengthened export controls from the perspective of national security and regulated exports of key technologies and components to China. In May 2019, the U.S. added Huawei Technologies Co., Ltd. (hereafter, Huawei) and 68 affiliates to the list of customers of concern. Furthermore, since 2020, the U.S. government has required even firms outside of the U.S. to obtain permission if products using U.S.-origin technology or software are exported directly or even indirectly to these Chinese firms.

Following these developments, the Japanese government has also strengthened export control regulations. Many countries, especially developed countries, have put in place security-related export controls based on the international export control regimes that regulate the export of weapons and dual-use goods.[2] The Japanese government requires exporters to obtain permission when exporting specific types of goods destined for specific countries. The specific goods and countries concerned have been frequently amended based on agreements reached at international export control regime meetings. While such regulations are necessary from a national security perspective, they may discourage Japanese firms from exporting due to the increased administrative burden. In addition to regulations by the Japanese government, the aforementioned tightened export regulations by the U.S. government are also likely to discourage Japanese firms from exporting certain products. In fact, export control regulations have now become one of the most crucial elements when firms make export decisions.

Against this backdrop, this study empirically examines the effect of export control regulations on Japan's exports using monthly export data at the destination country-product level. The study covers the period from January 2017 to December 2021. Specifically, we investigate three kinds of export regulations. The first is the export control measures adopted by the Japanese government. The second is the aforementioned restrictions regarding Huawei introduced by the U.S. government. The third is the export regulations

[1] See Bown (2021) for details on the timing and scale of the products subject to the tariff changes in the U.S.-China trade war.

[2] Dual-use goods are goods that can be used for both civilian military purposes. For example, carbon fibers can be used for golf club shafts and for the wings of fighter jets. A famous historical example involving the export of dual-use goods is the Toshiba-Kongsberg incident, when Toshiba Machine company sold machine tools, numerical control units, and software necessary to process submarine propellers to the Soviet Union in the 1980s.

introduced by the Japanese government with regard to the export of certain chemical products to South Korea. We examine the effects of these export regulations by estimating a model that controls for various types of fixed effects in order to minimize the risk of omitted variable bias. We conjecture that the introduction of export control measures raises the fixed costs of exporting and, as a result, reduces Japan's exports through a reduction in the number of firms that export. Based on this conjecture, we aim to determine the trade effects of recent export regulations on exports in the case of Japan.

Our findings can be summarized as follows. First, we find no significant effects of the introduction or tightening of export controls by the Japanese government on Japan's exports. Thus, the negative effects of export controls on exports may be limited. Second, the restrictions regarding Huawei introduced by the U.S. government significantly decreased Japan's exports of related products, especially to China. These results suggest that it is more costly for exporters to obtain export permission from a foreign government than from the domestic government. Third, the regulations introduced by the Japanese government regarding the export of a specific chemical product (hydrogen fluoride) to South Korea significantly decreased Japan's exports of this product to South Korea but increased exports of that product to the rest of the world. The decrease in exports to South Korea is driven by the decrease in the quantity of exports, while the export price of the product rose slightly.

Our study is related to several strands of literature. The first is the literature on the U.S.-China tariff war.[3] Many studies examine the direct effects of tariffs on the U.S. economy, including the pass-through to consumer prices (Amiti et al., 2019, 2020; Fajgelbaum et al., 2020; Flaaen et al., 2020), the price effects on retailers (Cavallo et al., 2021), the effects on U.S. exporters dependent on foreign inputs (Handley et al., 2020), the effects on the stock market (Egger and Zhu, 2020), and the effects on political elections (Blanchard et al., 2019). Some studies discuss the effects of the imposition of U.S.-China tariffs on China and other countries. For instance, Ma et al. (2021) investigate the effects of retaliatory tariffs imposed by China on China's imports from the U.S.[4] Meanwhile, examining whether the trade dispute between the U.S. and China had trade diversion effects towards third countries, Cigna et al. (2022) found no evidence of such effects. A more comprehensive analysis of trade diversion effects in global trade was undertaken by Fajgelbaum et al. (2020), who found that the impact on third countries was heterogeneous. However, although there are many studies on the tariff war between the U.S. and China, to our best knowledge no studies have examined the trade effects of export control regulations.

The second related strand of the literature consists of theoretical and empirical studies on voluntary export restraints (VERs). Like export controls based on international regimes, VERs restrict firms' exports. Examples of studies falling into this strand of the literature

[3] See, for example, Fajgelbaum and Khandelwal (2022) for a review of this literature.

[4] Other studies examining the impact on economic activity in China include those by Chor and Li (2021), who showed that U.S. tariffs had a negative effect on night-time luminosity in China, while Cui and Li (2021) found that they had a negative effect on firm entry rates in China.

include Levinsohn et al. (1999), Harris (1985), Krishna (1989), Pomfret (1989), and Calzolari and Lambertini (2007). Most studies in this literature examine VERs imposed on exports of automobiles from Japan in the 1980s. For example, Levinsohn et al. (1999) examined the impact of this case on U.S. consumer welfare, firm profits, and forgone tariff revenue. However, under VERs, the exporting country sets a limit on export quantities in order to avoid terms that would be worse such as tariffs and quotas rather than for national security reasons. In this sense, VERs differ from recent export control regulations.

Third, our study is related to the literature on the trade effects of trade facilitation, such as measures to increase customs efficiency. Trade facilitation is similar to export control regulations in that both relate to the fixed costs of exporting, where the former concerns the reduction of such costs while the latter increase such costs. Country-level studies on the effects of customs clearance times on trade include those by Djankov et al. (2010), Freund and Rocha (2011), and Portugal-Perez and Wilson (2012). Estimating gravity equations, these studies found that customs clearance times had a significant effect on trade values. Meanwhile, other studies have examined the relationship between customs clearance times and firm-level exports (Dollar et al., 2006; Li and Wilson, 2009; Shepherd, 2013; Carballo et al., 2014, 2016; Fernandes et al., 2015; Volpe Martincus et al., 2015; Hayakawa et al., 2019). In contrast to these studies on trade facilitation, we expect that export control regulations have a negative effect on exports.

The rest of this study is organized as follows. The next section provides an overview of export controls in Japan and the U.S. Section 3 then presents our empirical framework for examining the impact of export controls on Japan's exports, while Section 4 reports the results. Section 5 concludes.

2. Overview of Japan's Export Controls

This section provides an overview of international export control regimes, Japan's security trade controls, and U.S. export controls affecting Japan. Recent developments in Japan's exports are also briefly reviewed.

2.1. Security Trade Controls by the Japanese Government

Although the Cold War between East and West has ended, regional conflicts and acts of terrorism continue to occur frequently. Many countries around the world, therefore, are implementing security-related export controls as part of coordinated efforts to prevent the proliferation of weapons of mass destruction and the excessive accumulation of conventional weapons. Currently, there are four international export control regimes: the Wassenaar Arrangement for conventional weapons, the Nuclear Suppliers Group for nuclear weapons, the Australia Group for chemical and biological weapons, and the Missile

Technology Control Regime.[5] These four regimes control the export of weapons and the technologies and general-purpose items used in the development of weapons, etc. Meanwhile, weapons themselves are regulated in treaties such as the Treaty on the Non-Proliferation of Nuclear Weapons, the Chemical Weapons Convention, and the Biological and Toxin Weapons Convention.

Based on these treaties and international frameworks, major countries around the world, including Japan, control the export of equipment and materials related to the development and manufacture of weapons of mass destruction and conventional weapons and related dual-use goods, as well as the provision of related technologies to non-residents. In Japan's case, as shown in Figure 1, laws and regulations concerning trade control are stipulated by Article 48, Paragraph 1, of the Foreign Exchange and Foreign Trade Act (FEFTA). Those intending to export specific types of goods destined for specific countries are required to obtain permission (an export license) from the Ministry of Economy, Trade and Industry (METI), Japan. The "specific countries" and "specific types of goods" are specified in the Export Trade Control Order (ETCO), which is a cabinet order. Moreover, "specific technologies" and "specific countries" in the case of transactions for the purpose of providing technologies related to the design, manufacture, or use of specific types of goods ("specific technologies") in specific countries are stipulated in the Foreign Exchange Order, which is also a cabinet order.

=== Figure 1 ===

Export controls in Japan consist of two types of control: list control and catch-all control. List control focuses on the functions and performance (specifications) of goods and technologies and is regulated by a METI ministerial ordinance, namely, the "Ministerial Ordinance Specifying Goods and Technologies Pursuant to the Provisions of the Appended Table 1 of the ETCO and the Appended Table of the Foreign Exchange Order." While list control applies to all countries, Iran, Iraq, and North Korea are specified as countries of particular international concern under Appended Table 4 of the ETCO. Meanwhile, catch-all control regulates all items other than list-controlled items, with the exception of food products and wood products. However, unlike list control, which focuses on the performance (specifications) of goods and technologies, catch-all control focuses exclusively

[5] The Wassenaar Arrangement was formally established in July 1996 to control exports of conventional weapons and dual-use goods and technologies with the aim of preventing the excessive accumulation of conventional weapons in response to concerns about the outbreak and expansion of regional conflicts after the end of the Cold War. As of December 2021, there were 42 participating states. The Nuclear Suppliers Group, Australia Group, and Missile Technology Control Regime are international export control frameworks not for conventional weapons but for weapons of mass destruction (WMDs) and for dual-use goods that have a high risk of being diverted for the development, manufacture, use, or storage of WMDs.

on end-users and uses.[6] Catch-all control can be regarded as complementary export regulation because it complements list control. Catch-all control covers all countries except those listed in Appended Table 3 of the ETCO (the 26 countries[7] in the Preferred Trade Partner List Countries).

