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# Regional Trade Integration and Input Sourcing Patterns of Multinational Enterprise Plants: Evidence from the ECFA*

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May 2021

**Abstract**

This paper studies the impacts of regional trade integration on the input sourcing patterns of firms engaging in multinational production. We examine the responses of Taiwanese MNC affiliates in mainland China around the time of a single event — the signing of the Economic Cooperation Framework Agreement (ECFA) between the Mainland and Taiwan in June 2010. Using data on firm-level ownership linkages in conjunction with transaction-level trade flows between 2006 and 2015, we find strong evidence that in response to input tariff reductions, firms increased imports not only from members but also from non-member trade partners. The scale effect through the demand response to lower input costs appears to dominate the direct substitution effect from the enhanced trade relation across the Strait, leading to a trade creation effect outside the integrated bloc. Moreover, to a large extent, the trade created outside the bloc appears to be contained within multinationals' organizational boundary. In particular, for contract-intensive products, firms mainly increased sourcing from related parties. The findings suggest that MNC production networks strengthen the trade creation effect of regional trade agreements by reducing contractual frictions and search frictions along input-output linkages.

Keywords: Regional trade agreement; input tariff; input sourcing; multinational production linkage; trade creation; trade diversion.

JEL codes: F13, F14, F23

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# 1 Introduction

The world has become increasingly integrated over the past few decades. The emergence of multinational corporations (MNCs), which feature chains of production spanning multiple countries, has transformed the global landscape of industrial activities. In 2014, MNCs accounted for 55% of global exports and 49% of imports, with a large part consisting of intermediate goods trade within MNC networks.[1] Alongside the process of globalization, economic ties have been strengthened as neighboring countries sign regional trade agreements (RTAs). According to WTO's Regional Trade Agreement Database, total active RTAs among member countries increased from 124 to 264 between 2004 and 2014. In this paper, we seek to understand: (i) how RTAs influence MNCs' input sourcing patterns within or beyond the integrated region and the MNCs' organizational borders; and (ii) the role of MNC production networks in shaping trade creation or trade diversion outside the integrated bloc.

As shown in Antràs et al. (2017), foreign sourcing decisions are interdependent across markets. When making sourcing decisions, multinational enterprise plants import intermediate inputs with different degrees of complementarity and substitutability to achieve the optimal production scale. When tariffs decrease within the integrated bloc, two countervailing forces alter the patterns of input sourcing from suppliers outside the bloc. On the one hand, there is a direct substitution effect shifting imports towards the integrated region where the sourcing costs are now reduced. On the other hand, the decrease in input costs due to the formation of RTAs encourages MNCs to scale up production. This scale effect increases demand for inputs from all other countries. MNC production linkages, in turn, may play a crucial role in influencing these substitution and scale effects through moderating contractual and search frictions. Whether MNC production networks foster trade creation or strengthen trade diversion outside the integrated bloc is an empirical question that we investigate in this paper.

We draw on a unique panel data of Taiwan-MNC affiliates in mainland China, and study the changes in their input sourcing patterns around the time of a single event — the signing of the Economic Cooperation Framework Agreement (ECFA) between mainland China and Taiwan in mid-2010. The ECFA offers several advantages for assessing the global sourcing strategies of MNC affiliates. First, the ECFA is largely driven by geopolitical considerations. Hence, the tariff reduction scheduled in the Early Harvest Program is likely to be exogenous to the MNC affiliates under study. Second, to a large extent, the ECFA does not combine tariff reduction with other major policy changes, thereby providing a unique opportunity to isolate the role of tariff liberalization.[2] Third, mainland China and Taiwan are natural trading partners. In

[1] "Multinational Enterprises in the Global Economy", OECD report. See also Cadestin et al. (2018).

[2] The Early Harvest Program is the first and, to date, the only trade pact between the Mainland and Taiwan

particular, Taiwan became mainland China's sixth inward-FDI origin and second-largest import origin in 2007. Accordingly, Taiwan-based MNCs established a large number of manufacturing affiliates, spanning a wide range of industries, in China (UNCTAD, 2007), which allows us to exploit rich quasi-experimental variations in firm-specific input tariff shocks.

The dataset employed in this paper is built up from the ORBIS database, which provides comprehensive information on the organizational linkages and industry activities of firms worldwide. We extract the data on Taiwan-MNC manufacturing subsidiaries in mainland China, and match these firms with transaction-level trade data from China's General Administration of Customs. The baseline sample spans the period 2006 to 2015, and consists of 633 active Chinese subsidiaries belonging to 303 Taiwanese parent firms, along with 583 affiliated siblings spanning 32 countries. Another important feature of our empirical analysis is distinguishing between intra-firm and inter-firm trade. Specifically, following Alfaro and Charlton (2009), Atalay et al. (2014), and Alfaro et al. (2019), we construct proxy measures of intra-firm trade by combining the information on sibling affiliates' locations and industry affiliations from ORBIS with information on transaction flows from China's customs dataset. To capture the impact of the reduction in input tariffs on each subsidiary, we construct a firm-specific measure of the input tariff shock. The measure reflects the degree to which production costs fell due to cross-firm differences in initial intermediate input composition and cross-product differences in the ECFA tariff cuts.

We are interested in the changes in the sourcing behaviors of these Chinese manufacturing subsidiaries following the formation of the ECFA. We first present evidence that a reduction in import tariffs on Taiwan-sourced inputs led to higher imports not only from the integrated bloc (i.e., Taiwan), but also from other countries/regions outside the bloc. In addition, firms' exports also increased in response to the input tariff reduction, which hints at an expansion in the production scale of firms affected by the ECFA (i.e., firms importing inputs that enjoy preferential tariff treatment).[3] Moreover, the trade creation effect outside the bloc is more pronounced for subsidiaries facing a higher demand elasticity as the demand elasticity governs the responsiveness of a firm's profit and production scale to a reduction in variable production costs. These findings imply that the scale effect through the demand response to lower input costs dominates the direct substitution effect related to imports shifting toward locations where the costs of sourcing have been reduced. This result echoes the empirical findings in Antràs et al. (2017) — that an increase in input sourcing from China raises U.S. firms' domestic input purchases and imports from other countries.

(see Section 2 for further discussions).

[3]This finding is consistent with Blaum (2019) who shows the complementarity between importing and exporting decisions of global firms when profits are multiplicative in the scale of demand and the unit cost.

For imports originating beyond the integrated bloc, do RTAs have differential impacts on the MNCs' decision to source from foreign affiliates versus independent suppliers at arm's length? What are the key determinants of such differences? Using different proxies of intra-firm trade, we find that to a large extent, the RTA's trade creation effect outside the integrated bloc is contained within multinationals' organizational boundary. That is, for suppliers outside the bloc, the effects are larger for related suppliers than unrelated suppliers from third origins. Importantly, we show that in response to a reduction in input tariffs, firms mainly resort to sibling affiliates to source more contract-intensive inputs when production is scaled up. In contrast, firms tend to increase imports of less differentiated inputs from arms-length suppliers. These findings suggest that the MNC production networks facilitate trade creation outside the integrated bloc by reducing contractual frictions and search frictions.

We address a series of issues that may contaminate these findings. To verify the robustness of our findings, we use alternative measures of ownership linkages (e.g., the "narrow offshoring" measure employed by Feenstra and Hanson (1999) and Hummels et al. (2014)), alternative formulations of input tariffs, and different subsamples of Chinese firms (e.g., restricting the sample to firms established prior to 2008). Our results also remain robust to controlling for differential effects that work through a set of source-country characteristics (e.g., geographic distance, GDP per capita, average schooling, and institutional effectiveness).

The body of empirical evidence paints a consistent picture that tariff reduction associated with the ECFA strengthens economic linkages across and potentially beyond the Strait. The presence of MNC networks not only strengthens the trade creation effect of a RTA within the integrated region, but also promotes trade with countries outside the region. With the concurrent growths of regional trade integration and multinational production, our findings highlight the importance of gaining a better understanding of how MNCs influence the trade impacts of RTAs, which in turn has important implications on the political viability as well as the economic and welfare ramifications of trade agreements.

Our paper weaves together three strands in the literature. First and foremost, our paper is related to studies that highlight the interdependence of firms' global sourcing decisions (Alfaro et al., 2019; Antràs et al., 2017; Blaum, 2019). Our study complements this literature by using a quasi-experimental setting to provide empirical evidence on the complementarity of input sourcing from suppliers within and beyond the RTA bloc, and to demonstrate how such interconnection varies within and beyond organizational boundaries.

The paper also fits into a broader set of studies on RTAs that investigate policy relevant issues including: (i) the extent to which RTAs are able to create and divert trade, which in turn

governs the welfare implications of RTAs; and (ii) the factors that determine these forces.[4] The existing empirical evidence on the trade creation and trade diversion effects of RTAs, however, are not entirely conclusive. For instance, in the context of the Canada-United States Free Trade Agreement, Clausing (2001) and Trefler (2004) use disaggregated product-level trade data to identify a large trade creation effect within the bloc that dominates the trade diversion effect. Moser and Rose (2014) estimate the effects of news concerning RTAs on the returns of national stock markets. They find evidence that national stock markets rise more for RTAs signed between countries that are natural trading partners, while there is no evidence that capital markets expect significant trade diversion effects. Romalis (2007), on the other hand, examines the expansion of the North American Free Trade Agreement (NAFTA) to Mexico, and finds strong evidence that the regional trade agreement has been trade diverting. Based on a quantitative model with input-output linkages, Caliendo and Parro (2015) find welfare gains from trade creation with NAFTA members and welfare losses from trade diversion with the rest of the world. Our findings suggest that as MNC production linkages continue to strengthen, RTAs are more likely to have trade creating effects outside the integrated region.

Finally, our paper is also related to the literature on the impacts of RTAs on multinational activity. Antràs and Foley (2011) and Chen (2009) show that regional trade liberalization not only raises intra-bloc investment and input trade, but also attracts foreign direct investments — which are driven by multinational firm activities — originating outside the integrated bloc. In the NAFTA context, Feinberg and Keane (2001) show that Canadian affiliate sales to the U.S. increase in response to the reduction in Canadian tariffs, while U.S. parent sales to Canadian affiliates experience little change. The findings suggest that MNC production linkages facilitated the trade creation effect generated by NAFTA within the integrated bloc. Our paper differs from these studies as we focus more on the impacts of RTAs on the input sourcing decisions of multinational enterprise plants within the integrated bloc. Specifically, we investigate the changes in the firms' imports from related parties and arms-length suppliers outside the integrated region.

The remainder of this paper is organized as follows. In Section 2, we introduce the context of Cross-Strait relations and the ECFA Early Harvest Program signed between mainland China and Taiwan. Section 3 discusses the testable hypotheses. Section 4 describes data sources and the construction of key variables, followed by a series of stylized facts. The main results are reported in Section 5. We discuss the robustness of our findings in Section 6, and conclude in Section 7.

[4]Theoretical works by Kemp and Wan (1976), Krishna (1998), and Krishna (2003) highlight the sufficient conditions for welfare-enhancing RTAs and their political feasibility.

# 2 Context and Details of the ECFA

## 2.1 Cross-Strait Relations and the Rapprochement to the ECFA

Due to the long-standing political tension between the Mainland and Taiwan, there has been little direct cross-strait interaction since the two sides split in 1949. Cross-strait trade remained illegal until the late 1980s, progressing from indirect trade through Hong Kong eventually to direct trade in 2001. In May 2008, Ma Ying-Jeou of Kuomingtang won the leadership election in Taiwan, and resumed discussions on economic cooperation with the Mainland. In less than two years, cross-strait meetings led to fifteen bilateral treaties, including the 2010 Economic Cooperation Framework Agreement (ECFA).[5]

The ECFA proposes multiple targets on cross-strait trade, investment, and dispute settlements, aiming to establish closer economic ties across the Strait. With a focus on structure and objectives, the ECFA left detailed terms and plans to be negotiated at a later time. Negotiation primarily concentrated on tariff reduction. An Early Harvest List was initiated to liberalize tariffs on selected manufacturing and service industries. This tariff liberalization enabled early access to each other's market prior to the establishment of other agreements under the framework. The List took effect in January 2011, and tariffs on selected goods were gradually reduced to zero in three phases over two years. The implementation of the List was completed in January 2013.

Beyond the Early Harvest List, however, no definite content or time line was given for other negotiations. In fact, the Early Harvest List is the only trade pact under the ECFA that has been implemented to date, owing to the deterioration of cross-strait relations one year after the Early Harvest Program was completed. In March 2014, the Sunflower Movement in Taiwan protested against the Cross-Strait Trade in Service Agreement (CSTSA, a sub-clause of the ECFA). The protest intensified constitutional and political concerns across the Strait. As a result, the service pact was never ratified by the Taiwanese legislature. The Mainland and Taiwan continue to hold discussions on economic cooperation and integration under the ECFA. Nevertheless, no further mutual agreement has been made since then.

The 2011 ECFA provides a unique opportunity to investigate the effects of a regional trade agreement on the sourcing behavior within multinationals' production networks. First, due to close geographical proximity and cultural affinity, a handful of Taiwanese multinationals have invested and established subsidiaries in mainland China, most of which operate in the manufacturing sector. The existence of these subsidiaries allows us to draw on a large number

[5]Bilateral agreements established between 2008 and 2010 include direct links over air and sea, postal services, individual travel, protections of intellectual property rights, and judicial assistance.

of firm-level observations to study the spillover effects of RTAs beyond the integrated bloc through the multinational production networks. Second, to a great extent, the primary thrust of the ECFA was tariff reduction. No other major policy changes were introduced, and neither did macroeconomic disturbance occur. Hence, the ECFA provides a unique opportunity to isolate the role of tariff liberalization on MNC affiliates' sourcing strategies.

## 2.2 Cross-Strait Trade and Investment

Trade across the Strait was legalized in the late 1980s, progressing from indirect trade through Hong Kong and eventually to direct trade in 2001. Since then, cross-strait trade flows have risen dramatically. In 2007, Taiwan became China's second-largest import origin. Taiwan's exports to China are predominated by intermediate goods and components, which accounted for more than 80 percent of its total exports to China in 2006.[6]

The rapid development in cross-strait trade echoes the patterns in cross-strait investment. FDI flows from Taiwan to mainland China have increased since the early 2000s.[7] Accordingly, a large number of affiliates established by Taiwan-based MNCs ranked among the largest foreign affiliates in China (UNCTAD, 2007). Most Taiwanese exports are induced by its outward investment destined to the Mainland. The nexus between trade and investment was driven by the engine of globalization and fueled by Taiwanese MNCs, as mainland China became increasingly important in the global value chain. A handful of Taiwanese electronic-related manufacturers have a dominant role in Taiwan's exports to the Mainland; these manufacturers include Lite-on Technology Corp, Hon Hai Precision, and Inventec Corp. According to our firm ownership data, Taiwanese MNC production in China has a larger presence in the electronic and other electric equipment industry, as well as the industrial machinery and equipment industry.

## 2.3 The Early Harvest List and Tariff Cuts

The Early Harvest List entered into force on January 1, 2011. According to the agreement, mainland China will lower tariffs on 539 6-digit HS items, among which 413 are manufacturing products. Conversely, Taiwan will cut tariffs on 234 manufacturing items. Import tariffs on selected goods were gradually lowered to zero in three phases over two years, based on the level of MFN rates observed in 2009. On the Mainland side, the List stipulates that: (i) tariffs on

[6]The data are from China's General Administration of Customs. Each 6-digit HS product is classified into capital, intermediate, or consumption goods based on the Broad Economic Categories (BEC) codes. In 2006, 75.2% of mainland China's imports from Taiwan were intermediate goods and components. The share increased slightly to 79.3% in 2011. See also Chow (2013); Hong and Yang (2011).

[7]Taiwan became China's sixth-largest inward-FDI origin in 2007. The other top origins include Hong Kong, Korea, Japan, Singapore, and the United States.

products with MFN rates ranging from 0% to 5% in 2009 are reduced to 0% on January 1, 2011; (ii) tariffs on products with MFN rates ranging from 5% to 15% are reduced to 5% on January 1, 2011 and 0% on January 1, 2012; and (iii) tariffs on products with MFN rates higher than 15% are reduced to 10% on January 1, 2011, 5% on January 1, 2012, and 0% on January 1, 2013. Taiwan's tariff schedules are designed in a similar fashion but with different cutoffs.[8] The majority of the selected items on the Mainland's List have MFN tariffs in the range of 10 to 15 percent, while the products on Taiwan's List mostly lie in the range of 2.5 to 3 percent. Henceforth, we refer to the products included in the Early Harvest Program as ECFA products.

