

Do firms react to supply-chain disruptions?*

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Abstract

Since the outbreak of the Covid-19 pandemic, the disruption of supply chains has become a major concern for global firms. This paper uses a representative sample of Spanish manufacturers that participate in global value chains to analyze whether firms are implementing strategies to respond to this concern. Using data for the period 2017-2022, we find that, on average, manufacturers have not increased the number of countries they source their inputs from since the Covid-19 pandemic. Firms have not either shifted their imports to countries that are geographically and geopolitically close to Spain, and have not reshored imports. However, firms have significantly increased the stock of intermediates. Firms only diversify when they have one supplier, export to many destinations, and the imported input has a high risk of experiencing a supply-chain disruption. Firms nearshore and friendshore when their main supplier is geographically distant.

JEL: F10, F14

Keywords: supply-chain disruptions, diversification, nearshoring, friendshoring, reshoring, stocks, Spain.

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1 Introduction

The Covid-19 pandemic turned supply-chain disruptions from a firm and location-specific concern to an economy-wide and global preoccupation. The shutdown of factories in China and the confinement measures adopted by many countries made firms aware that the halt of production processes due to a lack of inputs could become a real possibility. The concern about supply-chain disruptions raised more even when the more stringent Covid-related measures had been lifted. The shift in demand from services to durable goods, capacity constraints in some maritime routes, and labor shortages generated supply-chain disruptions in a wide range of industries. Furthermore, the Russian invasion of Ukraine, and its repercussion on the supply of energy and some primary products, made firms aware that systemic shocks to supply chains were not unusual. As shown by EBRD (2022), these events led global firms to rank supply-chain disruptions as their second most important risk in the first quarter of 2022.

Firms can use different strategies to cope with supply-chain disruptions. First, they can diversify the pool of suppliers. If disruptions do not occur simultaneously in all suppliers, diversification enables firms to substitute the input of an affected supplier with the input of a non-affected supplier. Second, firms can increase their inventory of components and finished products to hold safety stocks. A third strategy is reshoring or backshoring, which refers to a firm decision to repatriate previously offshored activities.¹ Fourth, firms can shorten their supply chain relocating previously offshored activities to a neighboring country of the home country: nearshoring.² Finally, firms may relocate production to trusted countries to reduce the disruption risks due to trade-policy and geopolitical tensions: friendshoring.

This paper explores whether firms have implemented any of the above-mentioned strategies in response to the rising concern about supply-chain disruptions. We combine a representative sample of Spanish manufacturers that participate in global value chains (GVCs) with a database that covers the universe of import transactions in intermediate products between 2017 and 2022. We focus on firms involved in GVCs because their participation in cross-border production sharing puts them at risk of experiencing supply-chain disruptions and, consequently, are more prone to use strategies to cope with those disruptions. Moreover, in a world where GVCs are the prevalent model for global production and trade, we want to know whether economic shocks and geopolitical tensions are restructuring and reconfiguring supply chains.

¹In addition to reducing the chances of supply-chain disruptions, reshoring decisions are also a response of a growing domestic opposition to globalization due to the loss of offshored jobs (Broz et al., 2021; Essletzbichler et al., 2021).

²This strategy also make firms more agile to respond to changing preferences in consumer demand (Betti and Hong, 2020; Qiang et al., 2021).

We find that Spanish manufacturers participating in GVCs have not implemented any significant diversification, nearshoring, or friendshoring strategies as a response to the rising concerns about supply-chain disruptions from 2020 onward. We observe no reshoring of intermediates either. However, we find that firms significantly increased their stock of intermediates in 2021. In any case, we would need data for later years to confirm that there is a permanent shift in this latter strategy.

We examine heterogeneity in the implementation of strategies across several dimensions. We discover that firms diversify the countries they import intermediates from when (i) they have one supplier; (ii) have many export destinations; (iii) the imported intermediate has more risks of experiencing supply-chain disruptions; and (iv) the imported intermediate input belongs to the electronics industry. However, we find no differences in diversification trends after 2019 in firm \times intermediate combinations that (i) have few potential suppliers; (ii) do not last long; (iii) represent a firm's top input; (iv) are mostly used in GVCs; (v) are standardized and have a low cost; (vi) the main supplier is outside the EU or in China; and, (vii) are imported by firms that are large, highly productive, owned by foreign companies, or multinational.

We also find that Spanish manufacturers only nearshore when the main supplier is outside the EU or in China. However, this is a mechanical effect that occurs for all firm \times intermediate combinations in which the main supplier is distant from Spain. As the main supplier is already far from Spain, if the firm adds, or shifts to, a random new supplier, this will tend to be closer to Spain, leading to a mechanical nearshoring process. There are no differences in nearshoring across subsamples in the remaining dimensions mentioned in the above paragraph. We find that firms increase the share of imports from countries that are friends of Spain if their main supplier is outside the EU or in China. Furthermore, we confirm that this friendshoring process is not the result of a mechanical effect. Friendshoring is also more intense in firm \times intermediate combinations that had initially one supplier or a small number of potential suppliers. Finally, we find that stocks have raised more in high-productive firms.

The lack of evidence of a widespread use of strategies to cope with supply-chain disruptions can be explained by the hysteresis and the stickiness of offshoring decisions (Antràs, 2020; Antràs and Chor, 2022). The fixed costs associated with offshoring, such as the gathering of information about suitable providers (search costs), relationship-specific investments, or the learning about bureaucratic procedures and contracts in a different legal environment, are nontrivial and sunk in nature. Furthermore, as noted by Baldwin and Freeman (2022), the niche expertise needed to manage specific value chains makes buyer-supplier networks sticky. Therefore, the relocation of production processes that were offshored is likely to require large additional fixed costs. This would explain

the persistence of firms' decisions on how to organize their value chains globally.³ As demonstrated during the Great Recession, GVCs are remarkably resilient to shocks when they are perceived to be transitory (Behrens et al., 2013). The lack of diversification, reshoring, nearshoring, or friendshoring strategies documented by our study suggests that recent disruptions have not been either perceived as a permanent to firms participating in GVCs. Consequently, firms have been reluctant to introduce profound changes in their supply chain.⁴

The nearshoring and friendshoring in firms whose main supplier was outside the EU or, specifically, in China, can be related to strategies that began to be adopted before the outbreak of the Covid pandemic. These strategies would be motivated by the reduction in labor cost differentials between China and closer countries, and the increasing uncertainty about trade policy. Hence, the recent disruption events might be accelerating already existing trends of supply-chain rationalization, as demonstrated by Antràs (2020) and Bacchetta et al. (2021) for Covid-19.

This paper contributes to the literature on supply-chain disruptions. Carvalho et al. (2020) and Boehm et al. (2019) used the 2011 Tōhoku earthquake to analyze how a supply-chain disruption affected the production of other firms in Japan and Japanese affiliates in the US. Freund et al. (2022) showed that countries more dependent on auto and electronics imports from Japan did not diversify their suppliers, switched to geographically-close suppliers, or reshored production after the 2011 earthquake. Shingal et al. (2020) examined how Asian countries' GVC-based imports responded to prior epidemic outbreaks such as SARS and MERS. They found no evidence for reshoring, some evidence of nearshoring for SARS, and some evidence of geographical diversification for MERS. Some evidence of nearshoring has been observed since 2012 for the European Union (EU) as a whole (Stöllinger et al., 2018; Pegoraro et al., 2020; Bontadini et al., 2022) and Spain (Díaz-Mora et al., 2020). Related to the COVID-19, Khanna et al. (2022) found that Indian firms more exposed to the Covid-19 shock diversified towards geographically-close, larger, and well-connected suppliers. Lafrogne-Joussier et al. (2022) found that French exporters that had a more geographically-diversified pool of suppliers experienced the same Covid-19-related disruption than the less-diversified exporters. Di Stefano et al. (2022) showed that Covid-19 did not spur large waves of reshoring in Italian multinational firms. In sum, the empirical evidence on reshoring, nearshoring, and friendshoring highlights that, in the most recent years, these strategies remain so far limited in scale (Marvasi et al., 2022)).

³Javorcik et al. (2022) found that friendshoring provides insurance against extreme disruption and secures the supply for vital inputs. However, in the medium-run, friendshoring leads to real output losses globally.

⁴Minondo (2021) found that most of the drop in Spanish exports during the Covid-19 pandemic was explained by the intensive margin. This suggests that customer-supplier relationship were also resilient during the Covid crisis.

We make three contributions to the literature. First, instead of analyzing a particular strategy, we explore many strategies to respond to supply-chain disruptions. This enables us to identify whether firms use a dominant strategy to cope with supply-chain disruptions or they combine different strategies.⁵ We found that firms have only implemented a raise in stocks strategy to respond to growing concerns about supply-chain disruptions.

Second, our dataset covers a period that includes the outbreak-of-Covid year and two additional years. In contrast to the above-mentioned studies that have analyzed the effect of Covid-19, the longer time span of our dataset enables us to analyze whether the supply-chain disruptions in the aftermath of Covid-19 and the Russian invasion of Ukraine had any effect on firms' strategies. Furthermore, firms need time to implement the strategies to respond to supply-chain disruptions. The longer time-span of our dataset relative to previous studies enables us to detect whether firms are implementing those strategies. Finally, by covering a three-year period before the pandemic, we can also detect whether the recent supply-chain disruptions have led firms to adopt novel strategies or they are simply accelerating supply-chain-rationalization strategies that begun to be implemented before the pandemic. Despite using a larger time span, we do not observe any significant changes in firms diversification, nearshoring, friendshoring, and reshoring strategies. We also find that nearshoring and friendshoring processes implemented by firms whose main supplier was outside the EU or in China had already begun before the Covid-19 outbreak.

Third, we contribute to the literature showing that there is heterogeneity in the implementation of strategies depending on supplier, intermediate, geographical, and firm characteristics. In particular, we discover that diversification strategies are only implemented when firms have one supplier, export to many destinations, the imported product has a high risk of experiencing a supply-chain disruption, and the intermediate belongs to the electronics industry. Firms nearshore and friendshore when their main supplier is geographically distant.

The remainder of the paper is organized as follows. The next section explains our data sources and how we combine them to build our dataset. Section 3 analyzes whether manufacturers participating in GVCs adopted strategies to respond to the growing concern about supply-chain disruptions since the Covid-19 pandemic. This section also explores whether the implementation of strategies varied across supplier, input, geographical origin, and firm characteristics' dimensions. The last section concludes.

⁵For example, using a survey of 113 major firms participating in GVCs, (McKinsey, 2022) concluded that most of them apply some combination of inventory increases, dual sourcing, and regionalization to boost the resilience of their supply chains.

2 Data

Our data set is a large sample of Spanish manufacturing firms with 10 or more employees that imported and exported continuously over the period 2017-2022. The sample of firms is obtained after combining the information from two different sources. Our primary source of information is the Spanish Customs’s records. It is a confidential micro data made available to us by the Customs and Excise Department of the Spanish Tax Agency (AEAT-Customs), which reports the value (in euros) of exports and imports for each firm, by product, country of destination or origin, and year. Products are defined according to the eight-digit combined nomenclature (CN 8-digit).⁶ Countries or territories with a population below 1 million in 2017 are excluded. Some shipments are excluded as well from this data collection. Inside the EU, firms are required to report their shipments by product and country (of origin/destination) only if their annual trade value in the current or the previous year exceeds the threshold of 240,000 euros. For exports outside the EU all flows are recorded, unless their value is smaller than 1,000 euros or one ton. Those thresholds only eliminate a very small proportion of total exports and imports (less than 3%). The period for which we have the data is from 2012 to 2022.

A second source of information is a balance-sheet data called Bureau Van Dick SABI (Iberian Balance Sheet Analysis System, sabi.bvdinfo.com). In addition to annual accounts, this database provides other relevant firm-level information, such as employment, capital, and sector of main activity. The period for which we have the data is from 2017 to 2021.

The final data set is the result of merging both databases after applying the following steps. First, we select from AEAT-Customs database all the regular two-way traders, that is, firms that export and import every year over the period 2017-2022. Second, we consider only those imported products that are classified as intermediate goods. Out of 8,292 CN-8 digit products in the AEAT-Customs database, the total number of intermediate goods is 4,671.⁷

Third, we use SABI to identify firms whose main activity is manufacturing and have at least 10 workers between 2017 and 2022.