2.2. Recent Amendments by the Japanese Government

In Japan, as mentioned above, trade controls are implemented under the FEFTA. Since Japan is also a participant of the above four international export control regimes, the goods subject to control are reviewed, and the ETCO is revised from time to time based on agreements reached at international meetings. Major revisions in recent years include the amendments to the ETCO on November 22, 2017, and November 27, 2020. The November 2017 amendment included a review of the goods subject to control based on an agreement reached at international export control regime meetings in 2016. On December 6 of the same year, the relevant METI ministerial ordinance ("Ministerial Ordinance Specifying Goods and Technologies Pursuant to Provisions of the Appended Table 1 of the ETCO and the Appended Table of the Foreign Exchange Order") was revised, and with its implementation, items subject to the ETCO increased as of January 22, 2018.[8]

The November 2020 revision included a review of goods and technologies subject to control based on the agreement at international export control regime meetings in 2019, and the related METI ministerial ordinance ("Ministerial Ordinance Specifying Goods and Technologies Pursuant to Provisions of the Appended Table 1 of the ETCO and the Appended Table of the Foreign Exchange Order") was partially revised on December 10, 2020. This revision came into effect on January 27, 2021. At this time, for example, regulations were tightened for electronics-related items (e.g., technology required for slicing, grinding, and polishing silicon wafers), communications-related items (e.g., encryption equipment, devices for measuring the security management functions of information

[6] Under catch-all control, exporters are required to obtain an export license under the "informed" or the "know" condition. In the former case, the "informed condition," METI informs an exporter that a license is required for a specific export because there is a risk of WMD proliferation or military end-use. On the other hand, the "know condition" refers to the case in which an exporter comes to know, for example through contract documents, that the export could contribute to WMD proliferation, and/or when a company or organization is on METI's End User List of foreign entities of concern.

[7] While there were previously 27 countries on the list, with the exclusion of South Korea in September 2019, there were 26 countries as of December 31, 2021. Preferred Trade Partner List Countries and therefore exempt from catch-all control are countries that participate in international conventions and the four international regimes on export controls and strictly enforce their own catch-all control. According to the Nikkei (August 3, 2019), METI cited the lack of intergovernmental dialogue for a certain period of time and the fact that South Korea's export control regime is considered weak as reasons for the country's exclusion from the Preferred Trade Partner List Countries.

[8] According to the Export Statistical Schedule published by Japan Customs, the number of items subject to the ETCO increased by nearly 200 items at the HS nine-digit level in January 2018.

systems, and monitoring technology), and propulsion equipment-related items (e.g., spacecraft for aerospace). More specifically, while these items had been already subject to list control, the range of technologies, functions, and/or specifications subject to list control was expanded for these items. On the other hand, regulations were relaxed for some goods and technologies related to advanced materials (e.g., fiber molded products, equipment designed for alloy manufacturing) and materials processing-related items (e.g., bearing specifications, technologies related to the design of accessory devices for numerically controlled equipment).

In Sections 3 and 4 below, we will examine the impact of the ETCO amendments which came into effect in January 2018 and January 2021. As these consist of list control, the regulations apply to all destination countries. However, as explained below, the examination process for an export license differs depending on the destination country or region. We therefore expect the impact of the ETCO amendments to differ across destination countries/regions.

Export items that may be associated with the functions and performance (specifications) of goods and technologies subject to list control are flagged as "ET" (meaning that they are subject to the ETCO) in each annual edition of the Export Statistical Schedule published by Japan Customs. For example, in the 2021 edition of the Export Statistical Schedule, 2,926 items at the HS nine-digit level, or 45% of total export items at the nine-digit level, are flagged as linked with Appended Table 1 of the ETCO (i.e., flagged as potentially list-controlled items). However, whether or not an item is actually subject to control is determined through an examination of the specifications and other details of the exported item. When exporting goods with functions or specifications subject to regulations, exporters need to apply for an export license from METI. However, the review process – such as the number of application documents required and whether the application needs to be filed with the headquarters of METI or one of the Regional Bureaus of Economy, Trade and Industry – depends on the technology field and the export destination.

As of February 2022, there were 13 export destination categories, among which Preferred Trade Partner List Countries are classified as "I region (1)" (regions are labeled using Japanese letters) and export license applications for these countries follow a simplified procedure. On the other hand, the "Ro region" is a list of all countries except those in "I region (1)," "I region (2)," and "Ri region." "I region (2)" and "Ri region" consist of countries that participate in international export control regimes and meet certain conditions (South Korea, the three Baltic states, etc.).[9] The "Ro region" also includes UN arms embargo countries. In other words, the "Ro region" consists of all countries of (potential) concern, i.e., countries other than Preferred Trade Partner List Countries and those treated similar to preferred countries. In applying for an export license for "Ro region" countries, the applicant is required to submit documents detailing the identity of the importer and end-

[9] A list of countries classified as "Ro region" countries is provided in Appendix A.1. "Ri region" includes South Korea only.

user, the intended use of the goods, location, transportation route, payment conditions, and the existence of confidentiality requirements, as well as – depending on the goods and technology – documents related to the manufacturing process. These documents are used for a rigorous examination. On the other hand, for "I region (1)" countries, only basic application documents (an application form for an export license, reasons for the application or a detailed statement of the application, contract, etc.) need to be submitted.

Other than these major revisions, the Japanese government partially amended the ETCO in August 2019, removing South Korea from the Preferred Trade Partner List Countries (effective on August 7). Therefore, South Korea was dropped from the "I region (1)" and moved to the "Ri region." However, South Korea is still treated almost the same as the preferred countries, and the procedures for applying for an export license and the examinations are virtually unchanged, i.e., for almost all items the procedures are the same as those for Preferred Trade Partner List Countries. However, prior to this revision of the Cabinet Order, a "Review of Operation of Export Controls to Korea" was announced in July 2019, and for three specified items (photoresists, fluorinated polyimide, and hydrogen fluoride), a switch was made from bulk export licenses to individual export licenses (effective July 4, 2019). As a result of this revision, for goods among the three specified items with specifications that are subject to list control, an export license application is required for each individual export contract, and information on the end-user, product specifications, technology, etc., must also be submitted. This revision increases the time and cost of applying for a permit, especially for transactions that are on an ongoing basis. In addition, for the export of hydrogen fluoride, which is classified as a chemical weapons-related product, the examination of the manufacturing process has been made stricter, requiring the submission of documents on the end-user's procurement record, whether and to what extent the end-user produced the final product in the past, and the final product manufacturing flow of the plant that will use the goods. We will examine the impact of the tightening of controls on the export of these items to South Korea in the empirical analysis below.

2.3. The Foreign Direct Product Rule by the U.S. Government

While changes in export controls by the Japanese government such as those described in Section 2.2 are expected to have some impact on the volume, value, and composition of Japan's exports, changes in trade control regulations by other governments may also affect Japan's exports. Of particular concern in recent years has been the tightening of restrictions on exports to China by the U.S. government. The U.S., like Japan, controls trade under the international export control regimes. The Export Control Reform Act (ECRA), signed into law on August 13, 2018, requires the U.S. Commerce Department's Bureau of Industry and Security (BIS) to impose export controls on emerging and foundational technologies (EFTs)

that are "essential to the national security of the United States."[10] In recent years, the ECRA has been used as the basis for adding EFTs to the list of controlled items that had not previously been included in export controls.

In addition to the expansion of controlled items, there have been moves to add Chinese companies to the Entity List (EL), which is a list of parties of concern. In May 2019, the U.S. announced that Huawei and 68 affiliates would be added to the EL. In addition, one year later, on May 15, 2020, the Foreign Direct Product Rule (FDPR) of the U.S. Export Administration Regulations (EAR) was strengthened to cover Huawei and its affiliates on the EL, and prior authorization was required if "direct products" – products manufactured directly using U.S.-origin technology or software – are used in the production and development of chipsets and other products designed by Huawei and its affiliates. This FDPR for designated Huawei entities captured only those foreign-produced items that had been "produced or developed" by a designated Huawei entity and were designated for such an entity.[11]

In August 2020, the regulations were further tightened and the foreign-produced direct product rule requiring prior authorization now also applied to the "production" or "development" of any "part," "component," or "equipment" purchased or ordered by Huawei or its affiliates, even if Huawei and its affiliates are not directly involved in the production or development.[12] Thus, no person may re-export, export from abroad, or transfer (in-country) the specified foreign-produced items with "knowledge" that either (a) any designated entity is a party to any transaction involving the foreign-produced item or (b) the foreign-produced item will be incorporated into or used in production or development of any part, component, or equipment produced, purchased, or ordered by one of the designated Huawei entities.[13]

While under Japan's export control system, a "Foreign End Users List" listing end-

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[10] The ECRA repealed the Export Administration Act (EAA) of 1979, which served as the basis for dual-use export controls. For details, see, for example, Congressional Research Service (2020).

[11] For details on the amendments to the EAR, see U.S. Federal Register, Vol. 85, No. 97, Page 29849, May 19, 2020: "Export Administration Regulations: Amendments to General Prohibition Three (Foreign-Produced Direct Product Rule) and the Entity List" (codified in 15 CFR Parts 730, 732, 736, and 744). Available at: https://www.govinfo.gov/content/pkg/FR-2020-05-19/pdf/2020-10856.pdf.

[12] For details on the amendments to the EAR, see U.S. Federal Register Vol. 85, No. 162, Page 51596, August 17, 2020: "Addition of Huawei Non-U.S. Affiliates to the Entity List, the Removal of Temporary General License, and Amendments to General Prohibition Three (Foreign-Produced Direct Product Rule)" (codified in 15 CFR Parts 736, 744, and 762). Available at: https://www.govinfo.gov/content/pkg/FR-2020-08-20/pdf/2020-18213.pdf.