Figure 1 plots the average bilateral tariffs imposed by mainland China and Taiwan over the sample period of 2006 to 2015. The tariffs imposed by mainland China on products from Taiwan remained relatively stable at 10% on average between 2006 and 2010. Following the implementation of the Early Harvest List in 2011, the Mainland's import tariffs on ECFA products gradually declined from an average of 9% in 2011 to 0% in 2013. On Taiwan's side, the average import tariffs imposed on products from mainland China were stable at 5% prior to the ECFA. Taiwan's import tariffs on ECFA products were reduced from an average of 4% in 2011 to 0% in 2013 and thereafter. In both regions, non-ECFA products are subject to the MFN tariffs and remain largely unchanged throughout the period. In 2006, ECFA products accounted for 18.24% of manufacturing imports by mainland China from Taiwan and 11.17% of manufacturing imports by Taiwan from mainland China. Notably, more than half of the products on the Early Harvest List are in the chemicals, textiles, and electrical machinery sectors. ECFA products account for a large import share in some sectors. For example, in the textile sector, the 6-digit products on mainland China's List constituted 15.07% of the total number of textile products and 64.56% of total textile imports from Taiwan in 2006.[9]

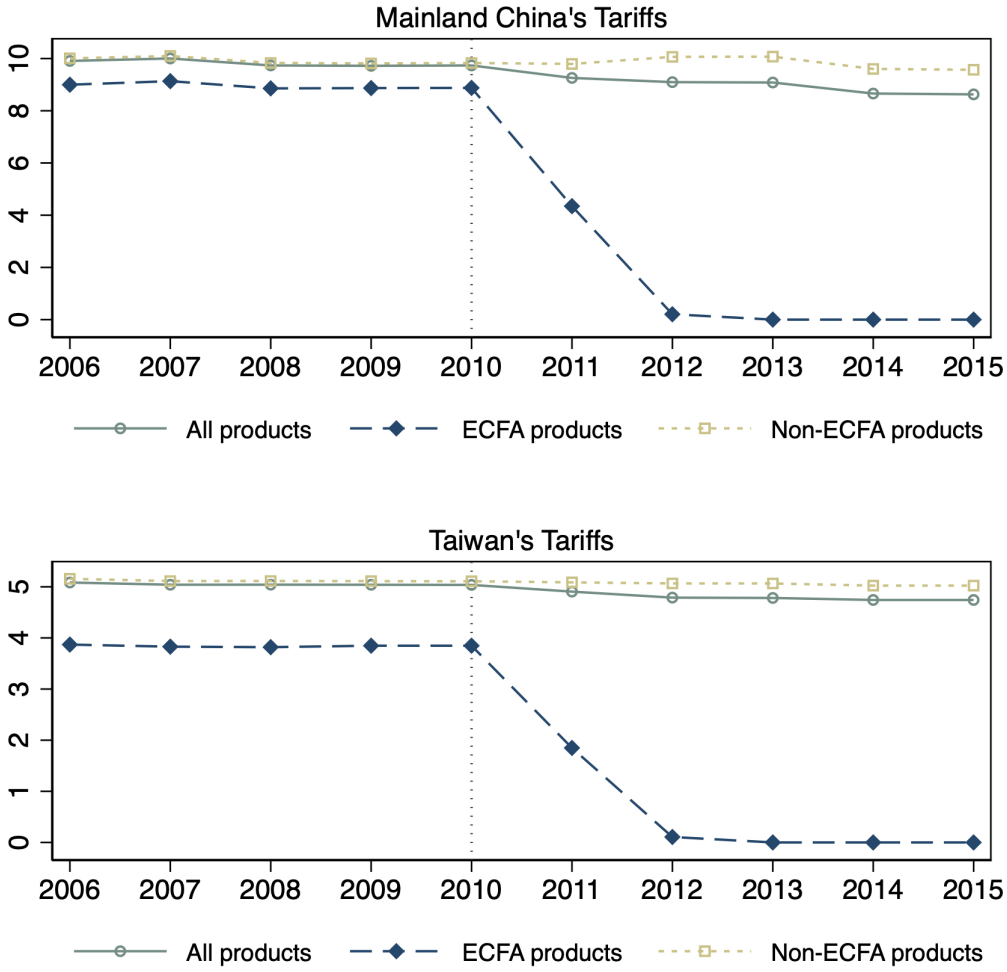
Our empirical analysis utilizes variations in tariff changes across products. An endogeneity problem may arise if policymakers impose different tariff reductions on products that are on different trajectories in terms of import demand, or if the MNCs seeking to expand the global supply chain are able to lobby for larger tariff reductions.[10] In the context of the cross-strait

[8]On the Taiwan side, the List stipulates that: (i) tariffs on products with MFN rates ranging from 0% to 2.5% in 2009 are reduced to 0% on January 1, 2011; (ii) tariffs on products with MFN rates ranging from 2.5% to 7.5% are reduced to 2.5% on January 1, 2011 and 0% on January 1, 2012; and (iii) tariffs on products with MFN rates higher than 7.5% are reduced to 5% on January 1, 2011, 2.5% on January 1, 2012, and 0% in January 1 2013. See Table A.1 for an outline of the Early Harvest Program.

[9]See Table A.2 in the Appendix for a detailed industry breakdown of the products on the Early Harvest List.

[10]See, for example, Blanga-Gubbay et al. (2021). A related concern is that policymakers in MNCs' home country/region (in our context, Taiwan) have incentives to improve market access for imports from foreign affiliates (in our context, Chinese affiliates) (Blanchard and Matschke, 2015). This concern is less acute in our analysis. As shown in Section 4, the share of exports from Chinese subsidiaries to Taiwan in the sample is relatively small. Therefore, we do not focus on the market access channel. Instead, we focus on the implications

Figure 1: Product-Level Tariffs from 2006 to 2015




*Notes:* The upper panel of this figure plots the simple averages of tariffs imposed by mainland China on products from Taiwan of all 6-digit HS products, ECFA products and non-ECFA products, respectively. The lower panel report the corresponding statistics of tariffs imposed by Taiwan on products from mainland China.

political economy, this is less a concern in the specific case of the ECFA. Qualitative analysis indicates that the driving force for ECFA stems from political motives rather than special interest groups from the private sector. In particular, mainland China regards the ECFA as a strategic move and a vehicle towards an environment conducive for future political reconciliation (Hong and Yang, 2011; Hu and Vanhullebusch, 2014).[11]

of the reduction in variable production costs due to the ECFA tariff reductions on input sourcing by Chinese affiliates.

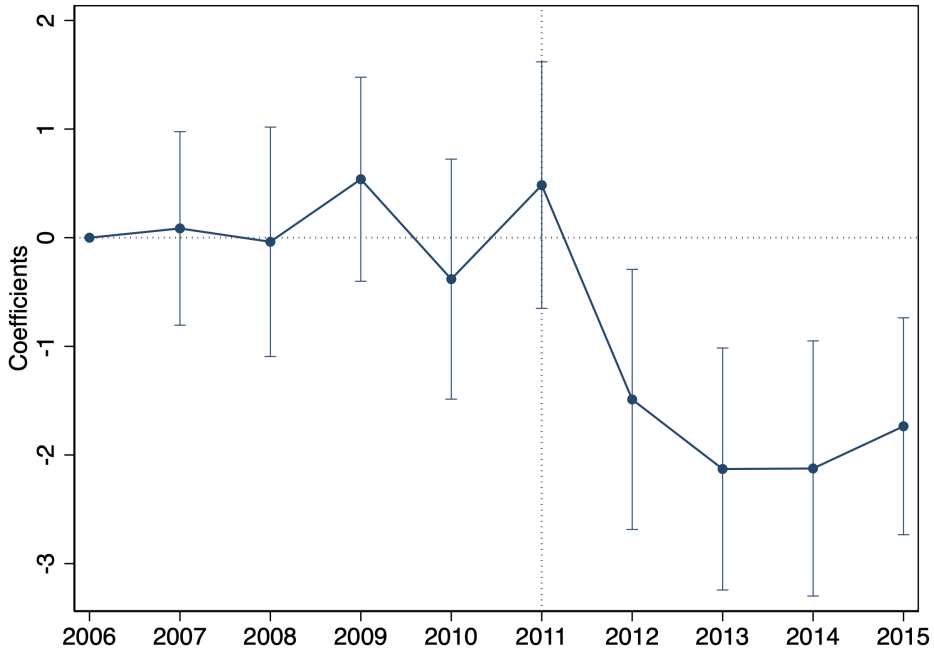
[11] As put by The Economist (August 8, 2009): "Free trade agreements (FTAs) are often contentious but rarely would one have as much strategic significance as that proposed between China and Taiwan... Nevertheless, in the long run China hopes that economic interdependency and goodwill will eventually encourage the island to return to the fold. The trade pact will be a test of whether that hope can be fulfilled."

To provide further support for the exogeneity of tariff reductions, we estimate the following dynamic specification using product-level import data:

$$\ln(Import_t^k) = \sum_{s=2006}^{2015} \beta_s \big(\mathbf{1}\{t=s\} \times \Delta \ln \tau^{k,CHN}\big) + D^k + D_t^K + \epsilon_t^k. \tag{1}$$

The dependent variable is the change in log of import by mainland China from Taiwan of a 6-digit HS product $k$ in year $t$; $\Delta \ln \tau^{k,CHN} = \Delta \ln(1+Tariff^{k,CHN})$ captures the change in the tariff imposed by mainland China on Taiwanese product $k$ from 2010 to 2013; $D^k$ denotes the product dummies; and $D_t^K$ is the sector-year dummies, where the sectors are defined by the 2-digit HS codes. Standard errors are clustered at the product level to account for potential serial correlations within each product. The coefficients $\beta_s$ reported in Figure 2 reveal the timing of the effects of the overall tariff reduction introduced by the ECFA. The estimates are statistically indistinguishable from zero for periods before 2011, which alleviates the concern that the pre-determined trends in the product-level imports are correlated with subsequent tariff reductions. In addition, we find that starting from 2012, the tariff cuts encouraged imports, and the effect remains stable in subsequent periods.

Figure 2: Changes in Imports and Changes in Import Tariffs at Product Level




*Notes:* This figure plots the estimated coefficients $\beta_s$ of the regression $\ln(Import_t^k) = \sum_{s=2006}^{2015} \beta_s \big(\mathbf{1}\{t=s\} \times \Delta \ln \tau^{k,CHN}\big) + D^k + D_t^K + \epsilon_t^k$. Error bands show 90% confidence intervals. Standard errors are clustered at the 6-digit product level.

Analogously, we examine the dynamic effects of the changes in tariffs imposed by Taiwan on exports from mainland China. The results are reported in Figure B.1 in the Appendix. The estimated coefficients prior to 2011 are negative and statistically significant, which implies that tariffs declined more for products that saw stronger growths in import from China in the preceding periods before 2011. Hence, the tariff reductions by Taiwan could be an endogenous response to domestic import demands. Given this observation and the fact that the decline in tariffs in Taiwan is relatively small in magnitude, in our baseline analysis, we focus on the impacts of tariff reductions in mainland China on the sourcing activities of Chinese subsidiaries owned by Taiwanese MNCs. As evident in Figure 2, we can reasonably assume that in the absence of the ECFA, Chinese imports from Taiwan across the affected and unaffected products would have followed a common trend.

# 3 MNC Production Networks and Testable Hypotheses

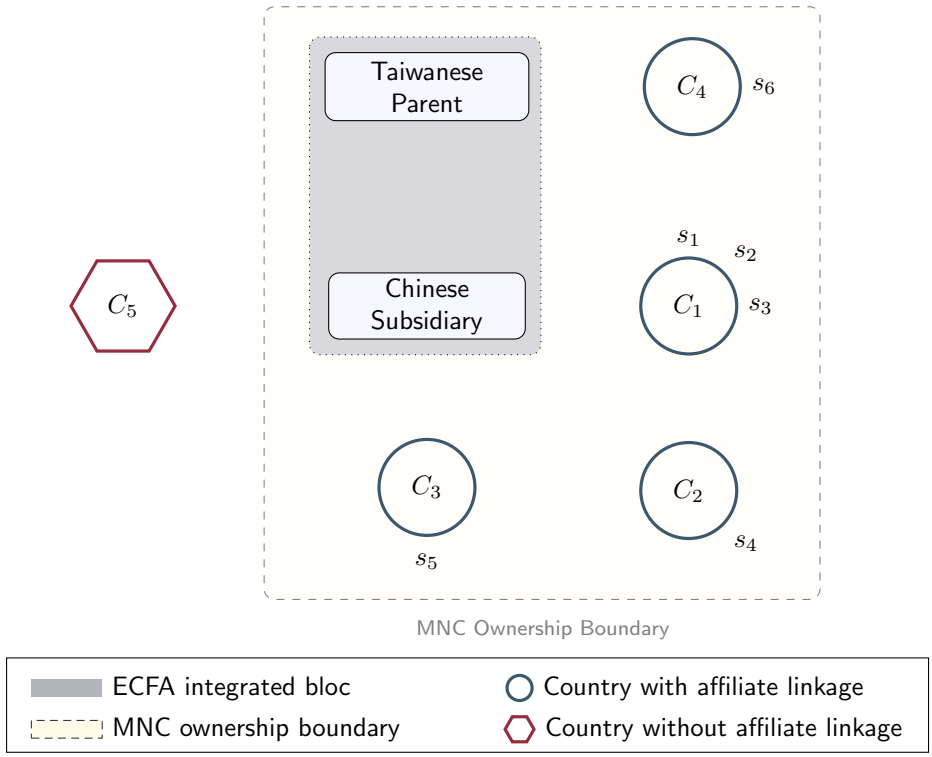
In this section, we discuss the implications of a regional trade agreement on MNCs' sourcing decisions in the context of the ECFA. We separately examine four sets of hypotheses concerning how firms' sourcing strategies should vary across inputs and across suppliers. We analyze the following outcomes: (i) imports within the RTA bloc; (ii) out-of-bloc imports beyond MNC networks; (iii) out-of-bloc imports within MNC networks; and (iv) heterogeneous responses within and beyond MNC networks.

We focus on the sourcing decisions of a Chinese affiliate of a Taiwan-based multinational. Figure 3 depicts the boundary of such a multinational organization. The gray zone represents the Mainland-Taiwan integrated region. In this zone we highlight an MNC linkage, the Taiwanese Parent and the Chinese Subsidiary. This parent company owns production facilities in four other countries/regions (e.g., three subsidiaries, $s_1$, $s_2$, and $s_3$ in country $C_1$). The MNC ownership boundary is represented by the light yellow area.[12]

In Figure 4, we turn to the trade flows of intermediate inputs. Firms in our sample use imported inputs from Taiwan (henceforth, within-bloc imports) as well as from other origins (out-of-bloc imports) to produce a final good. Out-of-bloc imports can be sourced from affiliated firms or through arms-length trade. This diagram provides an illustration of the sourcing strategies of a Chinese subsidiary. The firm imports from: (i) Taiwan, as indicated by the

[12]For example, consider a Taiwanese multinational optoelectronic firm, *Lite-On Technology*. The firm owns manufacturing facilities in ten countries, including mainland China, Japan, Malaysia, and Singapore. In particular, *Lite-On* has 25 manufacturing affiliates in the Mainland. These plants purchase inputs from suppliers across the world, both from countries with and without affiliate linkages. According to the large-scale related-party transactions disclosed in *Lite-On*'s consolidated financial statement, in 2015, its Chinese subsidiaries purchased inputs from and sold inputs to related affiliates in Germany, Malaysia, Singapore, and the United States.

Figure 3: MNC Ownership Boundary



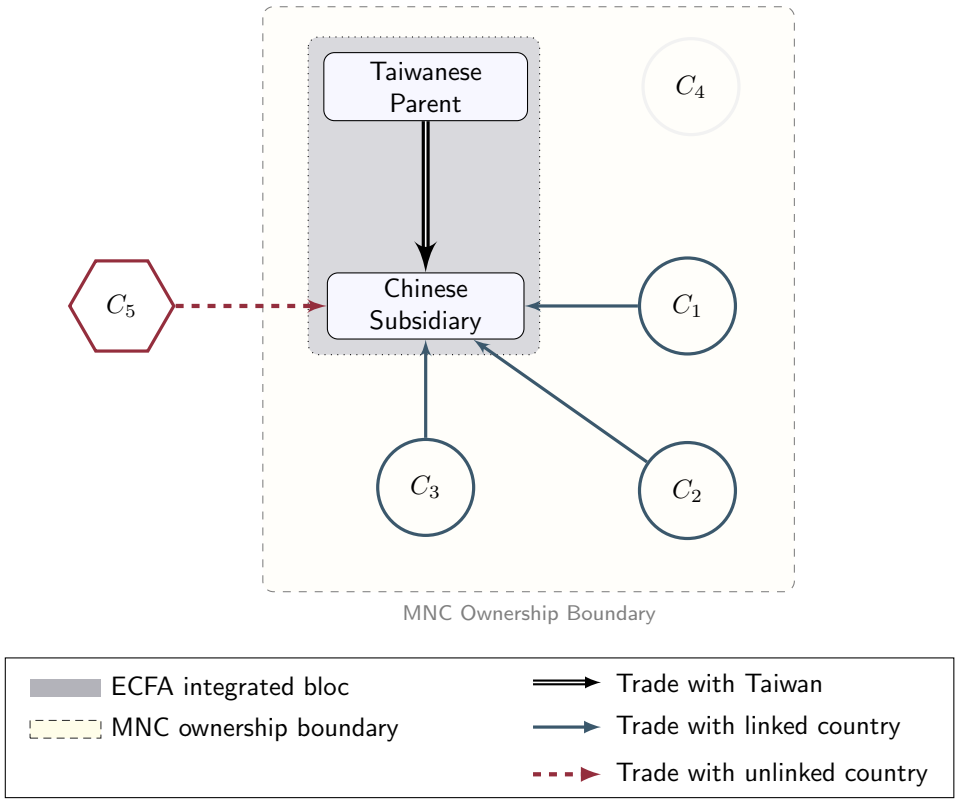

double arrow; (ii) countries/regions outside the bloc that host affiliated firms within the MNC network (blue arrows); and (iii) other countries/regions that lie beyond the MNC network (red dashed arrow). Due to data limitations, we do not directly observe inter-firm or intra-firm trade. In Section 4.3, we will construct measures to infer whether a transaction is intra-firm or inter-firm trade based on the locations and industry affiliations of the sibling firms.

Conceptually, multinational firms decide whether to purchase intermediate inputs within or beyond national borders, and within or beyond organizational borders. When making sourcing decision, firms typically look for the best-valued intermediate inputs with different degrees of complementarity and substitutability to meet the optimal production scale. Therefore, the RTAs that affect a segment of the MNC production network may change the cost of the input bundle, and hence the optimal production scale. MNCs may subsequently alter sourcing patterns among all linkages within the network.

## 3.1 Within-Bloc Imports

The formation of a preferential trade agreement directly reduces the trade costs of participating countries. This reduction in trade costs is the primary driver of our first testable hypothesis that within-bloc imports (i.e., imports from Taiwan) should increase after the ECFA. The reduction

Figure 4: MNC Production Linkages




in variable production costs consequently leads to an expansion in the firm's production scale. The extent to which tariff liberalization affects within-bloc imports is governed by the demand elasticities in the final-goods market. When demand for the final good is relatively elastic, firms' profits are especially responsive to a reduction in variable production costs. As a result, firms tend to ramp up production and hence demand for intermediate inputs following a tariff reduction for inputs.

**Hypothesis 1 (Within-Bloc Imports):** *Following the formation of the ECFA, firms using inputs that were affected by tariff reduction increased their imports of inputs from Taiwan. The effect becomes more pronounced as the demand elasticity for final good increases.*

## 3.2 Out-of-Bloc Imports and Heterogeneity within and beyond MNC Networks

A positive shock to sourcing from one location could result in a firm expanding to the degree that it increases imports from other countries. This prediction is evocative of Antràs et al. (2017), who show that this scenario is more likely to occur under two conditions. First, when demand is elastic, profits are particularly responsive to variable cost reductions. Second, when

inputs from different markets are less substitutable, the increase in within-bloc imports has a smaller negative effect on out-of-bloc imports.

