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Import Competition, Technology Intensity, and Firms' Heterogenous Production Adjustment: Evidence from Indonesian Low-, Mid-Level, and High-Technology Intensive Manufacturing Industries

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Abstract

Manufacturing expansion and improved market access have enabled China to penetrate multiple overseas markets. Using shift-share instrumental variable and 2005 ASEAN-China Free Trade Area multilateral agreement, this paper finds that Chinese import competition causes heterogenous adjustments in production scale and product variety across Indonesia's low-, mid-level, and high-technology industries. Both pro-competitive – product pruning, switching, technical change – and input-facilitation effects could channel these transmissions. No evidence of 'escape competition by exporting' emerges, while price rigidity is observed. Differences in firms' absorptive capacity, capital intensity, labour productivity, and fixed headquarter costs across industries become potential mechanisms leading to the heterogenous adjustments.

Keywords: Import Competition, Trade, Manufacturing Industries, Technology Intensity, Production Scale, Product Variety, Indonesia.

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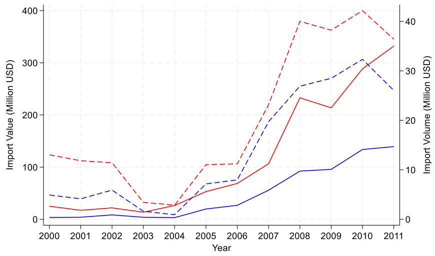
1. Introduction

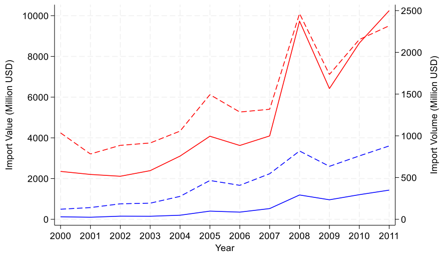
In the early 2000s, China experienced a substantial improvement in Total Factor Production (TFP), allocative efficiency, and international market access following WTO accession and numerous Preferential Trade Agreements (PTA), allowing them to penetrate both developed and developing countries' markets (Brandt et.al., 2012; Khandelwal et.al., 2013; Darko et.al., 2021). Literature has discussed the impacts of trade-induced competition, including due to China's import penetration, to firms in import-receiving countries on various firm-level measures, such as productivity and quality upgrading (Amiti and Konings, 2007; Bas and Strauss-Kahn, 2015; Medina, 2024). Literature has also highlighted heterogenous effects of import competition within industries (Utar and Ruiz, 2013) and elaborated two main channels through which those effects are transmitted: pro-competitive and input-facilitation effects. Despite extensive discussions, existing research either focuses on a specific industry or aggregating multiple industries, hence overlooking the important heterogeneity from different industries. Figure 1.1. shows different rates of increase in Chinese import penetration to Indonesia between 2000-2011 for apparels, automotives, and electronics industries. The different rate of increase between industries may cause different adjustments and responses between and within industries. Since these industries differ in the intensity of technology use, one question remains underexplored: how does Chinese import competition differently affect firms' behaviour in low-, mid-level, and high-technology industries?

In this paper, I provide empirical evidence that trade-induced competition causes heterogenous production adjustments for firms in low-, mid-level, and high-technology industries. This adjustment is investigated by observing firms' production at HS6 (harmonized system) product level in each industry in 2000-2011. Apparel industry represents low-technology, automotive industry represents mid-level technology, and electronics industry represents high-technology industries following Organization for Economic Cooperation and Development's (OECD) industrial technological intensity categories. This empirical setting provides three important features for the identification strategy. First, China's and Indonesia's involvement in ASEAN-China Free Trade Area (ACFTA) 2005 provides an exogenous variation in the increase of Chinese imports to Indonesia which allows me to establish causality. ACFTA is a multilateral agreement, therefore, magnitudes and schedules of tariff reduction were decided by and applied to ASEAN members concurrently. This eliminates an alternative explanation that increasing imports from China is a response to Indonesia's domestic policies. Second, China's accession to the WTO in 2001 strengthens the validity of exogenous increase in Chinese import penetration. Third, OECD classification provides clear division of industries which eliminates self-selection concerns in categorizing industrial technological use.

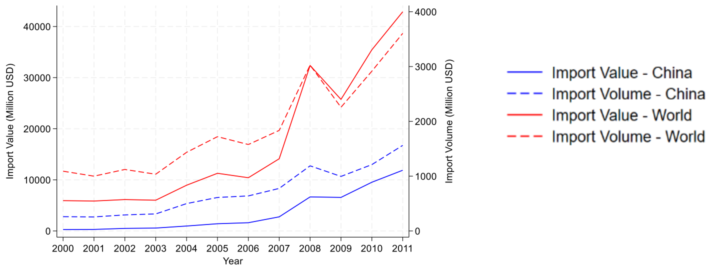
Figure 1.1. Indonesia's Imports from China and World (2000-2011)



(a) Apparels (HS 61, 62)



(b) Automotives (HS 73, 87)



(c) Electronics (HS 84, 85)

Source: UN Comtrade (2025). Calculated by Author.

