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Machinery production networks that bridge East Asia and Europe:

A case against 'near-shoring' in the post-COVID-19 era

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A case against 'near-shoring' in the post-COVID-19 era

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Abstract

This study examines recent changes in international production networks facing various risks. We primarily investigate how import sources of the European Union (EU) countries in machinery industries have changed from the pre-pandemic to the post-pandemic period using monthly and annual international trade data at the finely disaggregated level, with a particular focus on East Asia. We confirm that Factory Asia experienced a much smaller negative impact and had a more rapid recovery from the COVID-19 pandemic compared with Factory America and Factory Europe, showing its robust and resilient nature. At least until 2023, the inter-regional linkages of East Asia as a supplier did not weaken. Moreover, we reveal that the two directions of links between East Asia and the EU are asymmetric. East Asian countries are important suppliers for the EU, particularly in general and electrical machinery industries, and the relative importance of the Association of Southeast Asian Nations (ASEAN) and China, in particular, as EU import sources strengthened further in the post-pandemic period. We also demonstrate that EU countries increased imports from longer-distance countries, indicating no quantitative evidence of intensifying near-shoring in machinery industries in the post-COVID-19 era. Furthermore, we demonstrate that EU countries have prioritised friend-shoring from an economic perspective but not necessarily from a political perspective when purchasing machinery products in the post-pandemic period.

Keywords: International production networks, machinery trade, East Asia, EU, near-shoring, friend-shoring, post-COVID-19

JEL classification: F14, F15, F53

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1. Introduction

Recent years have witnessed worldwide disruptions caused by the coronavirus pandemic (COVID-19), along with interruptions from intensifying geopolitical tensions, including the United States (US)-China trade conflict and Russia's full-scale invasion of Ukraine. It has often been asserted that this combination of risks was a trigger for reconsidering the resilience and reorganisation of global value chains (GVCs)/international production networks (IPNs) and accelerating the debate about decoupling GVCs/IPNs.[1] Rising geopolitical tensions and pandemic-related disruptions to GVCs/IPNs have also motivated policy makers to prioritise approaches to advance the security and resilience of supply chains, such as near-shoring, re-shoring, back-shoring, de-risking and friend-shoring.

For instance, near-shoring is an approach that focuses on geographical proximity and locating production processes in neighbouring or nearby countries, which is often considered to reduce transportation costs and lead times and mitigate supply chain disruptions. Friend-shoring is a growing trade practice and a strategy for establishing trade primarily between countries that share similar values or countries that are perceived as politically and economically safe or low-risk.[2] According to Javorcik et al. (2024), many countries are considering friend-shoring as a way to minimise exposure to trade weaponisation and secure access to critical inputs, but friend-shoring may result in real GDP losses of up to 4.7% of GDP in some economies. They emphasise that although friend-shoring may provide insurance against extreme disruptions and increase the security of supply of vital inputs, it would come at a substantial cost.

This study investigates trade links (particularly in machinery industries) between East Asia, including Northeast and Southeast Asia, and the European Union (EU). In this study, machinery industries include general machinery (Harmonized System (HS) 84), electrical machinery (HS85), transport equipment (HS86-89) and precision machinery (HS90-92). Even among these machinery industries, the degree of the task-by-task international division of labour may vary. Partly reflecting the physical size and weight of the products and industrial characteristics, the electrical machinery industry in particular is likely to conduct long-distance transactions more easily, while the transport equipment industry tends to prefer forming industrial clusters and having transactions nearby. Considering the different natures of industries and the strong performance of East Asia, particularly in general and electrical machinery industries, it is essential to investigate recent changes in global supply chains linking East Asia and the EU not only in the transport equipment industry but also in other machinery industries.

Indeed, machinery industries have become central players in GVCs/IPNs and have developed long and sophisticated supply chains in the past decades that include multi-layered production processes with different technologies and diversified materials involving many domestic and international players. Massive machinery IPNs have been formed in East Asia, North America and Europe (respectively referred to in this

[1] For instance, Lebastard et al. (2023) noted that COVID-19 triggered a debate concerning whether GVC trade is primarily a source of vulnerability or a source of resilience.

[2] Ellerbeck (2023) emphasised that there are fears within the international community that the move towards friend-shoring may risk further geopolitical fragmentation and deglobalisation of the world's economy.

study as Factory Asia, Factory America and Factory Europe). Pessimism over globalisation has expanded worldwide since the 2008/2009 global financial crisis, and the growth rate of world trade was lower than that of world GDP in the 'slow trade' period between 2011 and 2016. Even during this period, however, network trade in East Asia continued to grow steadily (Obashi and Kimura 2018). At least before COVID-19, East Asia had aggressively leveraged the mechanics of IPNs (Ando and Kimura 2005) or the second unbundling (Baldwin 2016), establishing machinery IPNs that involved countries at more widely varying stages of development than those in other regions. As a result, machinery IPNs in East Asia had led the world in general and electrical machinery industries in particular.

Our empirical analysis utilises the most recent monthly and annual international trade data at the finely disaggregated level to examine the changes in machinery IPNs amid various risks since COVID-19. We primarily investigate how EU import sources in machinery industries, with a particular focus on East Asia, have changed from the pre-pandemic to the post-pandemic period in the descriptive analysis at the industry level and in the quantitative and qualitative analysis at the product level. We also conduct similar analyses for non-machinery industries and other regions for comparison. In the context of the EU's policy to ensure EU member countries' access to a secure and sustainable supply of critical raw materials (CRMs), it is also interesting to examine how the pattern of inter-regional purchases altered in industries that include CRMs.[3]

More specifically, we examine three types of 'shoring', that is, near-shoring, economic friend-shoring and political friend-shoring.[4] Some recent studies have investigated political friend-shoring in global trade, revealing its significance in the recent uncertain era (Blanga-Gubbay and Rubínová 2023; Jakubik and Ruta 2023; Gopinath et al. 2024). Such political friend-shoring behaviour has also been confirmed by Aiyar et al. (2024) for foreign direct investment (FDI). Compared with previous research, our study is more comprehensive in that it investigates more kinds of 'shoring'.

Our major findings from the descriptive analysis at the industry level are threefold. First, Factory Asia incurred a much smaller negative impact and enjoyed a more rapid recovery from COVID-19 than Factory America and Factory Europe, exhibiting its robust and resilient nature. At least until 2023, machinery IPNs in East Asia performed relatively well, and inter-regional links as suppliers did not weaken. Second, the two link directions between East Asia and EU are asymmetric, with East Asia being an important supplier for the EU, particularly in general and electrical machinery industries. This linkage from East Asia (and, most notably, from China) to the EU has further strengthened in the post-COVID era. Third, Central and Eastern Europe (CEE) has gained a larger share as a supplier within the region in the post-COVID period while rapidly increasing the share of imports from East Asia, although its dominant import source is still the Western EU (WEU).[5]

Our quantitative and qualitative analysis at the product level for bilateral trade (and FDI) demonstrate additional interesting insights. First, EU countries have increased imports from longer-distance countries more in the post-pandemic period, and no quantitative evidence indicates intensifying near-shoring

[3] For a list of CRMs for the EU, see European Commission (n.d.).

[4] We regard intensifying near-shoring as an increase in imports at the product level from countries that are at a shorter distance compared with those from countries at a longer distance.

[5] Among the 27 EU countries plus the UK, 10 countries, i.e., Bulgaria, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia, are classified into CEE, and the rest of the countries are defined as WEU in the following.

across all machinery industries. Second, EU countries have expanded imports from regional trade agreement (RTA) partner countries more in the post-pandemic period in all machinery industries, reflecting their economic friend-shoring approach. Third, EU countries have not necessarily prioritised political friend-shoring when purchasing machinery products, while they have for their imports and exports, on average, as well as for their machinery exports. These findings indicate that economic considerations are still highly prioritised on the purchasing side in machinery IPNs even for the EU. Fourth, after controlling for the three types of 'shoring' and cultural links, the relative importance of the Association of Southeast Asian Nations (ASEAN) and China, in particular, as EU import sources has intensified in general and electrical machinery industries (and in the precision machinery industry for ASEAN only).

The remainder of this paper is organised as follows. The next section investigates monthly machinery exports since COVID-19 by East Asia, North America and Europe. Section 3 descriptively examines the changes in the pattern of intra- and inter-regional machinery trade in the EU since the pandemic, with a particular focus on the link with East Asia. Section 4 quantitatively and qualitatively analyses the product-level changes in EU bilateral import sources using the finely disaggregated annual trade statistics until 2023 while also conducting a corresponding analysis on the export side, including similar analyses for other regions for comparison. In Section 5, we discuss our estimated results from the perspective of trade links. Section 6 subsequently investigates changes in EU countries' outward FDI and discusses the results. The final section summarises our major findings and proposed policy implications.

2. Machinery Production Networks in East Asia

Massive machinery IPNs have been formed in East Asia, North America and Europe.[6] To present an overview of these global supply chains facing various risks, this section investigates monthly machinery exports from these three regions since the pandemic. To clarify why it is essential to focus on East Asia in particular, we first briefly discuss the features of machinery IPNs in East Asia in the pre-pandemic period compared with those in other regions, and then we examine the features in the post-pandemic era.

At least prior to COVID-19, machinery IPNs in East Asia had two distinctive features. First, they were highly competitive, particularly in general and electrical machinery industries. Among the top 20 countries in global machinery exports in the pre-pandemic year, half and 30%-40% are East Asian countries for parts and components and final products, respectively, of general and electrical machinery or precision machinery (Table A.1). This suggests that East Asian countries are important global suppliers of parts and components and final products, particularly in general and electrical machinery industries.

Second, machinery IPNs in East Asia had strong inter-regional links as suppliers. Comparing actual machinery trade values in 2019 with those predicted based on the gravity model estimations, intra-regional exports from the three regions are at or above the predicated level (Table 1). In addition, inter-regional exports from East Asia are 2.1 times the predicted value for North America and 1.5 times that for Europe, while inter-regional exports from North America and Europe are much lower than or around the predicted level. These results confirm that machinery trade is basically regional, but also that Factory Asia has stronger inter-regional links as suppliers compared with Factory America and Factory Europe (or at least it did in the pre-pandemic era).

Table 1 / The Gap Between Actual and Predicted Machinery Trade Values in 2019

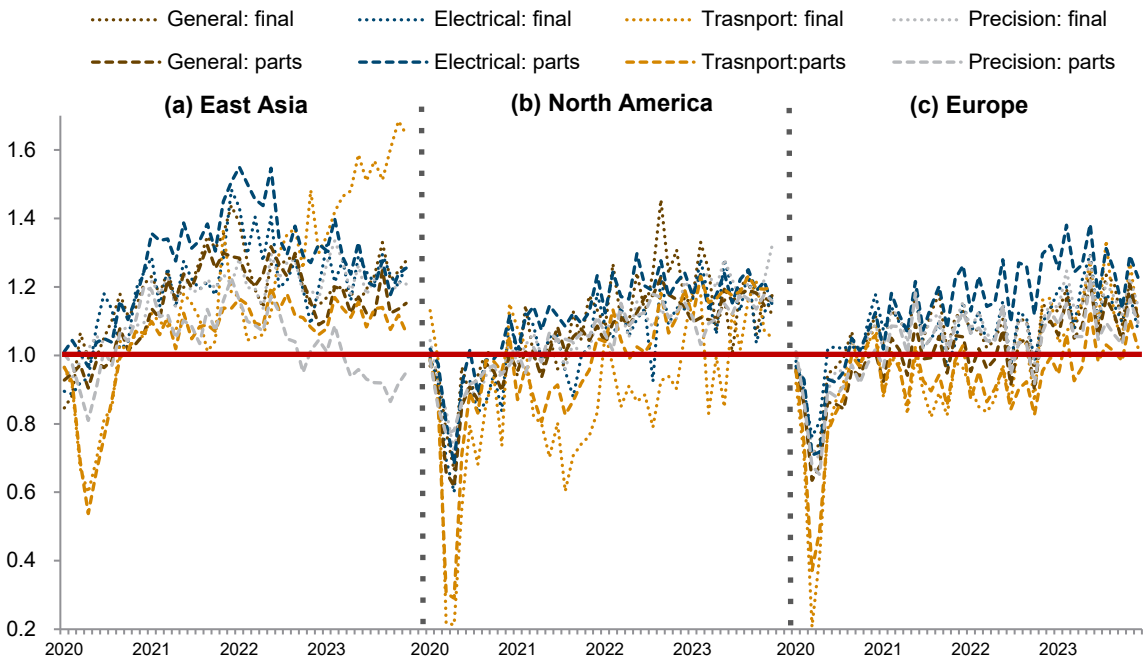
Importer / Exporter	East Asia	China	Japan	Korea	ASEAN	North America	Europe	Rest of the world	Total (World)
East Asia	1.5	1.6	0.8	1.1	2.7	2.1	1.5	1.6	1.6
China	1.2		0.6	0.9	2.2	1.8	1.4	1.5	1.4
Japan	1.4	1.1		0.9	2.8	2.0	1.1	1.2	1.4
Korea	1.9	1.8	0.4		6.3	3.1	1.6	2.1	2.1
ASEAN	2.4	2.1	2.1	3.7	2.7	3.4	2.2	2.3	2.5
North America	0.7	0.6	0.4	1.2	1.0	1.0	0.6	0.5	0.8
Europe	1.1	1.2	0.6	1.4	1.3	0.9	1.2	0.8	1.0
Rest of the world	0.5	0.5	0.3	0.6	0.9	0.4	0.4	0.5	0.5
Total (World)	1.1	0.9	0.6	1.1	1.8	1.1	1.0	0.9	1.0

Notes: Gap ratios are calculated by dividing actual values by predicted values, which are estimated using the gravity model for 175 countries.
Source: Authors' calculations based on Ando et al. (2022).