Our data set contains 3,939 firms, 3,156 imported intermediates, and 26,122 firm-

⁶Since the CN 8-digit is revised annually, we ensure a consistent concordance across the CN 8-digit products over time following [Van Beveren et al. \(2012\)](#).

⁷In order to select the intermediate products, first we converted the Combined Nomenclature eight-digit codes to Harmonized System 6-digit 1992 classification. Next, we identified the list of Harmonized System 6-digit 1992 classification codes that belong to the category of intermediate goods according to the Broad Economic Categories, rev.5 classification (BEC). The list was elaborated using the Concordance HS1992-BEC tables built by United Nations (UNSD — Classifications on economic statistics). We also use the BEC rev. 5 to identify the IPS goods (Intermediate Processed Specific) as the intermediate goods that are more likely to participate in GVCs.

product pairs for every year between 2017 and 2022. The total number of countries of origin in the sample is 147, though the choice of countries is different every year. The total number of firm-product-country triplets in 2017 is 57,530 and reaches 60,028 in 2022. According to the AEAT-Customs database, our sample accounts for 42% of total exports and 38% of total intermediate imports in 2017. When we consider only exports and imports by manufacturing firms, our sample accounts for 81% of total exports and 62% of total imports in 2017. The dataset also accounts for 45% and 59% of employment and output in manufacturing in 2017, respectively. Appendix A describes the construction of the data set in detail and provides additional descriptive analyses.

3 Firm-level strategies to cope with supply-chain disruptions

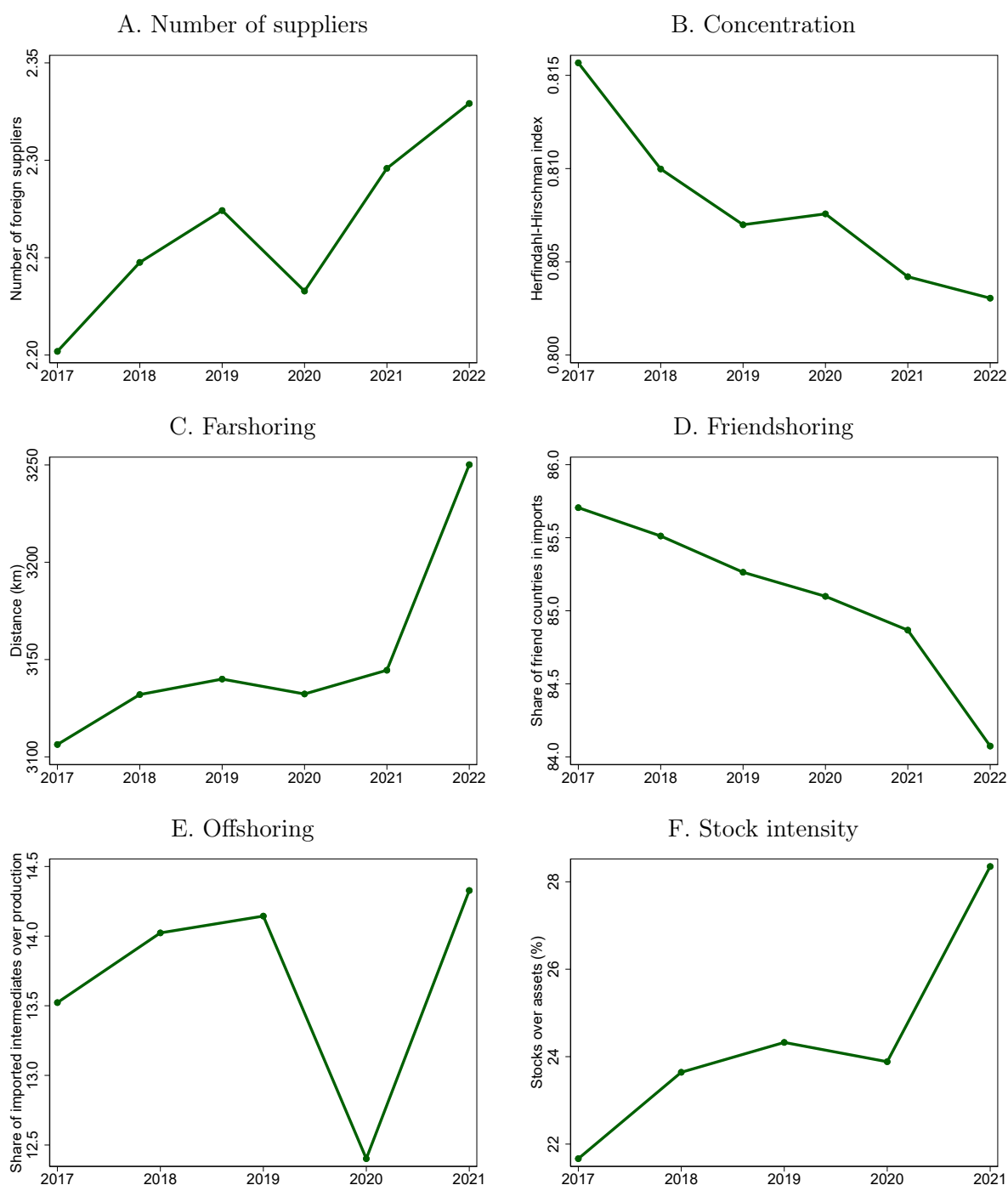
We divide this section in two subsections. First, we describe whether Spanish manufacturing firms participating in GVCs are adopting diversification, nearshoring, friendshoring, reshoring, and stock-increasing strategies in response to the growing concern about supply-chain disruptions. Second, we analyze whether the implementation of these strategies varies depending on four dimensions: supplier, input, geography, and firm characteristics.

3.1 Evolution

Figure 1 shows whether firms are implementing diversification, nearshoring, friendshoring, reshoring, or stock accumulation strategies. We define that a firm diversifies if it increases the number of countries it imports a particular intermediate from. Panel A plots the average number of countries supplying a firm \times intermediate combination during the period 2017-2022. As average, a firm imported an intermediate from 2.2 countries in 2017. This number increased between 2017 and 2019, but it decreased in 2020, the Covid-19 year. Firms increased the number of suppliers in 2021 and 2022, reaching a 2.3 figure in the latter year. The figure indicates that, except for 2020, there is a modest upward trend in the number of suppliers. The median number of suppliers was 1 in 2017 and rose to 2 for the rest of the period. The evolution of the mean and the median indicate that firms have not significantly increased their number of suppliers in response to the growing concerns about supply-chain disruptions from 2020 onward.

Next, we calculate the Herfindahl-Hirschman concentration index of imports by supplier country in each firm \times intermediate combination and plot the yearly average (panel B). We observe a reduction in concentration, only interrupted by the Covid-19 pandemic. We do not observe a major change in how Spanish exporters distribute their purchases across importers from 2020 onward.

Figure 1: Implementation of strategies to respond to supply-chain disruptions



Note: Each figure plots the yearly average of the variable. Panel A plots the number of countries per firm×intermediate combination. Panel B plots the Herfindahl-Hirschman index of the value of imports by supplier in a firm×intermediate combination. Panel C plots the import-value weighted distance of suppliers in a firm×intermediate combination. Panel D plots the share of imports that originate in countries that are friends of Spain in a firm×intermediate combination. A country is a friend of Spain if it voted “Yes” in the UN General Assembly’s Resolution ES-11/1 “Aggression against Ukraine” (March 2, 2022). Panel E plots the share of imported intermediates in total output in a firm. Panel F plots the stocks/total assets ratio in a firm. Data in panels A to D is at the firm×intermediate level and at the firm level in panels E and F.

To analyze whether firms are switching to geographically closer suppliers, we calculate the value-weighted distance of the suppliers in each firm \times intermediate combination and compute the yearly average. Since a larger value denotes a more distant supplier, we have titled panel c “Farshoring” instead of “Nearshoring”. In 2017, the average supplier was at 3,106 km, similar to the road distance between Madrid and Stockholm. There is an increase in the average distance of the supplier in the period 2017-2022. This indicates that firms did not shift to geographically-closer suppliers in response to the rising concern about the disruption of supply chains from 2020 onward.

Panel D plots the average share of the import value that originates from countries that are friends of Spain. Following Javorcik et al. (2022), we identify a supplier as a friend of Spain if it voted “Yes” in the UN General Assembly’s Resolution ES-11/1 “Aggression against Ukraine” (March 2, 2022). We define that a firm friendshores if it increases the share of imports that originates in friend countries. There is a steady decrease in the share of imports that originate from friend countries between 2017 and 2021, and this trend accelerates in 2022. Therefore, we do not find either that the concern about supply-chain disruptions led manufacturers to increase the sourcing from countries that are friends of Spain from 2020 onward.

Panels E and F analyze the evolution of reshoring and stocks. Contrary to the previous panels where data was at the firm \times intermediate level, in these latter panels data is at the firm level. This data comes from SABI, which reports the information about firms’ annual accounts with a lag. In the moment of writing this paper, the latest data available was for 2021, so we have to shorten the time span of the analysis to the period 2017-2021 for panels E and F.

Panel E presents the evolution of the share of imported intermediates over total output. A raise in this ratio denotes offshoring and a decrease shows reshoring. After a decline in 2020, the ratio in 2021 recovers its pre-Covid level. Therefore, we find no reshoring by Spanish manufacturers participating in GVCs after the 2020 pandemic.

Our data set, by construction, forces firm \times intermediate combinations to be alive in all years during the period 2017-2022. It might be the case that since the Covid-19 crisis, some firms decided to stop importing intermediates and procure them domestically. Our data set does not capture these cases and, hence, it might underestimate firms’ reshoring activities. To address this concern, we build a new data set where firm \times intermediate combinations have to be alive only between 2017 and 2019. The offshoring trend in the new sample, which captures firms that decided to reshore their intermediate imports since 2020, is the same as the one shown in panel E of Figure 1.⁸

Reshoring can be the result of two strategies: (i) the substitution of imported inter-

⁸To save on space, the figure is not reported in the paper. It can be requested from the authors.

mediates by production in the firm; or (ii) the substitution of imported intermediates by intermediates manufactured by domestic firms. To understand the mechanism driving the evolution of offshoring, we decompose the imported intermediates/output ratio in the following two ratios:

$$\frac{\textit{Imported intermediates}}{\textit{Output}} = \frac{\textit{Imported intermediates}}{\textit{All intermediates}} \times \frac{\textit{All intermediates}}{\textit{Output}} \quad (1)$$

Panel A of Figure B.1 in Appendix B shows that the evolution of the share of imported intermediates over total intermediates is very similar to the share of imported intermediates over production. Panel B shows no major changes in the share of intermediates over production during the period 2017-2021. Information from these two panels suggests that the substitution away from foreign intermediates toward domestic ones was only temporary and it was reversed in 2021. We observe no substitution of intermediates by production at the firm.

Panel F plots the average share of stocks over total assets, denoted as stock intensity, across Spanish manufacturers participating in GVCs. We observe a clear increase in stock intensity after Covid: the share of stocks over total assets was 4 percentage points larger in 2021 than in 2019. This result suggests that firms have respond to the rising concerns about supply-chain disruptions increasing their stocks of intermediates and final products and shifting from just-in-time to just-in-case supply chain management systems (Jiang et al., 2021). Such a response would be in line with available empirical evidence which shows that firms with large inventory stocks are less sensitive to input supply disruptions than those with relatively low inventories (IMF, 2022; Lafrogne-Joussier et al., 2022). However, we should take our result with care, since we only have data for one year after the Covid-19 pandemic. Hence, we cannot determine whether the increase in stocks has become a permanent strategy.

To sum up, we find that Spanish manufacturers participating in GVCs have not implemented any diversification, nearshoring, friendshoring, or reshoring strategies in response to the growing concern about the disruption of supply chains since the outburst of the Covid-19 pandemic. We only observe that firms have increased their stock of intermediates. Hence, contrary to widespread expectations (De Backer et al., 2018; Lagarde, 2022; UNCTAD, 2022), we do not observe that firms are introducing profound changes in their supply-chain strategies by prioritizing safety over efficiency. They are not either rebalancing globalization and regionalization shifting suppliers to geographically closer and friendly countries. The lack of changes in how firms organize their value chains are related to the high costs of offshoring and their sunk nature. These reasons lead to hysteresis in offshoring decisions and make buyer-supplier networks sticky.