To capture causal links between increasing import competition from China and firm's production adjustments, I adopt Shift-Share Instrumental Variable as in Autor et.al. (2013) and Medina (2024) for the identification strategy. The IV approach allows me to capture exogenous variation and accommodates gradual implementation in ACFTA which increases competition gradually. I use firm-level data from Statistics of Indonesia Manufacturing Industry (SI) from Statistics Indonesia (BPS) combined with HS6 product-level import flows from UN Comtrade for 2000-2011, disregarding 2006 due to incompleteness at firm-level measures. I construct firm-specific measures on Chinese import penetration and examine firms' production adjustments in domestic and export markets. I first briefly show Chinese import competition effects to firms' output values and product variety, allowing for adjustment in extensive and intensive margins. I then look at a subsample of firms and products with standardized volume, for which I decompose output values into volumes and unit prices and examine sources of their changes. I then switch to intensive margin, examining only firms operating in all observation period, to observe adjustments specific to incumbents. Finally, I discuss possible mechanisms that may explain the findings and their policy implications.

I found that firms have different production adjustments in different industries when facing increasing Chinese import penetration at domestic market. In low-technology industries, increasing Chinese import penetration do not affect firms' revenues; however, it decreases firms' product variety. Firms in low-technology industries streamline their product mix, producing more core products and cutting out peripheral product lines, signalling a pro-competitive effect and product pruning strategy of multi-product firms following trade liberalization (Bernard et.al., 2010). In mid-level technology industries, Chinese import penetration leads to an increase in firms' output value and new varieties which had not been previously manufactured without changing overall product variety. These adjustments signal a combination of product pruning and switching, occurring either through trade-induced technical change and/or input-facilitation effect (Bloom et.al, 2016; Goldberg et.al, 2010a). In high-technology industries, Chinese import penetration does not affect firms' output values and product variety, signalling a specialization strategy and product mix that are difficult to prune and switch despite higher degree of import penetration (Goldberg et.al, 2010b). Chinese import competition at export destination markets have no effect to firms' production.

The decomposition of output values using subsample of firms with standardized volume provides insights on the sources of their changes. In mid-level technology industries, positive output value comes from increasing production volume in domestic market with unchanged unit prices, indicating no quality upgrading in new varieties. In high-technology industries, the null effect on output values comes from opposing effects of higher output volumes and lower unit prices in domestic and export markets. A slight deviation to 'All Firms' analysis for total output values in high-technology industries also signals for heterogeneous response between firms within industries. The decomposition analysis also highlights the absence of 'escape competition by exporting' strategy and the existence of price rigidity in all industries and markets except for export prices in high-technology industries. Incumbent firms adjust their production similarly to the aggregate adjustments in mid-level technology industries but differently in low-technology industries. Incumbent firms in low-technology industries increase unit prices amidst price rigidity and have their products variety unaffected following Chinese import penetration at domestic market. This suggests a possible quality upgrading for the same product set and that aggregate adjustments in these industries are predominantly driven by entrants and exiting firms. While this paper does not pinpoint the exact mechanism, differences in firms' absorptive capacity, capital intensity, labour productivity, and fixed headquarter cost may become potential mechanisms leading to heterogenous adjustments between industries that highlights a necessity for heterogenous policies for each industry.

This paper relates with strands of literature discussing trade liberalization effects to firm-level adjustments (Amiti and Konings, 2007; Mion and Zhu, 2013; Bas and Strauss-Kahn, 2015;

Bloom et.al., 2016). This paper is also guided by Melitz (2003), Bernard et.al. (2010), Utar and Ruiz (2013), and Medina (2024), of which firms are heterogenous in the exposure to import competition, produce multiple goods, and can adjust their product mix in response to competition from other producers. This paper joins the literature in examining behaviour of multi-product firms in adjusting their production following increasing import competition and/or trade liberalization. The contribution of this paper to the literature is three-fold. First, this becomes one of the few papers which captures causality links and combines heterogeneity between-industry, based on technological use, and within-industry in low-income setting. Second, this paper is the first in Indonesia that directly analyse firm's production adjustments in both extensive and intensive margins, as other research focuses on TFP and probability of exit without distinguishing those margins. Third, this paper extends the literature to better understand the emerging South-South trade and its effects to local firms.

The rest of the paper is organized as follows. Section 2 provides a conceptual framework and potential mechanisms on how Chinese import competition affects firms' production. Section 3 describes the data. Section 4 elaborates the empirical strategy. Section 5 discusses the findings and elaborate potential mechanisms. Section 6 concludes.