[6] To highlight the degree of IPN participation, Appendix Figure A1 arranges countries with higher export shares of machinery parts and components from left to right. Many East Asian countries have high shares of parts and components for both exports and imports. In addition, the US and Mexico in North America and some CEE countries (e.g. Czechia, Hungary and Romania) as well as Germany in Europe, in particular, are located on the left-hand side. This indicates East Asian countries' active involvement in machinery IPNs, emerging US-Mexico production sharing and IPNs in Europe.

What has happened to these global supply chains facing various risks since COVID-19? First, Factory Asia experienced a much smaller negative impact and more rapid recovery than Factory America and Factory Europe, exhibiting its robust and resilient nature.[7] Figure 1 presents the monthly exports from the three regions for four machinery industries, distinguishing between final products and parts and components from 2020 to 2023.[8] It clearly demonstrates that the export decline was much smaller and the recovery was more rapid for East Asia in 2020. Negative supply and demand shocks were relatively small because East Asia curbed the COVID-19 spread more successfully and also implemented government policy responses to the pandemic with an emphasis on IPNs, including the exclusion of crucial areas from factory closures. In addition, owing to East Asia's strong global position in general and electrical machinery industries, combined with accelerated e-commerce expansion, machinery IPNs in East Asia enjoyed exceptional benefits from positive demand shocks for many electrical products (e.g. laptop computers) during the pandemic.[9]

Figure 1 / Monthly Global Machinery Exports in 2020-2023: Comparison of Factory Asia, Factory America and Factory Europe (each month of 2019=1)



Notes: Data for January and February are aggregated to consider the effects of the Lunar (Chinese) New Year. 'East Asia' includes six countries of the Association of Southeast Asian Nations (ASEAN) as well as China, Hong Kong, Taiwan, Korea and Japan; 'North America' is defined as the US, Mexico and Canada; and 'Europe' includes 14 countries of European Union (EU) and the UK. 'Final' and 'Parts' indicate final products as well as parts and components, respectively.
Source: Global Trade Atlas.

[7] Miroudot (2020) defined robustness as being less likely to be interrupted and resilience as being more likely to be resumed even if interrupted.

[8] Our definition of machinery parts and components references Kimura and Obashi (2010), and we consider machinery goods other than parts and components as final products. For concordance, we treat data for HS901380 in all years as HS8524, which was newly established in the HS2022 classification and are included in HS85 final products.

[9] See Ando et al. (2021) for three types of shocks during the COVID-19 pandemic and Hayakawa et al. (2023) for the role of e-commerce in mitigating the negative effects of COVID-19 on trade.

Second, until at least 2023, machinery IPNs in East Asia were performing relatively well. After rapidly returning to the pre-pandemic levels in 2020, exports of parts and components and final products from East Asia as a region in all four machinery industries have maintained the pre-pandemic levels, with the exception of precision machinery parts and components, unlike exports from North America and Europe.[10] This finding indicates that, in general, Factory Asia is still doing relatively well.

Notably, exports for general and electrical machinery industries from East Asia slowed in the second half of 2022. Major products that reduced exports substantially during this period include laptop computers (HS841730), DRAM modules for computers (HS847330), memory integrated circuits (ICs) (HS854232), and smartphones (HS851712) and their parts (HS851770), and the export decline of these products can be largely explained by product-specific reasons.[11] In contrast, final products of transport equipment grew dramatically beginning in the second half of 2022, with considerable fluctuation. The major product that expanded exports most substantially is electric vehicles (EVs) (HS870380), reflecting a global shift to EV transportation.

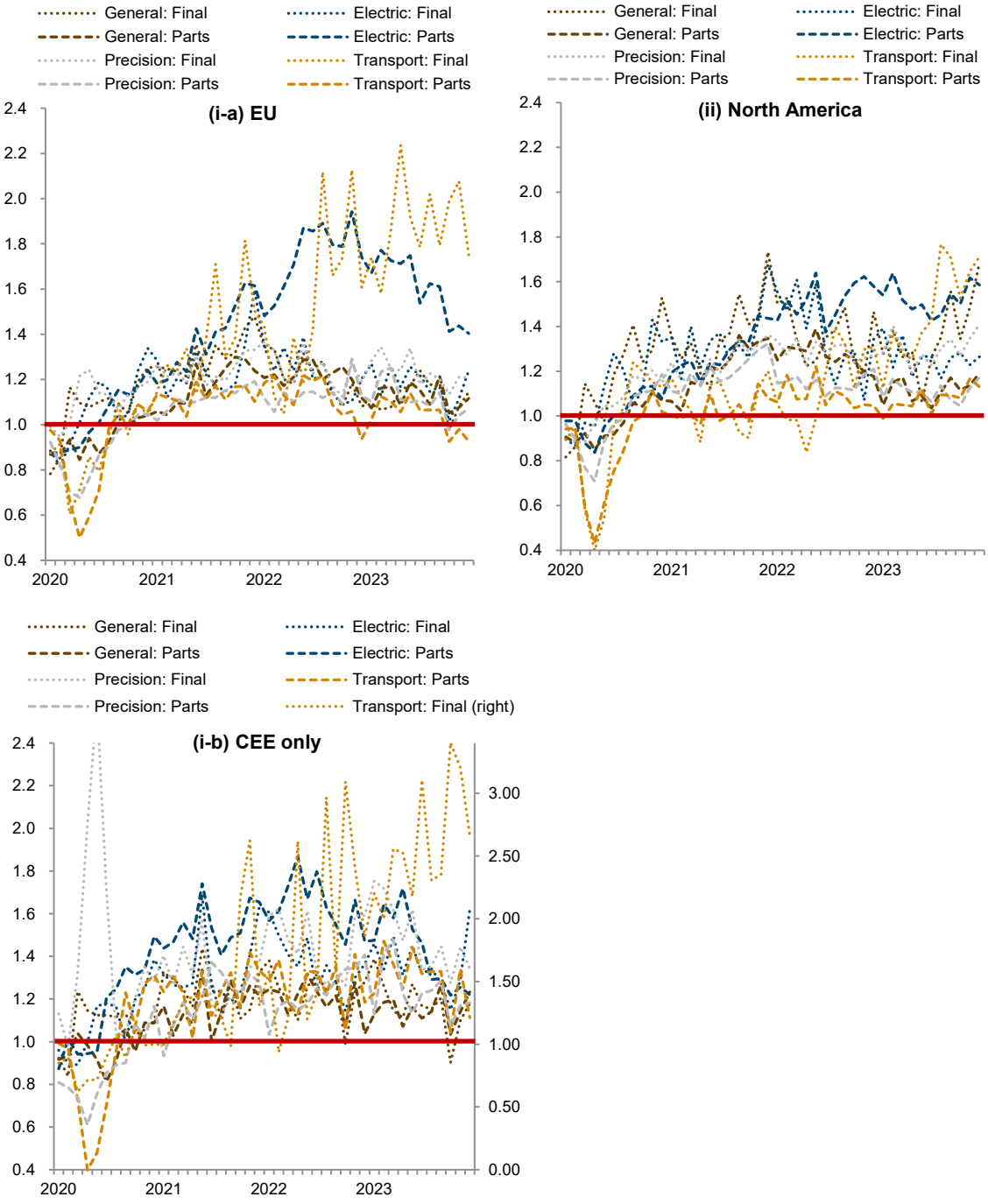
Third, up to 2023, East Asia's inter-regional links as suppliers did not weaken. East Asian exports to the EU have been above pre-pandemic levels since their recovery in 2020, with the exception of transport equipment parts and components for a few months (Figure 2). In particular, exports of parts and components of electrical machinery and final products of transport equipment were much larger than their pre-pandemic levels in 2022 and 2023, although exports of parts and components of electrical machinery showed a declining trend in 2023.[12] Moreover, only exports to CEE are growing faster than exports to the EU as a whole, although they tend to fluctuate. This indicates that East Asia's inter-regional links with the EU (and with CEE, in particular) as suppliers have not yet weakened in the post-COVID period. Similarly, East Asian exports to North America have been above pre-pandemic levels since their recovery in 2020, with the exception of final products of transport equipment for a few months. This implies that the East Asia's inter-regional links with North America as suppliers have also not yet weakened at the regional level in the post-COVID period.

[10] Major products of precision machinery that reduced exports from East Asia in 2022 include lasers (HS901320), sheets and plates of polarising material such as those used for liquid crystal display panels (HS900120), and microtomes and their parts and accessories (HS902790).

[11] See Ando et al. (2024) for details concerning product-specific reasons.

[12] The next section examines the major factors behind this dramatic growth.

Figure 2 / Inter-regional Monthly Machinery Exports from East Asia in 2020-2023: EU and North America (each month of 2019=1)



Notes: 'East Asia' as exporters here includes six ASEAN countries as well as China, Hong Kong, Taiwan, Korea and Japan. As a destination, 'EU' includes all EU countries and the UK; 'CEE' includes EU countries in Central and Eastern Europe (CEE); and 'North America' includes the US, Mexico and Canada.
Source: Global Trade Atlas.

3. Changes in the EU's Intra- and Inter-regional Machinery Trade

This section descriptively investigates the changes in the EU's intra- and inter-regional machinery trade pattern since the pandemic, with a particular focus on the links with East Asia. Table 2 presents the proportions of East Asia and the EU (separately as WEU and CEE) in the EU's machinery imports/exports in 2023, with a distinction between final products and parts and components. Intra-regional proportions are as high as around 60% for both imports and exports, suggesting active intra-regional transactions in EU trade.

Table 2 / By-region Shares and Values of EU Machinery Trade in 2023

	Imports				Exports			
	Final products		Parts and components		Final products		Parts and components	
	All	excl. transport	All	excl. transport equipment	All	excl. transport equipment	All	excl. transport equipment
(a) Share in total (%)								
East Asia	23.4	31.1	21.9	25.2	8.8	8.5	12.7	14.2
- CHN	14.8	21.2	12.4	14.5	4.6	4.6	6.6	7.0
- ASEAN	3.4	5.1	3.6	4.4	1.3	1.7	2.7	3.1
- JKT	5.2	4.8	5.9	6.4	2.8	2.2	3.5	4.0
WEU	49.2	43.3	46.2	43.5	51.7	51.3	48.0	46.0
CEE	13.9	12.7	16.9	14.9	10.4	11.6	13.7	12.7
(b) Value index (2019=1)								
East Asia	1.34	1.27	1.43	1.46	0.98	1.05	1.14	1.17
- CHN	1.34	1.24	1.64	1.65	0.99	1.06	1.11	1.15
- ASEAN	1.26	1.26	1.28	1.30	0.87	1.06	1.14	1.17
- JKT	1.38	1.47	1.18	1.24	1.03	1.00	1.20	1.22
WEU	1.11	1.15	1.12	1.16	1.15	1.18	1.19	1.25
CEE	1.35	1.28	1.36	1.41	1.27	1.21	1.24	1.25
Total (world)	1.21	1.23	1.23	1.27	1.17	1.18	1.16	1.20

Notes: 'EU' is defined as the 27 EU countries and the UK. As trading partners, 'CHN' includes China and Hong Kong, 'JKT' denotes Japan, Korea and Taiwan; 'WEU' refers to Western EU (including the UK); and 'CEE' denotes the EU countries in Central and Eastern Europe (CEE).
Sources: Global Trade Atlas and Eurostat.

Interestingly, the two link directions between East Asia and the EU are asymmetric. East Asia has a proportion of over 20% for both final products and parts and components of all machinery imports into the EU. The corresponding proportion is even higher when excluding transport equipment, at 31% for final products and 25% for parts and components. In addition, EU imports from East Asia grew faster than total imports for final products and parts and components; the value indices in 2023 in comparison to 2019 for imports from East Asia (world) were 1.34 (1.21) for final products and 1.43 (1.23) for parts and components. These high shares and larger value indices clearly demonstrate the significance of

East Asia to the EU's import side, particularly in machinery industries other than transport equipment, which seems to be further increasing.