Since there is a single market for goods in the EU, Spanish firms may consider imports

from different EU countries as if they originated from the same country. For example, it is unlikely that a Spanish firm would consider the substitution of a supplier in Sweden with a supplier in Portugal as nearshoring. As an additional robustness check, in Figure B.2 in Appendix B, we reproduce panels A to D of Figure 1 assuming that all EU members belong to the same country.⁹ We can only perform this robustness analysis for the variables that are calculated using data from AEAT-Customs, because this database provides information about the origin of intermediates. Although grouping EU countries leads to a change in the absolute value of the variables, their evolution is very similar to that presented in Figure 1.

3.2 Heterogeneity in the implementation of strategies

In the previous subsection, we concluded that Spanish manufacturers participating in GVCs have not implemented any diversification, nearshoring, friendshoring, or reshoring strategies to cope with the rising concerns about supply-chain disruptions. However, this lack of action may conceal differences in implementation across sub-groups. In this subsection, we explore the heterogeneity in the implementation of strategies across supplier, intermediate, geography, and firm characteristics.

For each analyzed dimension, we separate the firm \times imported intermediate combinations in two groups. For example, one exercise separates the firm \times imported intermediate combinations in which China was the main supplier in 2017 from those in which it was not. For each group, we estimate the following equation:

$$y_{fkt} = \sum_{t=2017}^{t=2022} \beta_t D_t + \gamma_{fk} + \epsilon_{fkt} \quad (2)$$

where y_{fkt} is a variable capturing the implementation of an strategy (diversification, nearshoring, friendshoring) by firm f in product k in year t . For strategies whose variable is measured at the firm level, reshoring and stock intensity, the dependent variable is defined as y_{ft} . D_t is an indicator variable that turns one if the observation belongs to year t . γ_{fk} is a firm \times intermediate fixed effect. It controls for all time-invariant factors at the firm-intermediate level that affect the intensity at which any of the analyzed strategies is implemented. ϵ_{fkt} is the disturbance term. We select 2019, the year before the Covid-19 pandemic, as the reference year. Hence, the β_t coefficients capture whether the dependent variable in year t was smaller or larger than in 2019. In particular, we want to analyze whether the coefficients for 2020, 2021, and 2022 were significantly different to that in 2019. We identify heterogeneity comparing the trend of the β_t coefficients in one group

⁹Although the UK officially left the EU in 2020, we consider it as an EU member for the whole 2017-2022 period.

with that in the alternative group.

Figure 2 analyzes heterogeneity in the number of suppliers. Panel A1 compares the evolution of the number of suppliers in a group of firm \times intermediate combinations that had only one supplier in 2017 with another group that had >1 supplier in 2017. The red-dashed line links the point values of the group that appears in the title of the panel. For example, the title of panel A1 is “One supplier”. Hence, the red-dashed line links the point estimates of the one-supplier group. The blue line plots the point estimates of the >1 -supplier group. We also plot the 95% confidence interval of each point estimate. In all dimensions, our expectation is that, from 2020 onward, diversification in the red-dashed-line group (title of figure) to be more intense than in the blue-line one.¹⁰ For example, we expect diversification to be more intense in the one-supplier group than in the >1 -supplier group, since the former does not have the option to shift to another incumbent supplier if there is a disruption in the supply chain. The one-supplier group (red-dashed line) has an ascending trend before 2019 and continues to increase after that year. By contrast, there is a reduction in the number of suppliers in the >1 -supplier group. Hence, in line with expectations, we find that the diversification effort was more intense among the one-supplier group than in the >1 -supplier one since 2020. However, the diversification process in the one-supplier group had already begun before the Covid-19 pandemic and, therefore, does not seem to be the result of the rising concerns about supply-chain disruptions.

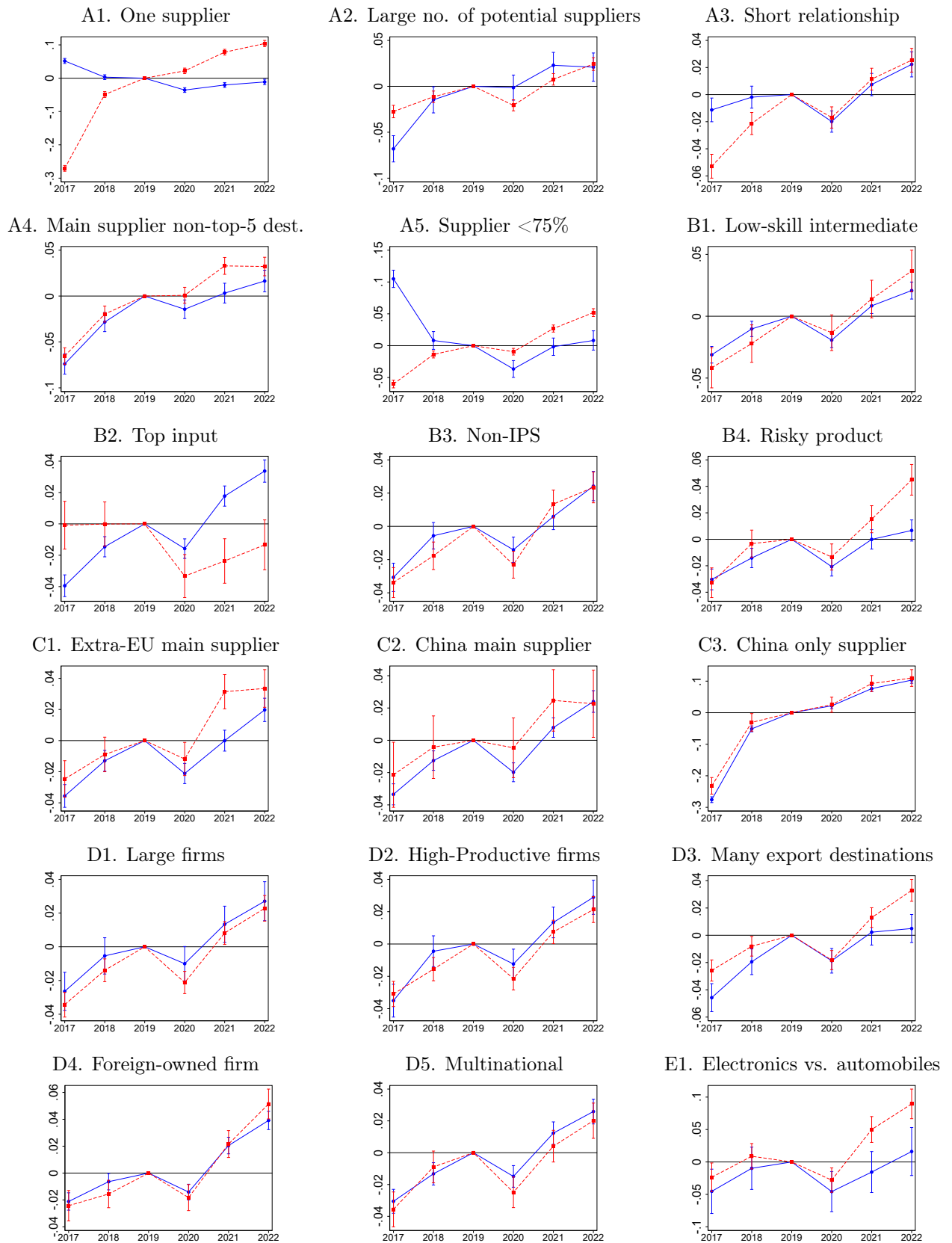
Panel A2 compares firm \times intermediate combinations that had a large number of potential suppliers in 2017 with those that had a small number of potential suppliers. We measure the number of potential suppliers counting the countries that supplied the intermediate to Spain in 2017. We use the median as threshold. Because they have more options to diversify, we expect the high-potential-suppliers’ group to diversify more than the low-potential-suppliers one from 2020 onward. Contrary to our expectation, we do not observe any difference between the two groups.

Panel A3 analyzes the duration of the relationship between the firm and the supplier country. For each firm \times intermediate combination, we select the period 2012-2016 and compute the number of years a firm imported from each country. Then, we calculate the import-value-weighted average duration of a relationship at the firm-intermediate level. We use the median as threshold. A long relationship suggest that the supplier is providing the firm with an intermediate that is well suited to its needs. This makes the relationship more sticky and the supplier difficult to substitute (Martin et al., 2021; Antràs, 2020). Hence, we expect a firm to diversify less if its relationship is long. Contrary to expectations, we observe a similar trend after 2019 for long and short relationships.¹¹

¹⁰Table A.8 in Appendix A presents descriptive statistics of the dimensions analyzed in this section.

¹¹Results are qualitatively similar when we compare a group whose duration is below the 25th percentile with the another whose duration is above the 75th percentile.

Figure 2: Heterogeneity. Number of suppliers



Note: Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.

We analyzed heterogeneity in two additional supplier’s dimensions. First, in each firm×intermediate combination, we selected the one corresponding to the country that was the most important supplier in 2017. Then, we analyzed whether that supplier was among the top5 export destinations of the firm in 2017. Following [Stöllinger et al. \(2018\)](#), we expect firms to have stickier relationships with their suppliers if the country in which the supplier is located is also a major export destination for the firm. There are two reasons explaining this relationship. First, having a local supplier enables firm to react more swiftly to changes in preferences in consumer demand. Second, some countries may require some local content to allow the import of goods. Contrary to our expectations, we find that the diversification trend for firm×intermediate combinations in which the main supplier was among the top5 destinations of the firm was similar to those in which the main supplier was not among the top5 destinations (panel A4).

Second, we focus on firm×intermediate combinations in which there are more than one supplier country. Following ([Martin et al., 2021](#)), we consider that the quality of a supplier-customer matching increases with the value of the transaction. We define that the quality of a matching is high if the supplier accounts for 75% or more of a firm’s intermediate imports. We expect diversification for this class of intermediate imports to be lower than for other intermediate imports. Panel A5 confirms our expectations.

Next, we explore the heterogeneity along intermediates’ characteristics. We explore whether diversification in low-skill/low-technology intermediates has been more intense than in high-skill/high-technology ones.¹² Substitutability between suppliers is much easier when intermediates are intensive in low-skilled labor, have a low technological content, and they are standardized. In contrast, it is more difficult and costly to find alternative suppliers for highly complex and customized inputs ([IMF, 2022](#)). Contrary to our expectations, we find no statistically significant differences between groups (panel B1).

In panel B2, we focus on firms that import more than one intermediate and identify their top intermediate. We find an increase in diversification in the non-top group and a reduction in diversification in the top group from 2019 onward. This result is contrary to our expectation. We predicted that a firm would put more effort into diversifying the suppliers of its top input than in the non-top ones.

The BEC discriminates between processed and specific intermediates (IPS) and the rest of intermediates. The first group encompasses intermediates used in GVCs. Since firm-supplier relationships tend to be stickier in GVCs ([Antràs, 2020; Martin et al., 2021](#)), similar to Panel A3, we expect less diversification in IPS than in non-IPS from 2019 onward. Contrary to our expectations, both groups follow a similar trend (panel B3).

The risk of supply-chains disruptions may be higher in some intermediates than others.

¹²We use the low-skill/low-technology classification in [Basu and Das \(2011\)](#).

We use the list of high-risk products developed by Reiter and Stehrer (2022) to classify intermediates as risky or non-risky. If firms are concerned about supply-chain disruptions, we expect them to prioritize diversification in intermediates belonging to the risky group. Panel B4 confirms this expectation.

Panels C explore the heterogeneity in the response due to the geographical location of the supplier. Panel C1 analyzes the evolution of diversification when the most important supplier is outside or within the EU. We expect diversification to be stronger after 2019 in intermediates that are sourced outside the EU, since a Spanish firm is likely to perceive a higher risk of disruption if the main supplier is in that region. Contrary to our expectations, we observe that the trends are similar for intermediates whose main supplier is outside the EU or within the EU.¹³

Panel C2 explores whether diversification efforts were stronger for firms whose main supplier was in China. We expect diversification efforts to be stronger for this group, because Covid-related social distancing measures lasted longer in China than in other countries. Contrary to our expectations, we find that having the main supplier in China did not lead to a more intense diversification effort.