2. Conceptual Framework

Literatures have discussed how import competition and/or trade liberalization is associated with firm-level measures, covering productivity, quality upgrading, technology absorption, and skill upgrading (Amiti and Konings, 2007, Crino, 2012; Mion and Zhu, 2013; Utar, 2014; Bas and Strauss-Kahn, 2015; Bloom et.al., 2016; Medina, 2024). Researchers have also underlined two channels through which the effects are transmitted. A strand of literature identifies pro-competitive effects. In this channel, import competition intensifies degree of competition in the market which pushes firms to adjust their outputs, inputs, and investments in efficiency-enhancing means of production to maintain competitiveness (Lileeva and Trefler, 2010; Lu and Ng, 2013). Another line of thought identifies input-facilitation effects. Imports provide accession to new, more varied, lower priced, and/or higher quality input, enabling firms to reduce production costs and upgrade into higher-quality production (Amiti and Khandelwal, 2013; Kugler and Verhoogen, 2012). These channels are not mutually exclusive, as both channels may affect firm-level adjustments concurrently (Topalova and Khandelwal, 2011).

To further elaborate those channels and examine potential mechanisms on how Chinese import competition affect firms' production in low-, mid-level, and high-technology industries, I adopt features in Hopenhayn (1992), Melitz (2003), Bernard et.al. (2007), Melitz and

Ottaviano (2008), and Medina (2024) that firms have heterogenous inherent productivity and produce multiple goods. Following Bernard et.al. (2010, p. 75), firms in monopolistic market under Constant Elasticity of Substitution (CES) consumer preferences with relative taste weights face the following profit maximization problems:

$$\pi_i(\varphi, \lambda_i) = \frac{R_i(A\varphi\lambda_i)^{\sigma-1}}{\sigma} - f_{vi} \text{ ...... (2.1.)}$$

$$\pi(\varphi) = \int_{k=1}^{K} \left[\int_{\lambda_i^*}^{\bar{\lambda}} \pi_i(\varphi, \lambda_i)\omega_{zi}\, d\lambda_i\right] d_i - f_h \text{ ...... (2.2.)}$$

Equation (2.1.) resembles firm's expected profit for individual product, while Equation (2.2.) resembles firm's expected aggregate profit across all products. Intuitively, Equation (2.1.) implies that for each product, firm gathers revenue, R_i, depending on its productivity, φ, and consumer taste for a specific firm-product pair, λ_i. Firm also needs to pay a variable production cost for each product i produced, f_{vi}. Since there are shocks to consumer taste that fluctuates profitability of a product and that firm needs to pay for the production cost, there is a zero-profit cutoff for consumer taste, λ_i^*, below which firm stops producing a product since profit from that particular product becomes negative. This leads to firm adding and dropping products over time. The higher the firm's productivity, the lower the cutoff. Equation (2.2.) implies that, in the long run, profit from each product is averaged using stationary distribution of consumer taste, ω_{zi}, and that across all K products, positive profits from some varieties cancel out negative profits from others. This leads to firm's aggregate profit to depend on firm's productivity after subtracting for fixed headquarter costs, f_h, such as building, machinery, R&D, and licenses.

By introducing import penetration from China as an exogenous shock for consumer taste, Equation (2.1.) and (2.2.) provides potential mechanisms on how Chinese import competition affects firms' production. As China increases its export of multiple goods to overseas markets, local firms face tougher competition in both domestic and export destination markets. For each product penetrated by imports from China, the higher the share of that product in firm's product mix, the greater firm's exposure to the competition. When imported products from China appear in the market, consumers have more options to buy a product from. This may diminish consumer taste (preferences) for an individual product from a certain firm, as they may shift to buy imported products, which diminishes firm's profitability from producing that product. The intensified competition and diminishing profit leads to local firms losing market shares (Utar and Ruiz, 2013), forcing them to respond by adjusting what and how many to produce in their product mix considering the level of exposure they encounter.

Firms in different industries respond with respect to their productivity and fundamental capacity. In responding the competition, firms in higher-technology industries may have higher inherent productivity and absorptive capacity, allowing them to keep product lines as they have lower consumer taste cutoff, adjust production scale, and/or innovate to shift production for new varieties (Bloom et.al., 2016). Firms in lower-technology industries may have much limited productivity and absorptive capacity, making their preferred adjustment to include streamlining their production lines instead of shifting or only rescaling production. Moreover, variable and headquarter costs may also be determinants. Firms in high-technology industries require higher labour investment (f_{vi}), higher R&D and license fees, and specific building and machinery setup (f_h) that makes the overall costs higher. Since acquiring more inputs and licenses require high additional costs, and that laying off these inputs leaves considerable sunk costs, firms in high-technology industries may have specialized in producing certain product mix that, following the shock, they prefer to change the scale of production without changing the existing product mix, even when these are unprofitable (Goldberg et.al., 2010b).

To introduce the exogenous import shock, I utilize the implementation of ASEAN-China Free Trade Area (ACFTA) as the source of exogenous increase in Chinese imports to Indonesia. ACFTA is a multilateral trade agreement between China and ASEAN members that started its effective implementation from January 2005. In ACFTA, China and ASEAN members agreed to gradually reduce tariffs of all parties in multiple stages throughout 2007, 2009, and 2010. The magnitude and schedule of tariff reduction was applied to ASEAN members concurrently. This positioned Indonesia as 'price takers' and eliminates an alternative explanation that the increase of Chinese imports to Indonesia occurs as a response to Indonesia's domestic policies, hence allowing me to establish causal links. Besides ACFTA, China's WTO accession in 2001 also serves as another source of exogenous variation in Chinese import penetration which further strengthens the empirical strategy in this research.