Conversely, the proportion of East Asia on the export side is much lower, at only around 10%. Moreover, the value index for exports to East Asia is lower than that for total exports, suggesting that exports to East Asia are relatively decreasing. Combined with the fact that machinery exports from the EU to East Asia only reached the predicted level in the pre-pandemic year, these figures demonstrate that East Asia is not an important destination for EU exports, and that export links with East Asia are further weakening. Therefore, we focus on the links from East Asia to the EU.

To examine the recent changes in EU machinery imports more precisely, we look at intra- and inter-regional patterns in the pre- and post-pandemic years for four machinery industries.[13] Considering that some cases of exports from East Asia to the EU changed significantly in 2022 and 2023 (as shown in Figure 2), Table 3 presents the shares in both years in addition to the pre-pandemic year. Five notable findings emerge at the industry level. First, the link from East Asia to the EU strengthened for all machinery industries in the post-COVID year. The EU's imports from East Asia of both final products and parts and components in four machinery industries expanded at a faster rate than those from the world, resulting in an increased East Asian proportion.

Second, the link from East Asia to the EU is strong, particularly in general and electrical machinery industries. The share of East Asia is high for general final machinery products (30%), electrical final machinery products (40%) and parts and components (34%), and precision machinery parts and components (24%). Although East Asia's proportion is low in the transport equipment industry (10%), its share and value increased in this industry, as well, in the post-pandemic period.

Third, rather than decoupling, the link with China seems to have actually intensified. China increased its share and value for both final products and parts and components in all four machinery industries in 2023 compared with 2019. In particular, the increase was outstanding for electrical machinery parts and components and transport equipment final products.[14] The major commodities of electrical machinery parts and components behind the rapid expansion include lithium-ion batteries (HS850760) and photosensitive semiconductor devices that are used for solar panels (HS854140). These decarbonised and newly traded products significantly contributed to this growth rather than existing traded products.[15] The major commodity of transport equipment final products that induced the drastic increase is EVs, which began to be produced in and exported from China, reflecting a global shift to EV transportation.[16]

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[13] See Appendix Table A.2 for EU machinery exports by industries. East Asia's share decreased in all cases except general machinery parts and components. In addition, EU exports to East Asia decreased to lower values than pre-pandemic levels for general machinery parts and components and both final products and parts and components of transport equipment.

[14] As a result, monthly exports of these products from East Asia to the EU drastically expanded in 2022, as shown in Figure 2.

[15] While monthly exports of HS854140 expanded rapidly in 2022, they declined to 2021 levels in 2023.

[16] The top five firms in China exporting new energy vehicles, including EVs, based on exports from January 2022 to August 2023, are: Tesla (Shanghai) Co., Ltd; SAIC Motor Corporation Limited; eGT New Energy Automotive; BYD; and Geely Automobile Holdings Ltd. Since September 2022, the China–Europe Railway Express (scheduled cross-border rail freight services between China and Europe) has started to be used for new energy vehicle exports. Therefore, China's exports by train may accelerate in addition to those using marine transport (JETRO 2023).

Fourth, the pattern of trade within the EU seems to have changed, and CEE is increasing its share as a supplier within the region. While the share of WEU decreased, the share of CEE increased in all cases, with the exception of final products of transport equipment, for which EU imports from CEE grew at a faster rate than those from the world, although the share of CEE decreased.

Table 3 / Pre- and Post-COVID Machinery Imports to the EU

	Final products				Parts and components			
	Share in total (%)			Values in 2023	Share in total (%)			Values in 2023
Exporters	2019	2022	2023	(2019=1)	2019	2022	2023	(2019=1)
General machinery (HS84)								
East Asia	28.0	32.2	29.7	1.25	15.3	18.8	16.2	1.19
- CHN	19.9	24.1	20.1	1.18	8.2	10.4	8.5	1.17
- ASEAN	3.1	3.1	3.1	1.18	2.1	2.5	2.2	1.20
- JKT	4.9	5.1	6.4	1.54	5.0	6.0	5.4	1.21
WEU	51.0	47.0	48.6	1.12	51.5	48.3	50.0	1.09
CEE	12.1	12.4	12.7	1.23	12.7	12.6	13.1	1.16
Total	100.0	100.0	100.0	1.17	100.0	100.0	100.0	1.13
Electrical machinery (HS85)								
East Asia	39.0	42.8	40.0	1.28	29.9	37.0	33.9	1.66
- CHN	28.5	31.5	28.7	1.26	14.8	22.0	20.4	2.02
- ASEAN	7.5	7.2	7.5	1.27	6.8	7.2	6.3	1.34
- JKT	3.1	4.1	3.7	1.52	8.3	7.7	7.2	1.26
WEU	39.6	34.9	36.2	1.14	43.3	36.4	37.4	1.26
CEE	14.8	15.1	15.5	1.31	15.0	15.4	17.3	1.69
Total	100.0	100.0	100.0	1.25	100.0	100.0	100.0	1.46
Transport equipment (HS86-89)								
East Asia	7.3	10.8	10.9	1.75	9.2	12.3	9.7	1.15
- CHN	1.4	4.7	4.5	3.89	3.4	5.6	4.7	1.50
- ASEAN	0.7	0.9	0.7	1.23	0.9	1.0	0.7	0.95
- JKT	5.3	5.2	5.7	1.27	4.9	5.7	4.3	0.95
WEU	64.8	58.3	58.6	1.07	59.5	55.3	56.0	1.02
CEE	20.2	16.1	16.0	1.45	21.0	22.2	24.1	1.25
Total	100.0	100.0	100.0	1.18	100.0	100.0	100.0	1.09
Precision machinery (HS90-92)								
East Asia	14.8	17.1	15.3	1.33	22.1	25.2	24.4	1.25
- CHN	7.2	8.9	7.6	1.35	10.6	12.5	11.6	1.24
- ASEAN	3.2	3.7	3.6	1.42	5.2	5.6	5.8	1.28
- JKT	4.3	4.5	4.2	1.23	6.3	7.2	7.0	1.25
WEU	51.3	47.4	48.2	1.20	46.7	43.3	43.8	1.06
CEE	6.6	6.7	6.9	1.34	7.6	7.6	8.4	1.26
Total	100.0	100.0	100.0	1.28	100.0	100.0	100.0	1.13

Sources: Global Trade Atlas and Eurostat.

Fifth, in many cases, East Asia's share of CEE imports increased much more than its share of WEU imports, though both shares increased (Table 4). As a result, East Asia's share of CEE imports reached close to the corresponding proportion of WEU imports, reflecting a rapid increase from China in most cases. Nonetheless, WEU remains a dominant import source for CEE, although its share for CEE imports is decreasing.

Table 4 / Pre- and Post-COVID Machinery Imports to WEU and the CEE

	(a) Western EU						(b) CEE					
	Final products			Parts and components			Final products			Parts and components		
	Share in total (%)		Values in 2023	Share in total (%)		Values in 2023	Share in total (%)		Values in 2023	Share in total (%)		Values in 2023
Exporters	2019	2023	(2019=1)	2019	2023	(2019=1)	2019	2023	(2019=1)	2019	2023	(2019=1)
General machinery (HS84)												
East Asia	29.2	30.6	1.23	15.1	16.0	1.19	21.9	32.2	1.39	16.7	16.9	1.20
- CHN	21.0	20.8	1.16	7.8	8.3	1.17	14.5	24.1	1.38	10.1	9.9	1.16
- ASEAN	3.2	3.2	1.18	2.2	2.4	1.19	3.0	3.1	1.16	1.3	1.4	1.24
- JKT	5.0	6.6	1.53	5.0	5.4	1.20	4.4	5.1	1.55	5.2	5.6	1.27
WEU	49.5	47.6	1.12	50.0	48.2	1.08	58.7	47.0	1.11	58.9	58.4	1.17
CEE	11.9	12.3	1.20	12.1	12.8	1.18	13.0	12.4	1.36	15.7	14.5	1.09
Total	100.0	100.0	1.17	100.0	100.0	1.12	100.0	100.0	1.21	100.0	100.0	1.18
Electrical machinery (HS85)												
East Asia	41.0	41.0	1.23	31.1	35.6	1.71	30.3	42.8	1.60	26.4	28.3	1.45
- CHN	29.4	29.1	1.21	14.9	20.8	2.10	24.3	31.5	1.53	14.5	19.2	1.78
- ASEAN	8.3	8.0	1.18	7.5	7.1	1.41	3.5	7.2	2.15	4.8	3.6	1.02
- JKT	3.2	3.9	1.51	8.7	7.7	1.32	2.5	4.1	1.59	7.1	5.5	1.04
WEU	38.8	36.3	1.15	40.5	34.3	1.27	43.4	34.9	1.12	52.2	48.3	1.24
CEE	13.2	13.8	1.28	15.2	17.5	1.72	22.1	15.1	1.38	14.3	16.9	1.59
Total	100.0	100.0	1.23	100.0	100.0	1.50	100.0	100.0	1.36	100.0	100.0	1.35
Transport equipment (HS86-89)												
East Asia	7.8	11.3	1.67	9.0	9.7	1.12	3.5	10.8	3.22	9.8	9.9	1.27
- CHN	1.4	4.7	3.85	3.5	4.8	1.44	0.8	4.7	4.39	3.0	4.2	1.78
- ASEAN	0.8	0.8	1.23	0.9	0.8	0.92	0.2	0.9	1.11	0.5	0.5	1.15
- JKT	5.6	5.7	1.18	4.6	4.0	0.92	2.4	5.2	2.99	6.3	5.2	1.04
WEU	65.3	58.6	1.04	59.3	55.7	0.98	60.7	58.3	1.33	60.5	57.0	1.19
CEE	20.4	15.1	1.45	20.0	23.0	1.20	19.6	16.1	1.42	24.9	27.8	1.41
Total	100.0	100.0	1.16	100.0	100.0	1.04	100.0	100.0	1.37	100.0	100.0	1.26
Precision machinery (HS90-92)												
East Asia	14.9	15.2	1.30	22.1	24.5	1.26	13.7	17.1	1.63	21.7	23.7	1.24
- CHN	7.2	7.4	1.31	10.3	11.2	1.23	7.0	8.9	1.71	12.0	14.1	1.34
- ASEAN	3.4	3.8	1.41	5.6	6.2	1.27	1.6	3.7	1.50	2.7	3.5	1.46
- JKT	4.3	4.0	1.18	6.2	7.1	1.29	5.1	4.5	1.57	7.1	6.2	0.99
WEU	49.8	46.8	1.19	44.8	41.9	1.06	65.3	47.4	1.27	59.0	55.5	1.07
CEE	6.1	6.2	1.30	7.2	8.1	1.27	11.6	6.7	1.55	10.2	10.9	1.22
Total	100.0	100.0	1.27	100.0	100.0	1.13	100.0	100.0	1.35	100.0	100.0	1.14

Sources: Global Trade Atlas and Eurostat.

4. Empirical Framework

In the following sections, we empirically investigate the recent change in EU import sources quantitatively and qualitatively. To investigate the change from pre- to post-pandemic periods, we examine the product-level changes in the EU's import shares from 2019 to 2023. Specifically, our baseline equation is formalised as follows:

$$Share_{ijp2023} - Share_{ijp2019} = \mathbf{R'}_i\boldsymbol{\beta} + \mathrm{u}_{jp} + \epsilon_{ijp}, \tag{1}$$

Where

$$Share_{ijpt} \equiv 100 \cdot \left(\frac{Imports_{ijpt}}{\sum_k Imports_{ikpt}}\right)$$

$Imports_{ijpt}$ refers to the imports of product *p* (defined at the HS six-digit level) from country *i* to EU country *j* in year *t*, and exporting countries include all countries in the world. **R** represents four regional dummy variables of ASEAN, China (including Hong Kong), Japan-Korea-Taiwan (JKT), and the rest of the world (ROW), with the EU being the base region. We also control for exporter-product fixed effects. ϵ_{ijp} is a disturbance term. With this baseline equation, we investigate which region EU countries increased their imports from, on average.

We then extend the equation to examine qualitative changes, specifically, adding five variables as follows:

$$\begin{aligned} Share_{ijp2023} - Share_{ijp2019} \\ = \beta_1 RTA_{ij2023} + \beta_2 Agree_{ij2022} + \beta_3 \ln Dist_{ij} + \beta_4 Lang_{ij} + \beta_5 Colony_{ij} + \mathbf{R'}_i\boldsymbol{\beta} + \mathrm{u}_{jp} \\ + \epsilon_{ijp}, \end{aligned} \tag{2}$$

We first examine friend-shoring using two variables. The first is RTA_{ij}, which takes a value of one if countries *i* and *j* belong to the same regional trade agreement (RTA) as of December 2023, considering the increase in imports from RTA partners as economic friend-shoring. The data are obtained from the updated version of Egger and Larch (2008) in addition to the World Trade Organization (WTO) website. The other variable represents political friend-shoring, which is denoted as $Agree_{ijt}$. This variable references the voting similarity index in 2022. The data for this was obtained from the updated version of Bailey et al. (2017), which indicates the similarities in state preferences inferred from voting behaviour in the United Nations General Assembly. Second, we use geographical distance (*Dist*) to examine near-shoring. Third, we introduce two dummy variables as indicators of cultural links. The first is a language-commonality dummy (*Lang*), and the other is a colonial-relations dummy (*Colony*). The data on *Dist*, *Lang* and *Colony* are obtained from the CEPII website.