We further explore diversification from China focusing on firm \times intermediate combinations in which China was the only supplier in 2017. Some media analyses contend that firms that have all their suppliers in China began to seek suppliers in other countries after the Covid-19 pandemic.¹⁴ This strategy is denoted as China+1. We build a subsample of firm \times intermediate combinations that only had one supplier country in 2017. Panel C3 compares the evolution of diversification for China-only-supplier combinations with that of other single-supplier combinations. There is a diversification process in the China-only-supplier group. However, there is an identical process in the other group. Although the results point out towards a China+1 strategy, the diversification effort is similar to that followed by firms that only had one supplier per intermediate.

Panels D explore heterogeneity among firm dimensions. First, we find that diversification efforts after 2019 were similar for large and small firms, and for high-productive and low-productive firms in 2017 (panels D1 and D2).¹⁵ These results are contrary to our expectations. We predicted large and high-productive firms to have more resources to overcome the barriers to identify suitable suppliers in new countries. Panel D3 analyzes whether diversification has been more intense in firms that had many export destinations in 2017 than in those that had few export destinations in 2017.¹⁶ Our expectation is that

¹³We get the same results when we perform the analysis for the top input.

¹⁴See, for example, the Financial Times analysis about Apple's dependence on China published on January 17, 2023: <https://www.ft.com/content/d5a80891-b27d-4110-90c9-561b7836f11b>.

¹⁵The size and productivity of firms is measured with employment and labor productivity, respectively. We use the median as threshold. Results are similar if we compare the above-75th-percentile group with the below-25th-percentile one.

¹⁶We use the median number of export destinations to define the two groups.

firms exporting to many markets can gather more information about potential suppliers than firms selling to few markets.¹⁷ In line with this prediction, we find that firms exporting to many destinations diversified more their suppliers after 2019.

In addition, we analyze diversification in Spanish firms whose capital is controlled by foreign firms and Spanish firms that have foreign affiliates.¹⁸ In both cases, we expect a larger diversification, since these firms have more information to identify alternative foreign suppliers. Contrary to our expectations, we find no significant differences between foreign-owned and domestically-owned firms (panel D4), and multinational and non-multinational firms (panel D5).

Finally, we analyze heterogeneity across two major global industries: electronics and automobiles. The first is characterized by GVCs centered in Asia, whereas the second is characterized by regional value chains.¹⁹ In response to a shock, we expect the number of supplier countries to raise more in electronics than in automobiles, since the potential number of suppliers countries is larger in the former than the latter. In line with expectations, diversification in electronics was more intense than in automobiles since 2020 (panel E1)

Figure 3 explores heterogeneity in farshoring.²⁰ It has the same structure and includes the same dimensions as Figure 2. We only observe a significant difference in 2022-point estimates between groups in 5 out of the 18 dimensions. A process of nearshoring occurs for firm×intermediate combinations where the main supplier was outside the EU, in China, or the only supplier was in China in 2017 (panels C). However, in all cases, the downward trend begins in 2017 and it does not accelerate from 2019 onward. Furthermore, the nearshoring processes may reflect a reversion to the mean: it is easier to reduce a firm’s distance to its suppliers if its more important supplier is already distant. To test this hypothesis, we build a sub-sample of firm×intermediate combinations where the main supplier was located at more than 9,000 km (flight distance) from Spain. Panel A of Figure B.3 in Appendix B compares the nearshoring process when the main supplier was in China (red-dashed line) or another distant country (blue line). The nearshoring process happens in both groups. We obtain a similar result when we compare firm×intermediate combinations whose only supplier is in China with those whose only supplier is also at a distant country.²¹ These results indicate that the nearshoring processes observed in

¹⁷A positive correlation between export and import activity due to operational costs complementarities was modelled by (Kasahara and Lapham, 2013; Bernard et al., 2018; Albornoz and Garcia-Lembergman, 2019)

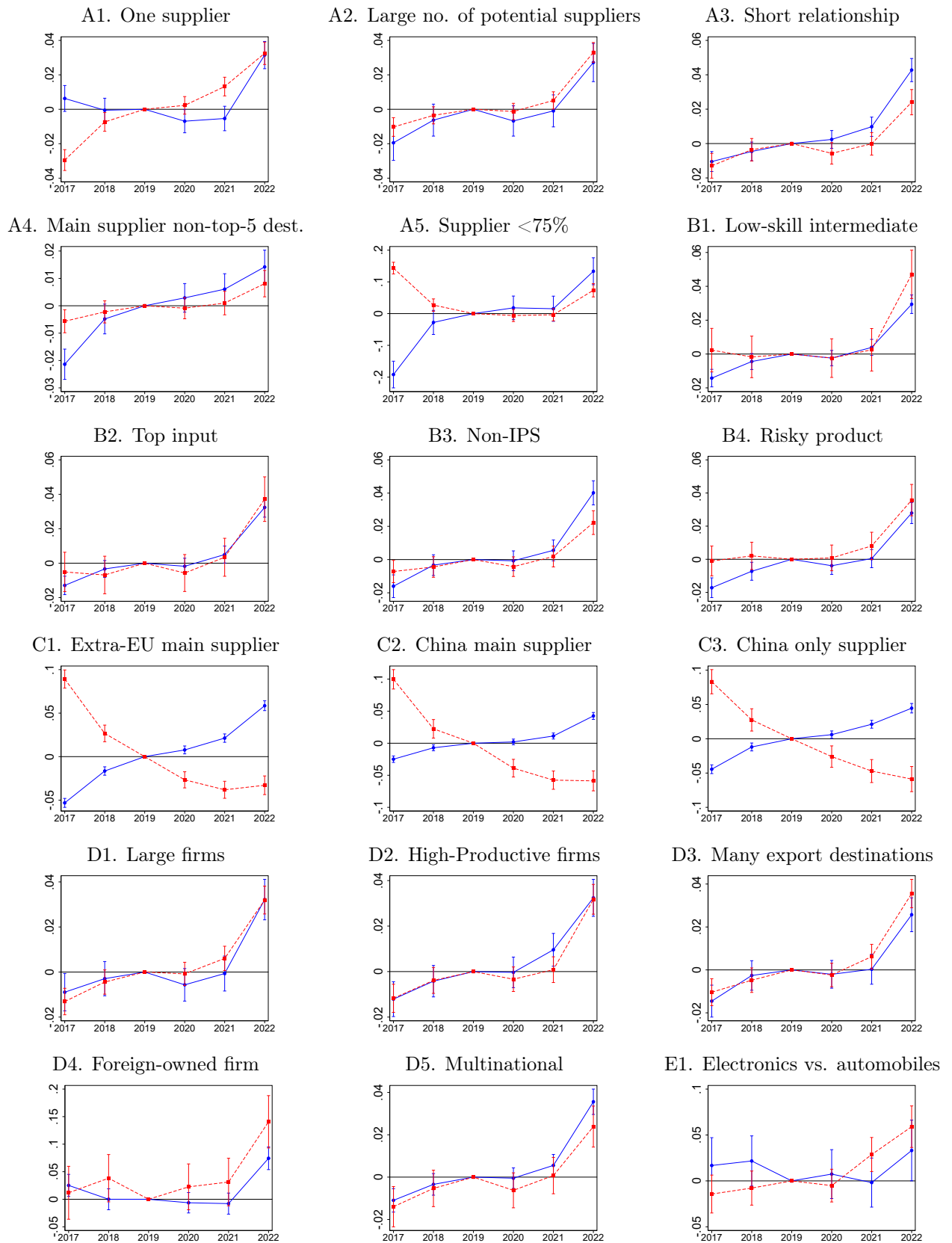
¹⁸We define that a Spanish firm is controlled by a foreign firm if the latter has more than 50% of the capital or the former. We define that a Spanish firm is a multinational if it controls more than 50% of the capital of a foreign firm. Data comes from SABI.

¹⁹In the case of Spain, these value chains are located in Europe

²⁰We do not present the figures for concentration, since the trends are qualitatively similar to those reported in Figure 2. These figures can be requested from the authors.

²¹To save on space, we do not report this figure. It can be requested from the authors.

Figure 3: Heterogeneity. Farshoring



Note: Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.

panels C are the result of a mechanical effect.

We also find that farshoring was less intense in short-term relationships (panel A3) and non-IPS (panel B2). This is against our expectations since both characteristics are connected to less-sticky supplier-customer relationships.

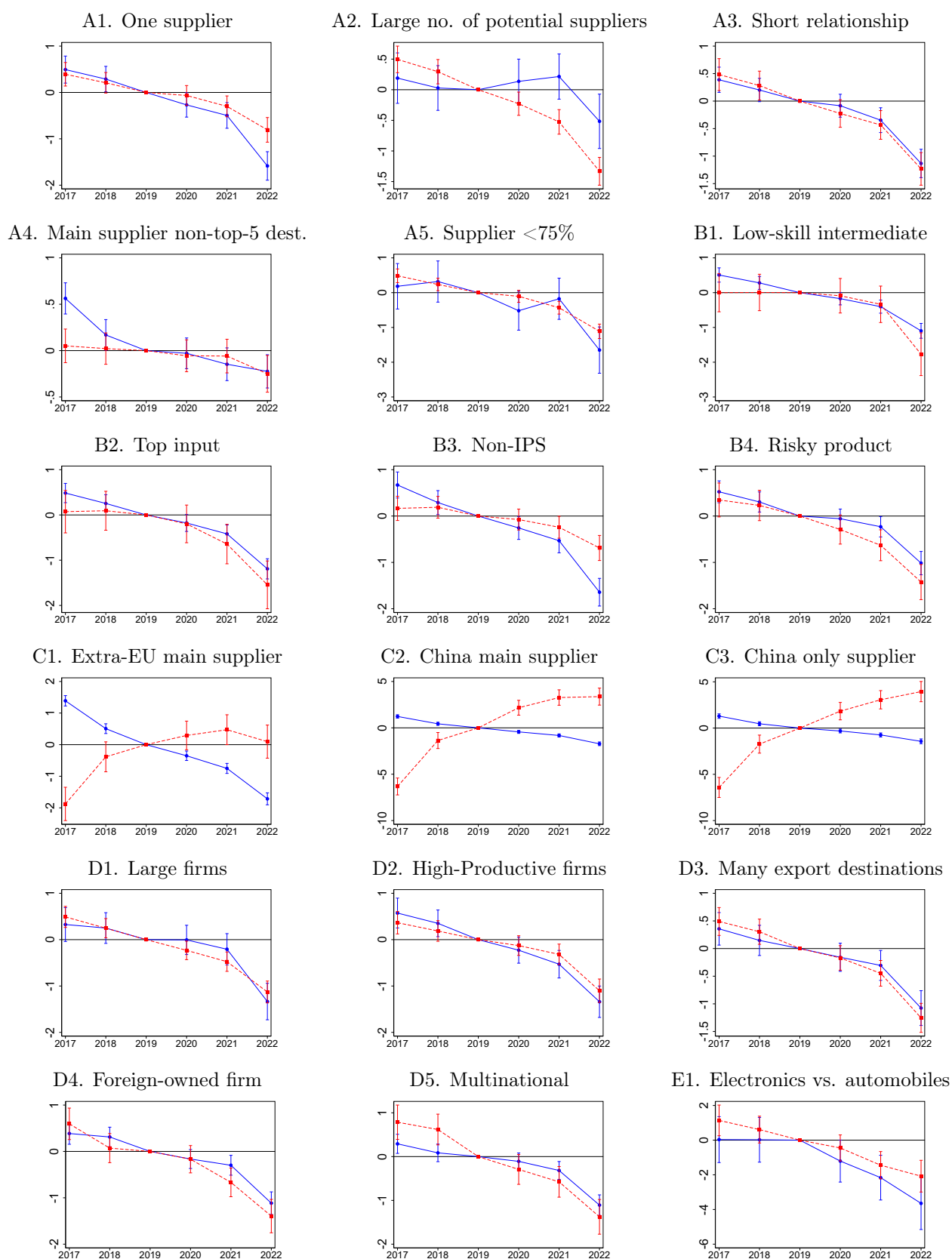
Figure 4 explores heterogeneity in friendshoring. We observe a significant difference between groups in 2022-point estimates in 6 out of 18 dimensions. Friendshoring decreases less among firm \times intermediate combinations that had one supplier or a small number of potential suppliers in 2017 (red-dashed line in panel A1 and blue line in panel A2). This result is in line with our expectations: having a small number of actual or potential suppliers makes manufacturers less likely to substitute a friendly with an unfriendly supplier than firms that had many actual or potential suppliers. Friendshoring decreases less in non-IPS than in IPS from 2020 onward (panel B2). This is against our expectations. We predicted a lower reduction in friendshoring for IPS, since they are characterized by longer and more sticky customer-supplier relationships.