The outlined framework leads to imply that production adjustments may be different between and within industry, of which the following proposition will be examined empirically.

Proposition: Increasing import penetration from China causes Indonesian firms to adjust production:

(1) In low-technology industries, by streamlining product mix without adjusting scale of production

(2) In mid-level technology industries, by changing product mix, including shifting to new products, and adjusting scale of production

(3) In high-technology industries, by adjusting scale of production without changing the product mix

3. Data

This paper utilizes two main data sources for the period of 2000 to 2011, disregarding 2006 due to incompleteness at firm-level measures. The first main data source is Statistics of Indonesia Manufacturing Industry (SI), produced annually by Statistics Indonesia (*Badan Pusat Statistik*, BPS), for firm-related production data. I then combine SI with the second data source of HS6 product-level trade flows data from UN Comtrade to construct firm-specific measures of import competition in domestic and export destination markets.

3.1. Indonesian Firm-Level Data: Statistics of Indonesia Manufacturing Industry (SI)

Statistics of Indonesia Manufacturing Industry (SI) contains detailed information on Indonesian firms' output value and volume in local currency (IDR) and percentage of export for each product classified under 9-digit (KKI9) and 7-digit (KKI7) Indonesian Commodities Classification in each year. This data source is used to construct measures for: (i) firm-level production; (ii) initial shares of total output for import penetration at domestic market; and (iii) initial shares of exported output for competition at export destination market.

Table 3.1. OECD Industry Technological Intensity Classification by ISIC

High Technology	Medium-High Technology	Medium-Low Technology	Low Technology
21 Pharmaceutical	20 Chemical	23 Fabricated Metal	10-11 Food & Beverage
26 Computers, Electronics, and Optics	27 Electrical Equip	**24 Metal Base**	12 Tobacco
	28 Machinery	**25 Metals**	13 Textile
	29 Motor & Trailers	22 Rubber & Plastic	**14 Apparel**
	30 Other Transport Equipment	19 Products from Coal and Oil Refinery	15 Leather & Footwear
			17 Paper & Printing
			18 Printing & Recording
			31 Furniture
Corresponding HS HS 84, HS 85	**Corresponding HS HS 73, HS 87**		**Corresponding HS HS 61, HS 62**

Source: OECD (2011) in Sugiharti et.al. (2022). Modified. Medium-High and Medium-Low Technology Industries are merged into 'Mid-Level Technology Industries' as automotives consist of both industries. Bold entries are industries which correspond to HS 84, 85 (electronics) for high-tech; 73, 87 (automotives) for mid-level tech; and 61, 62 (apparels) for low-tech industries.

To construct firm-level production data, I first match product codes from KKI9 and KKI7 to HS6 codes using product identification conversion data from Statistics Indonesia (BPS) and generate HS6 product-level data of firms' output and export values. I deflate these values using Indonesia's GDP deflator to eliminate inflation factors and convert them into USD using annual exchange rates as applied in UN Comtrade data. After counting the number of total varieties and new varieties that had not been previously manufactured each year based on HS6 product-level data, I aggregate the product-level data into firm-level data, where each firm has a distinct observation per year as the unit of analysis. From this dataset, I select firms producing apparel under Chapters 61 and 62 for low-technology industries, motor vehicle and parts (automotive) under Chapters 73 and 87 for mid-level technology industries, and electronics under Chapters 84 and 85 of HS codes for high-technology industries. These HS codes correspond to the International Standard Industrial Classification (ISIC) used by OECD to categorize industries based on technological intensity as shown in Table 3.1. HS codes are more robust to define these industries since SI does not rigorously list ISIC.

The SI does not present output volume with standardized units of quantity. Therefore, for volume and unit price, I further standardize the units of quantity at HS6 product-level data. I use 'piece' as the standardized unit of quantity since most of volumes are expressed using units that can be converted to pieces. The standardized output volume and its value are then aggregated to firm-level observations to create subsample of firms for the regressions. The 'Standardized Volume' covers at least 93 percent of the product-level volume aggregate in each industry compared to 'All Firms' analysis (see Appendix A1). To address concerns on selection bias, balance tests of mean differences between firms included and excluded in Standardized Volume are conducted for three observable characteristics: firm size, capital intensity, and labour productivity. Firm size is proxied by firm's total fixed assets, covering land, building, machinery, vehicle, and other capital. Capital intensity is measured by total machinery costs over total labour expenses. Labour productivity is measured by firms' output value over total labour expenses. Table 3.2. shows balanced observable characteristics between included and excluded firms, indicating no selection bias among included firms due to greater firm size, faster technological adoption due to higher capital-intensive, and higher labour productivity.