We estimate these equations for total industry and by industry using the ordinary least squares (OLS) method. Although our main interest is in machinery industries, we also conduct analyses of non-machinery industries for comparison, which are defined at an HS tariff section. One exception is the differentiation between general and electrical machinery industries. In the later analyses, we also differentiate between final machinery products and parts and components. One will notice that the data on *Agree* are not available for Taiwan. For this reason, we do not include Taiwan as an exporter when introducing this variable, and the JKT region dummy is replaced with a JK dummy.

As described above, our main study period is from 2019 to 2023; however, we employ different analytical periods in robustness tests. It is difficult to define the appropriate period of past trends or pre-COVID trends to examine deviations, considering factors such as structural changes (e.g. an accelerated production shift towards EVs) and drastic product demand shifts (e.g. rapidly expanded demand for 5G smartphones and solid-state drive laptops). Therefore, we conduct similar analyses of changes in the 2017-2023 and 2019-2022 periods to validate the robustness of our major findings from the analysis for the 2019-2023 period.

5. Estimation Results

5.1. ANALYSIS OF EU MACHINERY IMPORTS

Table 5 presents the OLS estimation results of equation (1) for each of the machinery industries and the whole industry. The coefficients for four regions as import origins are all positive and statistically significant in the total industry analysis. It indicates that, on average, inter-regional imports from all four regions outside the EU expanded from the pre- to the post-pandemic period compared with intra-EU imports. In addition, the coefficients for ASEAN and China are statistically positive and larger in general and electrical machinery industries (and precision machinery industry for ASEAN only) than those in the whole industry. In particular, the coefficients for China in these machinery industries are extremely large. This implies that ASEAN and China, in particular, saw an increase in their relative importance as import sources at the product level for EU bilateral imports in general and electrical machinery industries (and the precision machinery industry for ASEAN only), and that this tendency is getting stronger compared with the average pattern for the whole industry, including machinery and non-machinery industries. Unlike ASEAN and China, JKT became insignificant in all four machinery industries.

Table 5 / Basic Results for EU Imports: Machinery Industries and Total Industry

	ASEAN	CHN	JKT	ROW
General machinery	0.108***	0.650***	-0.03	0.104***
Electrical machinery	0.166***	0.436***	0.019	0.164***
Transport equipment	0.036	0.051	-0.052	0.031
Precision machinery	0.114***	0.054	0.047	0.120***
Total	0.087***	0.119***	0.044***	0.090***

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. 'Total' means the entire industry, including both machinery and non-machinery industries.
Source: Authors' estimation.

Table 6 presents the estimation results of equation (2) that incorporates three types of 'shoring' (i.e. near-shoring, economic friend-shoring and political friend-shoring), cultural links and the four regional dummy variables. As noted previously, when introducing the proxy variable for political friend-shoring, we do not include Taiwan as an exporter, and we replace the JKT region dummy with the JK dummy. Estimation results with and without the political friend-shoring variable are presented in Table 6 because Taiwan may have a key role in EU imports of ICs. Table 7 presents the corresponding results for imports from (a) WEU and (b) CEE separately.

Table 6 / Estimation Results for EU Imports: Machinery Industries and Total Industry

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(In Dist)			ASEAN	CHN	JKT/JK	ROW
i) Without political friend-shoring (including Taiwan as an import origin)									
General machinery	0.013***		0.027***	-0.033**	0.039	0.060***	0.610***	-0.081**	0.066***
Electrical machinery	0.008***		0.021***	-0.017	-0.067**	0.127***	0.401***	-0.024	0.133***
Transport equipment	0.012**		0.020**	-0.025	0.047	0.003	0.024	-0.088	0.005
Precision machinery	0.012***		0.024***	-0.054**	0.045	0.070***	0.019	0.002	0.086***
Total	0.013***		0.026***	0.005	-0.042***	0.040***	0.078***	-0.009	0.052***
ii) With political friend-shoring (excluding Taiwan as an import origin)									
General machinery	0.018***	-0.074***	0.044***	-0.047**	0.019	0.022	1.209***	-0.099**	0.037**
Electrical machinery	0.009***	0.032	0.043***	-0.027	-0.086**	0.113***	0.912***	-0.089*	0.127***
Transport equipment	0.008	0.026	0.029**	-0.057	0.051	-0.003	0.023	-0.004	0.004
Precision machinery	0.016***	-0.01	0.039***	-0.080***	0.044	0.051*	0.276	-0.047	0.074***
Total	0.013***	0.017***	0.044***	-0.012**	-0.075***	0.023***	0.129***	-0.026***	0.045***

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. The data on 'Agree' are not available for Taiwan. Thus, 'JK' is used instead of 'JKT' in the analysis with political friend-shoring. 'Total' means the entire industry, including both machinery and non-machinery industries.
Source: Authors' estimation.

Table 7 / Estimation Results for WEU and CEE Imports: Machinery Industries and Total Industry

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(In Dist)			ASEAN	CHN	JK	ROW
(a) WEU									
General machinery	0.026***	-0.153***	0.064***	-0.067***	0.064**	-0.021	0.673***	-0.200***	0.001
Electrical machinery	0.015***	0.031	0.062***	-0.058***	-0.049	0.087***	0.497**	-0.164***	0.133***
Transport equipment	0.016**	-0.093*	0.029**	-0.116***	0.183***	-0.007	-0.052	-0.061	0.012
Precision machinery	0.027***	-0.072*	0.059***	-0.095***	0.076*	-0.017	-0.625**	-0.245***	0.014
Total	0.019***	-0.034***	0.054***	-0.045***	-0.005	0.019***	-0.138***	-0.044***	0.053***
(b) CEE									
General machinery	0.004	0.034	-0.001	0.112	-0.667***	0.100***	2.265***	0.108	0.104***
Electrical machinery	0.000	-0.015	0.008	0.750***	-0.685***	0.145***	1.719***	0.059	0.103***
Transport equipment	-0.008	0.156**	0.008	1.248***	-1.752***	-0.01	0.147	0.136	-0.024
Precision machinery	-0.004	0.091*	-0.006	0.046	-0.468*	0.186***	2.072***	0.352***	0.195***
Total	0.002*	0.054***	0.016***	0.537***	-1.058***	0.018**	0.641***	0.022	0.017**

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. 'Total' means the entire industry, including both machinery and non-machinery industries.
Source: Authors' estimation.

Our results provide several interesting insights concerning EU machinery imports. First, EU countries increased imports from longer-distance countries more in the post-pandemic period, indicating no quantitative evidence of intensifying near-shoring at the product level in all machinery industries. The coefficient for distance is positive and statistically significant in all machinery industries (and the whole industry). It suggests that the share of machinery imports from longer-distance countries increased in the post-COVID era compared with imports from shorter-distance countries. Although this coefficient becomes insignificant for machinery imports by CEE only, this does not imply that CEE increased imports from shorter-distance countries. Therefore, no quantitative evidence on intensifying near-shoring is found at the product level for the EU (including CEE) in the post-pandemic period.

Second, EU countries expanded imports from RTA partner countries more in the post-pandemic period in all machinery industries, reflecting an economic friend-shoring approach. The coefficient for the RTA dummy is positive and statistically significant in all machinery industries (and the total industry), with the exception of the transport equipment industry in the analysis without Taiwan as an exporter. As noted, this result reflects EU countries' economic friend-shoring approach in the post-COVID era. Note that, similar to the case of distance, the coefficient becomes insignificant for machinery imports of CEE only. This implies that CEE countries did not necessarily take an economic friend-shoring approach when purchasing machinery products.

Third, it appears that EU countries did not prioritise political friend-shoring at the product level when purchasing machinery products, although they did so on average. While the coefficient for political friend-shoring is positive and statistically significant for the total industry, it is significantly negative for the general machinery industry and insignificant for the remaining machinery industries. This indicates that EU countries did not necessarily increase machinery imports from politically similar countries more in the post-pandemic period, unlike the average pattern. The political perspective may be more sensitive to industries' nature and circumstances than the economic perspective. Our results suggest that economic aspects are still strongly considered and prioritised on the purchasing side in machinery production networks even in the EU. Note that WEU and CEE countries may take contrasting approaches because the coefficient is negative with statistical significance in three machinery industries for WEU, while it is positive in two for CEE.

Fourth, WEU and CEE countries are likely to have contrasting cultural links for machinery imports. The coefficient for the two kinds of cultural links is insignificant in many cases when analysing machinery imports by all EU countries; however, it becomes statistically significant in most cases when WEU is distinguished from CEE. Specifically, the coefficient for language commonality is negative with statistical significance in all machinery industries for imports by WEU, while it is positive in two machinery industries for imports by CEE. Moreover, the coefficient for colonial relations is positive with statistical significance in machinery industries other than transport equipment for imports by WEU, while it is negative in all machinery industries for imports by CEE. These results suggest that WEU expanded imports from countries without common languages and those with colonial relations. In contrast, CEE increased imports from countries with common languages and without colonial relations.

Fifth, even after considering three types of 'shoring' and cultural links, our findings for regional dummies of ASEAN and China in the analysis excluding them basically hold for machinery imports by the EU as a whole. Namely, the relative importance of ASEAN and China, in particular, as import sources to the EU was strengthened at the product level in general and electrical machinery industries (and the precision

machinery industry for ASEAN only).[17] The coefficient for China in these machinery industries is much larger than that for ASEAN and ROW, with positive significance in the same machinery industries and that for China in the total industry. This result indicates that China's relative importance as an import source increased at the product level on average but was more significant in these machinery industries. It also indicates that China's relative importance intensified more than those of ASEAN and ROW did. In the case of ASEAN, the coefficient is much larger in the electrical machinery industry than that in other machinery industries or the whole industry. This indicates that ASEAN's relative importance as an import source intensified at the product level on average, but it is particularly true for the electrical machinery industry. Unlike China and ASEAN, JKT became negatively significant in the general machinery industry, indicating that the relative importance of Japan, Korea and Taiwan as import sources to the EU weakened.

Sixth, when distinguished from WEU, CEE countries exhibit intensified inter-regional links in machinery industries other than transport equipment in the post-COVID period, particularly with East Asian countries. Specifically, ASEAN, China and ROW increased their import shares to CEE in general and electrical machinery industries. In addition, all four regions outside the EU increased shares in the precision machinery industry, including Japan and Korea, which did not necessarily enlarge their shares on average. Moreover, China expanded its shares in these machinery industries more significantly compared with other regions. These results indicate that East Asian countries, particularly China, intensified their relative importance as import sources at the product level for imports by CEE countries in all machinery industries other than transport equipment. In contrast, China's share of imports by WEU at the product level decreased on average and also in the precision machinery industry, although it increased in the general and electrical machinery industries. Moreover, the shares of Japan and Korea in all machinery industries other than transport equipment decreased. WEU shows a pattern somewhat different from that of CEE.

Table 8 presents the results of the separate analysis of machinery final products and machinery parts and components. Considering that the region dummies in all estimations in Tables 6 and 7 are insignificant in the transport equipment industry, we focus on final products and parts and components in all machinery industries other than transport equipment. In addition, since we found that East Asia's share is particularly high for both final products and parts and components in the electrical machinery industry in Section 2, Table 8 also presents the results for this industry only. Our results analysing imports by the EU as a whole and CEE imports demonstrate that China increased its import share the most, followed by ASEAN and ROW, for both final products and parts and components. Moreover, when we focus on HS85, the coefficients of China and ASEAN are larger for parts and components than for final products, implying that the intensifying links with China and ASEAN are stronger for parts and components in this industry. Conversely, Japan and Korea saw their shares for final products and parts and components decrease in the case of imports by WEU, while their shares for final products increased in the case of imports by CEE.

[17] The coefficient for ASEAN becomes insignificant in the case of the general machinery industry in the analysis without Taiwan as an exporter.