There is friendshoring for inputs whose main supplier was outside the EU, in China, or the main supplier was in China in 2017. This result is in line with our expectations: firms diversify towards friend countries if their supplies originate from non-friend countries. If countries that are not friends of Spain are farther and firms having distant suppliers diversify to closer suppliers, the friendshoring processes observed in panels C could be the result of a mechanical process. To rule out this possibility, we compare the friendshoring process in firm \times intermediate combination in which China was the main supplier with other combinations where the main supplier was also more than 9,000 km away from Spain. Panel B of Figure B.3 in Appendix B shows a friendshoring process for combinations whose main supplier was in China, but not for combinations whose main supplier was in another distant country.

Figure 5 presents the heterogeneity analyses for offshoring and stock intensity. Since these indicators are calculated at the firm level, all heterogeneity analyses are performed on firm-level variables: employment, productivity, number of export destinations, foreign-owned, and multinational.

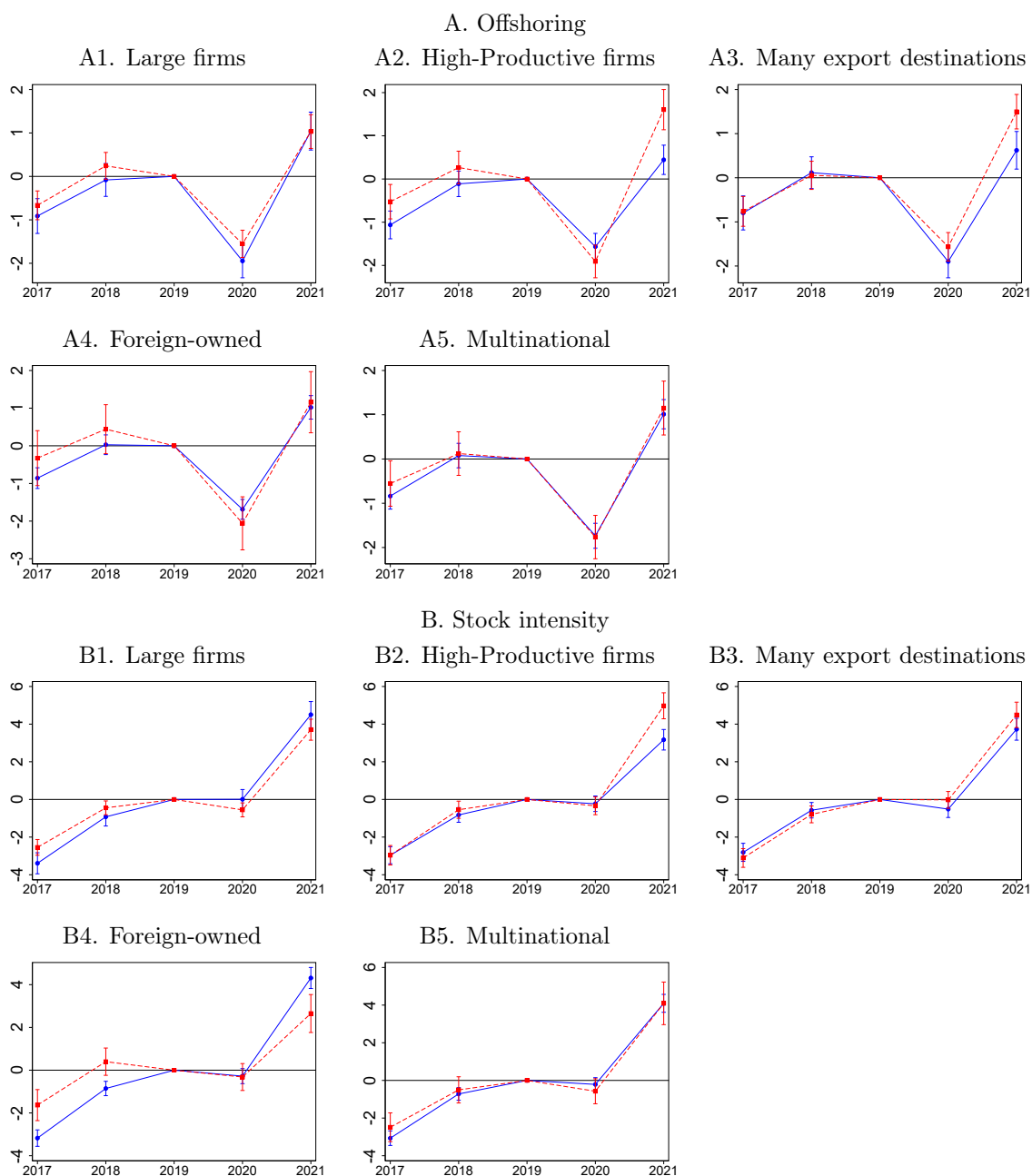
Panel A shows that the foreign intermediates/production ratio increased more among high-productive firms and manufacturers that had many export destinations after 2020. We observe similar trends for large and small firms, foreign-owned and domestic firms, and multinational and non-multinational firms. Panel B shows that the increase in stocks was larger in high-productive than low-productive firms, and in domestic than in foreign-owned firms since 2020. We observe no significant differences in trends between large and small firms, firms with many or few export destinations, and multinational and non-multinational firms.

Figure 4: Heterogeneity. Friendshoring



Note: Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.

Figure 5: Heterogeneity. Offshoring and stock intensity



Note: Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.

As in the previous subsection, we investigate whether results are robust to grouping all EU members into a single country. Results confirm that diversification is more intense among firms that import intermediates from one supplier and it has a higher risk of experiencing a disruption in the value-added chain. However, we also find now that there is more diversification when the input is sourced within the EU or China is the main supplier. When we consider all EU members as part of a single country, it is less likely

that a non-EU country will remain as the main supplier. If it remains, it may indicate that the supplier is more difficult to substitute and, hence, less diversification occurs. We also find that diversification is similar for firms that had few or many export destinations in 2017. We still find that farshoring is less intense for intermediates whose main supplier is outside the EU or in China. There are no longer differences between IPS and the rest of intermediates. Finally, results are also robust for friendshoring.

4 Conclusion

This paper has examined whether Spanish manufacturers participating in GVCs have implemented any strategy in response to the rising concern about supply-chain disruptions since the outbreak of the Covid-19 pandemic. We analyzed six strategies a firm can implement to smooth the effect of a supply-chain disruption: (i) increase the number of supplier countries; (ii) reduce the dependence on some suppliers; (iii) substitute geographically-distant by close suppliers; (iv) substitute suppliers from countries that do not share some core values with countries that share them; (v) substitute imports by domestic production; and (vi) increase the level of stocks.

We find that despite a growing concern about supply-chain disruptions since 2020, Spanish firms have only adopted one of the above-listed strategies: the increase in stocks. Against this overall result, we also discover that firms have adopted diversification strategies in some particular cases. For example, firms do increase the number of countries they import from when they have one supplier, export to many destinations, or the intermediate has a high risk of experiencing a supply-chain disruption. We also observed that diversification has been more in intermediates related to the electronics than the automobile industry. Firms switch imports to countries that are geographically and geopolitically close to Spain when their main supplier is geographically distant. This is the only sign of a some rebalancing in GVCs. However, this trend process predates the Covid-19 pandemic.

Our results indicate that there is a high level of stability in GVCs. This happens because there are costs in reconfiguring GVCs. The easiest and least-cost strategy seems to be increasing firms' inventories to hold safety stocks. The remaining strategies are more difficult and costly to implement because they involve an alteration of the firms' supply-chains. The design of these supply-chains is based on production efficiency and they tend to be sticky due to the trust and reliability that is built between customers and suppliers. This creates a hysteresis effect in offshoring decisions. Among these strategies, diversification seems to be a less costly way to reduce foreign exposure. Consequently, it is more intensively adopted by firms with a higher supplier concentration and which use intermediates that have a higher risk of supply-chain disruptions. Nearshoring and friendshoring are supply-chain reorganization strategies that bear higher fixed costs. This explains why

these strategies are only adopted by firms whose main supplier is geographically distant. Reshoring is the highest-cost strategy, since it entails the reversion of previous offshoring decisions. This explains why we do not observe any reshoring strategy among Spanish firms.

Hence, contrary to widespread expectations, we do not observe systemic changes in how firms organize their supply chains since the outbreak of the Covid-19 pandemic. Our results suggest that recent disruptions have not been perceived as severe and permanent enough shocks to justify the adoption of reshoring, nearshoring, and friendshoring strategies. Moreover, the trends observed in some particular cases towards greater diversification, reshoring, and friendshoring began to be adopted before the outbreak of the Covid pandemic. That is, the recent disruption events seem to be accelerating already existing trends of supply-chain rationalization motivated by the reduction in labor cost differentials between China and closer countries, and the increasing uncertainty about trade policy. Although increasing geopolitical tensions, technological factors, and sustainability reasons might contribute to the reconfiguration of GVCs, this process could take longer than initially expected.

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Appendix A Data, variables, and descriptives

We construct our data set as follows. First, we select all firms in the AEAT-Customs database in 2017 that import at least one product from one country of origin (column 1 of Table A.1). There are 85,306 importing firms, buying 8,292 different products from 222 countries (or territories) for a value of 298 billion euros. The number of firm-product pairs is 591,729 and the number of firm-product-country triplets is 845,885. The average value of imports per firm-product is 504 thousand euros and the median value is 16 thousand euros. Second, we select only intermediate imported products and countries with more than 1 million population (column 2 of Table A.1). There are 48,143 importing firms, buying 4,667 different intermediates from 149 countries for a value of 170 billion euros (column 3 of Table A.1). Third, we select only firm-product pairs that regularly show positive imports six consecutive years. There are 19,834 firms, 87,603 firm-product pairs, and 178,081 firm-product-country triplets (column 3 of Table A.1). Fourth, we select manufacturing firms with 10 or more employees over the sample period. There are 4,318 firms, 27,088 firm-product pairs, and 59,399 firm-product-country triplets (column 4 of Table A.1). Fifth and last, we identify firms exporting and importing simultaneously over the sample period. The sample contains 3,939 firms importing 3,156 intermediates from 138 countries. The final number of firm-product pairs in 2017 is 25,859 and the final number of firm-product-country triplets is 57,302 (column 5 of Table A.1).

Table A.1: Construction of sample

| | Customs ⇒ | Intermediates ⇒ | Regular ⇒ | Manuf10 ⇒ | Twoway |
|---------------|-----------|-----------------|-----------|-----------|--------|
| Observations | 845885 | 403644 | 178081 | 59399 | 57530 |
| Firms | 85306 | 48143 | 19834 | 4318 | 3939 |
| Products | 8292 | 4667 | 4035 | 3237 | 3156 |
| Origins | 222 | 149 | 145 | 138 | 138 |
| Value(bn eur) | 298 | 170 | 139 | 78 | 77 |
| N fp | 591729 | 276287 | 87603 | 27088 | 26122 |
| Mean(th eur) | 504 | 616 | 1592 | 2900 | 3012 |
| P50(th eur) | 16 | 19 | 99 | 127 | 129 |

Notes: Intermediates stands for products classified as intermediate goods according to BEC rev 5 classification. Regular stands for firms importing six consecutive years the same intermediate product. Manuf10 stands for firms whose main activity is manufactures and employ 10 or more employees over six years. Twoway stands for firms exporting and importing simultaneously over the six years.

Table A.2 shows the evolution of the number of firm-intermediate-country triplets. The number of triplets is 57,530 in 2017 and 60,859 triplets in 2022, exhibiting an average yearly growth rate of 1.1% over the six-year period.

Figure A.1 shows the distribution of the 3,939 firms by manufacturing sector (NACE 2 digits). The sectors with the largest proportion of firms are metal products (438 firms), mechanical machinery (419), chemistry (402), and food (400).