We further examine the extent of complementarity across source markets for inputs transacted within the boundaries of multinational firms (i.e., blue arrows in Figure 4), and separately for inputs traded at the arm's length market (red dashed arrow). There may be heterogeneous responses due to the inherent contractual frictions affecting the organization of production across borders. Conducting transactions of intermediate inputs often requires investments that are specific to a buyer-seller pair. This is the case especially for highly differentiated inputs, whose value are higher within than outside of the relationship, and thus more susceptible to a holdup problem. When contracts cannot be perfectly enforced, firms are concerned with underinvestment and delayed delivery by suppliers, and hence the transaction is less likely to be organized by an arms-length arrangement.[13] We hypothesize that in response to the expansion of the production scale due the RTA, the composition of out-of-bloc imports will change depending on the degree of differentiation of the input. The more differentiated the input, the smaller the increase in out-of-bloc imports from arms-length suppliers, and the greater the increase in out-of-bloc imports from related parties.

We summarize the hypotheses as follows:

**Hypothesis 2 (Out-of-Bloc Imports: beyond the MNC Network):** *Following the formation of the ECFA, in response to the reduction in variable product costs, firm tend to increase their imports from arms-length suppliers outside the liberalized bloc. The effect becomes more pronounced as (i) the demand elasticity for the final good increases; or (ii) the degree of differentiation of the inputs decreases.*

**Hypothesis 3 (Out-of-Bloc Imports: within the MNC Network):** *Following the formation of the ECFA, in response to the reduction in variable production costs, firms tend to increase imports from related suppliers outside the liberalized bloc. The effect becomes more pronounced as (i) the demand elasticity for the final good increases; or (ii) the degree of differentiation of the inputs increases.*

Our last hypothesis concerns the differential responses of imports from suppliers within or beyond the MNC networks. Due to contractual frictions, firms may be better able to increase

[13]Existing studies have shown that firms are more inclined to source inputs within firm boundaries if products are complex and susceptible to imperfect contract enforcement (Bernard et al., 2010; Defever and Toubal, 2013; Nunn, 2007; Nunn and Trefler, 2013). Studies on the property-rights model also emphasize the role of input contractibility (Antràs, 2003; Antràs and Helpman, 2004). The literature has mostly focused on the cross-sectional relation between input contractability and sourcing modes of MNCs. We contribute to the literature by studying the spillover effects of RTAs that vary by input differentiation based on a firm-input-level panel data.

sourcing capability from related parties relative to arms-length suppliers. Following the same logic discussed above, such difference could be more pronounced for the less contractible inputs.

**Hypothesis 4 (Out-of-Bloc Imports: Heterogeneous Effects):** *Following the formation of the ECFA, in response to the reduction in variable production costs, the increase in imports from related parties is larger within the MNC network than outside the MNC network. The difference becomes more pronounced as the degree of differentiation of the inputs increases.*

# 4 Data and Key Variables

In this section, we describe the main datasets, together with the construction of key variables in our analysis. In what follows, we use $i$ to index Chinese subsidiaries, $c$ to denote the input source countries, $k$ to index 6-digit HS products, and $t$ to represent years. Unless otherwise stated, the sample period covers 2006 to 2015, i.e., five years before and after the ECFA shock. Additional details are described in Appendix A.

## 4.1 Trade and Tariff Data

The transaction level data are obtained from China's General Administration of Customs. The customs data allow us to observe for each transaction the value and quantity of import (export) flows by 8-digit HS products and source (destination) country. The data also provide information on trade regimes so that we may classify transactions into two main organizational forms, i.e., ordinary trade and processing trade.[14] For each firm, we aggregate import (and export, separately) transactions to the 6-digit HS product level by source (destination) country and by year. For the analysis at the firm-product-country-year level, we employ trade flow measures based on quantity to alleviate the concern of transfer pricing among affiliated firms in MNCs (Cristea and Nguyen, 2016).[15]

Data on the most-favored-nation (MFN) tariffs at the 6-digit HS product level are obtained from the UN TRAINS database and the WTO Integrated Database from 2006 to 2015. We supplement the tariff data with the official ECFA tariff schedules from 2011 onwards.[16]

[14]Within processing trade, there are two forms: import and assembly and pure assembly. Both forms allow for duty free imports, but face restrictions to sell to the domestic market. Because of these similarities, we combine these two organizational forms into a single form that we refer to as "processing".

[15]We also provide a set of results using import value as dependent variable in Appendix B. When using the value of trade as a dependent variable, observations with zero import quantity are dropped.

[16]Legal text and the ECFA tariff schedules are available at http://rtais.wto.org/rtadocs/713/TOA/English/Combined%20ECFA%20Text.pdf.

## 4.2 Firm-Level Tariffs

**Input Tariffs.** From the perspective of Chinese firm $i$, the exposure of input cost to tariffs imposed on goods from Taiwan in year $t$ is determined by:

$$\ln(\tau_{it}^{M}) = \sum_{k \in \mathcal{O}} \left( \frac{M_{i,t_0}^{k,TWN}}{\sum_c \sum_{k \in \mathcal{M}} M_{i,t_0}^{k,c}} \right) \ln\left(1 + Tariff_t^{k,CHN}\right), \tag{2}$$

where $Tariff_t^{k,CHN}$ represents the ad valorem tariff imposed by mainland China on product $k$ from Taiwan; $\mathcal{M}$ is the set of the firm's total import products, which is the union of the ordinary import set ($\mathcal{O}$) and the processing import set ($\mathcal{P}$); $M_{i,t_0}^{k,TWN}$ denotes the Taiwan sourced import of product $k$ in the first year the firm appears in the sample; and $\sum_c \sum_{k \in \mathcal{M}} M_{i,t_0}^{k,c}$ represents total imports by the firm in the initial year. For the empirical analysis, we take differences of (2) and obtain a measure of the firm-level input tariff shock as follows:

$$\Delta \ln(\tau_{it}^{M}) = \sum_{k \in \mathcal{O}} \left( \frac{M_{i,t_0}^{k,TWN}}{\sum_c \sum_{k \in \mathcal{M}} M_{i,t_0}^{k,c}} \right) \Delta \ln\left(1 + Tariff_t^{k,CHN}\right). \tag{3}$$

On the one hand, the weighted-average structure of measures (2) and (3) resembles the firm-level input tariff measures that are employed in existing studies on the impacts of input trade liberalization on firm outcomes (Amiti and Konings, 2007; Goldberg et al., 2010; Topalova and Khandelwal, 2011). Following the literature, we employ time-invariant weights derived from firms' initial input bundles, which helps to avoid the potential endogeneity problem that the composition of imported inputs may change over time due to tariff reductions. On the other hand, our measures also feature two differences. First, as with Yu (2015), the set of processing imports does not appear in (2) and (3) because import duties are exempted on intermediate goods entering processing trade.[17] Second, we consider only the changes in tariffs imposed on goods from Taiwan. As shown in Appendix B.1, MFN tariffs and applied tariffs imposed on the rest of the world by mainland China and Taiwan did not respond to the tariff reductions associated with the ECFA. Summing up, the variation in $\Delta \ln(\tau_{it}^{M})$ stems from: (i) cross-firm differences in sourcing composition and the importance of ordinary trade in the initial year; and (ii) cross-product variations in tariff reductions due to the ECFA. We assess in Section 6 the robustness of the empirical results to alternative formulations of input tariffs based on different weighting schemes.

[17] In China, special tariff treatments are afforded to imported inputs for processing trade — a trade regime that involves a firm importing intermediate goods and exporting final goods after processing and assembly (Feenstra and Hanson, 2005; Yu, 2015).

**Export Tariffs.** Analogously, the effective tariff faced by Chinese exporters when shipping goods to Taiwan is determined by:

$$\ln(\tau_{it}^{X}) = \sum_{k \in \mathcal{X}} \left( \frac{X_{i,t_0}^{k,TWN}}{\sum_c \sum_{k \in \mathcal{X}} X_{i,t_0}^{k,c}} \right) \ln \left( 1 + Tariff_t^{k,TWN} \right), \tag{4}$$

where $Tariff_t^{k,TWN}$ is the ad valorem tariff imposed by Taiwan on product $k$ from mainland China; $\mathcal{X}$ is the set of products that the firm exports; $\frac{X_{i,t_0}^{k,TWN}}{\sum_c \sum_{k \in \mathcal{X}} X_{i,t_0}^{k,c}}$ represents the firm's export of product $k$ to Taiwan as a share of its total export in the initial year. We do not distinguish between ordinary exports and processing exports here because they are both subject to tariffs imposed by Taiwan. The firm-specific export tariff change is defined accordingly:

$$\Delta \ln(\tau_{it}^{X}) = \sum_{k \in \mathcal{X}} \left( \frac{X_{i,t_0}^{k,TWN}}{\sum_c \sum_{k \in \mathcal{X}} X_{i,t_0}^{k,c}} \right) \Delta \ln \left( 1 + Tariff_t^{k,TWN} \right). \tag{5}$$

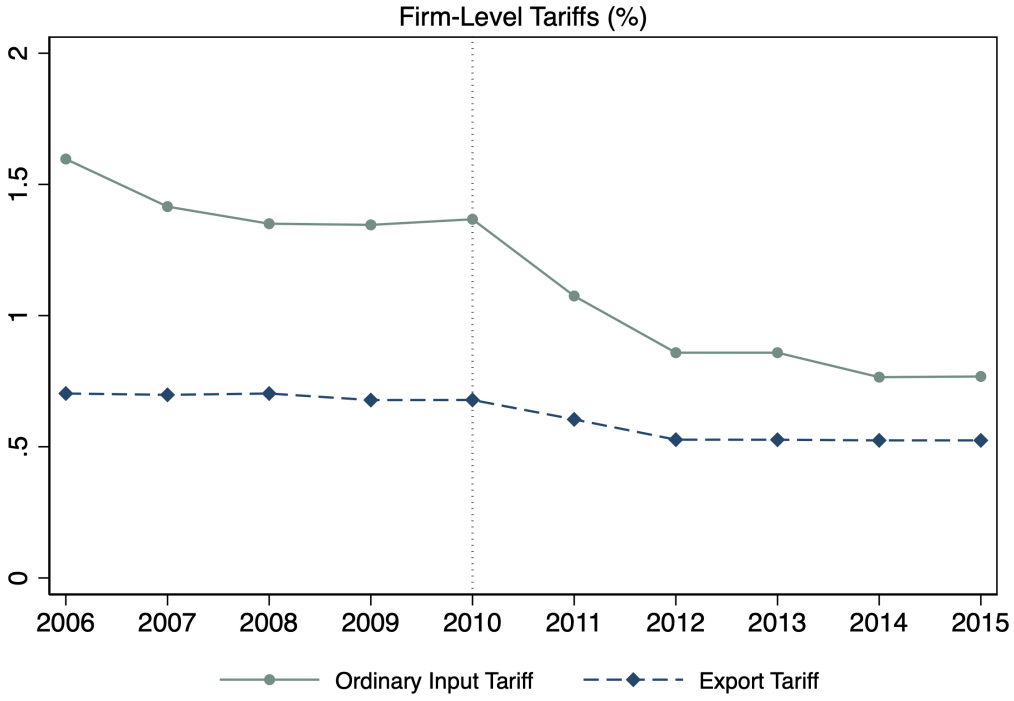
**Summary Statistics.** The solid line in Figure 5 presents the changes in the firm-level input tariff over time. In 2006, the average firm-level input tariff was 1.59%. Following the implementation of the ECFA Early Harvest Program, input tariffs started to declined from an average of 1.07% in 2011 to an average of 0.86% in 2013. There is substantial heterogeneity in the input tariff shock. As reported in Table A.6, the standard deviation of the changes in the input tariff across firm-year observations is 1.23%, which is larger than the average decline of the input tariff over the period. The dashed line shows the evolution of the export tariff. The absence of a discernible declining trend in export tariffs are due to two reasons. First, the share of exports to Taiwan in total exports is fairly low for the firms in our sample. Second, the tariff reductions implemented by Taiwan is considerably smaller than those implemented by mainland China. These factors, together with the endogeneity concern of $Tariff_t^{k,TWN}$ discussed in Section 2, motivate us to focus on input tariffs in our main analysis. Export tariffs will be included later to verify the robustness of our results.

## 4.3 Mainland-Taiwan MNC Production Network

### 4.3.1 MNC Ownership Linkages

The MNC organizational linkages are constructed based on ORBIS, a commercial administrative dataset compiled by the Bureau van Dijk Electronic Publishing, which provides comprehensive information on the ownership structure of firms worldwide. The unit of observation is an establishment, and each establishment is assigned a unique identifier. When applicable, ORBIS provides information on all identified subsidiaries, allowing us to keep track of organizational

Figure 5: Firm-specific Effective Input and Export Tariffs by Year




*Notes:* This figure plots the simple averages of input tariffs and export tariffs across firms in different years.

linkages within the dataset.

We focus on Chinese firms that are affiliated to MNCs headquartered in Taiwan. In ORBIS, we first retrieve the universe of Taiwanese firms that are the global ultimate owners of at least one Chinese firm. Then we link each Taiwanese headquarter to all of its subsidiaries across the world. We restrict our firm sample to Chinese subsidiaries in the manufacturing sector — that is, whose primary SIC code lies between 201 and 399 — and match them to foreign subsidiaries in both manufacturing and wholesale sectors[18]. We also exclude foreign subsidiaries residing in offshore financial centers. We are able to identify the organizational network for each Chinese subsidiary in our sample, which includes the Taiwanese parent firm and foreign affiliated firms (henceforth foreign sibling firms). More details of the matching procedure are discussed in Appendix A.1.

The main analytic sample contains 303 Taiwanese parent firms, 633 Chinese subsidiaries, and 583 foreign siblings across 32 countries. The distribution of industries of the top Taiwanese parent firms and the matched Chinese subsidiaries are tabulated in Tables A.4 and A.5, respectively. Among the 633 matched Chinese firms, in particular, 594 firms engaged in both importing and exporting activities during the sample period from 2006 to 2015. Regarding the

[18]The wholesale sector includes industries whose SIC code lie between 501 and 519.

year of incorporation, 625 out of 633 Chinese firms were established on or prior to 2011; 584 firms were established on or prior to 2008.

### 4.3.2 MNC Production Linkages

We propose two measures that proxy for whether a transaction is between related parties within the MNC production network.

**Existence of Sibling Firms.** We construct an indicator variable to capture the existence of linked subsidiaries in each country based on MNCs' ownership structure. Formally, $Linked_i^c$ equals one if Chinese firm $i$ has at least one linked subsidiary in country $c$, and zero otherwise. The imports from country $c$ is more likely to be a part of intra-firm trade when $Linked_i^c = 1$.

**Matching Imported Inputs and Sibling Firms' Potential Outputs.** In a spirit similar to Alfaro and Charlton (2009), Atalay et al. (2014), and Alfaro et al. (2019), we refine the above measure of multinational production linkages by exploiting information on the potential outputs of foreign siblings and the imported inputs of Chinese firms.[19]

To define the potential outputs for each foreign sibling, we designate the primary SIC code reported in ORBIS for each foreign subsidiary as its output industry and then map each industry to a set of potential 6-digit HS products. We then aggregate all potential 6-digit HS products of siblings in the same sourcing country for each Chinese subsidiary to obtain a set of products, $\mathcal{K}_i^c$, which denotes the set of intermediate inputs that the Chinese firm $i$ can in principle purchase from related parties in country $c$. This potential product set is firm-country specific.

Next, we compare the imported inputs and the potential output set of sibling firms in each sourcing country. The transaction level information on import and export activities in China's customs data enables us to infer the production linkages within the MNC network for each Chinese subsidiary over the sample period. Formally, we define a categorical variable $LinkType_{it}^{ck}$ that indicates the likelihood of intra-firm activities — that is, the likelihood of an input being purchased from MNC-related firms — for each import transaction. For product $k$ that firm $i$ imported from source country $c$ in year $t$, the type of linkage is defined according to

$$LinkType_{it}^{ck} = \begin{cases} 1, \text{ Unlinked} & Linked_i^c = 0 \\ 2, \text{ Some Linkage} & Linked_i^c = 1 \text{ and } k \notin \mathcal{K}_i^c \\ 3, \text{ Closely Linked} & Linked_i^c = 1 \text{ and } k \in \mathcal{K}_i^c \end{cases}$$

[19] Alfaro and Charlton (2009) classify inter-firm and intra-firm trade based on the industry codes of related parties and the aggregate input-output relationship between industries. Atalay et al. (2014) further rely on the location of firm's affiliates and the shipment destination. Alfaro et al. (2019) combine the primary and secondary SICs of parent firm and subsidiaries to construct a set of integrated SICs. They regard these as inputs that a multinational can in principle obtain within organization boundaries.

A transaction is labeled as *unlinked* when there is no affiliated firm in the source country, as the probability of intra-firm trade is in principle zero. As long as there is at least one sibling firm in the source country, trading with related suppliers becomes possible. When the imported product does not belong to the potential product set, the transaction is considered to involve firms with *some linkage*. Finally, when the imported product belongs to the potential product set, the transaction is considered to involve firms that are *closely linked*.

### 4.3.3 Stylized Facts of the Mainland-Taiwan MNC Production Network

In Table 1, we summarize a set of stylized facts on the Mainland-Taiwan MNC production network that are relevant to our setting. Firm-level summary statistics are reported in Panel A. Among the 633 Chinese subsidiaries, the average number of siblings is 5.58 with a median of 1. The average number of linked countries (i.e., countries that host at least one firm that is related to the subsidiary) is 2.78. For an average subsidiary, the number of 6-digit HS products that are imported from the linked countries is 1.58. Consistent with the fact that Taiwanese MNC subsidiaries in China play an important role in the global value chain, the average export-to-sales ratio is 0.70.[20]

At the firm-product-country-year level, customs transaction data covers a total of 601,935 firm-level transactions, of which 371,304 are imports. Panel B reveals that 26% of the import transactions involve countries/regions (other than Taiwan) that host at least one sibling firm, while 3% are classified as transactions that are highly likely to involve subsidiaries and foreign sibling firms. Panel C reports the summary statistics of variables defined at the firm-year level. An average subsidiary imports 49.69 distinct 6-digit HS products from 9.15 countries/regions, and around half of the import transactions involve Taiwan. The share of imports from linked countries/regions (other than Taiwan) is 12.63%. Panel D reports the corresponding descriptive statistics on exports. An average firm exports 11.39 products to 14.79 countries/regions. Among all export transactions, 24.14% are destined to Taiwan while 14.99% are shipped to other linked countries/regions.

# 5 Empirical Strategies and Main Results

This section investigates the effects of the ECFA between mainland China and Taiwan on the sourcing patterns of MNC. We test the hypotheses laid out in Section 3 by analyzing data at

[20]To calculate the export-to-sales ratio, we match the firms to the 2011 industrial annual survey by China's National Bureau of Statistics (NBS), which covers all state-owned firms and non-state firms with revenues above 5 million RMB. Using the survey data, we calculate the export-to-sales ratio for 580 (out of 633) firms that can be matched across datasets.

both the firm level and the firm-product-country level.