Table 8 / Estimation Results for EU Machinery Imports: Final Products and Parts and Components

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(In Dist)			ASEAN	CHN	JK	ROW
i) Machinery industries other than the transport equipment industry									
The Whole EU									
Final	0.015***	-0.012	0.046***	-0.068***	0.000	0.058***	0.989***	-0.039	0.076***
Parts	0.015***	-0.063***	0.038***	-0.02	-0.012	0.045***	0.851***	-0.155***	0.058***
WEU									
Final	0.021***	-0.072***	0.064***	-0.085***	0.038	0.012	0.480**	-0.178***	0.042**
Parts	0.026***	-0.108***	0.059***	-0.049***	0.033	0.004	0.164	-0.233***	0.036*
CEE									
Final	0.005	0.067**	0.005	0.115	-0.582***	0.142***	1.995***	0.241***	0.141***
Parts	-0.004	-0.02	-0.007	0.507***	-0.709***	0.113***	2.207***	0.004	0.096***
ii) Electrical machinery industry (HS85) only									
The Whole EU									
Final	0.004	0.059*	0.050***	-0.071**	-0.119**	0.111***	0.883***	-0.068	0.135***
Parts	0.014***	0.007	0.037***	0.012	-0.057	0.114***	0.938***	-0.109	0.119***
WEU									
Final	0.007	0.071*	0.068***	-0.102***	-0.085*	0.088**	0.575	-0.179**	0.147***
Parts	0.022***	-0.004	0.056***	-0.02	-0.017	0.087***	0.428	-0.151*	0.121***
CEE									
Final	0.001	-0.013	0.017	0.765***	-0.684**	0.137***	1.475***	0.154	0.100**
Parts	0.000	-0.017	0.001	0.737**	-0.686**	0.153***	1.937***	-0.025	0.106***

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust.
Source: Authors' estimation.

As explained above, we also conduct robustness checks, examining changes in the 2017-2023 and 2019-2022 periods (Table 9). The results of regional dummies in the 2017-2023 analysis are basically the same as those in the 2019-2023 analysis, but the coefficients are larger and the number of industries with positive and statistical significance increases. China, ASEAN and ROW are significantly positive in all machinery industries other than transport equipment. Similarly, in the 2019-2022 analysis, the coefficients are larger (as could be expected referencing Table 3 with a higher share for East Asia in 2022 than in 2023), and the number of cases with positive and statistical significance rises further. ASEAN and ROW are positive in all machinery industries other than transport equipment, and China is positive in all machinery industries including transport equipment. The robustness tests indicate that our major findings for import sources from the 2019-2023 analysis basically hold when we use different analytical periods and become even slightly stronger for the links of EU machinery imports with East Asia. For other variables, our major findings from the 2019-2023 analysis are also basically robust.

Table 9 / Robustness Tests for EU Imports: Machinery Industries and Total Industry

(a) Change in the 2017-2023 period

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(In Dist)			ASEAN	CHN	JKT/JK	ROW
i) Without political friend-shoring (including Taiwan as an import origin)									
General machinery	0.020***		0.023***	-0.073***	0.054**	0.130***	1.224***	-0.008	0.132***
Electrical machinery	0.011***		0.021***	-0.057***	-0.064*	0.154***	0.713***	-0.042	0.151***
Transport equipment	0.018***		0.015*	-0.071**	0.092	0.007	0.157	-0.109*	0.021
Precision machinery	0.015***		0.026***	-0.090***	0.064	0.066***	0.245*	0.024	0.078***
Total	0.015***		0.027***	-0.017***	-0.020**	0.066***	0.331***	0.014*	0.080***
ii) With political friend-shoring (excluding Taiwan as an import origin)									
General machinery	0.022***	-0.069***	0.046***	-0.088***	0.034	0.090***	2.323***	-0.017	0.102***
Electrical machinery	0.013***	0.042*	0.046***	-0.080***	-0.083**	0.146***	1.459***	-0.128**	0.152***
Transport equipment	0.015**	-0.048	0.029**	-0.095**	0.08	-0.035	0.211	-0.021	-0.013
Precision machinery	0.020***	-0.033	0.040***	-0.119***	0.069	0.045*	0.681***	0.008	0.066***
Total	0.014***	0.008	0.047***	-0.032***	-0.052***	0.046***	0.620***	0.003	0.070***

(b) Change in the 2019-2022 period

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(In Dist)			ASEAN	CHN	JKT/JK	ROW
i) Without political friend-shoring (including Taiwan as an import origin)									
General machinery	0.010***		0.023***	-0.038**	0.078***	0.093***	0.922***	0.032	0.098***
Electrical machinery	0.008***		0.023***	-0.035**	-0.070**	0.163***	1.112***	0.100***	0.166***
Transport equipment	0.003		0.014	0.015	0.095	0.031	0.323***	-0.081	0.019
Precision machinery	0.015***		0.028***	-0.095***	0.068*	0.069***	0.342***	0.037	0.089***
Total	0.009***		0.023***	-0.017***	0.023***	0.079***	0.371***	0.046***	0.087***
ii) With political friend-shoring (excluding Taiwan as an import origin)									
General machinery	0.020***	-0.107***	0.033***	-0.039**	0.064**	0.061***	1.797***	-0.02	0.072***
Electrical machinery	0.011***	0.096**	0.046***	-0.044**	-0.081**	0.169***	2.263***	0.025	0.179***
Transport equipment	0.009	-0.04	0.021*	0.015	0.088	0.018	0.694***	-0.154**	0.008
Precision machinery	0.022***	0.004	0.043***	-0.122***	0.077*	0.060**	0.915***	-0.007	0.087***
Total	0.013***	0.030***	0.038***	-0.031***	0.019**	0.075***	0.700***	0.013	0.091***

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. 'Total' means all industries, including both machinery and non-machinery industries.
Source: Authors' estimation.

5.2. OTHER ANALYSES FOR THE EU

Tables 10 and 11 present the respective results of equations (1) and (2) for non-machinery imports by the EU as a whole.[18] Among non-machinery industries, those that obtained statistically insignificant results for all four regions outside the EU are mineral products, wood products and precious metals (Table 10). As CRMs are included in mineral products, precious metals and base metals industries, this result may partially reflect the EU's policy to ensure its access to a secure and sustainable supply. Therefore, we focus on discussing the results for these industries including CRMs in Tables 11. All coefficients for regional dummy variables in the three industries are either insignificant or negatively significant except in two cases (i.e. positive coefficients for ASEAN and ROW in the base metal industry in the analysis without political friend-shoring). Negatively significant coefficients are found for China (only in the analysis with political friend-shoring), for JKT in the mineral products industry, and for ASEAN and ROW (only in the analysis without political friend-shoring) in the precious metals industry. This suggests that the EU did not necessarily increase imports of these products from countries outside the EU compared with intra-regional imports, and that it decreased in some cases, partially reflecting the EU's policy on CRMs.

Table 10 / Basic Results for EU Imports: Non-machinery Industries

	ASEAN	CHN	JKT	ROW
Live animals	0.084***	0.035	0.093***	0.090***
Vegetable products	0.115***	-0.001	0.123***	0.113***
Animal/vegetable fats & oils	0.104*	0.062	0.135**	0.114**
Food products	0.076***	0.159***	0.077***	0.090***
Mineral products	0.014	-0.138	-0.027	0.004
Chemical products	0.091***	0.391***	0.089***	0.091***
Plastics and rubber	0.060***	0.339***	0.086**	0.099***
Leather products	0.059	-0.188	0.083	0.071*
Wood products	0.007	-0.177	-0.001	-0.011
Paper products	0.104***	0.482***	0.086**	0.095***
Textiles	0.093***	-0.299***	0.035*	0.114***
Footwear	0.067*	-1.032***	-0.074*	0.044
Plastic or glass products	0.125***	-0.041	0.114***	0.120***
Precious metals	-0.035	-0.181	0.071	-0.029
Base Metal	0.080***	0.093	0.023	0.071***
Miscellaneous	-0.01	-0.330***	-0.111***	0.013

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust.
Source: Authors' estimation.

[18] The separate results for non-machinery imports by WEU and CEE and the results of our robustness tests for non-machinery imports by the EU as a whole are available upon request.

Table 11 / Estimation Results for EU Imports: Non-machinery Industries

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JKT/JK	ROW
i) Without political friend-shoring (including Taiwan as an import origin)									
Live animals	-0.004*		0.023***	-0.035*	-0.093**	0.032	-0.015	0.041*	0.050***
Vegetable products	0.004		0.010**	0.02	-0.230***	0.097***	-0.021	0.096***	0.098***
Animal/vegetable fats & oils	-0.002		0.029*	-0.018	-0.063	0.038	-0.001	0.07	0.063
Food products	0.008***		0.017***	-0.018	-0.035	0.046**	0.134***	0.044*	0.067***
Mineral products	0.036***		0.034***	0.076**	-0.035	-0.031	-0.173	-0.087**	-0.037
Chemical products	0.014***		0.034***	0.037***	-0.040*	0.028**	0.335***	0.02	0.038***
Plastics and rubber	0.017***		0.025***	-0.008	0.088**	0.019	0.306***	0.042	0.064***
Leather products	0.019**		0.033***	-0.07	-0.036	0.001	-0.235	0.018	0.027
Wood products	0.043***		0.047***	0.064*	-0.008	-0.060*	-0.230*	-0.085**	-0.070**
Paper products	0.028***		0.044***	-0.002	-0.082	0.032	0.421***	0.001	0.036
Textiles	0.001		0.021***	0.019	-0.085***	0.048***	-0.343***	-0.012	0.079***
Footwear	0.018***		0.016*	-0.001	-0.152**	0.046	-1.049***	-0.106**	0.027
Plastic or glass products	0.021***		0.042***	0.042	-0.049	0.050**	-0.107	0.03	0.058**
Precious metals	0.021**		0.043***	-0.022	0.03	-0.111*	-0.245	-0.011	-0.090*
Base Metal	0.023***		0.029***	0.033**	-0.025	0.036***	0.056	-0.032	0.032**
Miscellaneous	0.020***		0.011**	-0.060***	0.019	-0.018	-0.330***	-0.127***	0.008
ii) With political friend-shoring (excluding Taiwan as an import origin)									
Live animals	-0.002	0.011	0.030***	-0.062**	-0.113***	0.031	-0.096	0.038	0.055**
Vegetable products	0.002	0.088***	0.027***	0.001	-0.291***	0.103***	-0.182**	0.074***	0.110***
Animal/vegetable fats & oils	-0.009	0.197***	0.047**	0.000	-0.102	0.061	0.058	0.047	0.09
Food products	0.008**	0.060**	0.033***	-0.037	-0.066	0.039*	0.200***	0.015	0.067***
Mineral products	0.037***	0.06	0.055***	0.047	-0.078	-0.049	-0.363*	-0.164***	-0.047
Chemical products	0.018***	-0.035**	0.053***	0.032*	-0.066**	-0.004	0.599***	-0.003	0.016
Plastics and rubber	0.019***	0.000	0.043***	-0.017	0.07	0.001	0.514***	0.008	0.055***
Leather products	0.015	0.01	0.058***	-0.098*	-0.108	-0.028	-0.443	0.001	0.006
Wood products	0.031***	0.376***	0.084***	0.029	-0.026	-0.014	-0.326	-0.118***	-0.006
Paper products	0.030***	0.022	0.064***	-0.006	-0.120*	0.01	0.849***	-0.038	0.025
Textiles	0.000	0.027**	0.038***	-0.005	-0.148***	0.032**	-0.782***	-0.029	0.073***
Footwear	0.021***	0.111***	0.025**	-0.024	-0.183**	0.078*	-1.926***	-0.116**	0.061*
Plastic or glass products	0.019***	0.086***	0.071***	0.004	-0.077	0.037	-0.29	0.033	0.058**
Precious metals	0.021*	-0.047	0.056***	-0.037	0.02	-0.031	0.172	0.166	0
Base Metal	0.023***	0.006	0.050***	0.028*	-0.069**	0.001	0.048	-0.041	0.006
Miscellaneous	0.018***	0.012	0.025***	-0.103***	0.009	-0.007	-0.574**	-0.073	0.025

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. The data on Agree are not available for Taiwan. Thus, 'JK' is used instead of 'JKT' in the analysis with political friend-shoring.
Source: Authors' estimation.

Although our analysis focuses on the import side, we also conducted the same analysis on the export side. Our results for exports in machinery industries and the whole industry differ from those for imports in several points (Table 12).[19] Unlike the import pattern, inter-regional exports decreased for all regions outside the EU in all machinery industries (and the whole industry) compared with intra-EU exports. In

[19] See Appendix Table A.3 for the results for non-machinery exports from the EU.

addition, the absolute value is larger for East Asian regions than for ROW. This suggests that intra-EU exports have relatively intensified, and that inter-regional exports, particularly those from the EU to East Asia, decreased compared with intra-EU exports. As for friend-shoring and near-shoring, the tendency remains the same as the import pattern for economic friend-shoring and near-shoring. However, unlike the import pattern, the results for political friend-shoring are positive and statistically significant for all machinery industries other than transport equipment in addition to the total industry. This suggests that the EU expanded exports to politically similar countries, on average, including those for machinery industries.