Table 3.2. Balance Tests in Standardized Volume Firms

	Low-Tech		**Mid-Tech**		**High-Tech**	
	Mean Exc	Mean Inc	Mean Exc	Mean Inc	Mean Exc	Mean Inc
Firm Size	2,998,506	4,148,005	3,780,135	2.90e+07	6,054,989	1.93e+08
Capital Intensity	2.485	.4066	.3840	7.337	4.258	11.041
Labor Productivity	.0119	.0072	.0223	.0113	.0083	.0113
Test of H0: Mean Difference = 0						
p-Value Firm Size	0.7635		0.1112		0.5433	
p-Value Capital Int	0.1557		0.2438		0.3430	
p-Value Labor Prod	0.5876		0.1850		0.4833	

Note: 'Mean Exc.' are means of outcomes for firms excluded from and 'Mean Inc.' are means of outcomes for firms included in standardized volume analysis. Source: Statistics of Indonesia Manufacturing Industry (2000-2011). Calculated by Author.

Finally, three more adjustments are made in all scenarios to maintain consistency and reduce noise in firm-level data. First, I select firms which operate at least for 5 years, not necessarily consecutive, throughout the observation period. This is so that the results are not driven by firms which are very short-lived and only operate in certain years or economic conditions. Second, I consider firms and products with total values of at least IDR 1,000,000 annually (equivalent to USD 1000 in 2010). This is to avoid production and shipment of products that are only samples and not in firm's actual product mix, as similarly applied in Medina (2024). Third, I disregard the observation for 2006 due to SI data incompleteness. There is no data recorded on percentages of exports for all firms in 2006, which does not allow me to construct product- and firm-level export measures and initial shares of exported output necessary for the outcomes of interest and explanatory variables. The final dataset combining all industries contains 8,128 firm-year observations for all firms, 5,248 for standardized volume, and 1,155 for incumbent scenario (see Appendix A2).

3.2. HS6 Product-Level Import Flows Data: UN Comtrade

UN Comtrade provides information on trade flows up to HS6 product-level data, covering export and import values in USD. I utilized this data source to collect annual data at HS6 product-level for: (i) Indonesia's imports from China and the World, (ii) Thailand's and Vietnam's imports from China and the World; (iii) Indonesia's exports to all destination countries; and (iv) China's exports to all destination countries. These values are merged with firms' initial shares of total and exported output using HS6 product codes to construct firm-product pair data. The firm-product pair data are then aggregated into firm-level data and matched with firm-level production measures using firm's identity number in SI dataset.

4. Empirical Strategy

In this section, I introduce key measures used to capture firm-level import penetration at domestic and export destination markets. I then elaborate on the empirical specification and series of analysis used to observe the effects of Chinese import competition on Indonesian firms' production adjustments in low-, mid-level, and high-technology industries.

4.1. Firm-Specific Measure: Chinese Import Penetration at Domestic Market

As described in Section 2, Indonesian firms face different degree of exposure to import competition. All firms compete against imports from China at domestic market, while exporting firms also compete against China's exports at export destination markets. The competition sources from set of HS6 products shared between Indonesian firms' and China's production. For each HS6 product competing against Chinese imports, the higher the share of that product in firm's product mix, the more exposed the firm to Chinese import penetration. Therefore, firm-specific exposure to Chinese import penetration in the domestic market can be measured by adapting Medina (2024) and Ing et.al. (2016), as follows:

$$DImpPen_{it} = \sum_k \frac{y_{ikt_0}}{y_{it_0}} . ChinaPen_{kt}^{Indonesia} \text{ .... (4.1.)}$$

where $\frac{y_{ikt_0}}{y_{it_0}}$ is the initial share of HS6 product *k* output value compared to firms' total output value, with t_0 subscript refers to the first year where firms appear in the observation. While Medina (2024) used export shares due to limitation in firms' sales data, I can use output values data to form the shares as it is provided for all firms at HS6 product-level by SI. The share at t_0 is used to minimize endogeneity in the product shares as firms may adjust their product mix over time in response to competition from Chinese imports. $ChinaPen_{kt}^{Indonesia}$ refers to flows of Chinese imports of product *k* at time *t* to Indonesia (the shift). The interaction of these components at the firm level, $DImpPen_{it}$, reflects the intensity of competition against Chinese import penetration faced by Indonesian firms at domestic market.

4.2. Firm-Specific Measure: Chinese Import Penetration at Export Destination Market

For each HS6 product and exporting firm, the higher the share of a product exported to the same destination countries as Chinese exports, the more exposed Indonesian firms to Chinese import penetration at the destination markets. Therefore, firm-specific exposure to Chinese import penetration at export destination markets is constructed as follows:

$$FExpComp_{it} = \sum_k \frac{x_{ikt_0}}{x_{it_0}} . ChinaPen_{kt}^{World} \text{ .... (4.2.)}$$

where $\frac{x_{ikt_0}}{x_{it_0}}$ is the initial share of HS6 product *k* export value compared to firms' total export values to all destination markets on aggregate (world). $ChinaPen_{kt}^{World}$ refers to the flows of Chinese imports of product *k* at time *t* received by all China's export destination markets (equivalent to China's export to the world). The interaction of these components aggregated at firm level, $FExpComp_{it}$, reflects the intensity of competition against Chinese exported products faced by Indonesian firms at export destination markets.