Table A.3 shows the distribution of firm-product pairs by number of countries of

Table A.2: Sample descriptives

| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2017-22 |
|--------------|-------|-------|-------|-------|-------|-------|---------|
| Firms(f) | 3939 | 3939 | 3939 | 3939 | 3939 | 3939 | 3939 |
| Products(p) | 3156 | 3156 | 3156 | 3156 | 3156 | 3156 | 3156 |
| Countries(c) | 138 | 136 | 132 | 139 | 135 | 132 | 147 |
| fp pairs | 26122 | 26122 | 26122 | 26122 | 26122 | 26122 | 26122 |
| fpc triplets | 57530 | 58722 | 59419 | 58341 | 59981 | 60859 | 354852 |

origin. Half of the firm-intermediate pairs have only one country of origin in 2017 (50.7%), accounting for 42.6% of the imports value. Six years later, the participation is slightly smaller in number (48.4%), but large in imports value (45.9%).

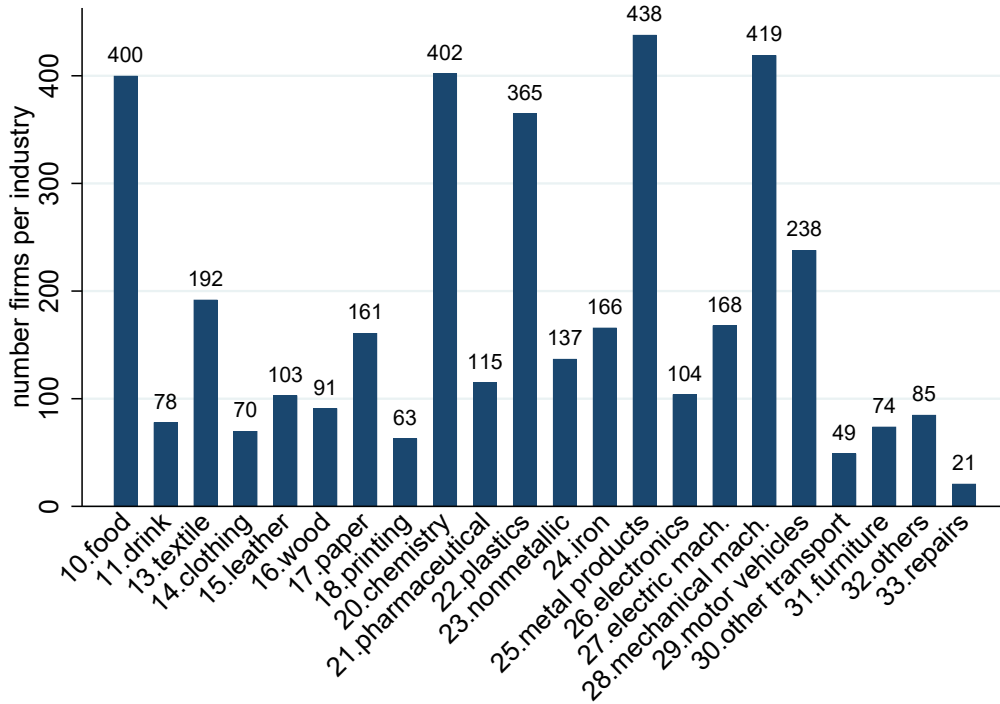
Figure A.1: Distribution of firms by manufacturing sector

Table A.4 shows the ranking of the top-15 countries of origin among all firm-product-country of origin triplets. In 2017, the most frequent country of origin is Germany (17.5%), followed by Italy (11.8%), and France (11.4%). The ranking is different when we sort countries according to the value of imports. France occupies the first position (17.8%), followed by Germany (17.0%) and Italy (6.5%). The fourth position in the ranking is occupied by China, which has increased its participation steadily over the entire period both in terms of frequency (from 7.6% in 2017 to 8.5% in 2022) and of imports value (from 4.0% in 2017 to 6.3% in 2022). In terms of number of triplets, United

Table A.3: Firm-intermediate pairs by number of countries of origin and year

| Number of suppliers | Year 2017 | | Year 2022 | |
|---------------------|-----------|----------------|-----------|----------------|
| | % pairs | % import value | % pairs | % import value |
| 1 | 50.77 | 42.6 | 48.41 | 45.9 |
| 2 | 23.31 | 23.4 | 23.09 | 22.9 |
| 3 | 10.97 | 8.7 | 11.45 | 8.8 |
| 4 | 5.56 | 5.7 | 6.34 | 7.2 |
| 5 | 3.36 | 6.8 | 3.56 | 4.4 |
| 6 | 1.96 | 5.7 | 2.32 | 2.5 |
| 7 | 1.26 | 4.6 | 1.60 | 3.9 |
| 8 | 0.86 | 2.1 | 0.93 | 1.6 |
| 9 | 0.62 | 1.3 | 0.56 | 0.6 |
| 10 o more | 1.33 | 3.9 | 1.74 | 2.2 |
| total | 100,00 | 100,00 | 100,00 | 100,00 |

Note: The number of firm-intermediate pairs is the same every year: 26,122.

States, Poland, India, and Turkey have gained market share, while United Kingdom has experienced a significant drop (from 5.1% in 2017 to 3.0% in 2022).

Table A.5 presents the transition matrix of the number of countries of origin a firm-intermediate sells to. When a firm-intermediate sells to only one destination, the probability to buy from one country of origin again is 81%; and the chances that the number of countries of origin moves from 1 to 2 is 14%. As the initial number of countries of origin per firm-intermediate increases, the likelihood of changing the number of countries of origin the next year increases. When the country portfolio is greater than one, the likelihood of entry is smaller than the one of exit.

Table A.4: Firm-intermediate-country triplets by top-15 countries of origin and year

| Country of origin | Year 2017 | | Year 2022 | |
|-------------------|------------|-----------|------------|-----------|
| | % triplets | % imports | % triplets | % imports |
| Germany | 17.57 | 17.02 | 16.54 | 14.57 |
| Italy | 11.84 | 6.59 | 11.81 | 6.42 |
| France | 11.43 | 17.86 | 10.68 | 15.31 |
| China | 7.58 | 4.02 | 8.55 | 6.32 |
| Netherlands | 5.26 | 3.24 | 5.30 | 3.28 |
| United kingdom | 5.11 | 4.70 | 3.00 | 4.82 |
| Portugal | 4.85 | 4.37 | 4.91 | 4.58 |
| United states | 4.07 | 4.08 | 4.15 | 5.14 |
| Belgium | 3.99 | 2.02 | 3.92 | 2.04 |
| India | 1.99 | 1.17 | 2.26 | 1.39 |
| Poland | 1.95 | 2.89 | 2.36 | 2.07 |
| Turkey | 1.82 | 1.29 | 2.22 | 2.14 |
| Austria | 1.66 | 0.89 | 1.81 | 0.81 |
| Czech republic | 1.60 | 1.89 | 1.72 | 1.79 |
| Sweden | 1.46 | 0.72 | 1.37 | 0.93 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

Note: The number of

firm-intermediate-country triplets is 57,555 in 2017 and 60882 in 2022.

The sample contains 3,156 intermediate imported products. Table A.6 presents the list of the top-30 intermediate products imported by Spanish manufacturers in 2017. The most important product is “Parts and accessories for the industrial assembly of: vehicles”,

Table A.5: Transition matrix of number of country of origin a firm-intermediate buys from, year-to-year, 2017-2022

| | Number of origins in t-1 | | | | |
|----------------------|--------------------------|--------------|--------------|--------------|--------------|
| | 1 | 2 | 3 | 4 | +5 |
| +5 or more countries | 0.001 | 0.003 | 0.005 | 0.006 | 0.016 |
| +4 countries | 0.002 | 0.004 | 0.005 | 0.007 | 0.015 |
| +3 countries | 0.008 | 0.010 | 0.016 | 0.022 | 0.032 |
| +2 countries | 0.029 | 0.041 | 0.050 | 0.058 | 0.067 |
| +1 countries | 0.147 | 0.152 | 0.145 | 0.144 | 0.141 |
| No change | 0.813 | 0.494 | 0.358 | 0.306 | 0.209 |
| -1 country | | 0.297 | 0.305 | 0.266 | 0.212 |
| -2 countries | | | 0.117 | 0.144 | 0.146 |
| -3 countries | | | | 0.047 | 0.080 |
| -4 countries | | | | | 0.043 |
| -5 o more countries | | | | | 0.040 |
| Total entries | 0.19 | 0.21 | 0.22 | 0.24 | 0.27 |
| Total exits | | 0.30 | 0.42 | 0.46 | 0.52 |

which represents 7.96% of total intermediate imports in 2017. Six years later, it is still the most important product. The main supplier is France in both years. The ranking of products changes over time as well as does the main supplier for 12 of the top-30 products.

Additionally, Table A.7 presents the top imported intermediate in each sector over the period 2017-2022. The main imported intermediate in some sectors represents a quite substantial share in the total imports of intermediates of the sector. For example, 33021040-Mixtures of odoriferous substances and mixtures accounts for 48.32% of all intermediate imports in the drinks sector and 30049000-Medicaments consisting of mixed or unmixed products for therapeutic accounts for 41.98% in the pharmaceutical sector.

Table A.6: Top 30 intermediate imports

| CN8 code | Description code | Share 2017 | Main supplier | Share 2022 | Main supplier |
|----------|--|------------|---------------|------------|---------------|
| 87089912 | Parts and accessories for the industrial assembly of: vehicles.. | 7.96 | FR | 4.62 | FR |
| 30049000 | Medicaments consisting of mixed or unmixed products for therapeut.. | 4.36 | CH | 3.32 | DE |
| 26030000 | Copper ores and concentrates | 2.77 | CL | 2.42 | CL |
| 87090000 | Parts and accessories for tractors, motor vehicles for the transp.. | 2.48 | DE | 3.46 | FR |
| 87084048 | Gear boxes and parts thereof, for the industrial assembly of: vehi.. | 2.33 | DE | 2.13 | DE |
| 84082056 | Compression-ignition internal combustion piston engine diesel or.. | 1.90 | FR | 0.86 | DE |
| 84073488 | Spark-ignition reciprocating piston engine, of a kind used for ve.. | 1.85 | DE | 0.59 | TR |
| 87082992 | Parts and accessories for the industrial assembly of bodies of: t.. | 1.77 | DE | 1.36 | DE |
| 85443000 | Ignition wiring sets and other wiring sets for vehicles, aircraft.. | 1.06 | MA | 0.62 | MA |
| 33021040 | Mixtures of odoriferous substances and mixtures, incl. alcoholic .. | 0.72 | IE | 0.54 | IE |
| 87089432 | Steering wheels, steering columns and steering boxes, and parts t.. | 0.72 | DE | 0.38 | DE |
| 73269096 | Sintered articles of iron or steel, n.e.s. | 0.66 | DE | 0.01 | US |
| 84099904 | Parts suitable for use solely or principally with compression-ign.. | 0.66 | DE | 0.44 | DE |
| 85371088 | Numerical control panels with built-in automatic data-processing .. | 0.63 | MA | 0.18 | MA |
| 87082912 | Parts and accessories for the industrial assembly of bodies of: p.. | 0.63 | DE | 0.58 | DE |
| 90111100 | Coffee (excl. roasted and decaffeinated) | 0.57 | VN | 0.77 | BR |
| 26011100 | Non-agglomerated iron ores and concentrates (excl. roasted iron p.. | 0.55 | BR | 0.49 | BR |
| 84119104 | Parts of turbojets or turbopropellers, n.e.s. | 0.53 | JP | 0.49 | US |
| 87087048 | Road wheels and parts and accessories thereof, for the industrial.. | 0.53 | FR | 0.26 | MA |
| 85371096 | Touch screens for electric control, without display capabilities,.. | 0.53 | CN | 0.60 | DE |
| 87084016 | Brakes and servo-brakes and their parts, for tractors, motor vehi.. | 0.51 | JP | 0.34 | FR |
| 39269096 | Articles made from plastic sheet, n.e.s. | 0.50 | DE | 0.54 | DE |
| 40111000 | New pneumatic tyres, of rubber, of a kind used for motor cars, in.. | 0.50 | IT | 0.29 | IT |
| 12019000 | Soya beans, whether or not broken (excl. seed for sowing) | 0.50 | BR | 0.49 | BR |
| 72042112 | Waste and scrap of stainless steel, containing by weight \geq 8% ni.. | 0.49 | NL | 0.40 | DE |
| 72104896 | Flat-rolled products of iron or non-alloy steel, of a width of \geq .. | 0.49 | IT | 0.66 | TR |
| 72044992 | Waste and scrap of iron or steel, not fragmented "shredded", no.. | 0.48 | PT | 0.31 | PT |
| 84073496 | Spark-ignition reciprocating piston engine, of a kind used for ve.. | 0.47 | DE | 1.15 | DE |
| 85122000 | Electrical lighting or visual signalling equipment for motor vehi.. | 0.44 | SK | 0.56 | MA |
| 87085032 | Drive-axles with differential, whether or not provided with other.. | 0.44 | IT | 0.24 | IT |