Table 12 / Estimation Results for EU Exports: Machinery Industries and Total Industry

	Friend-shoring		Near-shoring	Lang	Colony	Export destination			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JKT/JK	ROW
i) Without political friend-shoring (including Taiwan as an export destination)									
General machinery	0.047***		0.091***	0.210***	-0.566***	-0.202***	-0.371***	-0.302***	-0.158***
Electrical machinery	0.043***		0.080***	0.215***	-0.660***	-0.154***	-0.384***	-0.286***	-0.137***
Transport equipment	0.01		0.047***	0.044	0.009	-0.138***	-0.246***	-0.185***	-0.118***
Precision machinery	0.016***		0.085***	0.191***	-0.472***	-0.211***	-0.624***	-0.342***	-0.166***
Total	0.022***		0.056***	0.102***	-0.355***	-0.099***	-0.251***	-0.164***	-0.080***
ii) With political friend-shoring (excluding Taiwan as an export destination)									
General machinery	0.030***	0.288***	0.156***	0.212***	-0.700***	-0.256***	-0.547***	-0.479***	-0.190***
Electrical machinery	0.035***	0.305***	0.127***	0.254***	-0.786***	-0.166***	-0.386***	-0.452***	-0.136***
Transport equipment	0.011	-0.067	0.069***	0.074	-0.06	-0.212***	-0.436***	-0.315***	-0.182***
Precision machinery	0.015**	0.110**	0.125***	0.236***	-0.569***	-0.256***	-0.464***	-0.512***	-0.201***
Total	0.022***	0.078***	0.084***	0.104***	-0.436***	-0.127***	-0.299***	-0.248***	-0.098***

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the export share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. 'Total' means the entire industry, including both machinery and non-machinery industries. The data on 'Agree' are not available for Taiwan. Thus, 'JK' is used instead of 'JKT' in the analysis with political friend-shoring.
Source: Authors' estimation.

5.3. ANALYSIS OF MACHINERY IMPORTS BY OTHER REGIONS

Table 13 presents the corresponding results for imports by some countries/regions in North America and East Asia in machinery industries and the total industry.[20] For imports by the US and Mexico, the coefficient for the RTA dummy is positive and statistically significant for the total industry and all machinery industries, excluding transport equipment and precision machinery for the US. Moreover, this coefficient is much larger than that of the EU. This implies that the US and Mexico prioritise the economic friend-shoring approach for imports more than the EU does. In contrast, the result concerning distance is insignificant in the total industry and all machinery industries, with the exception of the precision machinery industry for the US (with a negative coefficient) and electrical and precision machinery industries and the whole industry for Mexico (with positive coefficients). No quantitative evidence is found for intensified near-shoring by the US and Mexico on average and in machinery industries other than precision machinery for the US. The coefficient for political friend-shoring is also insignificant in the total industry and most machinery industries in the US, while it is positively significant in the whole industry and electrical and precision machinery

[20] See Appendix Table A.4 for the results concerning non-machinery industries.

industries in Mexico. According to Lovely (2023), friend-shoring is one of the three main approaches taken by US policy makers; however, the political friend-shoring approach is not dominant in the US, at least for bilateral machinery imports at the product level.

Table 13 / Estimation Results for Imports by the US/Mexico and East Asia: Machinery Industries and Total Industry

(a) US and Mexico

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JK	ROW
US									
General machinery	0.082***	0.012	-0.002	0.029***	-0.139*	0.111*	-2.919***	-0.416*	-0.065
Electrical machinery	0.118***	-0.042	-0.001	0.013	0.045	0.275***	-5.171***	-0.611*	-0.073**
Transport equipment	0.075	0.086	0.023	0.019	-0.287	0.276	-0.826	0.145	0.099
Precision machinery	0.02	0.161**	-0.048**	-0.034*	-0.138	0.082	-4.227***	-0.271	0.001
Total	0.071***	0.022	-0.003	0.022***	-0.103***	0.115***	-2.952***	-0.209***	-0.004
Mexico									
General machinery	0.024**	0.506	-0.003	-0.118	0.287	-0.032	7.460***	-0.312*	-0.042
Electrical machinery	0.046***	2.287***	0.017***	-0.418***	0.307	-0.404***	5.723***	-0.115	-0.309***
Transport equipment	0.046*	0.315	-0.001	-0.093	0.382	-0.033	3.709**	0.254	-0.041
Precision machinery	0.063**	1.104**	0.014	-0.238**	0.235**	-0.048	3.519*	0.415	-0.098
Total	0.036***	0.828***	0.007**	-0.150***	0.192**	-0.094***	4.062***	-0.058	-0.088***

(b) ASEAN, CHN and JK

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JK	ROW
ASEAN									
General machinery	0.009	0.119**	-0.027***	-0.064***	-0.144	-0.140***	5.593***	-1.206***	0.01
Electrical machinery	0.01	0.064	-0.015	-0.067**	0.073	-0.191***	4.224***	-1.084***	0.014
Transport equipment	0.006	0.007	-0.014	0.069	0.261	0.246**	3.134***	-1.030**	0.066
Precision machinery	0.018*	0.175*	-0.034**	-0.060*	-0.262	-0.118*	3.133***	-0.781***	-0.045
Total	0.013***	0.129***	-0.028***	-0.031***	-0.117**	-0.153***	2.776***	-0.741***	-0.032***
CHN									
General machinery	0.028	0.079	-0.039***	0.031	-0.083***	-0.13		-2.080***	-0.094
Electrical machinery	0.066**	0.077	0.004	-0.175	0.007	0.194		-0.495	-0.015
Transport equipment	0.071	0.423*	-0.005	0.013	-0.026	0.149		-0.497	0.035
Precision machinery	0.103*	-0.083	-0.003	-0.193	0.000	0.037		-0.169	-0.005
Total	0.046***	0.277***	-0.027***	-0.145***	0.003	-0.032		-0.616***	-0.084***
JK									
General machinery	0.005		-0.039***	-0.01	-0.598***	-0.002	1.485***	-0.776***	0.034
Electrical machinery	-0.003		-0.014	-0.025	-0.272**	0.124**	-0.094	-0.087	0.022
Transport equipment	0.033		-0.03	-0.057	-0.517**	-0.043	0.434	-0.754	0.014
Precision machinery	-0.004		-0.022**	-0.072***	-0.287***	-0.041	0.301	-0.482***	-0.004
Total	0.002		-0.028***	-0.042***	-0.289***	0.022	0.652***	-0.477***	0.011

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. 'Total' means all industries, including both machinery and non-machinery industries.
Source: Authors' estimation.

Concerning the regional dummies, the results for China show a picture for US imports quite different from that of the EU, as logically expected. China's share significantly decreased in the total industry and all machinery industries other than transport equipment. In particular, the coefficient for China in the electrical machinery industry is large in absolute terms. The considerable decline in this industry must reflect the US policy of strengthened export control regulations. Instead, ASEAN's share of US imports in general and electrical machinery industries increased, particularly in the electrical machinery industry. In contrast, the coefficient for imports by Mexico from China is positively significant and quite large in the total industry and all machinery industries, while it is insignificant or negatively significant for other regions outside the EU. This may partially reflect the strengthening role of Mexico as a bridge to connect China (as a part of Factory Asia) and Factory America in machinery industries.[21]

For imports by the six ASEAN countries, China, Japan and Korea, the coefficients for economic and political friend-shoring are insignificant in most machinery industries. As for distance, imports from shorter-distance countries increased on average but did not necessarily do so in machinery industries other than the general machinery industry. These results indicate that economic and political friend-shoring approaches and a near-shoring approach are not necessarily important for machinery imports by East Asian countries. Regarding regional dummies, imports by ASEAN exhibit substantial changes in the purchasing pattern within the region, unlike imports by China, Japan and Korea. Specifically, China's share in all machinery industries significantly increased, while the shares of Japan and Korea decreased. Intra-ASEAN imports also decreased relatively in all machinery industries other than the transport equipment industry, whereas intra-ASEAN imports increased compared with imports from the EU.

[21] The role of Mexico as a bridge for China has been strengthened due to various factors, including the US-China trade conflict, the US-Mexico-Canada Agreement that entered into force in 2020 with more restrictive rules of origin than those in the North American Free Trade Agreement (NAFTA), and the COVID-19 pandemic. See Ando et al. (2024) for recent developments related to trade and investment links between Mexico and China.

6. FDI Analyses

In this section, we investigate the changes in EU countries' outward FDI from 2017 to 2021. Specifically, we examine the share of sales by foreign affiliates of EU firms in manufacturing industries. To do so, we replace the dependent variable in equation (2) as follows:

$$Share_{ijst} \equiv 100 \cdot \left(\frac{Sales_{ijst}}{\sum_k Imports_{kjst}} \right),$$

where $Sales_{ijst}$ refers to the sales of EU country *i*'s affiliates in industry *s* in host country *j* in year *t*. Industries include three manufacturing industries in the North American Industry Classification System (NAICS), including the 'food & textile' industry (31), the 'wood & chemical' industry (32), and the 'metal & machinery' industry (33). Host countries include all countries in the world. The data are obtained from the Multinational Revenue, Employment, and Investment Database (Ahmad et al. 2023).

The most outstanding finding is that sales by EU affiliates in China decreased compared with those in the EU (Table 14). In the analysis of WEU, the coefficient for ROW is positive and significant, although it is much smaller than that for China in absolute terms. Considering that most investing EU firms are from WEU, we further decompose the sample into the three industries introduced above to analyse FDI by WEU. Sales by affiliates of WEU firms in China particularly decreased for the latter two industries. In contrast, sales by affiliates of WEU firms in Japan, Korea and ROW increased for the wood and chemical industry, and those by affiliates of CEE firms in politically dissimilar countries significantly increased.

In contract to the import pattern, both machinery exports from the EU to China and FDI in China by the EU decreased. This may imply that while China remains an essential supplier for the EU, it is not an important export destination for the EU and is further losing its attractiveness as an export destination and a host country for FDI, partially reflecting the slowdown of the Chinese economy and intensifying geopolitical tensions.

Table 14 / Estimation Results for Outward FDI by the EU

Origin	All	WEU	CEE		WEU	
NAICS	31-33	31-33	31-33	31	32	33
Economic friend-shoring	-0.169	0.172	-1.241	1.856***	-0.337	-0.702
	[0.335]	[0.299]	[6.632]	[0.635]	[0.441]	[0.469]
Political friend-shoring	-5.470***	-2.207	-58.919*	-2.789	-3.797	-0.366
	[2.119]	[1.663]	[34.716]	[3.092]	[3.229]	[2.382]
Near-shoring	-0.305	-0.182	-2.881	-0.104	-0.062	-0.359
	[0.327]	[0.208]	[2.655]	[0.358]	[0.318]	[0.384]
Lang	-0.204	-0.207	2.355	-1.168	-0.797	1.154
	[1.002]	[1.023]	[7.366]	[1.209]	[1.921]	[1.960]
Colony	0.208	0.549	-4.457	1.343	-0.055	0.575
	[0.877]	[0.878]	[4.024]	[1.275]	[1.713]	[1.587]
ASEAN	-0.332	0.347	-13.35	0.352	-0.439	0.915
	[0.768]	[0.551]	[12.470]	[0.887]	[0.978]	[0.941]
CHN	-6.116***	-5.486***	-13.437	-0.354	-7.286***	-8.482***
	[1.094]	[0.977]	[8.659]	[1.069]	[1.608]	[1.685]
JK	1.464*	1.156	7.272	0.821	2.058**	0.841
	[0.849]	[0.706]	[6.743]	[0.808]	[0.832]	[1.401]
ROW	0.569	0.980***	-5.941	1.094*	0.795*	1.026
	[0.582]	[0.339]	[5.572]	[0.616]	[0.447]	[0.670]
Number of obs.	1,917	1,759	158	480	630	649
Adj. R-sq	0.012	0.027	-0.022	0.02	0.046	0.033

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the shares of foreign affiliates' sales from 2017 to 2021. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. Robust standard errors are reported in brackets.
Source: Authors' estimation.

7. Policy Implications and Concluding Remarks

This study examined recent changes in machinery IPNs facing various risks. In particular, we primarily investigated how EU import sources in machinery industries changed from the pre-pandemic to post-pandemic period by shedding light on links with East Asian countries. We confirmed that Factory Asia experienced much smaller negative impacts and a more rapid recovery from COVID-19 compared with Factory America and Factory Europe, revealing its robust and resilient nature. At least until 2023, East Asia's inter-regional links as a supplier did not weaken. In addition, we found that the two directions of the links between East Asia and the EU are asymmetric. East Asian countries are important suppliers for the EU, particularly in general and electrical machinery industries, and the relative importance of ASEAN and China, in particular, as import sources of the EU has strengthened in these machinery industries since the pandemic. We also demonstrated that EU countries increased imports at the product level from longer-distance countries more in the post-pandemic period. No quantitative evidence indicated intensified near-shoring in all machinery industries at the product level for the EU in the post-COVID-19 era. Moreover, we demonstrated that EU countries have prioritised friend-shoring from the economic perspective at the product level but not necessarily from the political perspective when purchasing machinery products since COVID-19, while this approach was employed from both perspectives for imports and exports, on average, and for machinery exports. The political considerations may be more sensitive to industries' nature and circumstances, and economic aspects continue to be highly prioritised on the purchasing side in machinery production networks in the EU.