Ideally, $FExpComp_{it}$ is aggregated from exposures at each product-destination country pair as in Medina (2024) and Ing et.al. (2016); however, SI dataset only provides data on export destination countries starting from 2010. While it is possible to use this, two caveats arise. First, using export destination data in 2010 may not reflect the actual initial exposure, since destination countries may change over time in response to increasing competition. Second, most firms do not specify or declare "Others" as export destination countries. Therefore, due to data limitations, I do not disaggregate Indonesian firms' export values in SI dataset based on destination countries and use China's export values of HS6 products to the world for 'the shift' as described in Equation 4.2. I also consider an alternative measure of $FExpComp_{it}$ in robustness test, where I use countries that Indonesia exported to the most in year 2000 (initial year) for each HS6 product. In this case, $ChinaPen_{kt}^{World}$ changes to $ChinaPen_{kt}^{Main}$ which denotes share of Chinese exports to Indonesia's main export destination in year 2000 compared to total Chinese exports for product *k* as similarly used by Medina (2024). While using $ChinaPen_{kt}^{World}$ and $ChinaPen_{kt}^{Main}$ may introduce some measurement errors; however, these measures are the closest alternatives to product-destination country pairs considering limitations in SI dataset.

4.3. Empirical Specification

To capture causal links between Chinese import competition and Indonesian firms' production adjustments, I can estimate the following specification as described in Medina (2024):

$$y_{it} = \alpha + \beta_d DImpPen_{it-1} + \beta_f FExpComp_{it-1} + \delta_i + \mu_t + \varepsilon_{it} \quad \dots\dots\dots (4.3.)$$

where y_{it} is the outcomes of interest, $DImpPen_{it-1}$ and $FExpComp_{it-1}$ measures firm-exposures to Chinese import penetration at domestic and export destination markets at the previous year. However, a concern of endogeneity would linger around the explanatory variable of interest, $DImpPen_{it-1}$ and the outcomes of interest, y_{it}. In this case, two first-order issues might arise. First, high productive firms in Indonesia may produce more output to enter international market which requires more imports to fulfil their input necessities. This raises a reverse causality issue where firms' output affects imports, making import penetration does not increase exogenously. Second, domestic economic boom may induce more demand for products, resulting in increases in both firms' output and imports simultaneously to accommodate the increasing domestic demand. This raises a simultaneity issue where other factors correlate with import competition and firm-level output simultaneously. The issue becomes less significant for $FExpComp_{it-1}$ as it covers all destination countries, which alleviates concerns regarding endogeneity in the increase of import penetration due to responding to local economy's demand.

To address endogeneity concerns, I use Shift-Share Instrumental Variable (SSIV) as in Autor et.al. (2013). This identification strategy provides two benefits. First, SSIV approach accommodates gradual tariff reduction in ACFTA multilateral trade agreement that increases import competition gradually. Second, by utilizing the presence of ACFTA as an exogenous source for increasing import penetration from China, I can instrument import penetration from China to Indonesia with penetration to a country that shares similar industrial and trade characteristics to Indonesia and is also bounded by ACFTA. Table 4.1. examines similarities in manufacturing industries between Indonesia, Thailand, and Vietnam. In terms of trade flows, Indonesia shares a similar manufacturing export and import activities with Thailand in low- and mid-level technology industries and with Vietnam in high-technology industries. In terms of manufacturing value added, Indonesia is closely similar to Thailand with Vietnam not far behind. In terms of labour market, Indonesia is also closely matching Thailand on industrial employment and labour force participation and Vietnam on monthly manufacturing wages.

Table 4.1. Country's Manufacturing Profile 2000 – 2011

	Indonesia	Thailand	Vietnam
A. Export (% of Total HS Export)			
Low & Mid-Level Tech (HS 61, 62, 73, 87)	7.57	11.71	16.12
High-Tech (HS 84, 85)	11.59	33.94	11.80
B. Import (% of Total HS Import)			
Low & Mid-Level Tech (HS 61, 62, 73, 87)	7.07	6.32	5.99
High-Tech (HS 84, 85)	22.78	32.93	23.76
C. Others			
Manufacturing VA (% of GDP)	26,80	29,50	18,61
Industrial Employment (% of Total Employment)	18,52	20,17	18,32
Labor force participation rate (ages 15-24)	49,20	50,51	57,35
Avg. Monthly Wage in Manufacturing (USD)	113.68	262.37	114.94

Note: Monthly wage uses only 2007 and 2011 data, constrained by Thailand data availability at ILO database. Source: SI dataset (Export & Import), World Bank's World Development Indicator and ILOSTAT (Others). Calculated by Author. Accessed: 25 July 2025.