[13] The foreign-produced items subject to this rule are items that are either the direct product of "technology" or "software" subject to the EAR and fall into certain Export Control Classification Numbers (ECCNs) under categories 3, 4, or 5, or the direct product of a plant or major component of a plant that is located outside the U.S., when the plant or major component of a plant, whether made in the U.S. or a foreign country, itself is a direct product of U.S.-origin "technology" or "software" subject to the EAR that is specified in certain Category 3, 4, or 5 ECCNs. The ECCN categories 3, 4, 5 denote electronics, computers, and telecommunications and information security, respectively.

users of concern that are subject to catch-all control is published, there is no list equivalent to the U.S. Entity List. As of February 2022, Japan did not have regulations on Chinese companies such as Huawei as strong as those of the U.S. However, the FDPR by the U.S. is expected to have a substantial impact on Japanese companies that supply parts to Huawei and its affiliates; for example, the Sony Group has reportedly sharply reduced shipments of image sensors for Huawei's smartphones (Nikkei, June 3, 2021).[14] When a Japanese company incorporates parts procured from the U.S. into a finished product at a Japanese factory and exports it from Japan to China, it must also submit an export license application to the U.S. BIS and obtain approval if the product is subject to the FDPR. For Japanese companies, applying for a permit from the U.S. BIS is likely to present a higher hurdle than applying for a permit from METI under the Japanese export control system due to the higher procedural and information gathering costs. Furthermore, for Japanese firms, changes in the U.S. system are likely to be more uncertain than changes in Japan, and obtaining a permit under the U.S. FDPR to export to China may be limited to relatively large firms.

2.4. Overview of Japan's Exports

In this subsection, we provide an overview of Japan's exports of products subject to export trade controls. Table 1 shows which HS sections and HS two-digit classifications are most likely to be subject to export controls. Looking at the number of products subject to the ETCO (referred to "ET products" hereafter) as of January 2021, machinery products (HS Section 16) as well as chemical products (HS Section 6) account for the largest shares of products subject to ETCO. In terms of export values, the share of transport equipment (HS Section 17) is also relatively high. The table also shows the shares of products subject to the revision of the ministerial order in December 2020. In terms of the number of products, 75% of all items subject to this revision are machinery products, with machinery products alone accounting for almost 50%. In terms of export value, the share of machinery products is even higher, at almost 85%.

=== Table 1 ===

Figure 2 shows developments in the share of ET products in the value of total exports and the number of total products at the nine-digit level. The figure indicates that about 70% of the value of exports and about 45% of the number of products are subject to the ETCO. It should be noted, however, that not all items in an HS nine-digit level category with an "ET"

[14] While Sony suspended shipments of semiconductor products to Huawei on September 15, 2020, in response to U.S. regulations that took effect in August 2020, it received permission from the U.S. Department of Commerce to resume exports by October 29, 2020. However, the permission was not granted for all components required for Huawei's smartphone production, and it was not clear whether Sony's export volume would return to the previous level (Nikkei, October 30, 2020).

flag require an export license, as many do not actually have functions or specifications that are subject to regulation. While the share in total exports has decreased to some extent since the third quarter of 2020 (2020Q3), the number of products has hardly changed since the revision of the ministerial ordinance in December 2017.

=== Figure 2 ===

Next, let us look at the impact of the U.S. FDPR. As discussed in Section 2.3, in May and August 2020, the FDPR was tightened with regard to Huawei and its affiliates, with exports not only from the U.S. but also from Japan now requiring prior approval from the U.S. government. In practice, it is difficult to clearly identify products potentially affected by this tightening of the FDPR. Therefore, we follow the product list in Global Trade Alert[15] and regard all products falling under HS8517 as affected by the tightening. Products include telephone sets, including telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network, etc.

Figure 3 shows developments in Japan's exports to China of ET-flagged products and products subject to the U.S. FDPR with regard to Huawei, i.e., HS8517 products. Panel (a) shows that exports to China account for about 20% of Japan's total exports of products potentially subject to list control (products flagged with ET), and this percentage has risen slightly. On the other hand, the share of Huawei-related FDPR products (products classified under HS8517) in Japan's total exports was about 0.6% in the most recent period, which is not a large share of Japan's total exports of such products. However, exports to China accounted for about 40% of Japan's exports of HS8517 products in 2017, which means that the Chinese market was extremely important for these products. However, since 2018, the share of exports to China has been declining, perhaps due in part to the U.S.–China trade friction. Panel (b) shows that while the export value of HS8517 items to China declined substantially from 2018, it recovered to some extent around 2020Q4, when Japanese firms obtained U.S. government export licenses under the strengthened FDPR.[16] That said, even

[15] See https://www.globaltradealert.org/intervention/71863/controls-on-commercial-transactions-and-investment-instruments/united-states-of-america-naming-of-huawei-technologies-co-ltd-to-a-list-of-controlled-entitie.

[16] As mentioned in footnote 9, while Sony suspended shipments of semiconductor products to Huawei on September 15, 2020, in response to U.S. regulations that took effect in August 2020, it received permission from the U.S. Department of Commerce to resume transactions by October 29, 2020. Large companies such as Sony likely immediately took steps such as obtaining export licenses from the U.S. government, thereby minimizing the decrease in exports to Huawei. However, it was reported that licenses were not granted for all of the components needed for Huawei's smartphone production, and it was not clear whether Sony's transaction volume would return to previous levels (Nikkei, October 30, 2020). Also, according to the Financial Times ("South Korean chip companies step up US lobbying efforts," January 3, 2022), South Korean semiconductor manufacturers are said to be actively lobbying U.S. political circles to obtain permission to supply Chinese companies with products that are subject to U.S.

in 2021Q4, exports had not recovered to the 2017 level.

=== Figure 3 ===

While one might think that Huawei stocked up on products imported from Japan before the tightening of the FDPR, Figure 3(b) does not suggest that this was the case. In fact, in April 2018, Chinese smartphone manufacturer ZTE was sanctioned by the U.S. Department of Commerce with a seven-year ban on domestic sales for exporting telecommunications equipment in violation of U.S. sanctions on Iran and North Korea; in May 2019, Huawei and 68 affiliates were added to the Entity List; and in August of the same year, five companies, including Huawei and ZTE, were banned from U.S. government procurements of telecommunications and other equipment. Amid these steps excluding Chinese companies from the U.S. market, exports of telecommunications equipment-related items from Japan to China were already on the decline from 2018 onward. Meanwhile, although it had been expected that the share of exports to China would decline further from 2020Q2 reflecting the strengthening of the U.S. FDPR, contrary to expectation, the share of exports to China has risen. A possible reason is that, by clearly spelling out stipulations, the FDPR may have reduced uncertainty, leading to an increase in exports with U.S. government export licenses.

Finally, let us look at the impact of the "Review of Operation of Export Controls to Korea" announced by the Japanese government in July 2019. Export controls were tightened for some specifications of photoresists (HS370790), fluorinated polyimide (HS392099), and hydrogen fluoride (HS281111) to South Korea. Since hydrogen fluoride is classified as a chemical weapons-related item and is subject to stricter screening than the other two products, we separate the former two products from hydrogen fluoride and look at changes in South Korea's share in Japan's exports of these products.

Figure 4(a) shows that even though South Korea's share in Japan's total exports of photoresists and fluorinated polyimides (Chemicals I in the figure) declined slightly in 2019Q4 after the review of operation, it has actually increased since then, hovering at around 15–18%. On the other hand, South Korea's share in Japan's total exports of hydrogen fluoride (Chemicals II in the figure) fell sharply from around 90% before the review of operation to around 50% after the review. While hydrogen fluoride accounts for only about 0.1% of Japan's total exports, so that the impact of the decline on Japan's overall exports is likely to be limited, the decline in exports of hydrogen fluoride to South Korea is extremely large in terms of the individual product.[17] Moreover, as can be seen from Figure 4(b), along

export controls.

[17] The Nikkei (July 20, 2019, morning edition) reports that the Japanese government's tightening of controls on exports of hydrogen fluoride from Japan to South Korea could reduce semiconductor production in China by Korean companies and affect China's semiconductor market, since some of the hydrogen fluoride exported from Japan to South Korea was used in the Chinese plants of major South

with the decrease in hydrogen fluoride exports to Korea, worldwide exports also fell, meaning that not all of the decrease in exports to Korea was compensated for by an increase in exports to other countries.

=== Figure 4 ===

While Figures 3 and 4 show changes in export values and shares of items related to the U.S. FDPR for Huawei and its affiliates and for items related to Japan's strengthening of export controls to South Korea, no major changes can be observed in overall exports of products that may be subject to Japan's list control. In the next section, we examine the impact of export controls through statistical analysis, controlling for various factors such as the impact of the COVID-19 pandemic and changes in demand by each country and for each item.