Our results have several policy implications. First, the private sector's judgment on selecting long-distance transactions must be respected if it is efficient and rational. The distance in transactions is one of the factors that may influence supply chains' resilience. However, other factors are also important, such as the price and quality of parts and components and final products, regardless of whether they are purchased from longer-distance countries, the probability of supply disruptions, and the possibility of switching to substitutes (or the availability of alternatives). At least up to 2023, EU firms did indeed import a large proportion of general and electrical machinery from East Asia, including parts and components. Excessive policy intervention to promote near-shoring may be costly. Generally speaking, in East Asia, no argument to shorten supply chains has emerged, and the first priority is efficiency and connecting with outside regions. While issues related to intensifying geopolitical tensions do matter, distance does not.

Second, instead of locking into the EU region, it may also be possible for the EU to develop/intensify links with third countries other than China, as well, just as the US expanded imports from third countries, such as ASEAN countries, in the face of the US-China trade war. At present, imports from China account for a large proportion of imports from East Asia by the EU in general and electrical machinery industries, which may require further analysis of risk factors that considers policy exchanges between the two sides going forward. It may be natural for the EU to consider increasing imports from other countries. Javorcik et al. (2024, pp 2872) noted that "*supply chain resilience could be achieved through further supply chain diversification: keeping old ties alive but adding more links globally".* It is important

not to exclude ‘old ties’, such as China, but to ‘add more links’ by developing/intensifying connections with other countries.

Third, it is essential to mitigate policy-derived uncertainty as much as possible by clarifying the division between economic activities that are regulated based on the logic of economic security and the other parts of the economy and to avoid unnecessary chilling effects, particularly when the EU considers how to manage trade with China in the future. It is hard to expect China to be completely decoupled from the world economy. Aside from sensitive sectors, China is likely to remain a strong source of imports. Therefore, it is necessary to maintain an environment that facilitates business activities.

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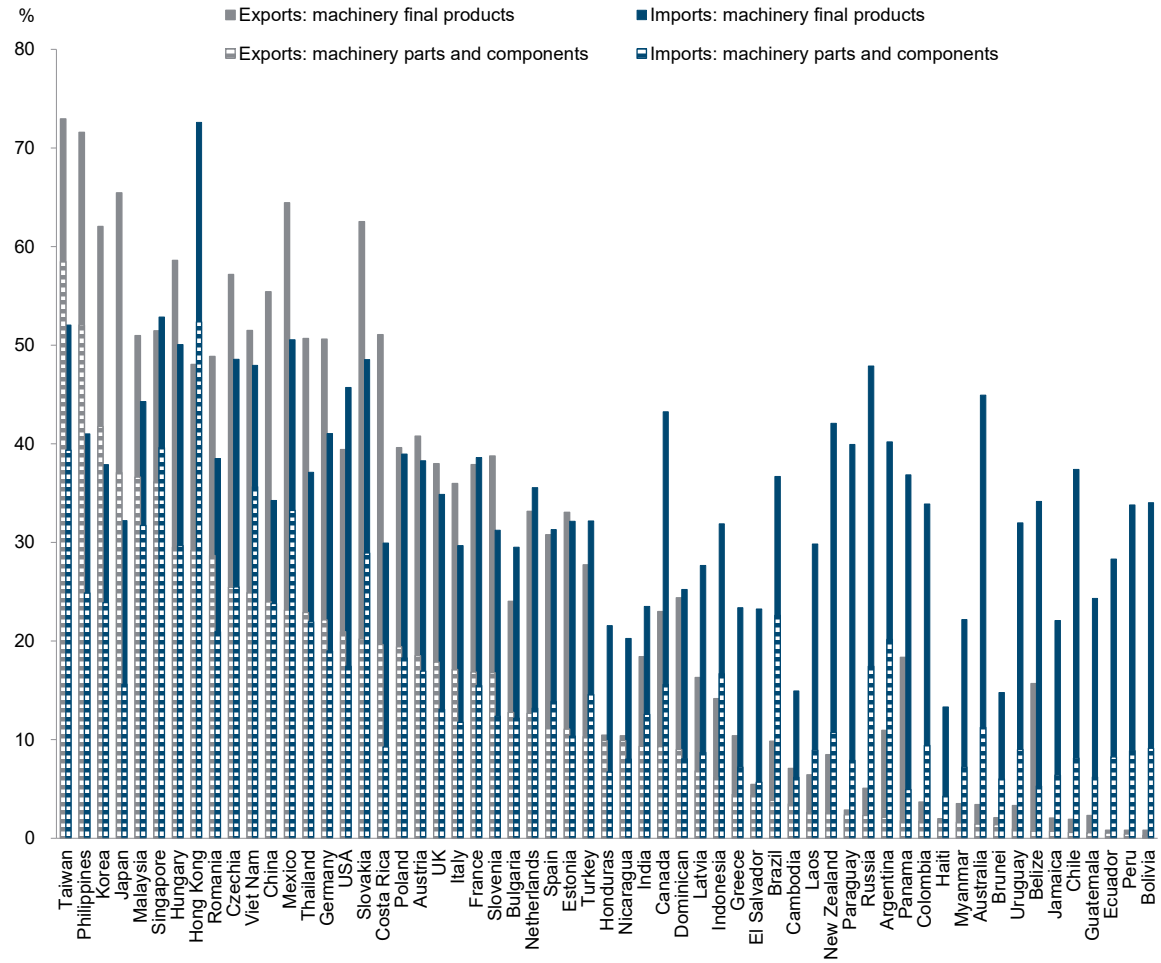
Annex

Figure A.1 / Each Country's Machinery Shares in Total Exports and Imports in 2021



Source: Ando et al. (2022).

Table A.1 / Top 20 Export Countries and Corresponding Shares in Global Machinery Exports (%) in 2019

	Final products						Parts and components					
	Gnrl & Elec		Transport		Precision		Gnrl & Elec		Transport		Precision	
1	China	33.4	Germany	15.7	US	16.5	China	19.1	Germany	14.8	China	21.7
2	Germany	8.7	US	9.7	Germany	12.5	US	9.1	US	11.3	Japan	10.1
3	US	6.4	Japan	9.6	China	8.6	Germany	9.0	China	8.4	US	10.0
4	Mexico	4.5	Mexico	7.0	Switzerland	7.1	Korea	6.7	Japan	7.5	Germany	8.8
5	Japan	3.8	France	6.3	Netherlands	6.9	Japan	6.3	Mexico	6.2	Korea	7.5
6	Netherlands	3.2	Korea	4.6	Japan	6.9	Taiwan	6.2	France	4.8	Taiwan	7.4
7	Viet Nam	3.2	China	4.5	Mexico	4.3	Singapore	3.6	UK	4.0	UK	3.3
8	Italy	3.1	Canada	4.2	Singapore	3.5	Malaysia	3.5	Korea	3.8	France	2.4
9	Korea	2.5	Spain	3.6	France	3.1	Mexico	3.0	Italy	3.7	Singapore	2.3
10	Taiwan	2.1	UK	3.6	UK	2.9	France	2.9	Czechia	3.2	Thailand	2.2
11	Thailand	2.0	Belgium	3.1	Ireland	2.8	Italy	2.7	Poland	3.2	Netherlands	2.1
12	Czechia	2.0	Italy	2.4	Italy	2.2	UK	2.5	Canada	3.0	Malaysia	1.9
13	Malaysia	1.7	Netherlands	1.8	Belgium	2.0	Viet Nam	2.1	Spain	2.7	Mexico	1.8
14	UK	1.7	Czechia	1.8	Korea	2.0	Netherlands	2.0	Belgium	1.5	Italy	1.8
15	France	1.6	Slovakia	1.8	Malaysia	1.7	Philippines	1.5	Thailand	1.5	Switzerland	1.7
16	Poland	1.5	Turkey	1.7	Taiwan	1.1	Thailand	1.4	Hungary	1.5	Viet Nam	1.4
17	Singapore	1.3	Thailand	1.6	Canada	1.1	Czechia	1.4	Sweden	1.4	Ireland	1.3
18	UAE	1.1	Poland	1.4	Israel	1.0	Poland	1.2	Romania	1.4	Canada	1.1
19	Sweden	1.1	Sweden	1.3	Austria	0.9	Canada	1.2	Taiwan	1.4	Hong Kong	1.0
20	Austria	1.1	India	1.2	Poland	0.9	Hong Kong	1.1	Netherlands	1.4	Philippines	0.7

Note: East Asian countries are highlighted.
Source: Ando et al. (2022).

Table A.2 / Pre- and Post-COVID Machinery Exports from the EU by Industries

	Final products			Parts and components			Final products			Parts and components		
	Share in total (%)		Values in 2023	Share in total (%)		Values in 2023	Share in total (%)		Values in 2023	Share in total (%)		Values in 2023
Exporters	2019	2023	(2019=1)	2019	2023	(2019=1)	2019	2023	(2019=1)	2019	2023	(2019=1)
	General machinery (HS84)						Transport equipment (HS86-89)					
East Asia	8.9	7.2	0.93	14.0	15.0	1.20	11.6	9.1	0.91	8.1	7.2	0.94
- CHN	4.9	3.9	0.93	6.4	7.2	1.27	5.9	4.6	0.90	5.4	4.9	0.94
- ASEAN	2.0	1.6	0.97	3.0	2.9	1.07	1.8	0.9	0.61	1.2	1.0	0.88
- JKT	2.1	1.6	0.91	4.6	4.8	1.18	3.9	3.5	1.05	1.4	1.4	1.01
WEU	50.0	49.7	1.16	42.5	42.8	1.13	54.4	52.2	1.11	56.3	55.8	1.04
CEE	11.0	11.2	1.19	9.7	9.9	1.14	17.3	8.7	1.37	15.1	17.3	1.21
Total	100.0	100.0	1.16	100.0	100.0	1.12	100.0	100.0	1.16	100.0	100.0	1.05
	Electrical machinery (HS85)						Precision machinery (HS90-92)					
East Asia	6.6	6.5	1.19	14.8	12.8	1.15	15.0	13.7	1.09	17.7	17.0	1.08
- CHN	3.3	3.6	1.29	8.9	6.8	1.01	8.2	7.4	1.08	7.5	7.2	1.09
- ASEAN	1.4	1.2	1.05	3.4	3.4	1.33	2.3	2.3	1.21	3.3	3.1	1.07
- JKT	1.9	1.7	1.10	2.5	2.6	1.42	4.6	4.0	1.03	7.0	6.6	1.07
WEU	57.7	57.5	1.19	46.8	50.4	1.43	43.9	45.8	1.24	41.3	45.0	1.23
CEE	15.2	15.7	1.23	16.7	17.2	1.36	6.3	6.6	1.24	7.7	8.1	1.18
Total	100.0	100.0	1.19	100.0	100.0	1.33	100.0	100.0	1.19	100.0	100.0	1.13

Sources: Global Trade Atlas and Eurostat.