Table 1: Summary Statistics

| | Mean (1) | Median (2) | SD (3) |
|---|---|---|---|
| **Panel A. Firm level, # obs = 633** | | | |
| # sibling affiliates | 5.58 | 1.00 | 15.62 |
| # sibling affiliates per country/region (excl. Taiwan) | 2.92 | 1.45 | 4.29 |
| # linked countries/regions | 2.78 | 2.00 | 2.62 |
| # matched 6-digit HS products from linked countries/regions | 1.58 | 1.00 | 0.92 |
| Export-to-sales ratio | 0.70 | 0.89 | 0.36 |
| **Panel B. Transaction level imports, # obs = 371,304** | | | |
| Log Imports from Taiwan (in thousands of USD) | 2.29 | 2.19 | 3.23 |
| Log Imports from other countries/regions (in thousands of USD) | 2.51 | 2.40 | 3.17 |
| Linked | 0.26 | 0.00 | 0.44 |
| LinkType = 2 (some linkage) | 0.23 | 0.00 | 0.42 |
| LinkType = 3 (closely linked) | 0.03 | 0.00 | 0.16 |
| **Panel C. Firm-year level imports, # obs = 5,266** | | | |
| Input tariffs (%) | 0.99 | 0.12 | 2.32 |
| # source countries/regions | 9.15 | 7.00 | 7.32 |
| # 6-digit HS products imported | 49.69 | 35.00 | 51.35 |
| # 6-digit HS products from Taiwan | 31.52 | 21.00 | 35.36 |
| Share of imports from Taiwan | 48.02 | 46.81 | 33.47 |
| Share of imports from linked countries/regions (excl. Taiwan) | 12.63 | 1.07 | 21.72 |
| **Panel D. Firm-year level exports, # obs = 4,506** | | | |
| Export tariffs (%) | 0.57 | 0.00 | 1.46 |
| # destination countries/regions | 14.79 | 8.00 | 16.86 |
| # 6-digit HS products exported | 11.39 | 4.00 | 17.74 |
| # 6-digit HS products to Taiwan | 5.76 | 2.00 | 10.89 |
| Share of exports to Taiwan | 24.14 | 3.03 | 35.93 |
| Share of exports to linked countries/regions (excl. Taiwan) | 14.99 | 0.00 | 27.64 |

*Notes:* See Section 4 for a description of the data sources. Panel A presents summary statistics at the firm level. Panel B presents summary statistics at the firm-product-country-year level. Panels C and D present summary statistics at the firm-year level for import and export transactions, respectively. Input tariffs in Panel C are computed as in Equation (2). Export tariffs in Panel D are constructed as in Equation (4). To calculate the export-to-sales ratio, we match the firms to the 2011 industrial annual survey by China's National Bureau of Statistics (NBS).

## 5.1 Firm-level Responses

We first explore the responses of firms to the reduction in input tariffs using firm-level data. Following the formation of the Mainland-Taiwan integrated zone, tariffs on selected products on the Early Harvest List were gradually reduced to zero. As a result, Chinese manufacturers that have been purchasing these products now face lower input tariffs, which may in turn lead

to increases in imports — originating from Taiwan and other origins — as well as increases in exports.

Formally, we evaluate the effects of the ECFA on a firm's behavior by the following equation:

$$\ln(y_{it}) = \beta \ln(\tau_{it}^{M}) + \psi_i + \phi_t + \epsilon_{it}, \tag{6}$$

where $\ln(y_{it})$ is the log import (or export) of firm $i$ in year $t$; the key explanatory variable $\ln(\tau_{it}^{M})$ is the firm's input tariffs, previously defined in Equation (2); and $\psi_i$ and $\phi_t$ denote firm and year fixed effects, respectively. We estimate the model by taking five-year differences. The estimating equation is then:

$$\Delta \ln(y_{it}) = \beta \Delta \ln(\tau_{it}^{M}) + D_t + \epsilon_{it}. \tag{7}$$

The regression stacks the first differences of five periods with each period including one pre-ECFA year and one post-ECFA year: 2006–2011, 2007–2012, 2008–2013, 2009–2014, and 2010–2015. The stacked-difference specification removes time-invariant firm-specific determinants for imports, and the year dummies $D_t$ absorb all macroeconomic factors that affect firms similarly. Standard errors are clustered at the firm level to account for serial correlation of unobserved shocks within firms. For the baseline analysis, we choose a stacked first-difference model over a fixed-effects model in levels because: (i) the five-year difference allows us to detect medium-term effects; and (ii) the stacked first-difference model removes the extremely demanding set of multi-way fixed effects when we analyze the responses at the firm-product-country-year level in the following sections.[21] Despite these considerations, we estimate the corresponding fixed-effects models in Appendix B.2 to verify the robustness of the main findings.

We have five sets of outcome variables: (i) imports from Taiwan; (ii) imports from countries without related affiliates; (iii) imports from countries with related affiliates; (iv) all imports; and (v) all exports. Table 2 reports our first set of results. The first column presents the estimate of Equation (7) with imports from Taiwan as the dependent variable. **Hypothesis 1** predicts that in the specification explaining within-bloc imports, the coefficient of $\beta_1$ should be negative. Indeed, the estimated coefficient is negative and statistically significant, confirming that firms import more from Taiwan after the ECFA tariff reduction. The point estimate implies that a one-standard-deviation reduction in firm's input tariff induces a 10.83% increase

[21] Estimating Equation (6) as a fixed-effects regression is more efficient when the errors are serially uncorrelated, while the differenced specification is more efficient if the errors are a random walk (Wooldridge, 2002). Since we cluster standard errors on firms (or on country and sector in the following sections), our estimates should be robust to either error structure.

in imports from Taiwan.[22] Columns 2 and 3 repeat the analysis, but focus on imports from outside the RTA bloc from unlinked and linked countries, respectively. We find that a reduction in a firm's input tariff is associated with higher imports from outside the RTA bloc, with the effects being more pronounced for countries with affiliate linkages. Our findings are consistent with **Hypothesis 2**, **Hypothesis 3**, and **Hypothesis 4**.

Table 2: Within-Bloc and Out-of-Bloc Trade: Firm-Level Regressions

| | **Within-Bloc Imports** | **Out-of-Bloc Imports** | | | |
|---|---|---|---|---|---|
| | **Taiwan** | **Unlinked Countries** | **Linked Countries** | **All Imports** | **All Exports** |
| **Dependent Variable:** $\Delta \ln(\text{Value}_{it})$ | (1) | (2) | (3) | (4) | (5) |
| $\Delta \ln \tau^M$ | -8.572* | -11.839** | -28.643*** | -14.242*** | -15.581** |
| | (4.485) | (5.847) | (8.864) | (4.297) | (7.008) |
| Year | Y | Y | Y | Y | Y |
| $N$ | 2,024 | 1,945 | 835 | 2,220 | 1,793 |
| $R^2$ | 0.023 | 0.024 | 0.032 | 0.032 | 0.044 |

*Notes:* The dependent variables are the changes in the log import (or export) value indicated in the column titles. *Linked countries* refer to countries/regions where the Chinese subsidiary has at least one affiliated party. Robust standard errors are clustered at firm level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

The increase in overall imports (Column 4) hints at an expansion in the production scale of firms that enjoy lower tariffs due to the ECFA. To verify the importance of this channel, we examine another regression by replacing the dependent variable with changes in log total exports over five-year periods. The estimates in Column 5 are negative and significant at the five percent level.

The findings suggest that the formation of the ECFA directly lowers the costs of inputs originating from Taiwan, thereby inducing firms to increase their imports from Taiwan. In increasing their production scale, firms may have to expand sourcing from other countries/regions despite that tariff rates for inputs from these third origins are unchanged. In the next few sections, we further examine patterns of input sourcing both within and outside the bloc, from related and unrelated suppliers. We also explore the roles of demand elasticity and input differentiation in determining the extent of interdependencies in MNCs' sourcing strategies.

[22]Standardized coefficients are computed using the descriptive statistics in Panel A of Table A.6 from 2006 to 2015. The standard deviation of a firm's input tariffs is 0.012. The implied magnitude is calculated to be $(e^{8.572 \times 0.012} - 1) \times 100\% = 10.83\%$.

## 5.2 Within-Bloc Imports

Thus far we have obtained primary evidence on the responses of firms following the formation of the ECFA. In this section, we examine the changes in imports at the product-country level within a firm to assess the validity of our hypotheses. We first focus on imports within the integrated bloc. For product $k$, firm $i$, and year $t$, we estimate the following equation:

$$\Delta \ln(Quantity_{it}^k) = \gamma \Delta \ln(\tau_{it}^M) + D_t^k + \epsilon_{it}^k, \tag{8}$$

where the dependent variable is the change in log within-bloc import quantity (i.e., imports originating from Taiwan). We take the same approach of stacking the five-year differences of five periods: 2006–2011, 2007–2012, 2008–2013, 2009–2014, and 2010–2015. The time-invariant firm-product-specific factors that determine demand for an input variety are differenced out. The product-year fixed effects $D_t^k$ account for any product-specific demand or supply shocks. We cluster the standard errors by 2-digit HS industry codes to account for potential serial correlations and cross-product correlation of regression residuals within industries. The firm-product-country-level analysis allows us to use data on imports measured in quantity, which alleviates the concern of transfer pricing between firms in the MNC network.

The results are reported in Column 1 of Table 3. The estimated coefficient is negative and statistically significant at the one percent level. The point estimates suggest that a decrease of one standard deviation in input tariffs is associated with, on average, a 14.72% increase in inputs from Taiwan. This finding supports **Hypothesis 1** that firms using inputs that were affected by the tariff reduction increased their imports from Taiwan after the ECFA.

### 5.2.1 The Role of Elasticities in Within-Bloc Imports

We now assess how firms' sourcing decisions depend on the demand elasticity for their final good. To do so, we adopt a median-cutoff specification to distinguish between firms facing low and high demand elasticity. The regressions are formulated according to:

$$\begin{aligned}\Delta \ln(Quantity_{it}^k) =& \gamma_1 \Delta \ln(\tau_{it}^M) \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} + \gamma_2 \Delta \ln(\tau_{it}^M) \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \gamma_3 \mathbf{1}\{\sigma_i > \sigma_{med}\} + D_t^k + \epsilon_{it}^k,\end{aligned} \tag{9}$$

where $\mathbf{1}\{\sigma_i > \sigma_{med}\}$ is a dummy variable for whether the firm faces a demand elasticity that is above the median. As detailed in Appendix A.2, we calculate the demand elasticity of the firm's output based on its primary industry and the estimates of product-level import demand elasticities from Soderbery (2015). Similar to the previous specification, we control for product-

year dummies ($D_t^k$), and cluster standard errors at the 2-digit HS industry level.

The coefficients of interest are $\gamma_1$ and $\gamma_2$, which govern the ECFA effects on imports for firms with low and high demand elasticity, respectively. Based on **Hypothesis 1**, we expect that $\gamma_2 < \gamma_1 < 0$. That is, a firm is more responsive to a reduction in input tariffs when it faces a high demand elasticity for its final good. Column 2 of Table 3 reports the results of estimating Equation (9). The estimated coefficients on the interaction terms are both negative, but only $\gamma_2$ is statistically significant. Indeed, we find that the negative effect is larger in magnitude for firms with a demand elasticity that is above the sample median, while the difference between $\gamma_1$ and $\gamma_2$ is statistically insignificant. We take these findings as suggestive evidence for **Hypothesis 1** that relates within-bloc sourcing decisions to the demand elasticity faced by firms. The magnitudes of these effects are fairly sizable: a one-standard-deviation decline in the input tariff translates to an 11.99% increase in imports for firms with a demand elasticity below the mean, and a 15.79% increase in imports for firms with a demand elasticity above the mean.[23]

For completeness, we also investigate the role of input differentiation, $\sigma^k$, in firms' responsiveness to the ECFA. We employ the estimates of product-level import demand elasticities from Soderbery (2015), and replace $\sigma_i$ and $\sigma_{med}$ in Equation (9) by $\sigma^k$ and its corresponding median value.[24] The relative size of parameters $\gamma_1$ and $\gamma_2$ are a priori ambiguous. On the one hand, when the required inputs are relatively homogeneous, firms are better able to shift their sourcing towards Taiwan, where the costs of trade are now reduced. On the other hand, when firms scale up production in response to the reduction in input costs, firms may also source more differentiated products from Taiwan if MNC production linkages alleviate contractual frictions. The results are reported in Column 3; the key independent variables are now the interactions between changes in input tariffs and dummies based on whether the degree of differentiation of an imported input $k$ is a below or above the median value of $\sigma^k$. The coefficients are similar in magnitude.

## 5.3 Out-of-Bloc Imports

In this section, we explore the effects of the ECFA on imports from outside the RTA-integrated bloc. Specifically, we focus on all import origins excluding Taiwan. Relative to Equation (8), we now further exploit variations across products and source countries. For firm $i$, product $k$,

[23] The implied magnitudes are calculated as $(e^{9.440\times0.012}-1)\times100\% = 11.99\%$ and $(e^{12.218\times0.012}-1)\times100\% = 15.79\%$.

[24] Our measure on input differentiation is constructed at the product level. Therefore, in regressions examining the role of input differentiation, the main effect $\mathbf{1}\{\sigma^k > \sigma_{med}\}$ is subsumed into the product-year fixed effects.

Table 3: Within-Bloc Imports

| | | Choice of Elasticity Measures | |
|---|---|---|---|
| | | **Output Demand Elasticity** | **Input Differentiation** |
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{k})$ | (1) | (2) | (3) |
| $\Delta \ln \tau^{M}$ | -11.447*** | | |
| | (3.736) | | |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | -0.045 | |
| | | (0.040) | |
| $\Delta \ln \tau^{M} \times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\gamma_1$) | | -9.440 | -10.385** |
| | | (8.070) | (4.887) |
| $\Delta \ln \tau^{M} \times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\gamma_2$) | | -12.218** | -11.517*** |
| | | (3.681) | (3.551) |
| $H_0 : \gamma_1 = \gamma_2$ | | 0.746 | 0.757 |
| Product × Year | Y | Y | Y |
| $N$ | 24,119 | 24,119 | 23,088 |
| $R^2$ | 0.196 | 0.196 | 0.190 |

*Notes:* The dependent variable is the change in log import quantities of different products from Taiwan. The elasticity measures are indicated in the column titles. In Column 3, the main effect of $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ is subsumed into the fixed effects as input differentiation is constructed at the product level. The table reports the $p$-values of the $t$-tests for the hypotheses that $\gamma_1 = \gamma_2$ under different specifications. Standard errors are clustered at the 2-digit HS industry level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

country of origin $c$, and year $t$, we estimate the following equation:

$$\Delta \ln(Quantity_{it}^{ck}) = \eta \Delta \ln(\tau_{it}^{M}) + D_{t}^{ck} + \epsilon_{it}^{ck}, \tag{10}$$

where the dependent variable is the changes in log out-of-bloc imports quantities (i.e., imports from origins other than Taiwan). We take the same approach of stacking the first differences of five periods, which accounts for any time-invariant firm-product-country-specific demand for an input variety. The dummies $D_{t}^{ck}$ absorb all product-country-specific demand or supply shocks. Standard errors are two-way clustered by country and 2-digit HS industry to account for potential serial correlation and cross-product correlation of regression errors within source countries and industries.

The results are presented in the first column of Table 4. The point estimate suggests that a one-standard-deviation reduction in the input tariff leads to a 24.61% increase in imports at the product-country level from outside the bloc.

### 5.3.1 The Role of Elasticities in Out-of-Bloc Imports

The next column in Table 4 displays how firms' sourcing decisions from regions outside the integrated bloc depend on the demand elasticity for the final good. We adopt a similar median-cutoff specification:

$$\begin{aligned}\Delta \ln(Quantity_{it}^{ck}) =& \eta_1 \Delta \ln(\tau_{it}^{M}) \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} + \eta_2 \Delta \ln(\tau_{it}^{M}) \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \eta_3 \mathbf{1}\{\sigma_i > \sigma_{med}\} + D_t^{ck} + \epsilon_{it}^{k}.\end{aligned} \tag{11}$$

The coefficients of interests are $\eta_1$ and $\eta_2$, which represent the effect of the ECFA tariff reduction on imports originating outside the integrated region, for firms with low and high demand elasticity, respectively. The estimated results are presented in Column 2. The coefficients $\eta_1$ and $\eta_2$ are both negative, but only $\eta_2$ is statistically significant. Moreover, the magnitude of $\eta_2$ is significantly larger than that of $\eta_1$. In other words, firms facing a higher demand elasticity are more responsive to input tariff shocks. In Column 3, we repeat the analysis, but replace $\sigma_i$ (demand elasticity) and $\sigma_{med}$ in Equation (11) with $\sigma_k$ (input differentiation) and its corresponding median value. The point estimates imply that a reduction in input tariffs leads to a greater increase in out-of-bloc imports for products with inputs that are highly differentiated, while the differential effect is statistically insignificant. The lack of statistical difference is consistent with the countervailing roles of input differentiation in sourcing responses within and beyond the MNC network as described in **Hypotheses 2** and **Hypotheses 3**. We now turn to our next sets of results where we further distinguish between differential import responses across the MNC boundary.

### 5.3.2 Out-of-Bloc Imports and MNC Production Networks

We further assess the differential responses in imports within and beyond the MNC's organizational network, in other words, the differential effects on imports of MNC and non-MNC input varieties. We adopt the following specification:

$$\begin{aligned}\Delta \ln(Quantity_{it}^{ck}) =& \alpha_1 \Delta \ln(\tau_{it}^{M}) \times Unlinked_i^c + \alpha_2 \Delta \ln(\tau_{it}^{M}) \times Linked_i^c \\ &+ \alpha_3 Linked_i^c + D_t^{ck} + \epsilon_{it}^{ck},\end{aligned} \tag{12}$$

where $Linked_i^c$ is a dummy that equals one if subsidiary $i$ has at least one sibling firm in country $c$, while $Unlinked_i^c = 1 - Linked_i^c$. Again, we stack the five-year differences of five periods and include product-country-year ($D_t^{ck}$) fixed effects. Standard errors are two-way clustered by source country and 2-digit HS industry.