3. Empirical Framework

This section presents the empirical framework we use to investigate the trade effects of export controls. As discussed in the previous section, export controls involve administrative procedures in which exporters are required to submit various documents to the relevant authority and obtain permission to export. Export controls therefore create fixed costs for firms that export products for which an export permit is required. Such fixed costs are incurred in addition to the other fixed costs involved in exporting, such as documentation for export declarations. Export controls therefore increase the fixed costs of exporting products that are subject to export controls. Higher fixed costs, in turn, are likely to reduce exports. Chaney (2008), for example, theoretically shows that higher trade fixed costs reduce the number of exporting firms, i.e., the extensive margin, although they do not affect exports per firm, i.e., the intensive margin. In other words, only firms for which the gains from exporting exceed the fixed costs of exporting choose to export, and an increase in fixed costs reduces total exports by reducing the number of exporters. Applying this simple logic to export controls, firms producing a product subject to export controls may refrain from exporting the product if the administrative costs imposed by export controls are prohibitively high, so that exports are lower than would be the case without export controls.[18]

Based on this simple conceptual framework, we examine the trade effect of export controls. We focus on the effects of list control and do not examine catch-all control in our

Korean semiconductor manufacturers Samsung Electronics and SK Hynix.

[18] In addition, export controls may also lower a country's exports when firms are denied export licenses or do not even try to obtain a license because they expect it to be denied.

empirical study on Japan's export controls because the latter regulates all items other than list-controlled items, with the exception of food products and wood products. The observation period is from January 2017 to December 2021. Using Japan's export statistics, we focus on products at the nine-digit level. We start by investigating the effect of export controls on Japan's trade by estimating the following equation:

$$Trade_{ipt} = \exp\{\alpha_1 \cdot ET_{pt} + \alpha_2 \cdot Revision_{pt} + \alpha_3 \cdot Revision_{pt} \cdot Ro\ region_i + \boldsymbol{\delta}\} \cdot \epsilon_{ipt} \quad (1)$$

where $Trade_{ipt}$ represents Japan's monthly exports (nominal value, in Japanese yen) of product p to country i at time t, and ET_{pt} is a dummy variable that takes a value of one if product p is subject to Japanese export controls (i.e., an ET product) at time t and zero otherwise. Similarly, $Revision_{pt}$ is a dummy variable taking a value of one if product p is one for which restrictions were tightened in the ministerial ordinance enforced on January 27, 2021 (and announced in December 2020) and time t is after January 2021. $Ro\ region_i$ takes a value of one if country i is classified into "Ro region" (see Section 2.2) and zero otherwise. We control for various fixed effects, denoted by $\boldsymbol{\delta}$. ϵ_{ipt} is the error term. We estimate this equation using the Poisson pseudo-maximum likelihood (PPML) method.

Given that we include product fixed effects, we expect the coefficient on the *ET* dummy to capture mainly the effect of the introduction of export controls for the approximately 200 products in January 2018 that were not subject to controls before. On the other hand, four chemical products were excluded from list control items in April 2019. We expect the coefficient on the *ET* dummy to be negative due to the additional costs involved in obtaining export permits. On the other hand, following the revision of the ETCO in November 2020, the regulations were further tightened on January 27, 2021, for approximately 200 products that had already been subject to export controls. The effect of this revision is captured by the dummy variable *Revision*. Therefore, for products for which the *Revision* dummy takes a value of one, the *ET* value also always takes one. The coefficient on *Revision* represents the effect of the tightening of regulations in addition to existing export controls and consequently is expected to be negative. Furthermore, we include the interaction term of the *Revision* dummy and the *Ro region* dummy in order to examine how the effect of the tightening of regulations differs depending on whether exports are destined to preferential countries or not. As explained in Section 2.2, the "Ro region" includes all countries except Preferred Trade Partner List Countries and countries treated almost the same as the preferred countries.

In our basic specification, we control for country-product fixed effects and country-time fixed effects. The former fixed effects include the average demand for each product in importing countries during our observation period. The country-product fixed effects also control for the technology level of products in Japan. The country-time fixed effects include the time-variant demand in importing countries in addition to factor prices (e.g., wage rates) in Japan. This type of fixed effect also controls for the impact of the COVID-19 pandemic in

each country. In this basic specification, our estimates may suffer from omitted variable bias due to the failure to control for time-variant product characteristics. In a later estimation we therefore introduce the log of country *i*'s total imports of product *p* from the world (except for Japan) in year *t* (ln *Total imports*) as a direct measure of the demand in importing countries. Since the data for this variable are available only for a limited number of countries, we estimate the model both with and without this control variable. We also run estimations in which we include product-year fixed effects.

Further, we examine two additional issues with regard to export controls. One is the effect of U.S. restrictions regarding Huawei on Japan's exports. As discussed in Section 2.4, the U.S. government has strengthened the FDPR for Huawei and its affiliates since May 2020. To examine the effect on Japan's exports, we introduce a dummy variable (*Huawei*) that takes a value of one if product *p* belongs to HS 8517 and time *t* is after April 2020. We further introduce the interaction term of this variable and a dummy variable that takes one if country *i* is China (*CHN dummy*).

$$Trade_{ipt} = \exp\{\alpha_1 \cdot ET_{pt} + \alpha_2 \cdot Revision_{pt} + \alpha_3 \cdot Revision_{pt} \cdot Ro\ region_i + \beta_1 \cdot Huawei_{pt} + \beta_2 \cdot Huawei_{pt} \cdot CHN\ dummy_i + \boldsymbol{\delta}\} \cdot \epsilon_{ipt} \quad (2)$$

We again estimate this equation using the PPML method.

The coefficients on the Huawei-related variables represent the sum of the direct effect, the chilling effect, and the trade diversion effect. First, the interaction term of the Huawei dummy and the China dummy captures the effect on Japan's exports to Huawei in China (i.e., the direct effect). We therefore expect the estimated coefficient to be negative. Furthermore, Japanese exporters may also hesitate to export products affected by the restrictions to other buyers in China if they are not 100% certain who the downstream producers in the supply chain are, since these could include Huawei. This effect could be called the chilling effect. Nevertheless, if other smartphone companies in China (e.g., Xiaomi) increase their production and imports, such a negative effect on Japanese exports to China may be small or insignificant. This decrease in the negative effect can be regarded as the trade diversion effect. Second, the *Huawei* dummy on its own will pick up similar effects. That is, the restrictions have a direct negative effect by decreasing Japan's exports to Huawei's overseas affiliates. Moreover, they will also have chilling and trade diversion effects with regard to exports outside of China. For example, non-Chinese smartphone makers such as Samsung in South Korea may increase their production and imports of related products.

The other issue we examine is the effect of the strengthening of Japan's controls of exports of three chemical products to South Korea, which took effect on July 4, 2020. As discussed in Section 2.4, the three products are fluorinated polyimide (HS392099), photoresists (HS370790), and hydrogen fluoride (HS281111). We create two dummy variables: one that takes a value of one if product *p* is either a polyimide or photoresist

product and time t is after June 2020 (*Chemicals I*), while the other dummy takes one if product p is a hydrogen fluoride product and time t is after June 2020 (*Chemicals II*). We distinguish hydrogen fluoride from the other two products because hydrogen fluoride, as a chemical weapons-related good, is subject to stricter examination. We further include the interaction terms of these dummy variables with a dummy variable taking a value of one if country i is South Korea (*KOR dummy*). Thus, our equation is specified as follows:

$$Trade_{ipt} = \exp\{\alpha_1 \cdot ET_{pt} + \alpha_2 \cdot Revision_{pt} + \alpha_3 \cdot Revision_{pt} \cdot Ro\ region_i + \gamma_1 \cdot Chemicals\ I_{pt} + \gamma_2 \cdot Chemicals\ I_{pt} \cdot KOR\ dummy_i + \gamma_3 \cdot Chemicals\ II_{pt} + \gamma_4 \cdot Chemicals\ II_{pt} \cdot KOR\ dummy_i + \boldsymbol{\delta}\} \cdot \epsilon_{ipt} \quad (3)$$

Again, we estimate this equation using the PPML method.

It should be noted that while the U.S. export restrictions examined in equation (2) target only Huawei and its affiliates, the restrictions examined in equation (3) apply to South Korea as a whole. In this sense, the effect here is similar to that examined in equation (1); that is, Japanese exports of restricted products to South Korea are expected to decrease after the strengthening of regulations due to the higher export fixed costs. However, there may also be trade diversion effects; that is, instead of exporting to South Korea, Japanese exporters may increase their exports to other countries. This effect will appear in the coefficients on *Chemicals I* and *Chemicals II*. Therefore, we expect these coefficients to be positive.

Our observation period is from January 2017 to December 2021. In this period, the HS 2017 nomenclature is employed in the trade statistics. The monthly data on Japan's exports are taken from the Trade Statistics of Japan by the Ministry of Finance.[19] These data cover all of Japan's exports, and the dataset covers 206 countries/economies. One note is that the nine-digit codes of a small number of products change during this period even though the HS version remained unchanged. Using the converter for nine-digit codes provided by the Japan Tariff Association,[20] we create identical nine-digit codes across years to define product-related fixed effects. A list of products flagged "ET," which we use for the *ET* variable, is available on the Japan Customs website.[21] Both the list of products for the *Revision* variable and the list of countries for the *Ro region* variable are obtained from the METI website.[22] As mentioned, we later introduce the log of total imports from the world, data for which are taken from the *Global Trade Atlas* by IHS Markit.[23] We compile data on monthly imports at the HS six-digit level for 40 countries/economies.[24] We do not include

[19] See https://www.customs.go.jp/toukei/info/tsdl_e.htm.
[20] See http://www.kanzei.or.jp/english/.
[21] See https://www.customs.go.jp/yusyutu/index.htm.
[22] See https://www.meti.go.jp/policy/anpo/index.html.
[23] See https://connect.ihsmarkit.com/gta/home.
[24] The countries are ARG, AUS, AUT, BEL, BRA, CAN, CHE, CHN, CIV, DEU, DNK, ESP, FIN, FRA, GBR, GRC, HKG, IDN, IND, IRL, IRN, ISR, ITA, KEN, KOR, LUX, MEX, MYS, NLD, NZL, PHL, PRT,

imports from Japan in this variable.