Table A.3 / Estimation Results for EU Exports: Non-machinery Industries

	Friend-shoring		Near-shoring	Lang	Colony	Export destination			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JKT/JK	ROW
i) Without political friend-shoring (including Taiwan as an import origin)									
Live animals	0.006**		0.029***	0.039	0.069*	0.01	-0.285***	-0.008	0.032*
Vegetable products	0.008**		0.036***	0.028	-0.126***	-0.035*	-0.093***	-0.053**	-0.021
Animal/vegetable fats & oils	0.007		0.037*	0.022	0.066	-0.112*	-0.493***	-0.224***	-0.119**
Food products	0.016***		0.042***	-0.03	-0.045	-0.084***	-0.188***	-0.093***	-0.058***
Mineral products	-0.009		0.034***	0.067	-0.157**	-0.101***	-0.187**	-0.141***	-0.082***
Chemical products	0.021***		0.033***	0.044**	-0.362***	-0.088***	-0.131***	-0.140***	-0.069***
Plastics and rubber	0.033***		0.068***	0.162***	-0.459***	-0.098***	-0.304***	-0.170***	-0.101***
Leather products	0.012		0.064***	-0.041	-0.197**	-0.029	-0.774***	-0.204***	-0.014
Wood products	0.014**		0.037***	-0.002	-0.245***	-0.072**	-0.355***	-0.124***	-0.070**
Paper products	0.028***		0.066***	0.119***	-0.345***	-0.114***	-0.157**	-0.234***	-0.094***
Textiles	0.025***		0.057***	0.141***	-0.539***	-0.031**	-0.122***	-0.119***	-0.02
Footwear	0.017**		0.066***	0.091	-0.606***	-0.086**	-0.354***	-0.269***	-0.072*
Plastic or glass products	0.020***		0.094***	0.156***	-0.536***	-0.158***	-0.226***	-0.175***	-0.135***
Precious metals	0.002		0.060***	0.067	-0.265**	-0.215***	-0.714***	-0.252***	-0.192***
Base Metal	0.023***		0.060***	0.114***	-0.298***	-0.135***	-0.253***	-0.172***	-0.124***
Miscellaneous	0.021***		0.059***	0.094***	-0.558***	-0.101***	-0.297***	-0.153***	-0.095***
ii) With political friend-shoring (excluding Taiwan as an export destination)									
Live animals	0.011***	0.009	0.038***	0.053*	0.071	0.017	-0.417***	-0.008	0.043**
Vegetable products	0.009**	0.081***	0.050***	0.023	-0.155***	-0.025	-0.03	-0.061**	-0.006
Animal/vegetable fats & oils	0.016	-0.061	0.046	0.043	0.062	-0.145**	-0.806***	-0.346***	-0.148**
Food products	0.018***	0.036	0.055***	-0.047	-0.042	-0.100***	-0.238***	-0.119***	-0.068***
Mineral products	-0.007	-0.082	0.038**	0.067	-0.235***	-0.116***	-0.295*	-0.150**	-0.095**
Chemical products	0.019***	0.063***	0.055***	0.042**	-0.446***	-0.119***	-0.205***	-0.212***	-0.092***
Plastics and rubber	0.025***	0.175***	0.105***	0.190***	-0.561***	-0.122***	-0.277**	-0.267***	-0.114***
Leather products	0.024**	-0.101	0.093***	-0.068	-0.238**	-0.108*	-0.576**	-0.258**	-0.076
Wood products	0.013*	-0.019	0.058***	-0.021	-0.296***	-0.114***	-0.370**	-0.130**	-0.102***
Paper products	0.029***	0.042	0.096***	0.154***	-0.450***	-0.149***	-0.138	-0.309***	-0.116***
Textiles	0.033***	0.016	0.085***	0.121***	-0.650***	-0.070***	-0.150***	-0.219***	-0.046***
Footwear	0.020**	0.049	0.101***	0.096	-0.695***	-0.124**	-0.183	-0.388***	-0.092*
Plastic or glass products	0.022***	0.033	0.133***	0.134***	-0.647***	-0.208***	-0.337***	-0.288***	-0.162***
Precious metals	0.015	-0.149	0.067***	0.044	-0.235*	-0.176**	-0.428**	-0.264**	-0.146**
Base Metal	0.024***	0.071***	0.085***	0.112***	-0.374***	-0.161***	-0.355***	-0.232***	-0.139***
Miscellaneous	0.021***	0.117***	0.086***	0.120***	-0.655***	-0.114***	-0.202*	-0.219***	-0.099***

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the export share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. 'Total' means all industries, including both machinery and non-machinery industries. The data on 'Agree' are not available for Taiwan. Thus, 'JK' is used instead of 'JKT' in the analysis with political friend-shoring.
Source: Authors' estimation.

Table A.4 / Estimation Results for Imports by the US/Mexico and East Asia: Non-machinery Industries

(a) US and Mexico

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JK	ROW
US									
Live animals	-0.036	0.047	0.011	-0.01	-0.061	0.022	-1.208*	0.49	0.001
Vegetable products	0.038	0.093	-0.002	0.022	-0.107**	0.042	-0.527	0.074	0.059
Animal/vegetable fats and oils	0.136	-0.553	0.031	-0.037	-0.147	-0.084	1.553	-0.251	-0.025
Food products	0.017	-0.091	0.000	-0.008	0.019	-0.017	-0.718**	0.027	-0.013
Mineral products	0.151	-0.192	0.035	0.075*	-0.019	-0.1	-2.980**	0.739	-0.1
Chemical products	0.078***	0.045	0.027	0.031*	-0.193**	0.054	-0.725	-0.515**	0.017
Plastics and rubber	0.107***	0.041	-0.028	0.035**	-0.131	0.158**	-1.150**	-0.374	0.01
Leather products	0.138	0.004	-0.056	-0.025	0.271	0.396	-2.94	0.494	0.124
Wood products	-0.028	0.087	-0.071	0.03	-0.13	0.522***	-4.131***	0.073	0.07
Paper products	0.100*	0.141	-0.115	0.014	-0.300*	0.358**	-4.870***	-0.347	0.127
Textiles	0.081***	-0.041	0.01	0.033***	-0.057	0.049	-6.453***	-0.352*	-0.062**
Footwear	0.068	-0.054	-0.001	0.000	-0.094	0.449***	-9.855***	0.286	-0.049
Plastic or glass products	0.101**	-0.265**	0.093	0.083***	0.124	-0.161	-4.538***	-0.294	-0.170**
Precious metals	0.023	0.302	0.054	-0.03	0.019	0.058	-2.904**	-0.177	0.196
Base Metal	0.094***	0.143*	-0.048	0.029**	-0.181***	0.239***	-2.174***	-0.269	0.06
Miscellaneous	0.103***	0.009	-0.033	0.002	0.039	0.237***	-6.765***	-0.124	-0.028
Mexico									
Live animals	0.019	0.457	0.016	-0.048	-0.176	-0.055	-0.096	-0.026	-0.041
Vegetable products	0.074***	0.67	0.048**	-0.016	0.843	-0.011	0.465	-0.022	-0.063
Animal/vegetable fats and oils	0.03	0.7	0.094*	0.313	-0.873	-0.541	0.143	-0.076	-0.101
Food products	-0.004	-0.164	-0.039**	-0.087	-0.372	0.082	2.203***	0.024	0.011
Mineral products	0.025	0.488	-0.036*	-0.134	0.172	-0.059	-0.396	-0.07	-0.035
Chemical products	0.025**	0.353	0.013**	-0.057	0.333*	-0.04	2.882***	0.168	-0.021
Plastics and rubber	0.047**	1.036*	-0.007	-0.221*	0.238	-0.192*	5.790***	0.338	-0.179**
Leather products	-0.007	0.522	-0.117**	-0.307	0.072	0.065	-2.7	-0.092	-0.173
Wood products	-0.04	-2.108**	-0.003	0.482***	0.045	0.446**	9.040***	0.044	0.249*
Paper products	0.068***	2.020***	0.009	-0.396***	0.510**	-0.219	7.690***	0.041	-0.174
Textiles	0.040***	1.525***	0.018**	-0.266***	-0.268	-0.180***	5.768***	-0.148	-0.126***
Footwear	0.052	0.102	-0.004	0.008	-0.35	0.173	1.007	-0.004	0.081
Plastic or glass products	0.106***	1.673**	0.011	-0.361***	1.880*	-0.227*	1.158	-0.015	-0.106
Precious metals	0.057*	1.037**	-0.008	-0.225**	0.760**	-0.118	0.611	0.475	-0.115
Base Metal	0.039***	1.270***	0.008	-0.222***	0.144	-0.222***	5.646***	-0.532**	-0.204***
Miscellaneous	0.039**	0.4	0.003	-0.094	0.173	0.117	6.499***	-0.303*	-0.052

contd.

Table A.4 / Continued

(b) ASEAN, CHN and JK

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JK	ROW
ASEAN									
Live animals	0.009	0.116	-0.025	-0.041	-0.482*	-0.091	0.617	0.202	-0.031
Vegetable products	0.034*	0.356***	-0.027	-0.035	-0.302	-0.241***	0.037	-0.476***	-0.062*
Animal/vegetable fats & oils	0.05	0.306	0.013	-0.04	0.654	-0.255	1.536*	0.221	-0.129
Food products	0.047***	0.545***	-0.077***	-0.052	0.136	-0.495***	2.214***	0.309	-0.124***
Mineral products	0.001	-0.069	-0.053	-0.052	0.009	-0.13	0.942	-0.561	0.112**
Chemical products	0.019***	0.227***	-0.065***	0.035*	-0.167	-0.169***	3.701***	-0.571***	-0.067***
Plastics and rubber	0.011	0.153**	-0.035***	-0.079***	-0.064	-0.185***	5.588***	-1.092***	-0.009
Leather products	0.023	0.038	-0.014	-0.076	0.531	-0.167	-0.701	-0.352	-0.056
Wood products	0.000	0.229	-0.039	-0.09	0.14	-0.175	2.123*	-0.967***	-0.08
Paper products	0.027**	0.202	-0.024	0.074*	0.073	-0.233**	4.404***	-0.778**	-0.055
Textiles	0.002	-0.027	0.012	-0.02	-0.219*	-0.109**	-0.221	-0.837***	-0.078***
Footwear	0.025	0.243*	-0.018	-0.016	-0.302	-0.422***	-1.716	-0.630***	-0.171***
Plastic or glass products	0.001	-0.072	-0.02	-0.079*	0.29	-0.13	3.430***	-1.064***	0.057
Precious metals	0.039	-0.1	-0.01	-0.181*	-0.314	-0.268	-2.22	-0.744	-0.04
Base Metal	0.008	0.061	-0.023**	-0.040*	-0.253**	-0.106**	5.472***	-1.296***	0.014
Miscellaneous	-0.021*	0.033	-0.011	-0.105***	0.352	-0.087	3.343***	-0.657***	0.032
CHN									
Live animals	-0.190**	0.184	-0.103***	-0.075	0.128	0.225		-0.454	0.127*
Vegetable products	0.161	0.760***	-0.063	-0.061	-0.08	-0.167		-0.085	-0.056
Animal/vegetable fats & oils	0.162	0.508	-0.174*	-0.583	-0.235	0.02		0.07	0.158
Food products	0.054	0.014	-0.008	-0.794**	-0.076	0.311		-0.058	-0.008
Mineral products	-0.053	0.820**	-0.016	0.657	0.213	-0.108		-0.488	-0.186
Chemical products	0.114***	0.606***	-0.045***	-0.131	-0.103***	-0.234**		-0.46	-0.154***
Plastics and rubber	0.032	0.226	-0.01	-0.047	-0.023	-0.011		-0.101	-0.069
Leather products	-0.055	0.183	-0.019	-0.649	-0.039	0.522		0.39	0.027
Wood products	0.026	0.566*	-0.02	-0.395	-0.082	-0.325		1.166*	-0.024
Paper products	0.094	0.348	-0.002	0.003	-0.018	-0.259		-0.409	-0.086
Textiles	0.080**	0.04	-0.022	-0.075	0.079	-0.158		-1.308***	-0.182***
Footwear	0.039	0.859***	-0.064	-0.277	-0.159	-0.183		-1.434	-0.423***
Plastic or glass products	0.032	0.038	-0.038	-0.188	-0.068	0.053		1.413	0.049
Precious metals	-0.117	0.536	-0.154**	0.041	-0.267	-0.479		0.256	-0.253
Base Metal	0.012	0.217**	0.023	-0.438**	0.167	0.270***		-1.128***	-0.105**
Miscellaneous	0.038	0.009	0.060*	-0.012	0.125*	-0.154		0.801	-0.129

contd.

Table A.4 / Continued

(b) ASEAN, CHN and JK

	Friend-shoring		Near-shoring	Lang	Colony	Import origin			
	Economic (RTA)	Political (Agree)	(ln Dist)			ASEAN	CHN	JK	ROW
JK									
Live animals	-0.001		-0.017	-0.085***	0.041	0.251***	-0.288	-0.197	0.044
Vegetable products	0.034		-0.024*	-0.109***	0.011	0.057	0.195	-0.109	0.034
Animal/vegetable fats & oils	0.022		-0.072**	-0.198**	-0.316	-0.105	0.804*	-0.495	0.022
Food products	-0.014		-0.01	-0.088***	0.093	0.037	0.273	0.834***	-0.041
Mineral products	0.023		-0.017	0.04	0.031	0.11	0.016	-0.347	0.021
Chemical products	0.011		-0.041***	0.004	-0.389***	0.003	1.231***	-0.497***	0.038*
Plastics and rubber	0.006		-0.041***	-0.043	-0.363**	0.099	1.393***	-0.940***	0.028
Leather products	-0.076		0.026	-0.204***	0.28	0.129	-0.478	-0.283	-0.081
Wood products	-0.002		0.008	0.004	-0.082	-0.066	1.189**	0.038	-0.021
Paper products	0.025		0.016	0.057	0.188	0.102	0.38	0.451	0.028
Textiles	-0.012		-0.023***	-0.056***	-0.294***	-0.118***	-0.015	-0.851***	-0.055**
Footwear	-0.063*		-0.002	-0.148***	-0.047	0.112	-1.179*	-0.429	-0.066
Plastic or glass products	0.002		-0.018	-0.015	-0.452**	0.025	0.952*	-0.687*	0.02
Precious metals	0.001		-0.006	0.018	0.39	-0.295**	-1.016	-1.14	-0.225***
Base Metal	-0.005		-0.061***	-0.061***	-0.665***	0.080*	1.609***	-0.741***	0.059***
Miscellaneous	0.016		-0.005	-0.024	-0.229***	-0.086	0.967***	-0.514***	-0.015

Notes: Estimation results are obtained using the OLS method. The dependent variable is the changes in the import share from 2019 to 2023. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. To save space, we do not report standard errors, which are robust. 'Total' means all industries, including both machinery and non-machinery industries.
Source: Authors' estimation.

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