Table 4: Out-of-Bloc Imports

| | | Choice of Elasticity Measures | |
|---|---|---|---|
| | | **Output Demand Elasticity** | **Input Differentiation** |
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) |
| $\Delta \ln \tau^M$ | -18.335*** | | |
| | (5.784) | | |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | -0.462*** | |
| | | (0.036) | |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ $(\eta_1)$ | | -3.867 | -12.321 |
| | | (6.534) | (9.429) |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ $(\eta_2)$ | | -25.499*** | -18.556** |
| | | (7.232) | (9.112) |
| $H_0 : \eta_1 = \eta_2$ | | 0.025 | 0.666 |
| Product × Country × Year | Y | Y | Y |
| $N$ | 32,372 | 32,372 | 31,553 |
| $R^2$ | 0.319 | 0.323 | 0.314 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. The elasticity measures are indicated in the column titles. In Column 3, the main effect of $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ is subsumed into the fixed effects as input differentiation is constructed at the product level. The table reports the $p$-values of the $t$-tests for the hypothesis that $\eta_1 = \eta_2$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

**Hypotheses 2** and **3** suggest that following the formation of the ECFA, imports from outside the bloc from suppliers both within and beyond the MNC network should increase. According to **Hypothesis 4**, we also expect to see larger effects for linked countries. That is, in scaling up production, firms tend to import more from third origins outside the integrated bloc, and disproportionately so within MNC networks, i.e., $\alpha_2 < \alpha_1 < 0$.

Panel A in Table 5 reports the estimation results. The results provide strong evidence supporting our hypotheses. Both $\alpha_1$ and $\alpha_2$ are estimated to be negative and significant. Magnitude wise, $\alpha_1$ is smaller than $\alpha_2$, and the difference between the two estimates is statistically significant at the one percent level. Our estimates show that the impact of the ECFA varies considerably depending on whether the firm has sibling firm in the source country. Using the estimates in Column 1, a one-standard-deviation decline in input tariffs lead to a 14.01% increase in imports from unlinked trade partners, and a 90.93% increase in imports from linked trade partners.

### 5.3.3 The Role of Elasticities in Out-of-Bloc Imports and MNC Production Networks

We have established that the reduction in China's import tariffs on Taiwanese products tend to raise imports from all origins in general, with larger effects on imports from countries with closer linkages. In this section, we test the extent to which elasticity parameters moderate such effects.

We first examine how the effects on imports within (or beyond) the MNC network depend on the elasticity of demand, using a median-cutoff specification:

$$\begin{aligned}\Delta \ln(Quantity_{it}^{ck}) =& \pi_1 \Delta \ln(\tau_{it}^M) \times Unlinked_i^c \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} \\ &+ \pi_2 \Delta \ln(\tau_{it}^M) \times Unlinked_i^c \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \pi_3 \Delta \ln(\tau_{it}^M) \times Linked_i^c \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} \\ &+ \pi_4 \Delta \ln(\tau_{it}^M) \times Linked_i^c \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \pi_5 Linked_i^c + \pi_6 \mathbf{1}\{\sigma_i > \sigma_{med}\} + \pi_7 Linked_i^c \times \mathbf{1}\{\sigma_i > \sigma_{med}\} + D_t^{ck} + \epsilon_{it}^{ck}.\end{aligned} \tag{13}$$

**Hypotheses 2** and **3** predict that $\pi_2 < \pi_1 < 0$ and $\pi_4 < \pi_3 < 0$. In other words, the ECFA effects should be more pronounced for firms that face an above-median demand elasticity in the final goods market.

The results are reported in Column 2 of Table 5. We verify that our hypothesis holds strongly when using a median-cutoff specification that distinguishes between firms facing high and low demand elasticities. The estimated coefficients $\pi_2$ and $\pi_4$ are negative and statistically significant, and larger in magnitude than $\pi_1$ and $\pi_3$, respectively. The findings indicate a substantial input complementarity due to the scale effect that is governed by demand elasticity.

Column 3 reestimates Equation (13) but replaces $\sigma_i$ (demand elasticity) and $\sigma_{med}$ by $\sigma_k$ (input differentiation) and its corresponding median value. Conceptually, inputs with higher degree of differentiation are more complex and difficult to contract. Based on our hypotheses, we expect that $\pi_2 < \pi_1 < 0$ and $\pi_3 < \pi_4 < 0$. The estimated results are consistent with the predictions. On the one hand, following the formation of the ECFA, Chinese subsidiaries import more from unlinked suppliers and the effect is larger for less differentiated inputs. On the other hand, Chinese subsidiaries also source more from related suppliers, and the effect is more pronounced for more differentiated intermediate inputs. Moreover, as reflected by the coefficients $\pi_1$ and $\pi_3$ in Column 3, for inputs that are with higher contract intensity, firms mainly source from related suppliers in response to the reduction in variable production costs.

Table 5: Out-of-Bloc Imports and MNC Production Networks

| | | Choice of Elasticity Measures | |
|---|---|---|---|
| | | **Output Demand Elasticity** | **Input Differentiation** |
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) |
| **Panel A. MNC Production Network: Matched Subsidiaries** | | | |
| Linked | -0.365*** | | |
| | (0.059) | | |
| $\Delta \ln \tau^M \times$ Unlinked ($\alpha_1$) | -10.924** | | |
| | (4.130) | | |
| $\Delta \ln \tau^M \times$ Linked ($\alpha_2$) | -53.894*** | | |
| | (15.419) | | |
| $H_0 : \alpha_1 = \alpha_2$ | 0.010 | | |
| **Panel B. MNC Production Network and Median Elasticity Cutoff** | | | |
| Linked | | -0.408*** | -0.372*** |
| | | (0.150) | (0.106) |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | -0.487*** | |
| | | (0.106) | |
| Linked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | 0.110 | -0.014 |
| | | (0.323) | (0.088) |
| $\Delta \ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\pi_1$) | | -2.081 | -1.781 |
| | | (8.474) | (8.824) |
| $\Delta \ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\pi_2$) | | -15.169** | -14.797** |
| | | (6.558) | (5.660) |
| $\Delta \ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\pi_3$) | | -4.589 | -75.397** |
| | | (8.421) | (31.031) |
| $\Delta \ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\pi_4$) | | -159.755*** | -24.625** |
| | | (16.086) | (11.637) |
| $H_0 : \pi_1 = \pi_2$ | | 0.316 | 0.251 |
| $H_0 : \pi_3 = \pi_4$ | | 0.000 | 0.237 |
| Product × Country × Year | Y | Y | Y |
| $N$ | 32,372 | 32,372 | 31,553 |
| $R^2$ | 0.321 | 0.325 | 0.316 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. The elasticity measures are indicated in the column titles. In Column 3, the main effect of $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ is subsumed into the fixed effects as input differentiation is constructed at the product level. The table reports the $p$-values of the $t$-tests for the hypotheses that $\alpha_1 = \alpha_2$, $\pi_1 = \pi_2$ and $\pi_3 = \pi_4$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

In Columns 2 and 3 of Table B.2, we demonstrate the robustness of the findings by adopting an alternative proxy for input contractibility based on the product classification in Rauch (1999).[25]

In sum, our results provide strong evidence of input complementarity that is mediated through the scale effect and contractual frictions. The Chinese subsidiaries in our sample tend to increase imports from both MNC related and unrelated suppliers following the ECFA tariff reduction, in line with **Hypotheses 2** and **3**. Moreover, the results indicate that these firms import more within multinational networks, especially for contract-intensive inputs, as suggested in **Hypothesis 4**. Our hypothesis on the role of demand elasticity is also strongly supported by the analysis based on the median cutoffs.

# 6 Robustness Checks

In this section, we describe a series of robustness tests. We first begin with alternative measures on key explanatory variables; we explore different definitions on ownership linkages and firm-level effective input tariffs.

## 6.1 Alternative Measures of MNC Production Linkages

In the main text, we construct a measure of firm's linkages based on the presence of sibling firms in the sourcing country, $Linked_i^c$. Now we introduce alternative measures by exploring: (i) the potential outputs of siblings; (ii) the number of siblings present in each foreign country; and (iii) sibling firms' operating industry (whether they are manufacturers and/or wholesalers). We also apply and extend the concept of narrow offshoring and confirm the robustness of our results.

### 6.1.1 Potential Output of Sibling Firms

In a spirit similar to Alfaro and Charlton (2009), Atalay et al. (2014), and Alfaro et al. (2019), we employ an alternative measure of firm linkages. The categorical variable $LinkType_{it}^{ck}$ as defined in Section 4 proxies the possibility of an input being imported from MNC-related affiliates.

[25]Details on the measure are discussed in Appendix A.2. In particular, the measure $Specificity_k$ is inversely related to $\sigma_k$.

Formally, we test:

$$\Delta \ln(Quantity_{it}^{ck}) = \sum_{m=1}^{3} \theta_m \mathbf{1}\{LinkType_{it}^{ck} = m\} \times \Delta \ln(\tau_{it}^{M}) + \sum_{m=2}^{3} \kappa_m \mathbf{1}\{LinkType_{it}^{ck} = m\} + D_t^{ck} + \epsilon_{it}^{ck}. \quad (14)$$

The key explanatory variables are the interaction terms. Recall that $LinkType_{it}^{ck}$ is defined by matching the inputs imported by the firm and the potential outputs of its overseas siblings. A larger value of $m$ indicates a higher probability that input $k$ is purchased from firm $i$'s sibling in country $c$. Therefore, we expect $\theta_m$ to be negative and to have a greater magnitude the larger the $m$. The results are reported in Panel A of Table 6. In line with our main findings, the estimated coefficients, $\theta_1$, $\theta_2$, and $\theta_3$, are negative and statistically significant. More importantly, the magnitude of the coefficients increases monotonically as the likelihood of intra-firm trade increases.

### 6.1.2 Number of Sibling Firms

The presence of a larger number of MNC-affiliated firms in a country indicates a higher supply capacity and lower search frictions. Therefore, we expect larger effects of the ECFA tariff reduction on imports from countries with more sibling firms. The estimated results are presented in Panel B of Table 6. Consistent with our main results, the decline in input tariffs induces more imports from countries outside the integrated bloc, and the effect is more pronounced when there are more sibling firms residing in the country.

### 6.1.3 Operating Sector of Sibling Firms

Next, we turn to the operating sector of sibling firms. The motivation is that siblings in different sectors may assume different roles that affect MNCs' sourcing strategies. First, siblings in the manufacturing sector may be potential suppliers. If the MNC organizational network is designed such that affiliates' products are complementary to one another, the foreign affiliates could be potential suppliers of the Chinese subsidiary. Hence, the Chinese subsidiary tends to import more from countries where its manufacturing siblings reside. Second, siblings in the wholesale trade sector may be helpful in fostering networks among local firms (both related and unrelated parties) in host countries. In other words, these siblings are well positioned to assist in keeping track of the local market, which enables effective acquisition of information on local suppliers. Furthermore, wholesalers and trading companies are experienced in customs clear-

ance formalities and have strong, established distribution networks. Therefore, the existence of a sibling wholesaler should foster imports from this country as well.

To verify these channels, we further categorize sourcing countries into four types: (i) with no sibling; (ii) with siblings in the manufacturing sector only; (iii) with siblings in the wholesale sector only; and (iv) with siblings in both the manufacturing and wholesale sectors. The results are presented in Panel C of Table 6. We find that the effect of the ECFA tariff reduction is more pronounced when there are manufacturing affiliates residing in the source country, and is the strongest when both manufacturing and wholesale affiliates are present.

### 6.1.4 Narrow Offshoring

In the main analysis, we proxy the likelihood of related-party trade based on the locations of foreign affiliates, and refine this measure by comparing the imported inputs of a Chinese subsidiary and the potential outputs of its foreign affiliates. Both measures are subject to potential measurement errors if the information of MNC networks inferred from ORBIS is incomplete or if foreign affiliates produce products that are beyond the reported primary industry.

To verify the robustness of the main findings, we adopt a different approach from previous studies that inferred firm-level offshoring by comparing the 4-digit HS categories of firms' imports and exports. The idea is that the closer an input to a firm's output, the more likely it is that the input is produced within the firm's boundary (Feenstra and Hanson, 1999; Handley et al., 2020; Hummels et al., 2014). In the same spirit, we define "narrow offshoring" for individual firms as the following. First, we restrict our sample to include firms only in the years in which they engaged in both importing and exporting.[26] Then for each firm $i$ in year $t$, we compare the 4-digit HS categories of the inputs it purchases (i.e., imports) and the outputs it sells (i.e., exports). The narrow-offshoring dummy for each 6-digit HS product $k$ is formulated as:

$$Narrow_{it}^{k} = \begin{cases} 1, & k \in \mathcal{H}_{it} \\ 0, & \text{Otherwise} \end{cases}$$

where $\mathcal{H}_{it}$ as the set of 4-digit HS categories that firm $i$ both imports and exports in year $t$. $Narrow_{it}^{k}$ takes a value of one if input $k$ purchased by the firm belongs to the same 4-digit HS category as that of its outputs.[27]

We use additional information on the existence of related firms in each exporting country.

[26] After this restriction, the number of Chinese subsidiaries drops from 633 to 584.

[27] It is worthwhile to contrast the variable $Narrow_{it}^{k}$ to our linkage variable $LinkType_{it}^{ck}$. The categorical variable $LinkType_{it}^{ck}$ is defined by comparing the imports of each Chinese firm and the product set of siblings residing in each foreign country. The binary variable $Narrow_{it}^{k}$, on the other hand, compares the 4-digit HS industry of imports and exports of the Chinese firm itself.

Table 6: Out-of-Bloc Imports: Alternative Measures of Firm Linkage

| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) |
|---|---|---|---|
| **Panel A. Matched Sibling Firm and Products** | | | |
| Some Linkage | -0.391*** | | |
| | (0.049) | | |
| Closely Linked | -0.252* | | |
| | (0.139) | | |
| $\Delta \ln \tau^M \times$ Unlinked | -10.585** | | |
| | (4.308) | | |
| $\Delta \ln \tau^M \times$ Some Linkage | -46.458*** | | |
| | (16.688) | | |
| $\Delta \ln \tau^M \times$ Closely Linked | -184.769*** | | |
| | (6.657) | | |
| **Panel B. Number of Sibling Firms** | | | |
| Number of Siblings | | -0.245*** | |
| | | (0.062) | |
| $\Delta \ln \tau^M$ | | -12.122*** | |
| | | (4.013) | |
| $\Delta \ln \tau^M \times$ Number of Siblings | | -26.509*** | |
| | | (5.115) | |
| **Panel C. Sibling Firm's Industry** | | | |
| Manufacturer Only | | | -0.159 |
| | | | (0.190) |
| Wholesaler Only | | | -0.266* |
| | | | (0.131) |
| Both Manufacturer and Wholesaler | | | -0.936*** |
| | | | (0.166) |
| $\Delta \ln \tau^M \times$ Unlinked | | | -10.329 |
| | | | (9.531) |
| $\Delta \ln \tau^M \times$ Manufacturing Siblings Only | | | -61.427*** |
| | | | (22.098) |
| $\Delta \ln \tau^M \times$ Wholesale Sibling Only | | | -7.936 |
| | | | (14.204) |
| $\Delta \ln \tau^M \times$ Both Manufacturing and Wholesale | | | -418.901*** |
| | | | (70.698) |
| Product × Country × Year | Y | Y | Y |
| $N$ | 32,372 | 32,372 | 32,372 |
| $R^2$ | 0.321 | 0.321 | 0.323 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

The combination of narrow offshoring and MNCs' ownership linkages in principle provides a more accurate proxy for the likelihood of intra-firm trade, as it takes into account whether there is indeed an affiliate firm in the exporting country. The alternative measure of the types of linkage is constructed as:

$$LinkTypeNarrow_{it}^{ck} = \begin{cases} 1, \text{ Unlinked} & Linked_i^c = 0 \\ 2, \text{ Some Linkage} & Linked_i^c = 1 \text{ and } Narrow_{it}^k = 0 \\ 3, \text{ Closely Linked} & Linked_i^c = 1 \text{ and } Narrow_{it}^k = 1 \end{cases}$$

According to this definition, a transaction is labeled "unlinked" when there is no affiliated firm operating in the source country. When a country hosts at least one sibling but the imported product belongs to a different 4-digit HS industry than the firm's own product, the transaction is considered to be from suppliers with "some linkage". Finally, when there is at least one sibling firm in the source country and the good being imported is close enough to the good being exported (in the same 4-digit HS industry), the transaction is more likely to be between related parties. We call this a "closely linked" transaction.

We replace the original linkage variables with $Narrow_{it}^k$ in Equation (12), and separately with $LinkTypeNarrow_{it}^{ck}$ in Equation (14). We expect the coefficient on the interaction term to be larger in magnitude when the linkage indicator takes on a higher value. The estimated results are reported in Columns 1 and 3 of Table 7. Following the ECFA tariff reduction, firms import more from countries outside the bloc, and the effects are more pronounced for the imports of intermediate inputs in the same 4-digit HS industry as the firms' output industry. In the specification using the categorical variable $LinkTypeNarrow_{it}^{ck}$, the effect of the input tariff reduction increases monotonically in magnitude as firms move from the unlinked case to the closely linked case. In both columns, the differential effects across different groups are statistically significant at the one percent level. These findings support **Hypothesis 4** — the RTA induced an increase in input trade from countries outside the bloc, and the effect is more pronounced within the MNC production network.

In Columns 2 and 4, we reconstruct the measures $Narrow_{it}^k$ and $LinkTypeNarrow_{it}^{ck}$ by comparing the 2-digit HS categories of the firm's imports and the firm's exports, and repeat the analyses. Again, we obtain results that are consistent with our main findings.