It should be noted that our export control-related variables contain an error component. Although we regard products in a specific HS code as "treated" products, not all items within a specific code are subject to export restrictions. One reason for this discrepancy is that even at the nine-digit level, commodity codes are not sufficiently detailed to accurately identify restricted items. Another reason is that restrictions depend on the use of products. For example, the only photoresists subject to export restrictions to South Korea are those used for extreme-ultraviolet lithography. Photoresists used for mass-produced semiconductors are not subject to these restrictions. Such error in our variables biases our estimates toward zero. Therefore, our estimates will underestimate the impact of export controls.

4. Empirical Results

This section presents our estimation results. In all estimations, we cluster standard errors by products. We begin with estimating equation (1) to investigate the trade effects of Japan's export controls. The results are shown in Table 2. In column (I), only the *ET* dummy in addition to country-product and country-time fixed effects is included. The coefficient on *ET* is insignificant and positive, i.e., it has the opposite sign of what we expected. As mentioned in the previous section, this coefficient mainly represents the effect of the introduction of export controls for approximately 200 products in January 2018. The insignificant coefficient estimate indicates that the introduction of these export controls did not significantly change Japanese firms' exports of these products. This suggests that the administrative burden of export controls is not significant for exporters and does not raise export fixed costs much.

=== Table 2 ===

In column (II), we add the *Revision* dummy to investigate the trade effect of the tightening of regulations for the approximately 200 products in January 2021. The coefficient on the *ET* dummy is again insignificant. Moreover, the coefficient on the *Revision* dummy is insignificant and has a positive sign. Thus, this tightening of regulations also did not significantly change Japan's exports of affected products. Next, in column (III) we add the interaction term of *Revision* and the *Ro region* dummy. All three variables have insignificant coefficients. The result for the interaction term indicates that the tightening of regulations did not change Japan's exports regardless of the destination country, i.e., whether exports were to preferential countries or not. As shown in column (VI), these results remain

RUS, SGP, SWE, THA, TWN, USA, VNM, and ZAF.

unchanged when we control for importing countries' size of demand to avoid any bias that might result from omitting demand. Due to the limited availability of data for this demand variable, the number of observations decreases by half. Naturally, the coefficient on the size of countries' demand is positive and significant.

We further conduct robustness checks of the results for the interaction term between the *Revision* dummy and the *Ro region* dummy. Since this interaction term is defined at a country-product-time level, we introduce product-time fixed effects in addition to country-product and country-time fixed effects. The product-time fixed effects control for changes in factor prices (e.g., wages) and technology in Japan at the product level. In this estimation, variables defined at the product-time level, i.e., the *ET* dummy and the *Revision* dummy, are dropped. The results are reported in columns (V) and (VI). In both columns, the coefficient on the interaction term is again insignificant. We therefore conclude that the tightening of regulations did not change Japanese exports to countries that are neither on the list of the preferred trade partners nor treated in much the same way as the preferred countries.[25]

Next, we estimate equation (2) to investigate the trade effect of U.S. regulations regarding Huawei and its affiliates. The results are shown in Table 3. In column (I), we do not include the interaction term between the *Revision* and *Ro region* dummy variables since China belongs to the "Ro region" and was subject to Japan's tightening of regulations in January 2021. In column (II), we add this interaction term to distinguish between the regulations by Japan and those by the U.S. In column (III), we add importing countries' demand. All the previous variables relating to Japan's export controls (i.e., *ET*, *Revision*, and *Revision* * *Ro region*) again have insignificant coefficients. On the other hand, the coefficient for *Huawei* is significantly negative in all three columns. Furthermore, its interaction term with the *CHN* dummy is also significantly negative. These results remain unchanged even when we control for product-year fixed effects, as shown in columns (IV) and (V).

=== Table 3 ===

We conduct one robustness check. Specifically, since Japanese exporters may supply their products through Hong Kong, we regard China and Hong Kong as one region. The results are reported in Table 4 and show similar results to those in Table 3. In sum, both Huawei-related variables have significant negative coefficients. Specifically, the coefficient estimates for the *Huawei* dummy indicate that Japanese exports to the rest of the world of products subject to the FDPR decreased by around 20% on average.[26] Meanwhile, the coefficient on the interaction term shows that such exports to China decreased by around

[25] We also included the interaction term of the *ET* dummy and the *Ro region* dummy but found that the coefficient was insignificant.

[26] Using the coefficient estimates for *Huawei*, for example in column (I) in Table 3 and in column (I) in Table 4, we obtain the magnitude of the impact: $\exp(-0.232) - 1 = -0.207$ for the former case and $\exp(-0.186) - 1 = -0.170$ for the latter case.

40%, which is a greater reduction than that in export to other countries.[27] These decreases imply that the direct and chilling effects are stronger than the trade diversion effect in exporting to both China and the rest of the world. As a result, Japan's exports of products subject to the Huawei-related FDPR experienced a dramatic decrease after the strengthening of the FDPR. These results suggest that export control regulations by the U.S. government raise export fixed costs for Japanese exporters to a greater extent than those by the Japanese government.

=== Table 4 ===

The estimation results of equation (3) are shown in Table 5. We find that the coefficients on *Chemicals I* and *Chemicals II* are positive and significant in all specifications, pointing to the existence of trade diversion effects. The coefficient estimate for *Chemicals I* indicates that exports of polyimide and photoresist products to the world increased by around 10%.[28] Meanwhile, the coefficient estimate for *Chemicals II* for hydrogen fluoride products shows a substantially larger increase of 80%.[29] In fact, Japan's exports of *Chemicals II* to other major trading partners such as Taiwan, the U.S., and China steadily increased during the observation period (see Appendix Figure A1), suggesting that there was some trade diversion from South Korea to other countries.[30] Meanwhile, the interaction terms with the Korea dummy yield contrasting results. While the coefficient on the interaction term for *Chemicals I* is positive and significant in some cases, that for *Chemicals II* is negative and significant in all cases.

=== Table 5 ===

The positive coefficient in the case of *Chemicals I* is somewhat puzzling, especially the results in columns (IV) and (V), in which product-time fixed effects are controlled for, and which show a significant increase in exports of *Chemicals I* to South Korea. A possible interpretation is that in the case of *Chemicals I*, Japanese firms increased their exports to South Korea to prepare for stricter regulations that might be imposed in the future. On the other hand, the results for *Chemicals II* suggest a dramatic decrease in exports of hydrogen

[27] Using the coefficient estimates in column (I) in Table 3 and in column (I) in Table 4, we obtain the magnitude of the impact: $\exp(-0.232-0.303) - 1 = -0.414$ for the former case and $\exp(-0.186-0.369) - 1 = -0.426$ for the latter case.

[28] Using the coefficient estimate for *Chemicals I* in column (I) in Table 5, the magnitude of the impact is $\exp(0.111) - 1 = 0.117$.

[29] Using the coefficient estimate for *Chemicals II* in column (I) in Table 5, the magnitude of the impact is $\exp(0.600) - 1 = 0.822$.

[30] Moreover, it is possible that Japanese firms switched to local production at their affiliates in Korea or to exports from their overseas affiliates to Korea. However, it is beyond the scope of the current study to examine the activities of foreign affiliates of Japanese firms. We leave this for future research.

fluoride to South Korea. In columns (I)-(III), the coefficients on the interaction term for *Chemicals II* are much larger than the coefficients for *Chemicals II* in absolute terms. Columns (IV) and (V) also show significantly negative coefficients for the interaction term of *Chemicals II* and *KOR dummy*. Specifically, these columns indicate a decrease in exports of hydrogen fluoride to South Korea by around 80% after the regulation.[31]

The estimation results so far show no significant negative effects of Japan's export controls on Japan's exports overall (i.e., the coefficients on *ET*, *Revision*, and *Revision* * *Ro region* are all insignificant). In contrast, the regulations on hydrogen fluoride exports to South Korea have had a considerable negative effect, suggesting that the regulations are exceptionally stringent. As mentioned in Section 2.2, the amendment of the ETCO for these products requires the strict examination of the manufacturing process, meaning that exporters of these products to South Korea need to submit more documents than before. Furthermore, this amendment attracted much public attention in both Japan and South Korea, which may have further tightened the examination by the relevant authorities.

Finally, to get an idea regarding the more detailed mechanisms underlying our results, we conduct regressions using unit prices and quantities as dependent variables. In these estimations, we restrict observations at the destination country-product-year level only to those with positive export values. We take the logs of unit prices and quantities and estimate the model using ordinary least squares (OLS). Specifically, we focus on the interaction terms with the region/country dummy variable because the negative effects are expected to be larger with regard to the exports to a specific country/region. The results are shown in Table 6. The coefficients on the interaction term between *Revision* and *Ro region* are insignificant both when prices and quantities are used as the dependent variable. Thus, the tightening of regulations in January 2021 changed neither the export prices nor quantities of products affected by the tightening.

=== Table 6 ===

Similarly, the coefficients on the interaction term between *Huawei* and *CHN dummy* are insignificant in both the price and quantity estimations. Since the estimations here, as mentioned, do not include observations with no exports, our results imply that the significant negative effects on export values found in Tables 3 and 4 are driven mainly by the change in the product-level extensive margin, i.e., export values turning to zero as a result of the FDPR. By contrast, we find significant results for the interaction term between *Chemicals II* and *KOR dummy*. The coefficient is significantly positive in the unit price estimation and significantly negative in the quantity estimation. These results suggest that the tightening of regulations led to a reduction in the quantity of hydrogen fluoride exports, resulting in a significant increase in the export prices of hydrogen fluoride products. In

[31] Using the coefficient estimates coefficients in column (I) in Table 5, the magnitude of the impact is $\exp(0.600-2.063)-1=-0.768$.

addition, the larger impact on quantities than on prices resulted in a significant decrease in export values.