Table A.7: Top intermediate input by sector

| Industry | CN8 code | Description code | share 2017-2022 |
|----------|----------|--|-----------------|
| 10 | 09011100 | Coffee (excl. roasted and decaffeinated) | 9.81 |
| 11 | 33021040 | Mixtures of odoriferous substances and mixtures | 48.32 |
| 13 | 55032000 | Staple fibres of polyesters, not carded, combed | 10.80 |
| 14 | 60041000 | Knitted or crocheted fabrics, of a width of > 30 cm | 13.55 |
| 15 | 41041160 | Full grains, unsplit and grain splits, in the wet state | 8.47 |
| 16 | 44101112 | Particle board of wood, whether or not agglomerated with resins | 10.75 |
| 17 | 47032900 | Semi-bleached or bleached non-coniferous chemical wood pulp, soda | 10.32 |
| 18 | 85285208 | Cathode-ray tube monitors "CRT" (excl. computer monitors) | 12.81 |
| 20 | 29173600 | Terephthalic acid and its salts | 3.75 |
| 21 | 30049000 | Medicaments consisting of mixed or unmixed products for therapeutic | 41.98 |
| 22 | 40111000 | New pneumatic tyres, of rubber, of a kind used for motor cars | 9.25 |
| 23 | 69101000 | Ceramic sinks, washbasins, washbasin pedestals, baths, bidets | 7.58 |
| 24 | 26030000 | Copper ores and concentrates | 22.22 |
| 25 | 87089992 | Parts and accessories for the industrial assembly of: cars | 6.01 |
| 26 | 85443000 | Ignition wiring sets and other wiring sets for vehicles, aircrafts | 37.83 |
| 27 | 85389096 | Electronic assemblies for electrical apparatus for switching | 7.81 |
| 28 | 84159000 | Parts of air conditioning machines, comprising a motor-driven fan | 7.77 |
| 29 | 87089912 | Parts and accessories for the industrial assembly of: cars | 22.76 |
| 30 | 84119104 | Parts of turbojets or turbopropellers, n.e.s. | 18.59 |
| 31 | 39205100 | Plates, sheets, film, foil and strip, of non-cellular polymethyl | 13.78 |
| 32 | 38220000 | Diagnostic or laboratory reagents on a backing, prepared diagnostics | 14.89 |
| 33 | 88033000 | Parts of aeroplanes or helicopters, n.e.s. (excl. those for gliders) | 29.41 |

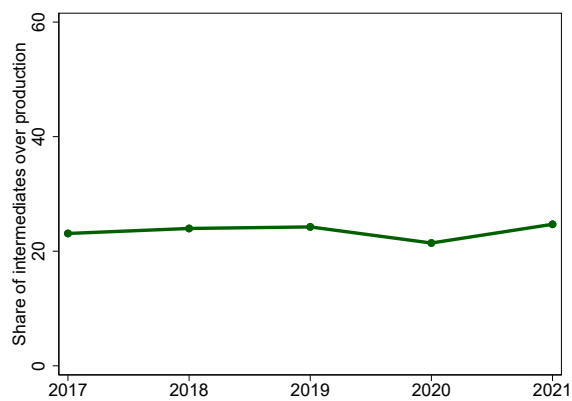
Table A.8: Descriptives on heterogeneity dimensions 2017

| | Obs_0 | Obs_1 | $NumS_0$ | $NumS_1$ | HH_0 | HH_1 | Far_0 | Far_1 | Fri_0 | Fri_1 |
|-------------------------|--------------|--------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Heterogeneity suppliers | | | | | | | | | | |
| A1 OneSup | 12859 | 13263 | 3,4 | 1 | 0,6 | 1 | 3211 | 3005 | 86,5 | 85 |
| A2 PotSup | 20498 | 5624 | 2,4 | 1,6 | 0,8 | 0,9 | 3385 | 2090 | 83,8 | 92,8 |
| A3 Long | 13570 | 12552 | 1,8 | 2,6 | 0,8 | 0,8 | 3441 | 2745 | 83,3 | 88,3 |
| Heterogeneity inputs | | | | | | | | | | |
| B1 Top | 22183 | 3044 | 2 | 3,4 | 0,8 | 0,7 | 3060 | 3311 | 86,4 | 82,7 |
| B2 PSI | 12306 | 13817 | 2,2 | 2,2 | 0,8 | 0,8 | 2872 | 3315 | 88,5 | 83,2 |
| B3 HighRisk | 16262 | 8050 | 2,1 | 2,4 | 0,8 | 0,8 | 2951 | 3429 | 87,1 | 82,6 |
| Heterogeneity geography | | | | | | | | | | |
| C1 Top Non-EU | 19406 | 6716 | 2,2 | 2,3 | 0,8 | 0,8 | 1534 | 7651 | 98,9 | 47,6 |
| C2 China main | 23451 | 2671 | 2,2 | 1,9 | 0,8 | 0,9 | 2409 | 9231 | 94,6 | 7,4 |
| C3 China only | 18002 | 1548 | 1,6 | 1 | 0,9 | 1 | 1861 | 9689 | 97,5 | 0 |
| Heterogeneity firm | | | | | | | | | | |
| D1 Large | 7676 | 18446 | 1,9 | 2,3 | 0,8 | 0,8 | 3530 | 2930 | 79,9 | 88,1 |
| D2 High prod. | 9658 | 16464 | 2 | 2,3 | 0,8 | 0,8 | 3267 | 3012 | 83,5 | 87 |
| D3 Export dest. | 10216 | 15906 | 2 | 2,3 | 0,8 | 0,8 | 2816 | 3293 | 88,4 | 84 |

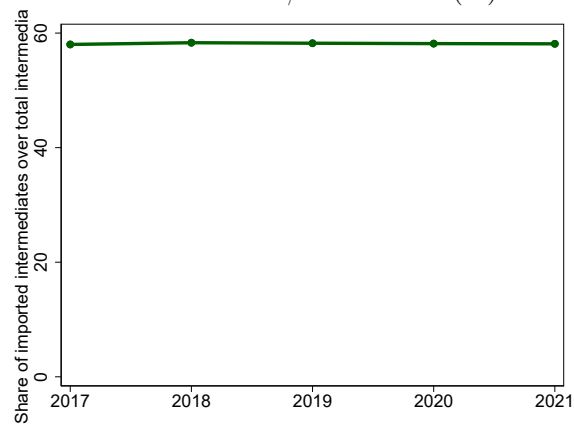
Appendix B Additional analyses

Figure B.1: Decomposition of reshoring, 2017-2021

A. Imported intermediates/total intermediates (%)

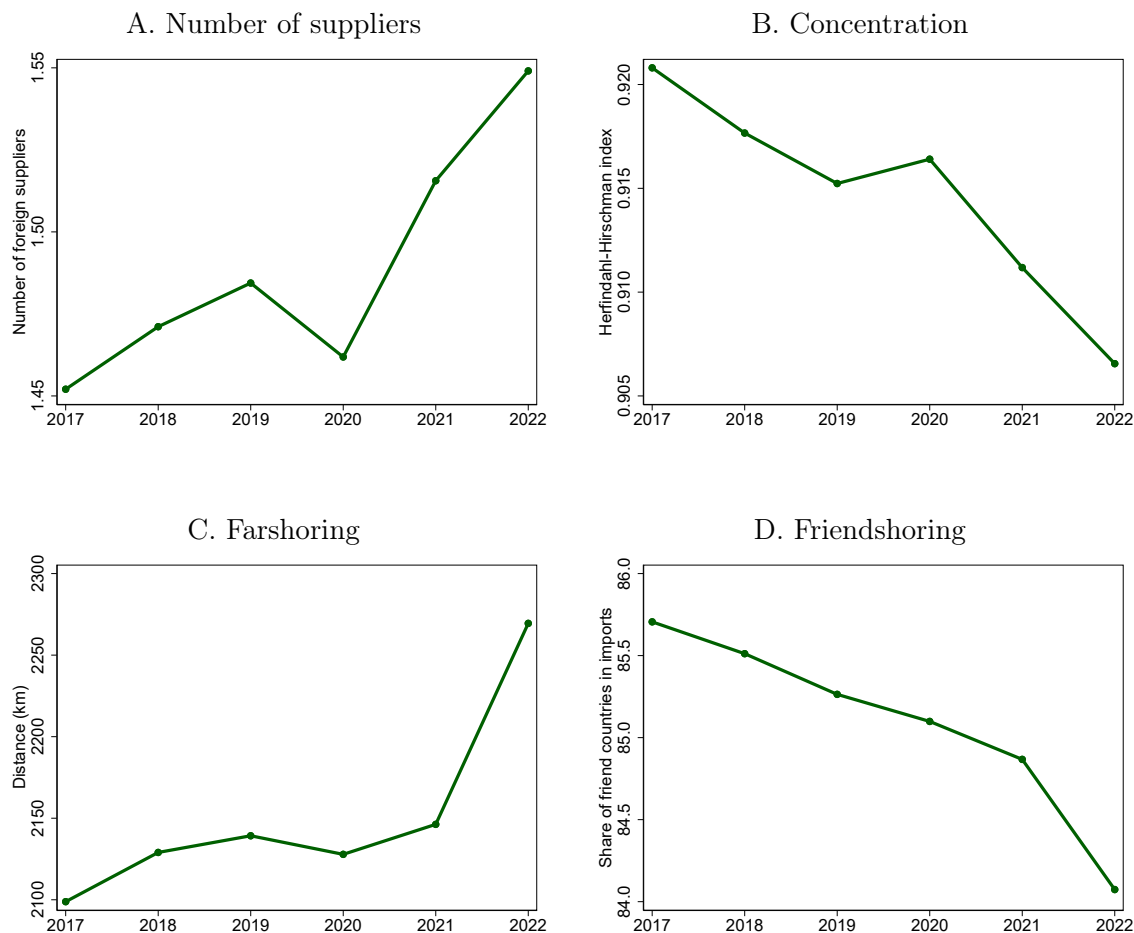


B. Intermediates/Production (%)



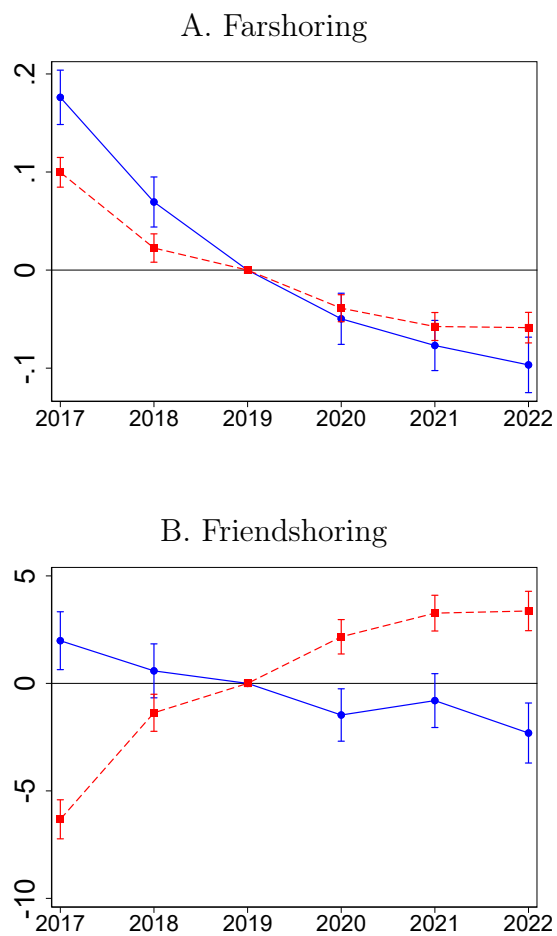
Note: Each figure plots the yearly average of the variable.