## 6.2 Alternative Measures of Input Tariffs

A potential caveat of the baseline input tariff measure is that it ignores the potential adjustments between organizational forms of trade and across countries/regions. For example, firms that

Table 7: Out-of-Bloc Imports: Narrow Offshoring

| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A. Narrow Offshoring** | | | | |
| Narrow | -0.267*** | -0.250*** | | |
| | (0.045) | (0.032) | | |
| $\Delta \ln \tau^M \times$ Not Narrow ($\alpha_1$) | -14.205** | -13.384 | | |
| | (6.579) | (8.052) | | |
| $\Delta \ln \tau^M \times$ Narrow ($\alpha_2$) | -62.301*** | -39.395*** | | |
| | (6.693) | (5.399) | | |
| $H_0 : \alpha_1 = \alpha_2$ | 0.000 | 0.026 | | |
| **Panel B. Matched Siblings + Narrow Offshoring** | | | | |
| Some Linkage | | | -0.249*** | -0.107*** |
| | | | (0.047) | (0.033) |
| Closely Linked | | | -0.660*** | -0.488*** |
| | | | (0.081) | (0.093) |
| $\Delta \ln \tau^M \times$ Unlinked ($\theta_1$) | | | -10.458 | -13.893*** |
| | | | (6.909) | (3.088) |
| $\Delta \ln \tau^M \times$ Some Linkage ($\theta_2$) | | | -41.534*** | -31.751*** |
| | | | (6.673) | (5.393) |
| $\Delta \ln \tau^M \times$ Closely Linked ($\theta_3$) | | | -201.825*** | -54.692** |
| | | | (9.230) | (25.253) |
| $H_0 : \theta_1 = \theta_2$ | | | 0.002 | 0.020 |
| $H_0 : \theta_1 = \theta_3$ | | | 0.000 | 0.138 |
| $H_0 : \theta_2 = \theta_3$ | | | 0.000 | 0.400 |
| Narrow Offshoring based on: | HS4 | HS2 | HS4 | HS2 |
| Product × Country × Year | Y | Y | Y | Y |
| $N$ | 31,490 | 31,490 | 31,490 | 31,490 |
| $R^2$ | 0.318 | 0.318 | 0.320 | 0.152 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. The "narrow offshoring" measure is defined based on the 4-digit HS categories in odd-number columns, and defined based on the 2-digit HS categories in even-number columns. The table reports the $p$-values of the $t$-tests for the hypotheses that $\alpha_1 = \alpha_2$, $\theta_1 = \theta_2$, $\theta_1 = \theta_3$, and $\theta_3 = \theta_4$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

previously relied on processing imports from Taiwan may still benefit from the ECFA tariff reductions by switching the import regime from processing trade to ordinary trade (Brandt and Morrow, 2017; Brandt et al., 2021). In such a scenario, our baseline analysis understates the impacts of the ECFA tariff reduction. To factor in this possibility, we adopt a different

weighting scheme and reconstruct the firm-level input tariff shock according to:

$$\Delta \ln(\tau_{it}^{M}) = \sum_{k \in \mathcal{M}} \left( \frac{M_{i,t_0}^{k,TWN}}{\sum_c \sum_{k \in \mathcal{M}} M_{i,t_0}^{k,c}} \right) \Delta \ln \left( 1 + Tariff_t^{k,CHN} \right). \tag{15}$$

The alternative measure differs from the formulation in Equation (3) as it assigns positive weights to the varieties that were sourced through processing trade in the initial period. In addition, following the ECFA tariff reduction, firms that previously imported only from other origins may start sourcing from Taiwan. To account for this, we also consider an alternative measure as follows:

$$\Delta \ln(\tau_{it}^{M}) = \sum_{k \in \mathcal{M}} \left( \frac{\sum_c M_{i,t_0}^{k,c}}{\sum_c \sum_{k \in \mathcal{M}} M_{i,t_0}^{k,c}} \right) \Delta \ln \left( 1 + Tariff_t^{k,CHN} \right). \tag{16}$$

Based on Equation (16), a firm has a positive exposure as long as it initially imported products that subsequently received ECFA tariff reductions. The variation of the measure therefore stems from the importance of each input in the initial year. The summary statistics of these two alternative measures are reported in Table A.6.

Columns 1 and 2 of Table 8, respectively, reestimate Equations (10) and (12) using the firm-specific input tariff shock constructed based on Equation (15).[28] All estimated coefficients remain negative and highly significant. In terms of magnitude, we find that a one-standard-deviation reduction in firm's input tariffs results in a 15.79% increase in imports from unlinked trade partners, and a 49.09% increase in imports from linked trade partners. These magnitudes align with our previous findings derived from the baseline measure. Columns 3 and 4 repeat the analyses but employ the measure based on Equation (16). The coefficients of interest remain negative but are now statistically insignificant, which suggest that the input tariff measure based on Equation (16) may be too noisy to reflect the actual exposure of firms to the ECFA tariff reductions.

## 6.3 Additional Checks

In the remainder of this section, we describe a series of additional checks that we have implemented.

Another potential concern is that the changes in input tariffs could be correlated with the changes in export tariffs, i.e., the tariffs faced by Chinese exporters when shipping goods to

[28]Note that by construction, the alternative input tariff measure is larger in size compared to the baseline measure. Therefore, we will gauge the magnitude of the estimated effects based on standardized coefficients.

Table 8: Out-of-Bloc Imports: Alternative Measures of Input Tariffs

| | **Initial Taiwan Inputs** | | **All Initial Inputs** | |
|---|---|---|---|---|
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) | (4) |
| $\Delta \ln \tau^M$ | -11.134*** | | -0.477 | |
| | (2.428) | | (1.259) | |
| Linked | | -0.384*** | | -0.395*** |
| | | (0.094) | | (0.085) |
| $\Delta \ln \tau^M \times$ Unlinked ($\alpha_1$) | | -8.144*** | | -0.965 |
| | | (2.473) | | (1.091) |
| $\Delta \ln \tau^M \times$ Linked ($\alpha_2$) | | -18.727*** | | -2.961 |
| | | (4.566) | | (1.810) |
| $H_0 : \alpha_1 = \alpha_2$ | | 0.060 | | 0.065 |
| Product × Country × Year | Y | Y | Y | Y |
| $N$ | 32,372 | 32,372 | 32,372 | 32,372 |
| $R^2$ | 0.319 | 0.321 | 0.212 | 0.320 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. Columns 1 and 2 use the input tariff measure defined in Equation (15). Columns 3 and 4 use the input tariff measure defined in Equation (16). The table reports the $p$-values of the $t$-tests for the hypothesis that $\alpha_1 = \alpha_2$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Taiwan. If so, our baseline estimates could be biased. We address this concern by directly controlling for firm-specific export tariffs, as defined in Equation (4). The first two columns of Table B.3 present the estimation results. The inclusion of export tariffs does not change our baseline results, as the coefficients on input tariffs remain very similar to the baseline estimates.

Columns 3 to 6 of Table B.3 examine the extent to which our results depend on the characteristics of the source countries. The concern here is that the locations of MNC subsidiaries are nonrandom. To expand production scale, firms may source more from countries with characteristics such as shorter geographic distance and better institutional quality; these characteristics may systematically correlate with the presence of an affiliated firm. To substantiate the mechanism emphasized by **Hypothesis 4** — that is, the differential impacts of the ECFA tariff reductions are driven by MNC production linkages — we further control for a set of interaction terms of the firm-specific input tariff shock and country characteristics such as geographic distance to mainland China, GDP per capita, human capital endowment, and institutional effectiveness. Our baseline results are robust to the inclusion of these additional controls.

In Table B.4, we restrict the sample to Chinese subsidiaries that were established before the formation of the ECFA. This sample restriction addresses the concern that Taiwanese MNCs may strategically establish subsidiaries in China to take advantage of the ECFA tariff reductions. If that is the case, our baseline findings may be driven by reverse causality. Reassuringly, among

all 633 Chinese MNC subsidiaries in our main sample, 584 were established in 2008 or earlier, 42 were established between 2009 and 2011, and only eight were established after 2011. When we restrict the sample to firms that were established in or before 2011 (the implementation of ECFA), or 2008 (the first discussion of ECFA), our results remain virtually unchanged.

In Table B.5, we address the possibility that the results could be driven by influential observations. We consider two alternative specifications where we remove Chinese subsidiaries that are affiliated to the largest Taiwanese parents — those with the most Chinese affiliates and those with the most foreign affiliates.[29] Our results demonstrate that the results are not driven by specific MNCs.

Lastly, we reestimate the regressions but replace the changes in log import quantity with the changes in log import value as the dependent variable. The results are reported in Tables B.6 and B.7. In Appendix B.2, we examine the robustness of our findings using fixed-effects models. The estimates are in line with the main results.

# 7 Conclusion

In this paper, we examine the implications of regional trade integration on the sourcing patterns of multinationals. Using detailed firm-level data on multinational enterprises' ownership linkages in conjunction with transaction-level trade flows, we examine how Taiwanese MNC affiliates respond to the tariff reductions implemented according to the Mainland-Taiwan Economic Cooperation Framework Agreement (ECFA). Our empirical analysis focuses on the effect of changes in firm-specific input tariffs induced by the ECFA on the changes in firms' imports from different suppliers — both within and outside the integrated bloc. The results provide strong support for the complementaries inherent in firms' sourcing decisions across markets. Specifically, following the ECFA, Chinese subsidiaries tend to increase imports not only from Taiwan, but also from countries outside the integrated bloc. The trade creation effect beyond the integrated bloc depends crucially on output demand elasticity which governs the responsiveness of firms' profits to a reduction in variable production costs. Moreover, we examine the extent to which the sourcing complementarity varies within or beyond the firm's organizational boundary. The findings reveal that the multinational production network strengthens the complementarity, especially for products with higher contract intensity.

Our study provides supportive evidence that regional trade agreements create trade between member and non-member countries, in particular through input-output linkages and multinational firms' global production activities. To a large extent, the spillovers appear to be

[29] Taiwanese MNCs with the most affiliates in China and other countries are reported in Table A.4.

contained within multinationals' organizational boundary. In other words, firms mainly resort to increasing intra-firm sourcing to meet the input demand when production scales up, even though the related parties reside outside the RTA bloc. These findings highlight the important role of MNCs in shaping the trade creation or diversion effects of regional trade agreements.

Although the formation of the ECFA provides a relatively clean setting for us to study the impacts of RTAs on trade patterns with member versus non-member partners through the MNC production networks, we acknowledge that there are limits to generalizing these findings to other contexts. Understanding the interactions of RTAs and sourcing strategies of MNCs and their implications on global value chains in a more general environment is left to future research.

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# Appendix

## A Data Appendix

### A.1 Details on Data Construction of MNC Ownership Linkages

The information on the production networks of MNCs are obtained from ORBIS, a commercial administrative dataset compiled by the Bureau van Dijk Electronic Publishing. We downloaded the following variables: company name, company ID, global ultimate owner (GUO) name, global ultimate owner ID, firm's SIC sector code, and country ISO code.

In downloading the data, we made a number of decisions. First, we selected all Taiwanese firms with at least one subsidiary in mainland China (with a direct ownership of over 25 percent). This rule resulted in a sample of 1,635 Chinese firms and 515 Taiwanese GUOs. After retrieving this initial sample, we manually matched the Chinese firms to China's customs data and restricted our sample to firms in the manufacturing sector. The process involved translating the names of firms as well as examining the reported address and primary industry to ensure that the match is correct. The matched sample comprises 633 Chinese subsidiaries belonging to 303 Taiwanese GUOs.

Second, we linked the 303 Taiwanese GUOs to all of their subsidiaries across the world. We dropped firms operating in offshore financial centers and further restricted our attention to firms operating in either manufacturing or wholesale sector.[30] These foreign subsidiaries are regarded as the siblings of the Chinese firms, as they are affiliated to the same Taiwanese parent company. The final dataset consists of 633 Chinese firms, 303 Taiwanese GUOs, and 583 foreign subsidiaries residing in 32 countries/regions. In particular, 103 Taiwanese parent firms have subsidiaries in both mainland China and other countries. Appendix A.3 reports the matching rates at each step.

Table A.4 provides the details of the top Taiwanese multinational corporations in our final sample. Pou Chen Corp. owns the most subsidiaries in mainland China, while Hong Hai Precision Industry Co., Ltd has the most foreign subsidiaries outside of China. Four out of the ten top Taiwanese MNCs in this table come from the computer and office equipment industry.

Table A.5 reports the industry distribution of the 633 matched Chinese firms. A third of firms operate in the electronic and other electric equipment industry. Most trading firms engage

[30] Offshore financial centers include Anguilla, Bahamas, Belize, Bermuda, Cayman Islands, Curacao, Cyprus, Gibraltar, Guyana, Hong Kong, Ireland, Jersey, Liberia, Lichtenstein, Luxembourg, Malta, Marshall Islands, Mauritius, Monaco, Nauru, Samoa, Seychelles, Singapore, Saint Vincent and the Grenadines, Switzerland, the British Virgin Islands, the Netherlands, and United Kingdom.

in both importing and exporting activities.

## A.2 Additional Data Sources

**Demand Elasticity and Contract Intensity.** Data on demand elasticities are from Soderbery (2015), which estimates the import supply and demand elasticities for highly disaggregated products using the hybrid methodology built on Feenstra (1994) and Broda and Weinstein (2006). For each firm, output demand elasticity is computed as the average demand elasticity across 6-digit HS products in the firm's primary SIC industry. Input demand elasticity is constructed at the product level. To mitigate measurement errors, in our empirical studies, we adopt median-cutoff specifications by dichotomizing the variable at the sample median.

Data on input specificity are from Rauch (1999), which classifies industries into one of the following three categories: homogeneous, reference priced, and differentiated products, according to the 4-digit SITC Rev.2 system. We match the data to the 6-digit HS product level. The variable *Specificity* equals one if the 6-digit HS product is classified as a differentiated product. We further dichotomize the variable at the median across products.[31]

**Country-level Characteristics.** The characteristics of source countries are included as control variables. We obtain data on the geographic distance to mainland China from CEPII. Data on GDP per capita, human capital endowment, and an index of government effectiveness in the year 2005 are retrieved from the World Bank.

Table A.1: ECFA Tariff Schedule

| $\tau$ = **MFN rates in 2009 (%)** | **2011 Jan 1** | **2012 Jan 1** | **2013 Jan 1** |
|---|---|---|---|
| **Panel A. China's Early Harvest tariffs** | | | |
| $0 < \tau \leq 5$ | 0 | | |
| $5 < \tau \leq 15$ | 5 | 0 | |
| $\tau > 15$ | 10 | 5 | 0 |
| **Panel B. Taiwan's Early Harvest tariffs** | | | |
| $0 < \tau \leq 2.5$ | 0 | | |
| $2.5 < \tau \leq 7.5$ | 2.5 | 0 | |
| $\tau > 7.5$ | 5 | 2.5 | 0 |

*Source:* The legal text of the Cross-Strait Economic Cooperation Framework Agreement (2010).
*Notes:* For the selected ECFA products, the ECFA stipulates that import tariffs be gradually reduced to zero, based on the level of MFN rates observed in 2009.

[31]The variable *Specificity* is not exactly a binary variable, because for products with missing values, we replace the missing value with the average value of the corresponding 4-digit (or 2-digit) HS code.

Table A.2: Manufacturing Products on the Early Harvest List

| **Panel A: Mainland China's Early Harvest List** | **# ECFA Products** | **% ECFA Products** | **% Imports from Taiwan in 2006** | **% ECFA Imports from Taiwan in 2006** | **Δ Tariffs 2006–2015** |
|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| Animal & Animal Products | 0 | 0.00 | 0.04 | 0.00 | -0.10 |
| Vegetable Products | 5 | 4.00 | 0.02 | 9.68 | -1.88 |
| Foodstuffs | 0 | 0.00 | 0.04 | 0.00 | -0.61 |
| Mineral Products | 4 | 7.84 | 1.13 | 64.54 | -1.01 |
| Chemicals & Allied Industries | 47 | 6.93 | 7.66 | 25.22 | -0.66 |
| Plastics / Rubbers | 48 | 24.37 | 7.65 | 35.31 | -2.26 |
| Raw Hides, Skins, Leather, & Furs | 3 | 5.77 | 0.58 | 0.17 | -1.19 |
| Wood & Wood Products | 1 | 0.48 | 0.60 | 0.06 | -0.12 |
| Textiles | 115 | 15.07 | 3.85 | 64.56 | -1.87 |
| Footwear / Headgear | 3 | 6.25 | 0.06 | 80.09 | -1.14 |
| Stone / Glass | 6 | 3.35 | 0.94 | 8.86 | -1.03 |
| Metals | 55 | 10.34 | 8.47 | 53.47 | -1.03 |
| Machinery / Electrical | 105 | 14.19 | 49.87 | 10.01 | -1.81 |
| Transportation | 13 | 14.13 | 0.39 | 80.43 | -1.93 |
| Miscellaneous | 8 | 2.41 | 18.69 | 2.24 | -0.87 |
| Total | 413 | | 100.00 | | |
| **Panel B: Taiwan's Early Harvest List** | **# ECFA Products** | **% ECFA Products** | **% Exports to Taiwan in 2006** | **% ECFA Exports to Taiwan in 2006** | **ΔTariffs 2006–2015** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| Animal & Animal Products | 0 | 0.00 | 0.38 | 0.00 | -3.43 |
| Vegetable Products | 0 | 0.00 | 0.33 | 0.00 | -0.28 |
| Foodstuffs | 0 | 0.00 | 0.61 | 0.00 | -0.83 |
| Mineral Products | 4 | 8.00 | 0.55 | 17.18 | -0.23 |
| Chemicals & Allied Industries | 77 | 10.85 | 8.25 | 30.89 | -0.39 |
| Plastics / Rubbers | 17 | 8.59 | 2.29 | 16.44 | -0.41 |
| Raw Hides, Skins, Leather, & Furs | 0 | 0.00 | 0.42 | 0.00 | -0.01 |
| Wood & Wood Products | 0 | 0.00 | 2.23 | 0.00 | 0.02 |
| Textiles | 20 | 2.71 | 3.20 | 8.54 | -0.22 |
| Footwear / Headgear | 0 | 0.00 | 0.62 | 0.00 | 0.00 |
| Stone / Glass | 4 | 2.22 | 1.58 | 2.56 | -0.09 |
| Metals | 7 | 1.32 | 18.76 | 2.60 | -0.07 |
| Machinery / Electrical | 76 | 10.11 | 50.66 | 10.99 | -0.36 |
| Transportation | 9 | 9.00 | 2.64 | 28.93 | -2.55 |
| Miscellaneous | 20 | 6.01 | 7.47 | 13.58 | -0.25 |
| Total | 234 | | 100.00 | | |

*Notes:* Panel A presents a description of mainland China's Early Harvest List. For each manufacturing sector, Column 1 reports the number of 6-digit HS products that are subject to tariff reductions under the ECFA; Column 2 reports the number of ECFA products as a share of the total number of 6-digit products in the sector; Column 3 reports the share of each sector in the imports from Taiwan in 2006; Column 4 reports the imports of the ECFA products as a share of total imports from Taiwan in 2006 for each sector; Column 5 reports the long difference in tariffs imposed by mainland China on goods from Taiwan between 2006 and 2015. Panel B reports the statistics for Taiwan's Early Harvest List accordingly. The total number of manufacturing products eligible for the ECFA tariff reduction is 413 on mainland China's side, and 234 on Taiwan's side.