5. Concluding Remarks

Due to the active tightening of export controls by the U.S. government, particularly with regard to Chinese firms, the impact of export control has been gaining increasing public attention. Following the U.S. government, many countries have come to introduce or tighten export controls. Based on these developments, this study empirically examined the trade effect of such controls focusing on Japan's exports. We found the following. First, the introduction or tightening of export controls by the Japanese government does not appear to have had significant effects on Japan's export values overall. It therefore seems that this type of regulation does not represent a significant burden for exporters. Second, the strengthening of the FDPR by the U.S. government significantly decreased Japan's exports of related products, especially to China. This result indicates that it is more costly for Japanese exporters to obtain export permission from the U.S. government than from the Japanese government. Lastly, the regulations introduced by the Japanese government with regard to exports of a specific chemical product, hydrogen fluoride, to South Korea significantly decreased Japan's exports of this product to South Korea. Although exports to the rest of the world increased significantly, this increase did not offset the decline in exports to South Korea. While the negative impact on Japan's exports overall is negligible (since hydrogen fluoride products make up only about 0.1% of Japan's total exports), the tightened export controls on hydrogen fluoride products may have severely affected specific firms that heavily relied on exports of this product to South Korea. Policymakers need to keep an eye on such micro-level impacts.

Last but not least, we should note some limitations of this study. First, as mentioned at the end of Section 3, although a wide range of products are potentially subject to export control regulations, export permission is required only for a limited number of products that are based on or embody technologies and specifications that are regulated. The difficulty of accurately identifying products that require export permission is likely to have biased our estimates towards zero. Therefore, although even at the nine-digit level HS code it is not easy to accurately capture regulated products, a task for the future is to measure the coverage and degree of regulation with greater precision. One idea to overcome the limitations highlighted here would be to use firm- and product-level export declaration data in order to conduct more detailed analyses by more accurately identifying regulated products and examining the heterogeneous impact of regulations across different firms. Second, the findings of this study suggest that the higher fixed costs of exporting due to tightened export controls may have reduced exports from Japan via changes in the extensive margin. Since the burden of fixed export costs likely is greater for small and medium-sized

enterprises (SMEs), we expect that the strengthening of export control has a greater negative impact on exports for them than for large firms. While the Japanese government has been promoting exports by SMEs, the tightening of export controls goes against this export promotion policy. While it is clearly important to regulate exports of weapons and dual-use goods from a security perspective, it is also necessary to recognize that there is a trade-off between security and export promotion, and how to balance the two is a difficult issue.

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Table 1. Distribution of Products Subject to the ETCO (%)

HS Section / HS 2-digit		ET			ET amendments in Dec. 2020	
		Number in 2021	Exports in 2017	Exports in 2021	Number in 2021	Exports in 2021
§1. Live animals		4.20	0.09	0.11		
§2. Vegetable products		0.58	0.02	0.01		
§3. Animal/vegetable fats and oils		0.10	0.00	0.00		
§4. Food products		0.89	0.13	0.23		
§5. Mineral products		1.30	0.24	0.34		
§6. Chemical products		16.81	7.20	10.03		
§7. Plastics and rubber		5.64	4.76	5.10		
§8. Leather products		1.09	0.01	0.01		
§9. Wood products		2.22	0.03	0.04		
§10. Paper products		0.41	0.05	0.05		
§11. Textiles		13.91	0.42	0.70		
§12. Footwear		1.37	0.04	0.06		
§13. Plastic or glass products		2.63	1.12	1.14		
§14. Precision metals		2.19	2.83	2.66		
§15. Base metal		9.57	4.31	4.81		
§16. Machinery		23.14	44.61	44.57		
84	General machinery				27.44	33.11
85	Electrical machinery				47.91	51.39
§17. Transport equipment		5.23	25.97	21.88		
86–87	Railways and vehicles					
88	Aircraft and spacecraft				1.86	0.77
89	Ships, boats and floating structures					
§18. Precision machinery		5.88	7.46	7.37		
90	Optical, medical instruments, etc.				22.33	14.73
91–92	Clocks, musical instruments, etc.					
§19. Arms		0.51	0.02	0.04	0.47	0.00
§20. Miscellaneous		2.08	0.63	0.81		
§21. Works of art		0.24	0.06	0.05		
Total		100	100	100	100	100

Source: Japan Customs.

Notes: "ET" refers to HS nine-digit level products subject to Japan's Export Trade Control Order, while "ET amendments in Dec. 2020" refers to those products for which export regulations were tightened by the ministerial ordinance that was passed on December 10, 2020 and came into effect on January 27, 2021.

Table 2. Baseline Results

	(I)	(II)	(III)	(IV)	(V)	(VI)
ET	0.234	0.235	0.235	0.299		
	[0.218]	[0.218]	[0.218]	[0.242]		
Revision		0.016	-0.019	-0.015		
		[0.058]	[0.077]	[0.077]		
*Revision * Ro region*			0.053	0.039	0.051	0.044
			[0.079]	[0.083]	[0.064]	[0.069]
ln *Total imports*				0.039***		0.022***
				[0.007]		[0.006]
Country * Product	X	X	X	X	X	X
Country * Time	X	X	X	X	X	X
Product * Time					X	X
Number of observations	11,478,398	11,478,398	11,478,398	6,136,415	11,144,107	5,839,977
Pseudo R-squared	0.953	0.953	0.953	0.955	0.964	0.967

Source: Authors' estimation.

Notes: Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by product are shown in brackets.

Table 3. Effects of Huawei-related Restrictions on Japan's Exports

	(I)	(II)	(III)	(IV)	(V)
ET	0.234	0.235	0.299		
	[0.218]	[0.218]	[0.242]		
Revision	0.024	-0.013	-0.01		
	[0.058]	[0.077]	[0.078]		
*Revision * Ro region*		0.057	0.043	0.053	0.046
		[0.080]	[0.083]	[0.064]	[0.068]
Huawei	-0.232**	-0.228**	-0.211*		
	[0.111]	[0.114]	[0.113]		
*Huawei * CHN dummy*	-0.303**	-0.316**	-0.331**	-0.207**	-0.195*
	[0.134]	[0.139]	[0.139]	[0.103]	[0.112]
ln *Total imports*			0.039***		0.022***
			[0.007]		[0.006]
Country * Product	X	X	X	X	X
Country * Time	X	X	X	X	X
Product * Time				X	X
Number of observations	11,478,398	11,478,398	6,136,415	11,144,107	5,839,977
Pseudo R-squared	0.953	0.953	0.955	0.964	0.967

Source: Authors' estimation.

Notes: Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by product are shown in brackets.

Table 4. Effects of Huawei-related Restrictions: Aggregating China and Hong Kong

	(I)	(II)	(III)	(IV)	(V)
ET	0.234	0.235	0.232		
	[0.217]	[0.217]	[0.210]		
Revision	0.021	-0.015	-0.014		
	[0.058]	[0.077]	[0.076]		
*Revision * Ro region*		0.054	0.051	0.047	0.046
		[0.081]	[0.080]	[0.069]	[0.068]
Huawei	-0.186**	-0.181*	-0.189*		
	[0.093]	[0.096]	[0.098]		
*Huawei * CHN dummy*	-0.369***	-0.382***	-0.372***	-0.267***	-0.256***
	[0.088]	[0.093]	[0.096]	[0.063]	[0.064]
ln *Total imports*			0.037***		0.019***
			[0.006]		[0.005]
Country * Product	X	X	X	X	X
Country * Time	X	X	X	X	X
Product * Time				X	X
Number of observations	11,230,542	11,230,542	11,230,860	10,911,357	10,911,357
Pseudo R-squared	0.955	0.955	0.955	0.965	0.965

Source: Authors' estimation.

Notes: Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by product are shown in brackets. In this table, we aggregate figures for Hong Kong and China.

Table 5. Effects of Export Restrictions to South Korea on Japan's Exports

	(I)	(II)	(III)	(IV)	(V)
ET	0.235	0.235	0.299		
	[0.218]	[0.218]	[0.242]		
Revision	0.017	-0.018	-0.014		
	[0.058]	[0.077]	[0.077]		
*Revision * Ro region*		0.053	0.039	0.05	0.043
		[0.079]	[0.083]	[0.064]	[0.068]
Chemicals I	0.111*	0.112*	0.109*		
	[0.057]	[0.058]	[0.057]		
*Chemicals I * KOR dummy*	0.215	0.21	0.200	0.250*	0.238*
	[0.136]	[0.136]	[0.133]	[0.140]	[0.138]
Chemicals II	0.600***	0.601***	0.600***		
	[0.023]	[0.023]	[0.022]		
*Chemicals II * KOR dummy*	-2.063***	-2.067***	-2.070***	-2.034***	-2.042***
	[0.037]	[0.036]	[0.035]	[0.032]	[0.032]
ln *Total imports*			0.039***		0.022***
			[0.007]		[0.006]
Country * Product	X	X	X	X	X
Country * Time	X	X	X	X	X
Product * Time				X	X
Number of observations	11,478,398	11,478,398	6,136,415	11,144,107	5,839,977
Pseudo R-squared	0.953	0.953	0.955	0.964	0.967

Source: Authors' estimation.

Notes: Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by product are shown in brackets.