Given these similarities, I use Thailand as the primary instrument, with Vietnam as secondary option when the former violates the relevance condition as an instrument. Using increasing import penetration to Thailand or Vietnam as a stand-in for what happens in Indonesia enables me to treat increasing Chinese imports as an external, supply-driven shocks – not endogenously driven by Indonesia's economy. Therefore, Equation (4.3) is estimated using two-stage regressions, similar to Medina (2024) but separately for each industry, as follows:

First-stage regression:

$$DImpPen_{it-1} = \gamma_1 DImpPen\_Inst_{it-1} + \gamma_2 FExpComp_{it-1} + \omega_i + \sigma_t + u_{it} \ldots \text{(4.4.)}$$

where $DImpPen\_Inst_{it-1} = DImpPen\_Thai_{it-1} = \sum_k \frac{y_{ikt_0}}{y_{it_0}} . ChinaPen_{kt-1}^{Thailand}$ … (4.5.)

or $DImpPen\_Inst_{it-1} = DImpPen\_Viet_{it-1} = \sum_k \frac{y_{ikt_0}}{y_{it_0}} . ChinaPen_{kt-1}^{Vietnam}$ … (4.6.)

when Thailand violates the relevance condition as an instrument.

Second-stage regression:

$$y_{it} = \alpha + \beta_d \widehat{DImpPen}_{it-1} + \beta_f FExpComp_{it-1} + \delta_i + \mu_t + \varepsilon_{it} \quad \ldots\ldots\ldots (4.7.)$$

where y_{it} is outcomes of interest covering output values (total and exported), output volumes and unit prices (total and exported, in standardized volume and incumbent), and number of total and new varieties. $DImpPen\_Inst_{it-1}$ is the instrument variable of Chinese import penetration to Thailand or Vietnam at previous year. $DImpPen_{it-1}$ and $FExpComp_{it-1}$ are firm-level exposures to Chinese import penetration at domestic and export markets at previous year respectively. ω_i and δ_i are firm fixed effects; σ_t and μ_t are year fixed effects.

I present the results in three scenarios for each industry. I first show briefly the effect of Chinese import competition to firms' revenue and product variety, allowing for extensive and intensive margin of adjustments (All Firms). I then look at a subsample of firms and products with standardized units of quantity (Standardized Volume), for which I decompose output values into volumes and unit prices and examine sources of their changes. I then switch to intensive margin, examining only incumbent firms using standardized volume, to observe whether incumbents have different production adjustments compared to aggregate firms adjustments (Incumbents). Finally, I discuss possible mechanisms leading to the findings and their policy implications.

5. Results and Discussions

5.1. Descriptive Statistics

Table 5.1. shows descriptive statistics of firm-level measures, signalling the nature of activities across industries. Firms in mid-level and high-technology industries score higher output values compared to low-technology industries, indicating higher revenues due to producing more output and/or having their products priced higher. Firms in high-technology industries have the highest export values. This is expected as these firms may produce goods manufactured under vertical specialization in global value chain (GVC), requiring them to import and re-export products with higher prices for complexity and value added (Hummels et.al., 2001).

Firms in mid-level and high-technology industries produces fewer number of varieties compared to firms in low-technology industries. This signals that, as described in Section II, firms in higher-technology industries tend to have narrower product scope compared to firms in low-technology industries. In terms of competition against Chinese imports, firms in higher technology industries face relatively higher degree of competition in both domestic and export destination markets. This highlights a diversity in China's product which includes a wide range of highly sophisticated products in their export mix (Rodrik, 2006; Schott, 2008).

Table 5.1. Descriptive Statistics of Main Variables

	Low-Tech		**Mid-Tech**		**High-Tech**	
	Mean	SD	Mean	SD	Mean	SD
Output Value	22,085.77	48,156.43	88,457.52	374,391.86	54,280.26	176,802.38
Export Value	8,816.37	20,908.3	5,898.56	52,459.96	14,065.38	77,242.19
No. of All Product	1.46	.98	1.23	.59	1.38	.83
No. of New Product	.33	.72	.12	.39	.19	.46
$DImpPen$	.53	2.09	4.68	12.33	8.2	23
$FExpComp$	616.07	831.77	689.5	1,059.01	1,305.25	3,405.61

Source: Statistics of Indonesia Manufacturing Industry (2000-2011). Calculated by Author.

5.2. All Firms

First-stage IV and OLS results – The discussion henceforth will focus on second-stage IV results, with full first-stage results shown in Appendix A3. Low- and mid-level technology industries use Thailand, $DImpPen\_Thai_{it-1}$, while high-technology industries uses Vietnam, $DImpPen\_Viet_{it-1}$, as instruments. Vietnam is used as an instrument for high-technology industries due to its similarities with Indonesia in high-technology manufacturing trade flows and value added, as shown in Table 4.1, whereas Thailand violates the relevance condition as an instrument in all scenarios for high-technology industries, making it an invalid instrument. All instruments provide good predictive power in all samples and pass the weak instrument tests using Cragg-Donald Wald F-statistics, except in incumbent scenario for high-technology industries which are weak instruments overall and only significant in export-related variables. OLS results are shown in Appendix A4, which are relatively consistent with IV results in terms of directions of effects albeit smaller in magnitudes due to biases from endogeneity as raised by Bloom et.al. (2016) and Medina (2024).