Table A.3: Matching Rates of Chinese and Foreign Subsidiaries

| | # Parent Firms in Taiwan | # Subsidiaries in China |
|---|---|---|
| **Panel A. Matching rates of Chinese subsidiaries** | | |
| Identified with Chinese subsidiaries in ORBIS | 515 | 1,635 |
| *Restrictions on Chinese subsidiaries:* | | |
| (1) with valid industry codes in the manufacturing sector | 310 | 678 |
| (2) matched to customs data | 303 | 633 |
| Customs-Orbis matched sample | 303 | 633 |
| | **# Parent Firms in Taiwan** | **# Subsidiaries (countries)** |
| **Panel B. Matching rates of foreign subsidiaries** | | |
| Identified with foreign subsidiaries in ORBIS | 179 | 2,515 (73) |
| *Restrictions on foreign subsidiaries:* | | |
| (1) exclude offshore financial centers | 147 | 1,216 (57) |
| (2) with valid industry codes in the manufacturing or wholesale sector | | |
| — manufacturing sector | 95 | 446 (24) |
| — wholesale sector | 52 | 138 (28) |
| Customs-Orbis matched sample | 103 | 583 (32) |

*Notes:* Panel A reports the matching rates of Chinese subsidiaries in the China customs-ORBIS matched sample at each step. Panel B starts with Chinese firms in the China customs-ORBIS matched sample, and reports the corresponding matching rates of foreign affiliates, with the number of residing countries in parentheses.

Table A.4: Top Taiwanese Multinational Corporations in China and Third Countries

| **Panel A. Top 5 corporations with most subsidiaries in mainland China** | | | |
|---|---|---|---|
| **Taiwanese MNC** | **SIC** | **Industry** | **# Chinese Subsidiaries** |
| Pou Chen Corp. | 314 | Footware, except rubber | 31 |
| Lite-on Technology Corp. | 357 | Computer and office equipment | 25 |
| YFY Inc. | 262 | Paper mills | 16 |
| Hong Hai Precision Industry Co., Ltd. | 357 | Computer and office equipment | 14 |
| Uni-President Enterprises Corp. | 209 | Misc. food preparations and kindred products | 12 |
| **Panel B. Top 5 corporations with most subsidiaries in third countries** | | | |
| **Taiwanese MNC** | **SIC** | **Industry** | **# Foreign Subsidiaries** |
| Hong Hai Precision Industry Co., Ltd. | 357 | Computer and office equipment | 101 |
| Delta Electronics Inc. | 367 | Electronic components and accessories | 39 |
| Formosa Plastics Corp. | 308 | Misc. plastic products | 24 |
| Teco Electric & Machinery Co., Ltd. | 363 | Household appliances | 23 |
| Tatung Company Ltd. | 357 | Computer and office equipment | 21 |

*Notes:* The sample includes all Taiwanese multinational corporations with at least one manufacturing plant in China. The upper panel lists the top five Taiwanese MNCs with the most subsidiaries in mainland China; the lower panel lists the top five Taiwanese MNCs with the most subsidiaries in the rest of the world.

Table A.5: Industry Distribution of Matched Chinese Subsidiaries

| **2-digit SIC Industry** | | **# Firms** | **Both Importing and Exporting** |
|---|---|---|---|
| 20 | Food and kindred products | 24 | 15 |
| 22 | Textile mill products | 8 | 8 |
| 23 | Appareal and other textile products | 9 | 9 |
| 24 | Lumber and wood products | 3 | 2 |
| 25 | Funiture and fixtures | 3 | 3 |
| 26 | Paper and allied products | 21 | 17 |
| 27 | Printing and publishing | 1 | 1 |
| 28 | Chemicals and allied products | 51 | 48 |
| 30 | Rubber and miscellaneous plastics products | 50 | 47 |
| 31 | leather and leather products | 12 | 12 |
| 32 | Stone, clay, and glass products | 14 | 14 |
| 33 | Primary metal industries | 23 | 21 |
| 34 | Fabricated metal products | 21 | 21 |
| 35 | Industrial machinery and equipment | 84 | 81 |
| 36 | Electronic and other electric equipment | 258 | 245 |
| 37 | Transportation equipment | 24 | 23 |
| 38 | Instruments and related products | 21 | 21 |
| 39 | Miscellaneous manufacturing industries | 6 | 6 |
| Number of Chinese subsidiaries in total | | 633 | 594 |

*Notes:* Industry distribution tabulated for the sample of 633 Chinese subsidiaries with primary SIC code in the manufacturing sector from 2006 to 2015.

Table A.6: Descriptive Statistics of Tariff Shocks and Changes in Imports

| | **Mean** (1) | **SD** (2) | **25th** (3) | **Median** (4) | **75th** (5) |
|---|---|---|---|---|---|
| **Panel A. Input Tariff Shocks at the Firm-Year-Level** | | | | | |
| Δ input tariffs (baseline) | -0.005 | 0.012 | -0.004 | 0.000 | 0.000 |
| Δ Input tariffs (Taiwan inputs) | -0.010 | 0.018 | -0.012 | -0.002 | 0.000 |
| Δ Input tariffs (all inputs) | -0.019 | 0.024 | -0.030 | -0.009 | -0.001 |
| **Panel B. Changes in Imports at the Firm-Year-Level** | | | | | |
| Δ Log imports (in thousands of USD) from Taiwan | -0.035 | 2.104 | -0.994 | 0.086 | 0.946 |
| Δ Log imports (in thousands of USD) from other origins | -0.017 | 2.206 | -1.064 | 0.015 | 1.045 |
| — Unlinked countries | 0.035 | 2.268 | -1.095 | 0.065 | 1.140 |
| — Linked countries | -0.119 | 2.554 | -1.343 | -0.165 | 1.058 |
| **Panel C. Changes in Imports at the Firm-Product-Country-Year-Level** | | | | | |
| Δ Log imports (in quantity) from Taiwan | -0.396 | 2.807 | -1.792 | -0.293 | 0.991 |
| Δ Log imports (in quantity) from other origins | -0.429 | 2.959 | -1.964 | -0.301 | 1.099 |
| — Unlinked countries | -0.333 | 2.926 | -1.826 | -0.223 | 1.158 |
| — Linked countries | -0.679 | 3.028 | -2.303 | -0.517 | 0.940 |

*Notes:* Panel A reports the summary statistics of different measures of the firm-specific input tariff shock. Panel B reports the summary statistics of the changes in imports at the firm level. In Panel C, the summary statistics are computed based on observations at the firm-product-country-year level.

Table A.7: Demand Elasticities, Input Differentiation, and Country Characteristics

| | **Mean** (1) | **SD** (2) | **25th** (3) | **Median** (4) | **75th** (5) |
|---|---|---|---|---|---|
| **Panel A. Demand Elasticities** | | | | | |
| Output demand elasticity (firm level) | 4.175 | 1.947 | 3.012 | 3.620 | 5.172 |
| Input differentiation (product level) | 4.766 | 10.936 | 1.549 | 2.043 | 3.857 |
| Input specificity (product level) | 0.825 | 0.365 | 0.000 | 1.000 | 1.000 |
| **Panel B. Country Characteristics** | | | | | |
| Log distance to mainland China | -0.143 | 0.567 | -0.341 | -0.105 | 0.274 |
| Log GDP per capita | -0.664 | 1.341 | -1.690 | -0.484 | 0.456 |
| Log years of schooling, aged 25 and above | -0.086 | 0.533 | -0.297 | 0.017 | 0.330 |
| Government Effectiveness Index | -0.516 | 1.115 | -0.925 | -0.181 | 0.258 |

*Notes:* Panel A reports the descriptive statistics of output demand elasticity at the firm level, and input differentiation and input specificity at the product level. Panel B reports the summary statistics for 155 source countries/regions in our main sample.

# B Additional Figures and Tables

## B.1 Detecting Adjustments in External Tariffs Outside the Bloc

We examine whether other reasons could account for the changes in imports from outside the bloc following the formation of ECFA. To this end, we investigate the trends in tariff adjustments outside the Mainland-Taiwan integrated bloc. Earlier studies point out that after the formation of a preferential trade agreement, there could be adjustments in external tariffs imposed by members (Estevadeordal et al., 2008), or tariffs imposed by nonmember countries (Saggi et al., 2018). These additional adjustments would be a potential threat to our empirical strategy. If the Early Harvest Program had induced any adjustment in external tariffs, the changes in imports from other countries outside the bloc would not be purely due to the changes in tariffs on ECFA products. In particular, aggregate imports may increase if external tariffs decreased following the formation of ECFA, leading to an overstatement of the effects of the ECFA input tariff reductions.

To alleviate this concern, we employ the following regression,

$$\ln(\tau_t^k) = \alpha\big(ECFA_k \times \mathbf{1}\{t \geq 2011\}\big) + D^k + D_t^K + \epsilon_t^k, \tag{B.1}$$

where $\tau_t^k = 1 + Tariff_t^k$ denotes different measures of tariffs. $ECFA_k$ is a dummy that equals one if the 6-digit HS product $k$ is included on the Early Harvest List, and $\mathbf{1}\{t \geq 2011\}$ is an indicator for periods after 2011. We control for the 6-digit HS product ($D^k$) and sector-year fixed effects ($D_t^K$), where sectors are defined using the 2-digit HS codes. In all regressions, standard errors are clustered at the 6-digit HS product level to account for the within-product correlations of unobserved shocks across different years.

We separately analyze the outcomes including the most-favored-nation (MFN) tariffs and the applied tariffs imposed on the rest of the world by China and Taiwan. The results are shown in Table B.1. Reassuringly, the estimated results are statistically and economically indistinguishable from zero. In other words, there is no significant adjustment in external import tariffs after the ECFA. We take this finding as evidence that the adjustment in external tariffs is unlikely a confounding factor in our context.

## B.2 Fixed-Effects Estimation

In this appendix, we verify that the main findings are robust to using fixed-effects specifications. We describe the details of the fixed-effects models and the baseline regression results as follows.[32]

[32]The results for other supplementary analyses are available in full upon request.

**Firm-level Responses.** We first evaluate the effects of ECFA on firm's aggregate import and export activities based on Equation (6). The dependent variable, $\ln(\text{Value}_{it})$, is the log import (or export) value of firm $i$ in year $t$ and the explanatory variable, $\ln(\tau^M)$, is the firm's input tariffs. Both variables are measured in levels. We present the results in Table B.8. The coefficients on input tariffs resemble the baseline estimates.

**Within-Bloc Imports.** We examine firms' responses at the product-country-year level using fixed-effects specifications. Formally, for imports within the Mainland-Taiwan integrated bloc, the fixed-effects model analogous to Equation (8) is:

$$\ln(Quantity_{it}^k) = \gamma \ln(\tau_{it}^M) + D_t^k + D_i^k + \epsilon_{it}^k, \tag{B.2}$$

where $\ln(Quantity_{it}^k)$ denotes the log import in quantity from Taiwan for firm $i$, product $k$, and year $t$ and $\ln(\tau_{it}^M)$ is defined as in Equation (2). Both variables are measured in levels. In addition to the product-year fixed effects ($D_t^k$), we include firm-product fixed effects ($D_i^k$), which control for time-invariant firm-product-specific determinants of input demand. We report the results in Column 1 in Panel A of Table B.9. The coefficients on input tariffs are similar to our baseline estimates.

In the next two columns in Panel A, we verify the role of elasticity parameters using fixed-effects specifications. The model is formulated as:

$$\begin{aligned}\ln(Quantity_{it}^k) =& \gamma_1 \ln(\tau_{it}^M) \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} + \gamma_2 \ln(\tau_{it}^M) \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \gamma_3 \mathbf{1}\{\sigma_i > \sigma_{med}\} \times t + D_t^k + D_i^k + \epsilon_{it}^k.\end{aligned} \tag{B.3}$$

This fixed-effects model corresponds to the original stacked-difference model in Equation (9). Specifically, it includes firm-product fixed effects and the interaction term of the indicator $\mathbf{1}\{\sigma_i > \sigma_{med}\}$ with a linear time trend. This interaction term allows for differential time trends of imports of firms facing different demand elasticities, which boils down to the term $\mathbf{1}\{\sigma_i > \sigma_{med}\}$ in the stacked-difference specification. Reassuringly, the results are consistent with the patterns seen in Table 3.[33]

**Out-of-Bloc Imports.** We perform similar robustness tests on imports from other origins. Relative to the within-bloc specifications (B.2) and (B.3), we focus on all import origins except Taiwan and exploit variations across products and source countries. We adopt similar fixed-

[33]Note that there is an increase in the number of available observations, from 24,119 in the stacked-difference model to 105,238 in the fixed-effects model. This increase is because when using stacked difference, we focus on firms that import the same input at the beginning and end of each five-year period. A fixed-effects model, on the other hand, does not require firms to import the same input in both $t-5$ and $t$.

effects models:

$$\ln(Quantity_{it}^{ck}) = \eta \ln(\tau_{it}^{M}) + D_t^{ck} + D_i^{ck} + \epsilon_{it}^{ck} \tag{B.4}$$

and

$$\begin{aligned}\ln(Quantity_{it}^{ck}) =& \eta_1 \ln(\tau_{it}^{M}) \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} + \eta_2 \ln(\tau_{it}^{M}) \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \eta_3 \mathbf{1}\{\sigma_i > \sigma_{med}\} \times t + D_t^{ck} + D_i^{ck} + \epsilon_{it}^{ck},\end{aligned} \tag{B.5}$$

where $\ln(Quantity_{it}^{ck})$ is log import quantities (in levels) for firm $i$, product $k$, country $c$, and year $t$. We include firm-product-country fixed effects ($D_i^{ck}$) to account for any time-invariant firm-product-country specific factor that determines demand for each input variety. Panel B of Table B.9 verifies that the findings we obtain from these alternative specifications are similar to those in Table 4.

**Out-of-Bloc Imports and MNC Production Networks**. To verify the robustness of our main results regarding the differential responses within and beyond multinationals' organizational network, we estimate a fixed-effects model analogous to Equation (12):

$$\begin{aligned}\ln(Quantity_{it}^{ck}) =& \alpha_1 \ln(\tau_{it}^{M}) \times Unlinked_i^c + \alpha_2 \ln(\tau_{it}^{M}) \times Linked_i^c \\ &+ \alpha_3 Linked_i^c \times t + D_t^{ck} + D_i^{ck} + \epsilon_{it}^{ck},\end{aligned} \tag{B.6}$$

where $\ln(Quantity_{it}^{ck})$ and $\ln(\tau_{it}^{M})$ are, again, measured in levels. The model interacts the indicator $Linked_i^c$ with a linear time trend, and includes a set of firm-product-country-year fixed effects. As presented in Panel A of Table B.10, the results remain consistent.

Finally, we test the robustness of our findings on the extent to which elasticity parameters affect firms' differential responses. We estimate the following model:

$$\begin{aligned}\ln(Quantity_{it}^{ck}) =& \pi_1 ln(\tau_{it}^{M}) \times Unlinked_i^c \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} \\ &+ \pi_2 \ln(\tau_{it}^{M}) \times Unlinked_i^c \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \pi_3 \ln(\tau_{it}^{M}) \times Linked_i^c \times \mathbf{1}\{\sigma_i \leq \sigma_{med}\} \\ &+ \pi_4 \ln(\tau_{it}^{M}) \times Linked_i^c \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \\ &+ \pi_5 Linked_i^c \times t + \pi_6 \mathbf{1}\{\sigma_i > \sigma_{med}\} \times t + \pi_7 Linked_i^c \times \mathbf{1}\{\sigma_i > \sigma_{med}\} \times t \\ &+ D_t^{ck} + D_i^{ck} + \epsilon_{it}^{ck},\end{aligned} \tag{B.7}$$

where we interact all time-invariant variables, $Linked_i^c$, $\mathbf{1}\{\sigma_i > \sigma_{med}\}$, as well as the interaction

between them, with a linear time trend. In Panel B, we verify that the estimates are in line with the main results in Table 5. Overall, we confirm that our main findings are largely intact when using fixed-effects specifications.

Figure B.1: Changes in Exports and Changes in Export Tariffs at the Product Level


*Notes:* This figure plots the estimated coefficients $\beta_s$ of the regression $\ln(Export_t^k) = \sum_{s=2006}^{2015} \beta_s \big(\mathbf{1}\{t = s\} \times \Delta \ln \tau^{k,TWN}\big) + D^k + D_t^K + \epsilon_t^k$. Error bands show 90% confidence intervals. Standard errors are clustered at the 6-digit product level.