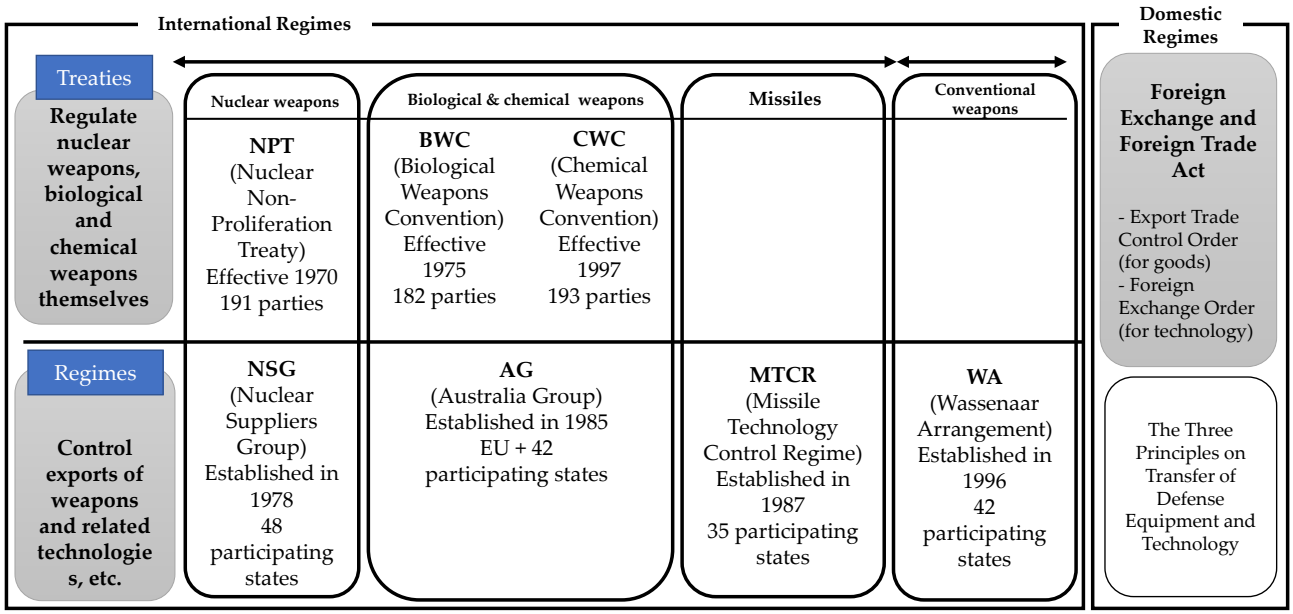
Table 6. The Price and Quantity Effects of Export Restrictions

	Prices (I)	Quantities (II)	Prices (III)	Quantities (IV)	Prices (V)	Quantities (VI)
*Revision * Ro region*	0.017	0.002	0.017	0.001	0.017	0.002
	[0.020]	[0.030]	[0.020]	[0.030]	[0.020]	[0.030]
*Huawei * CHN dummy*			-0.034	0.12		
			[0.307]	[0.298]		
*Chemicals I * KOR dummy*					-0.047	0.296
					[0.071]	[0.286]
*Chemicals II * KOR dummy*					1.330***	-3.487***
					[0.007]	[0.012]
ln *Total imports*	0.000	0.012***	0.000	0.012***	0.000	0.012***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Number of observations	2,695,997	2,695,997	2,695,997	2,695,997	2,695,997	2,695,997
Pseudo R-squared	0.904	0.883	0.904	0.883	0.904	0.883

Source: Authors' estimation.

Notes: Estimation results were obtained using OLS. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors clustered by product are shown in brackets. All specifications control for country-product, country-time, and product-time fixed effects.

Figure 1. Overview of International Export Control Regimes (as of April 2020)



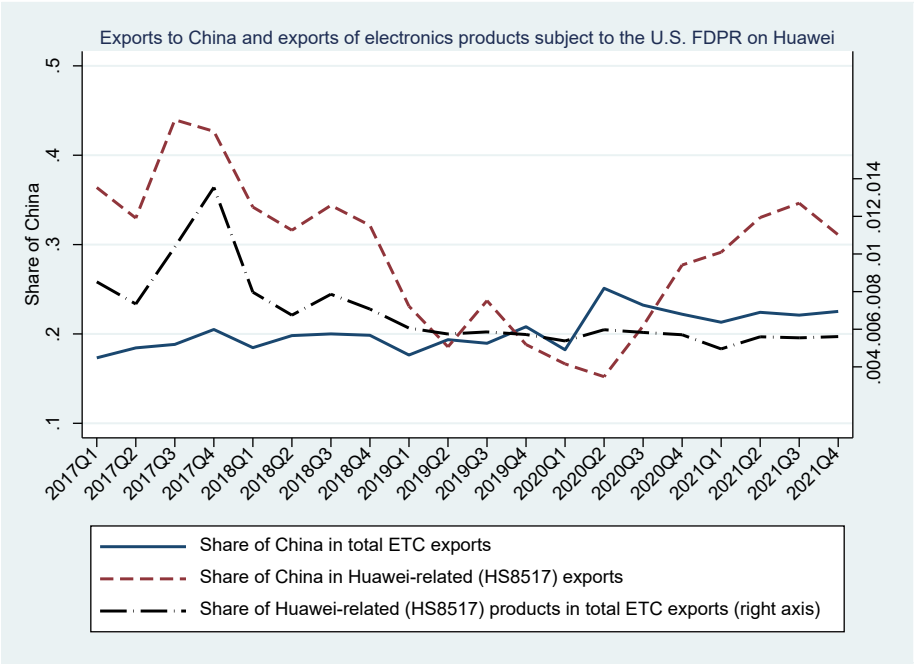
Source: Security Export Inspection Office, Ministry of Economy, Trade and Industry (2020).

Figure 2. Share of Products Subject to the ETCO

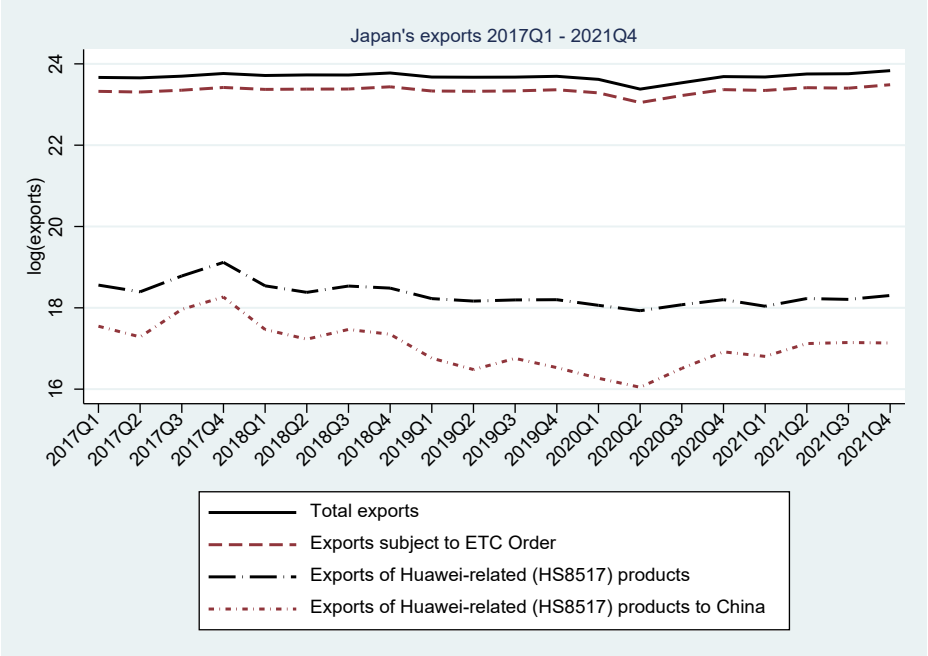
Source: Authors' calculations using export statistics from Japan Customs.

Figure 3. Exports to China and Exports of Electronics Products Subject to the U.S. FDPR on Huawei

(a) Exports to China and Exports of Electronics Products Subject to the U.S. FDPR on Huawei



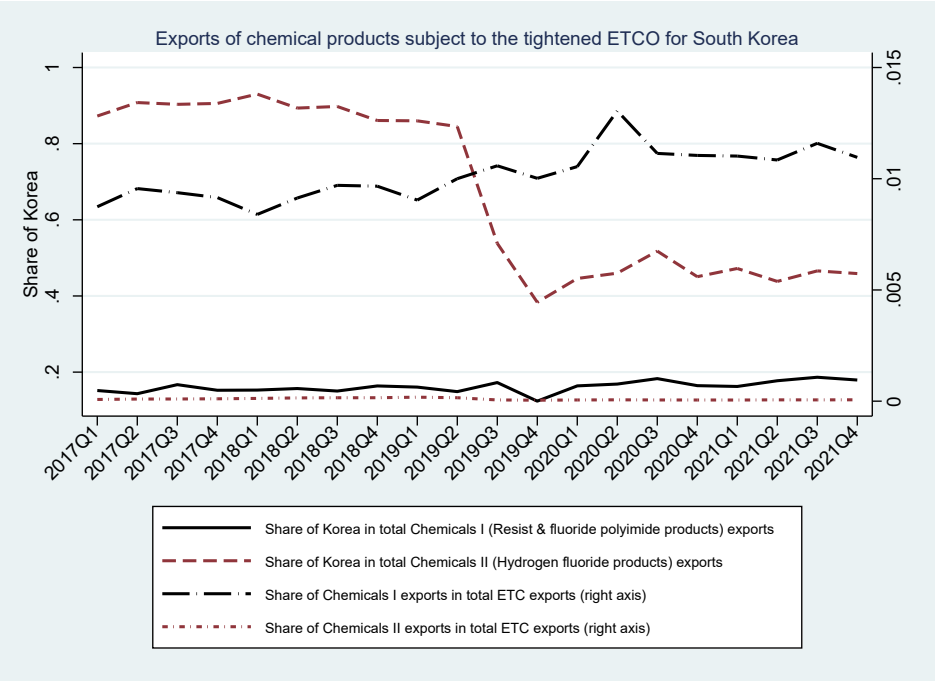
(b) Japan's Exports (in logarithm): 2017 Q1 – 2021 Q4