Figure B.2: Robustness. EU as a single country. Implementation of strategies to respond to supply-chain disruptions, 2017-2022



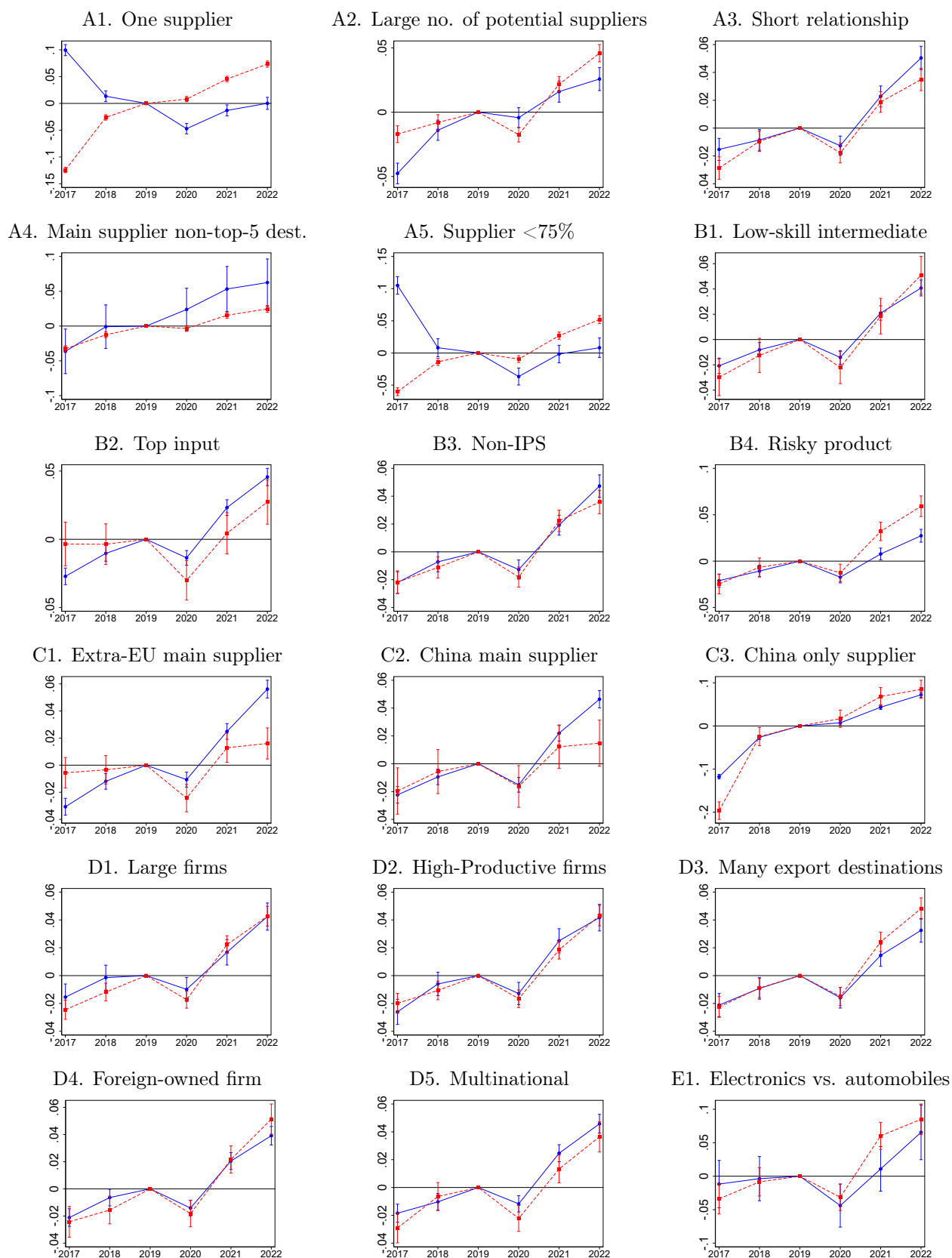
Note: Each figure plots the yearly average of the variable. Panel A plots the number of countries per firm \times intermediate combination. Panel B plots the Herfindahl-Hirschman index of the value of imports by supplier in a firm \times intermediate combination. Panel C plots the import-value weighted distance of suppliers in a firm \times intermediate combination. Panel D plots the share on imports that originate in countries that are friends in Spain in a firm \times intermediate combination. A country is a friend of Spain if it voted “Yes” in the UN General Assembly’s Resolution ES-11/1 “Aggression against Ukraine” (March 2, 2022). Data in panels A to D is at the firm \times intermediate level, whereas in panels E and F is at the firm level.

Figure B.3: China is the main supplier vs. other distant countries are the main suppliers



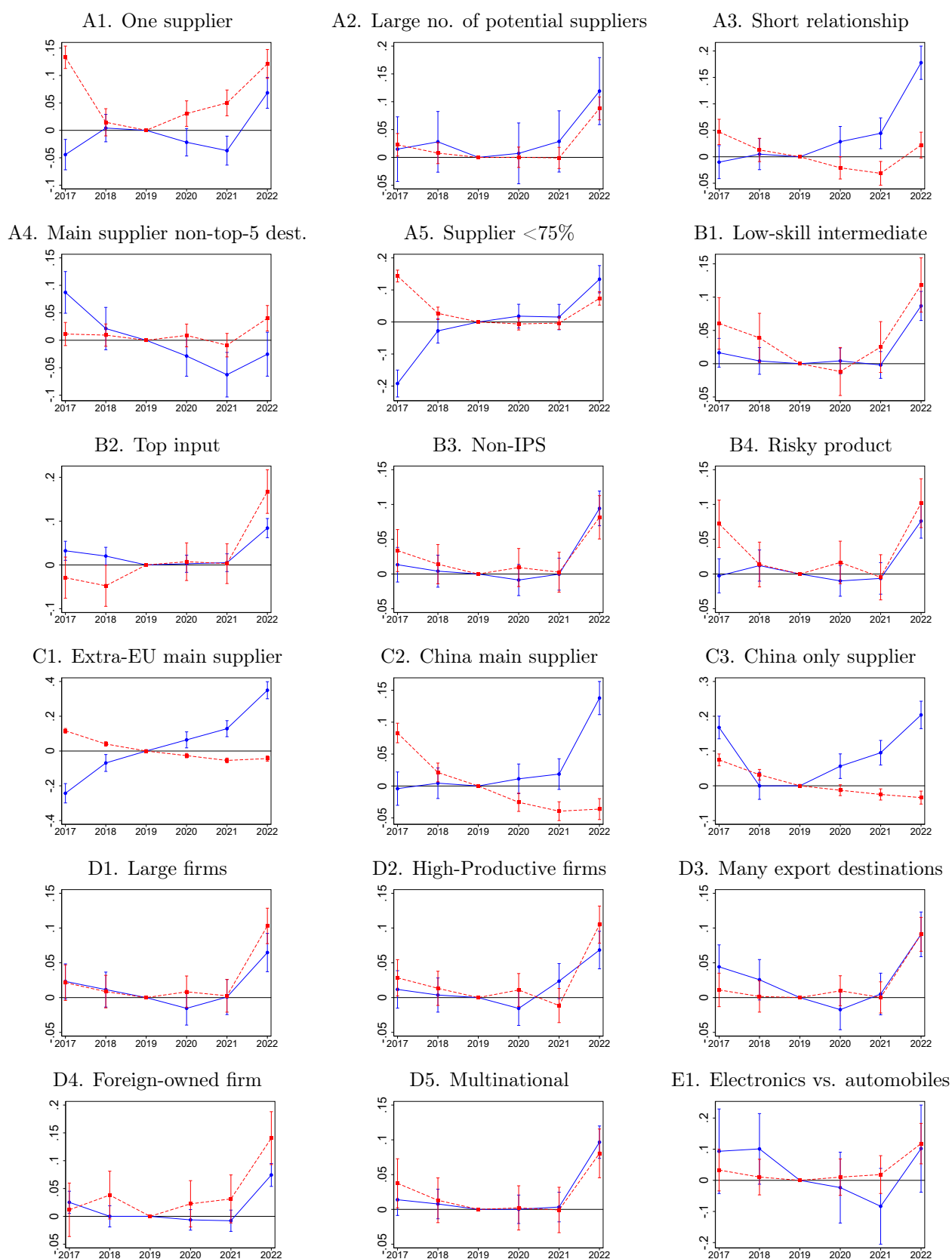
Note: Distant countries are those located at 9,000 km (flight distance) from Spain. Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.

Figure B.4: Robustness. Heterogeneity. EU as a single origin. Number of suppliers



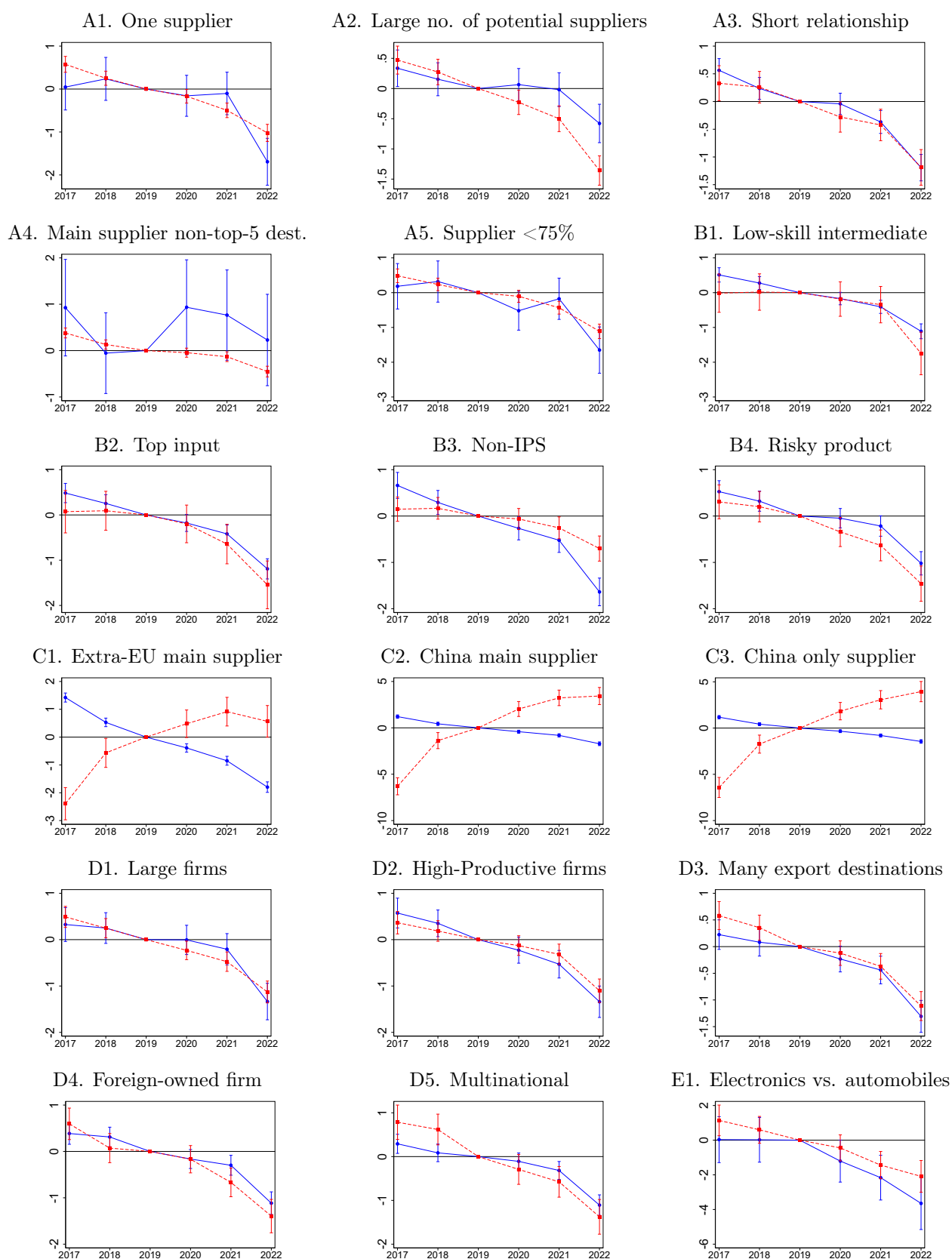
Note: Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.

Figure B.5: Robustness. Heterogeneity. EU as a single origin. Farshoring



Note: Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.

Figure B.6: Robustness. Heterogeneity. EU as a single origin. Friendshoring



Note: Each panel plots the point values and the 95% confidence intervals estimated with Equation (2). The red-dashed line links the point estimates of the group identified in the title of the panel and the blue line the ones of the alternative group.