Table B.1: Tariff Adjustments on Imports from Outside the ECFA Bloc

| | **China** | | **Taiwan** | |
|---|---|---|---|---|
| **Dependent Variable:** $\Delta \ln(\tau_t^k)$ | **MFN Tariff** (1) | **Applied Tariff** (2) | **MFN Tariff** (3) | **Applied Tariff** (4) |
| $ECFA_k \times \mathbf{1}\{t \geq 2011\}$ | -0.0002 | -0.0004 | 0.0003 | 0.0003 |
| | (0.0003) | (0.0003) | (0.0002) | (0.0003) |
| Product | Y | Y | Y | Y |
| Industry × Year | Y | Y | Y | Y |
| $N$ | 41,692 | 41,685 | 40,618 | 40,603 |
| $R^2$ | 0.9834 | 0.9315 | 0.9927 | 0.8115 |

*Notes:* The dependent variables are the changes in ln(1+import tariff) as indicated in column titles. Standard errors are clustered at the 6-digit HS product level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.2: Within-Bloc and Out-of-Bloc Imports: Input Specificity

| | **Within Bloc** | **Out of Bloc** | |
|---|---|---|---|
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) |
| **Panel A. Median Cutoff** | | | |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Specificity} \leq \text{Median}\}$ ($\gamma_1$ or $\alpha_1$) | -10.740** | -24.972*** | |
| | (5.123) | (8.843) | |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Specificity} > \text{Median}\}$ ($\gamma_2$ or $\alpha_2$) | -11.832*** | -14.855** | |
| | (3.966) | (5.936) | |
| $H_0 : \gamma_1 = \gamma_2$ | 0.826 | | |
| $H_0 : \alpha_1 = \alpha_2$ | | 0.239 | |
| **Panel B. MNC Production Network and Median Cutoff** | | | |
| Linked | | | -0.637*** |
| | | | (0.076) |
| Linked $\times \mathbf{1}\{\text{Specificity} > \text{Median}\}$ | | | 0.346*** |
| | | | (0.053) |
| $\Delta \ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Specificity} \leq \text{Median}\}$ ($\pi_1$) | | | -17.352*** |
| | | | (5.001) |
| $\Delta \ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Specificity} > \text{Median}\}$ ($\pi_2$) | | | -7.261 |
| | | | (8.217) |
| $\Delta \ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Specificity} \leq \text{Median}\}$ ($\pi_3$) | | | -45.462** |
| | | | (17.499) |
| $\Delta \ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Specificity} > \text{Median}\}$ ($\pi_4$) | | | -69.183*** |
| | | | (14.949) |
| $H_0 : \pi_1 = \pi_2$ | | | 0.232 |
| $H_0 : \pi_3 = \pi_4$ | | | 0.176 |
| Product $\times$ Year | Y | N | N |
| Product $\times$ Country $\times$ Year | N | Y | Y |
| $N$ | 22,443 | 32,372 | 32,372 |
| $R^2$ | 0.156 | 0.319 | 0.321 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. Columns 1-3 estimate specification in Column 3 of Table 3, Column 3 of Table 4, and Column 3 of Table 5, respectively, but replace $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ by $\mathbf{1}\{\text{Specificity} \leq \text{Median}\}$, and $\mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ by $\mathbf{1}\{\text{Specificity} > \text{Median}\}$. The main effect of $\mathbf{1}\{\text{Specificity} > \text{Median}\}$ is subsumed into the fixed effects as input specificity is constructed at the product level. The table reports the $p$-values of the $t$-tests for the hypotheses that $\gamma_1 = \gamma_2$, $\alpha_1 = \alpha_2$, $\pi_1 = \pi_2$ and $\pi_3 = \pi_4$ under different specifications. Standard errors in Column 1 are clustered at 2-digit HS level, while those in Columns 2 and 3 are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.3: Out-of-Bloc Imports: Additional Controls

| | **Export Tariffs** | | **Characteristics of Exporting Country** | | | |
|---|---|---|---|---|---|---|
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) | (4) | (5) | (6) |
| $\Delta \ln \tau^M$ | -18.283*** | | | | | |
| | (5.190) | | | | | |
| $\Delta \ln \tau^X$ | -2.887 | | | | | |
| | (4.886) | | | | | |
| Linked | | -0.341*** | -0.361*** | -0.360*** | -0.360*** | -0.360*** |
| | | (0.054) | (0.058) | (0.058) | (0.064) | (0.063) |
| $\Delta \ln \tau^M \times$ Unlinked ($\alpha_1$) | | -10.319* | -34.005** | -21.826 | -26.376 | -31.838 |
| | | (5.080) | (15.540) | (32.271) | (43.782) | (30.140) |
| $\Delta \ln \tau^M \times$ Linked ($\alpha_2$) | | -53.346*** | -68.004*** | -54.028** | -58.925 | -64.249** |
| | | (16.755) | (9.264) | (26.520) | (37.897) | (25.078) |
| $\Delta \ln \tau^X \times$ Unlinked | | -20.042*** | | | | |
| | | (3.318) | | | | |
| $\Delta \ln \tau^X \times$ Linked | | 7.768 | | | | |
| | | (8.609) | | | | |
| $\Delta \ln \tau^M \times$ Log Distance | | | -16.399* | -16.514* | -16.932 | -17.623* |
| | | | (8.931) | (9.622) | (11.401) | (10.107) |
| $\Delta \ln \tau^M \times$ Log GDP per capita | | | | -14.641 | -18.034 | -20.645 |
| | | | | (23.068) | (15.775) | (23.240) |
| $\Delta \ln \tau^M \times$ Log Years of Schooling | | | | | 17.237 | 9.871 |
| | | | | | (40.033) | (62.354) |
| $\Delta \ln \tau^M \times$ Governance | | | | | | 7.257 |
| | | | | | | (25.778) |
| $H_0 : \alpha_1 = \alpha_2$ | | 0.024 | 0.011 | 0.005 | 0.007 | 0.006 |
| Product × Country × Year | Y | Y | Y | Y | Y | Y |
| $N$ | 32,372 | 32,372 | 32,368 | 32,250 | 32,250 | 32,350 |
| $R^2$ | 0.319 | 0.321 | 0.321 | 0.321 | 0.321 | 0.321 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. The variables *Log Distance, Log GDP per capita, Log Years of Schooling*, and *Governance* are demeaned; the main effects of these country characteristics are absorbed by the product-country-year dummies. The table reports the $p$-values of the $t$-tests for the hypothesis that $\alpha_1 = \alpha_2$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.4: Out-of-Bloc Imports: Alternative Samples Based on Year of Establishment

| | **A. Firms Established in 2011 or earlier** | | **B. Firms Established in 2008 or earlier** | |
|---|---|---|---|---|
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) | (4) |
| $\Delta \ln \tau^M$ | -19.186*** | | -21.249*** | |
| | (5.515) | | (5.574) | |
| Linked | | -0.377*** | | -0.387*** |
| | | (0.065) | | (0.058) |
| $\Delta \ln \tau^M \times$ Unlinked ($\alpha_1$) | | -11.428*** | | -13.224*** |
| | | (4.301) | | (3.359) |
| $\Delta \ln \tau^M \times$ Linked ($\alpha_2$) | | -57.794*** | | -59.785*** |
| | | (15.697) | | (16.324) |
| $H_0 : \alpha_1 = \alpha_2$ | | 0.003 | | 0.002 |
| Product × Country × Year | Y | Y | Y | Y |
| Number of firms | 625 | 625 | 584 | 584 |
| $N$ | 32,236 | 32,236 | 31,796 | 31,796 |
| $R^2$ | 0.321 | 0.323 | 0.326 | 0.328 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. Panel A restricts the sample to importing firms established in 2011 or earlier. Panel B further restricts the sample to firms established in 2008 or earlier. The table reports the $p$-values of the $t$-tests for the hypothesis that $\alpha_1 = \alpha_2$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.5: Out-of-Bloc Imports: Removal of Influential Parent Firms

| | **A. Removing HQs with the Most Chinese Affiliates** | | **B. Removing HQs with the Most Foreign Affiliates** | |
|---|---|---|---|---|
| **Dependent Variable:** $\Delta \ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) | (4) |
| $\Delta \ln \tau^M$ | -19.412*** | | -10.970** | |
| | (4.352) | | (4.500) | |
| Linked | | -0.394*** | | -0.129 |
| | | (0.063) | | (0.097) |
| $\Delta \ln \tau^M \times$ Unlinked ($\alpha_1$) | | -11.277*** | | -8.070** |
| | | (2.658) | | (3.994) |
| $\Delta \ln \tau^M \times$ Linked ($\alpha_2$) | | -50.364*** | | -31.333** |
| | | (14.916) | | (15.020) |
| $H_0 : \alpha_1 = \alpha_2$ | | 0.015 | | 0.137 |
| Product × Country × Year | Y | Y | Y | Y |
| Number of Firms | 561 | 561 | 608 | 608 |
| $N$ | 30,833 | 30,833 | 27,976 | 27,976 |
| $R^2$ | 0.324 | 0.329 | 0.329 | 0.329 |

*Notes:* The dependent variable is the change in log import quantities of different products from different countries outside the integrated bloc. Panel A excludes Chinese firms whose Taiwan-based headquarter (HQ) has the most affiliates in China. Panel B excludes Chinese firms whose HQ has the most affiliates in other countries/regions. The table reports the $p$-values of the $t$-tests for the hypothesis that $\alpha_1 = \alpha_2$ under different specifications. Standard errors are two-way clustered by country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.6: Within-Bloc and Out-of-Bloc Imports: Import Value

| | | Choice of Elasticity Measures | |
|---|---|---|---|
| | | Output Demand Elasticity | Input Differentiation |
| **Dependent Variable:** $\Delta \ln(\text{Value}_{it}^{ck})$ | (1) | (2) | (3) |
| **Panel A. Within-Bloc Imports** | | | |
| $\Delta \ln \tau^M$ | -9.802*** | | |
| | (3.556) | | |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | -0.015 | |
| | | (0.050) | |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\gamma_1$) | | -4.199 | -6.961* |
| | | (5.944) | (3.800) |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\gamma_2$) | | -12.098*** | -12.688*** |
| | | (4.134) | (4.473) |
| $H_0 : \gamma_1 = \gamma_2$ | | 0.277 | 0.125 |
| Product × Year | Y | Y | Y |
| $N$ | 24,119 | 24,119 | 23,088 |
| $R^2$ | 0.176 | 0.176 | 0.171 |
| **Panel B. Out-of-Bloc Imports** | | | |
| $\Delta \ln \tau^M$ | -18.684*** | | |
| | (6.501) | | |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | -0.406*** | |
| | | (0.029) | |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\eta_1$) | | -6.795 | -17.786* |
| | | (6.442) | (10.465) |
| $\Delta \ln \tau^M \times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\eta_2$) | | -24.478*** | -13.151 |
| | | (7.371) | (10.080) |
| $H_0 : \eta_1 = \eta_2$ | | 0.024 | 0.767 |
| Product × Country × Year | Y | Y | Y |
| $N$ | 32,372 | 32,372 | 31,553 |
| $R^2$ | 0.305 | 0.308 | 0.299 |

*Notes:* The dependent variable in Panel A is the change in log import values of different products from Taiwan. The dependent variable in Panel B is the change in log import values of different countries outside the integrated bloc. The elasticity measures are indicated in the column titles. In Column 3, the main effect of $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ is subsumed into the fixed effects as input differentiation is constructed at the product level. The table reports the $p$-values of the $t$-tests for the hypotheses that $\gamma_1 = \gamma_2$, and $\eta_1 = \eta_2$ under different specifications. Standard errors in Panel A are clustered at the 2-digit HS level, while those in Panel B are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.7: Out-of-Bloc Imports and MNC Production Networks: Import Value

| | | Choice of Elasticity Measures | |
|---|---|---|---|
| | | **Output Demand Elasticity** | **Input Differentiation** |
| **Dependent Variable:** $\Delta \ln(\text{Value}_{it}^{ck})$ | (1) | (2) | (3) |
| **Panel A. MNC Production Networks: Matched Subsidiaries** | | | |
| Linked | -0.302*** | | |
| | (0.059) | | |
| $\Delta \ln \tau^M \times$ Unlinked ($\alpha_1$) | -11.202** | | |
| | (4.400) | | |
| $\Delta \ln \tau^M \times$ Linked ($\alpha_2$) | -59.194*** | | |
| | (19.627) | | |
| $H_0 : \alpha_1 = \alpha_2$ | 0.017 | | |
| **Panel B. MNC Production Networks and Median Elasticity Cutoff** | | | |
| Linked | | -0.297** | -0.285*** |
| | | (0.127) | (0.070) |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | -0.409*** | |
| | | (0.100) | |
| Linked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ | | 0.025 | -0.086*** |
| | | (0.282) | (0.018) |
| $\Delta \ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\pi_1$) | | -4.204 | -6.274 |
| | | (6.768) | (9.967) |
| $\Delta \ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\pi_2$) | | -14.637** | -9.612+ |
| | | (5.685) | (5.971) |
| $\Delta \ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\pi_3$) | | -12.944* | -90.667*** |
| | | (6.607) | (27.551) |
| $\Delta \ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\pi_4$) | | -155.825*** | -26.023*** |
| | | (21.701) | (7.424) |
| $H_0 : \pi_1 = \pi_2$ | | 0.255 | 0.798 |
| $H_0 : \pi_3 = \pi_4$ | | 0.000 | 0.048 |
| Product × Country × Year | Y | Y | Y |
| $N$ | 32,372 | 32,372 | 31,553 |
| $R^2$ | 0.307 | 0.310 | 0.301 |

*Notes:* The dependent variable is the change in log import values of different products from different countries outside the integrated bloc. The elasticity measures are indicated in the column titles. In Column 3, the main effect of $\mathbf{1}\{\text{Elasticity} > \text{Median}\}$ is subsumed into the fixed effects as input differentiation is constructed at the product level. The table reports the $p$-values of the $t$-tests for the hypotheses that $\alpha_1 = \alpha_2$, $\pi_1 = \pi_2$ and $\pi_3 = \pi_4$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. $p$ <0.10.

Table B.8: Within-Bloc and Out-of-Bloc Trade: Firm-Level Fixed-Effects Estimation

| | **Within-Bloc Imports** | **Out-of-Bloc Imports** | | | |
|---|---|---|---|---|---|
| | **Taiwan** | **Unlinked Countries** | **Linked Countries** | **All Imports** | **All Exports** |
| **Dependent Variable:** $\ln(\text{Value}_{it})$ | (1) | (2) | (3) | (4) | (5) |
| $\ln \tau^M$ | -9.382*** | -13.166*** | -15.170** | -16.426*** | -18.323*** |
| | (3.619) | (4.627) | (7.687) | (3.506) | (5.667) |
| Firm | Y | Y | Y | Y | Y |
| Year | Y | Y | Y | Y | Y |
| $N$ | 4,875 | 4,821 | 2,162 | 5,266 | 4,512 |
| $R^2$ | 0.802 | 0.785 | 0.765 | 0.810 | 0.803 |

*Notes:* The dependent variables are the log import (or export) values indicated in the column titles. *Linked countries* refer to countries/regions where the Chinese subsidiary has at least one affiliated party. Robust standard errors are clustered at firm level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.9: Within-Bloc and Out-of-Bloc Imports: Fixed-Effects Estimation

| | | **Choice of Elasticity Measures** | |
|---|---|---|---|
| | | **Output Demand Elasticity** | **Input Differentiation** |
| **Dependent Variable:** $\ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) |
| **Panel A. Within-Bloc Imports** | | | |
| $\ln \tau^M$ | -11.846*** | | |
| | (2.730) | | |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\} \times t$ | | -0.012 | |
| | | (0.008) | |
| $\ln \tau^M \times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ $(\gamma_1)$ | | -6.436 | -12.954*** |
| | | (4.689) | (4.165) |
| $\ln \tau^M \times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ $(\gamma_2)$ | | -14.798*** | -9.560*** |
| | | (2.559) | (2.311) |
| $H_0 : \gamma_1 = \gamma_2$ | | 0.101 | 0.382 |
| Firm × Product | Y | Y | Y |
| Product × Year | Y | Y | Y |
| $N$ | 105,238 | 105,238 | 100,114 |
| $R^2$ | 0.905 | 0.905 | 0.905 |
| **Panel B. Out-of-Bloc Imports** | | | |
| $\ln \tau^M$ | -13.109*** | | |
| | (3.642) | | |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\} \times t$ | | -0.080*** | |
| | | (0.008) | |
| $\ln \tau^M \times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ $(\eta_1)$ | | -1.871 | -8.362 |
| | | (3.691) | (6.382) |
| $\ln \tau^M \times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ $(\eta_2)$ | | -18.891*** | -13.543*** |
| | | (4.535) | (4.052) |
| $H_0 : \eta_1 = \eta_2$ | | 0.002 | 0.521 |
| Firm × Product × Country | Y | Y | Y |
| Product × Country × Year | Y | Y | Y |
| $N$ | 146,058 | 146,058 | 142,706 |
| $R^2$ | 0.915 | 0.915 | 0.914 |

*Notes:* The dependent variable in Panel A is log import quantities of products from Taiwan. The dependent variable in Panel B is log import quantities of products from different countries outside the integrated bloc. All variables are in levels. $t$ is a linear time trend. The elasticity measures are indicated in the column titles. In Column 3, the effect of $\mathbf{1}\{\text{Elasticity} > \text{Median}\} \times t$ is subsumed into the fixed effects as input differentiation is constructed at the product level. All columns include firm-product and product-year fixed effects. The table reports the $p$-values of the $t$-tests for the hypotheses that $\gamma_1 = \gamma_2$, and $\eta_1 = \eta_2$ under different specifications. Standard errors in Panel A are clustered at the 2-digit HS level, while those in Panel B are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table B.10: Out-of-Bloc Imports and MNC Production Networks: Fixed-Effects Estimation

| | | Choice of Elasticity Measures | |
|---|---|---|---|
| | | **Output Demand Elasticity** | **Input Differentiation** |
| **Dependent Variable:** $\ln(\text{Quantity}_{it}^{ck})$ | (1) | (2) | (3) |
| **Panel A. MNC Production Networks: Matched Subsidiaries** | | | |
| Linked $\times\, t$ | -0.051*** | | |
| | (0.010) | | |
| $\ln \tau^M \times$ Unlinked ($\alpha_1$) | -10.325*** | | |
| | (3.373) | | |
| $\ln \tau^M \times$ Linked ($\alpha_2$) | -19.057*** | | |
| | (5.424) | | |
| $H_0 : \alpha_1 = \alpha_2$ | 0.202 | | |
| **Panel B. MNC Production Networks and Median Elasticity Cutoff** | | | |
| Linked $\times\, t$ | | -0.072 | -0.082*** |
| | | (0.064) | (0.019) |
| $\mathbf{1}\{\text{Elasticity} > \text{Median}\} \times\ t$ | | 0.084*** | |
| | | (0.022) | |
| Linked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\} \times\ t$ | | 0.013 | 0.021** |
| | | (0.045) | (0.009) |
| $\ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\pi_1$) | | -2.653 | -4.823 |
| | | (3.672) | (9.147) |
| $\ln \tau^M \times$ Unlinked $\times \mathbf{1}\{\text{Elasticity} > \text{Median}\}$ ($\pi_2$) | | -13.809*** | -12.340** |
| | | (4.318) | (4.907) |
| $\ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Elasticity} \leq \text{Median}\}$ ($\pi_3$) | | 6.633 | -16.886 |
| | | (9.301) | (16.399) |
| $\ln \tau^M \times$ Linked $\times \mathbf{1}\{\text{Elas} > \text{Median}\}$ ($\pi_4$) | | -42.762** | -13.964 |
| | | (19.803) | (14.858) |
| $H_0 : \pi_1 = \pi_2$ | | 0.051 | 0.503 |
| $H_0 : \pi_3 = \pi_4$ | | 0.083 | 0.925 |
| Firm $\times$ Product $\times$ Country | Y | Y | Y |
| Product $\times$ Country $\times$ Year | Y | Y | Y |
| $N$ | 146,058 | 146,058 | 142,706 |
| $R^2$ | 0.915 | 0.915 | 0.914 |

*Notes:* The dependent variable is log import quantities of different products from different countries outside the integrated bloc. All variables are in levels. $t$ is a linear time trend. The elasticity measures are indicated in the column titles. In Column 3, the effect of $\mathbf{1}\{\text{Elasticity} > \text{Median}\} \times\ t$ is subsumed into the fixed effects as input differentiation is constructed at the product level. All columns include firm-product and product-year fixed effects. The table reports the $p$-values of the $t$-tests for the hypotheses that $\alpha_1 = \alpha_2$, $\pi_1 = \pi_2$ and $\pi_3 = \pi_4$ under different specifications. Standard errors are two-way clustered by source country and 2-digit HS industry. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.