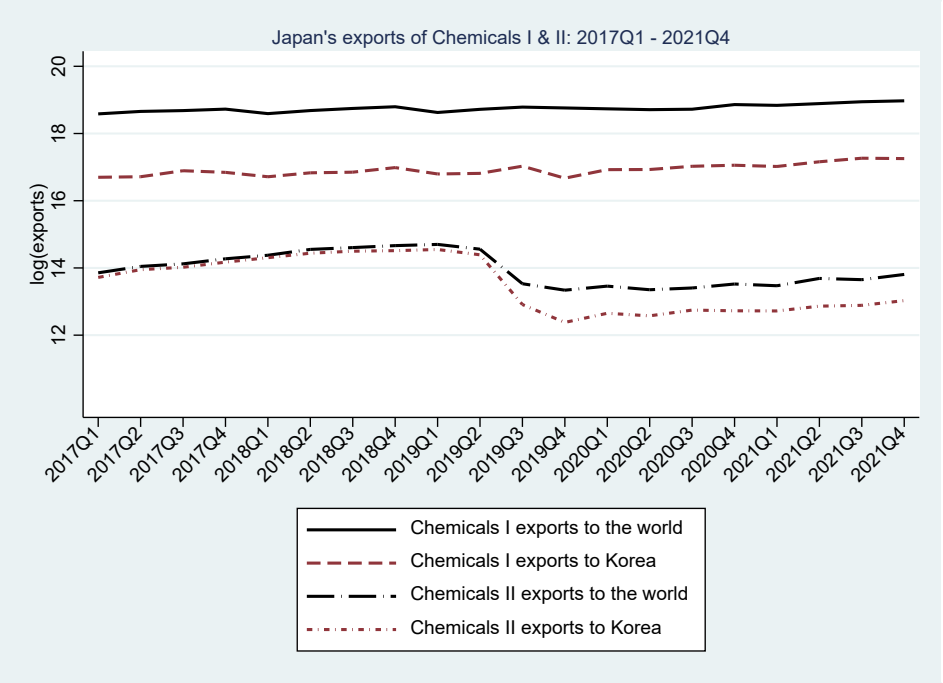
Source: Authors' calculations using export statistics from Japan Customs.

Figure 4. Exports of Chemical Products Subject to the Tightened ETCO for Korea

(a) Share of Chemical Products Subject to the Tightened ETCO for South Korea



(b) Japan's Exports (in logarithm) of Chemical Products Subject to the Tightened ETCO for South Korea: 2017 Q1 – 2021 Q4



Source: Authors' calculations using export statistics from Japan Customs.

Appendix.

A1. Countries classified as "Ro region" countries (as of 2021)

Africa

People's Democratic Republic of Algeria, Republic of Angola, Republic of Uganda, Arab Republic of Egypt, Kingdom of Eswatini, Federal Democratic Republic of Ethiopia, State of Eritrea, Republic of Ghana, Republic of Cabo Verde, Gabonese Republic, Republic of Cameroon, Republic of The Gambia, Republic of Guinea, Republic of Guinea-Bissau, Republic of Kenya, Republic of Cote d'Ivoire, Union of the Comoros, Republic of Congo, Democratic Republic of the Congo, Democratic Republic of Sao Tome and Principe, Republic of Zambia, Republic of Sierra Leone, Republic of Djibouti, Republic of Zimbabwe, The Republic of the Sudan, Republic of Seychelles, Republic of Equatorial Guinea, Republic of Senegal, Federal Republic of Somalia, United Republic of Tanzania, Republic of Chad, Central African Republic, Republic of Tunisia, Republic of Togo, Federal Republic of Nigeria, Republic of Namibia, Republic of Niger, Burkina Faso, Republic of Burundi, Republic of Benin, Republic of Botswana, Republic of Madagascar, Republic of Malawi, Republic of Mali, The Republic of South Sudan, Republic of Mauritius, Islamic Republic of Mauritania, Republic of Mozambique, Kingdom of Morocco, Libya, Republic of Liberia, Republic of Rwanda, Kingdom of Lesotho

Asia

Republic of India, Republic of Indonesia, Kingdom of Cambodia, North Korea, Republic of Singapore, Democratic Socialist Republic of Sri Lanka, Kingdom of Thailand, Taiwan, People's Republic of China, Nepal, Islamic Republic of Pakistan, People's Republic of Bangladesh, The Democratic Republic of Timor-Leste, Republic of the Philippines, Kingdom of Bhutan, Brunei Darussalam, Socialist Republic of Viet Nam, Hong Kong, Macao, Malaysia, Republic of the Union of Myanmar, Republic of Maldives, Mongolia, Lao People's Democratic Republic

Europe

Republic of Iceland, Republic of Azerbaijan, Republic of Albania, Republic of Armenia, Principality of Andorra, Republic of Uzbekistan, Kyrgyz Republic, Republic of Croatia, Republic of Kosovo, Republic of San Marino, Georgia, Republic of Serbia, Republic of Tajikistan, Turkmenistan, Vatican, Bosnia and Herzegovina, Republic of North Macedonia, Principality of Monaco, Republic of Moldova, Montenegro, Principality of Liechtenstein, Russian Federation

Latin America

Antigua and Barbuda, Oriental Republic of Uruguay, Republic of Ecuador, Republic of El Salvador, Republic of Guyana, Republic of Cuba, Republic of Guatemala, Grenada, Republic of Costa Rica, Republic of Colombia, Jamaica, Republic of Suriname, Saint Christopher and Nevis, Saint Vincent and the Grenadines, Saint Lucia, Republic of Chile, Commonwealth of Dominica, Dominican Republic, Republic of Trinidad and Tobago, Republic of Nicaragua, Republic of Haiti, Republic of Panama, Commonwealth of The Bahamas, Republic of Paraguay, Barbados, Bolivarian Republic of Venezuela, Belize, Republic of Peru, Plurinational State of Bolivia, Republic of Honduras, United Mexican States

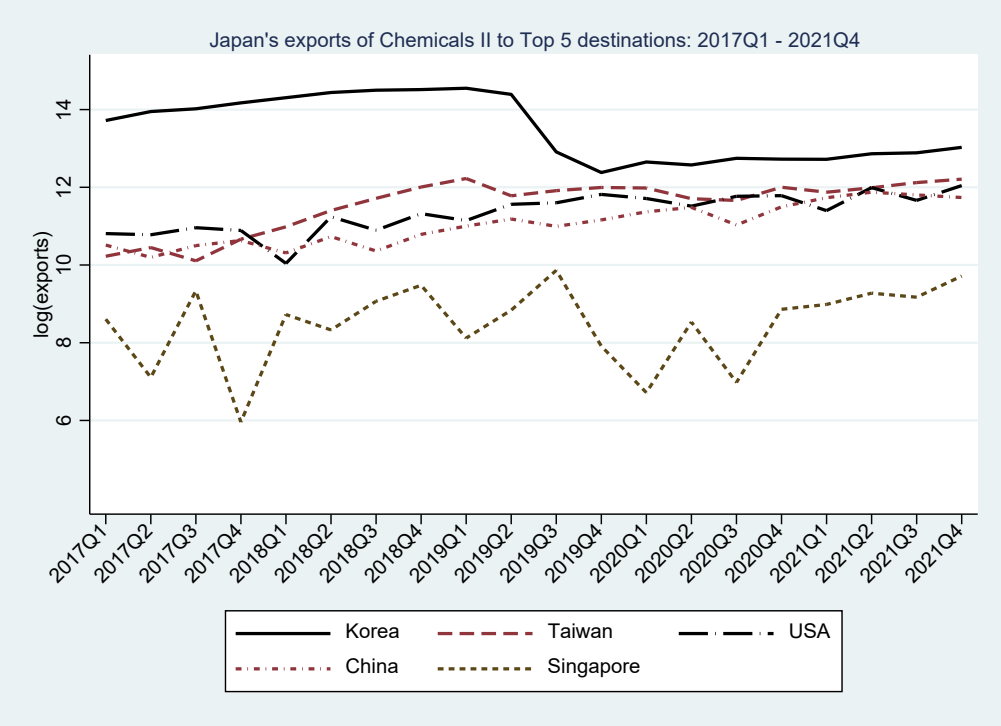
Middle East

Islamic Republic of Afghanistan, United Arab Emirates, Republic of Yemen, State of Israel, Republic of Iraq, Islamic Republic of Iran, Sultanate of Oman, State of Qatar, State of Kuwait, Kingdom of Saudi Arabia, Syrian Arab Republic, Kingdom of Bahrain, Jordan, Lebanese Republic

Pacific

Republic of Kiribati, Cook Islands, Independent State of Samoa, Solomon Islands, Tuvalu, Kingdom of Tonga, Republic of Nauru, Niue, Republic of Vanuatu, Independent State of Papua New Guinea, Republic of Palau, Republic of Fiji, Republic of the Marshall Islands, Federated States of Micronesia

Figure A1. Japan's Exports of Chemicals II (Hydrogen fluoride products) to Top 5 Destinations: 2017Q1 – 2021Q4



Source: Authors' calculations using export statistics from Japan Customs.