Main results – Table 5.2. shows that firms respond to increasing Chinese import penetration differently across industries. Panel A of Table 5.2. shows that in low-technology industries, increasing import penetration from China at domestic market do not affect firms' revenues; however, it decreases firms' product variety. An increase of one standard deviation (~2.09) in the degree of import competition at domestic market decreases firms' number of products by 0.10 (~7% of average number of products manufactured in the industries). Panel B of Table 5.2. shows that in mid-level technology industries, Chinese import penetration at domestic market leads to an increase in firms' total output value (domestic and export combined) and number of new products which had not been previously manufactured. An increase of one standard deviation (~12.33) in the degree of import competition at domestic market increases firms' output values by 47% and number of new products by 0.05 (4% of industrial average on number of products). The increase in values are concentrated on domestic production as export values appear unaffected. Panel C of Table 5.2. shows that in high-technology industries, Chinese import competition at domestic market does not affect firms' revenue and product variety. Chinese import competition at export destination market does not affect firms' production in any industry.

Table 5.2. Firms' Production Adjustment: All Firms

		Total Revenue		Number of Varieties	
		(1) Output Value (D+X)	(2) Export Value (X)	(3) All Product	(4) New Product
A. Low-Tech					
$DImpPen_{it-1}$		.0261	.0103	-.0496*	.0038
		(.0359)	(.0687)	(.0267)	(.0192)
$FExpComp_{it-1}$		.0002	.0002	.0001	-.0001
		(.0001)	(.0002)	(.0001)	(.0001)
B. Mid-Tech					
$DImpPen_{it-1}$		.0381***	.0189	.0028	.0044*
		(.014)	(.021)	(.0042)	(.0026)
$FExpComp_{it-1}$		-.0002	0	-.0002**	0
		(.0002)	(.0003)	(.0001)	(0)
C. High-Tech					
$DImpPen_{it-1}$		.0095	.0386	-.0002	-.0017
		(.0086)	(.0379)	(.001)	(.0015)
$FExpComp_{it-1}$		-.0001	-.0001	0	0
		(.0001)	(.0001)	(0)	(0)
Instrument Coefficient (First-stage)	Low-Tech	.454***	.320**	.454***	.454***
	Mid-Tech	.765***	.718***	.765***	.765***
	Hi-Tech	1.087***	.398***	1.087***	1.087***
CDW F-stat (First-stage)	Low-Tech	242.71	77.82	242.71	242.71
	Mid-Tech	464.44	594.47	464.44	464.44
	Hi-Tech	858.73	31.77	858.73	858.73
Observation	Low-Tech	1015	643	1015	1015
	Mid-Tech	360	141	360	360
	Hi-Tech	481	266	481	481
Firm and Year FE		Yes	Yes	Yes	Yes

Notes: Output and Export Values are in logs (log-linear) measured in USD. Number of Varieties are in linear form measured in count of 6-digit HS codes product. All first-stage regressions are statistically significant. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

While these results have signalled within- and between-industry heterogenous adjustments in response to increasing Chinese import penetration; however, production values are not enough to uncover channels of these adjustments. Output values may increase due to increases in production volume and/or price besides inflation effect which has been neutralized in this research. In the next subsection, I decompose production values into volumes and unit prices to further elaborate channels of adjustments leading to changes in these values.

5.3. Firms with Standardized Volume

Table 5.3. reinforces findings in 'All Firms' scenario by decomposing production values using standardized volume subsample described in Section III and becomes the main analysis of this paper. Column (1) – (6) decompose changes in values into output volumes and unit prices for domestic and export markets which provides insights on the sources of their changes.

Panel A of Table 5.3. shows that increasing import penetration from China at domestic market decreases firms' product variety with no effects on production values for firms in low-technology industries. Consistent with previous findings, Column (7) of Panel A suggests that an increase of one standard deviation (~2.09) in the degree of competition at domestic market decreases firms' number of products by 0.10 (~7% of industrial average). This signals a pro-competitive effect that firms in low-technology industries adjust their production following penetration of Chinese imports by streamlining product mix – producing more core products and cutting out peripheral product lines (Bernard et.al., 2010). This adjustment is in line with product pruning – a strategic process of multi-product firms that globalization makes firms leaner and meaner by discontinuing relatively costly varieties and producing more on varieties with lower average costs (Eckel and Neary, 2010). This behaviour is also similar with Iacovone et.al. (2013) in Mexico that firms tend to drop products facing more competition from China. While competition at export market is statistically significant on firms' production volumes and prices, these impacts are infinitesimal and negligible.

Panel B of Table 5.3. shows that firms in mid-level technology industries adjust their production following penetration of Chinese imports at domestic market by scaling up production and switching their product mix. An increase of one standard deviation (~12.33) in the degree of competition at domestic market increases firms' output volumes by 37% and number of new products by 0.08 (~6% of industrial average). Column (1) – (3) suggests that positive increase in production values for firms in mid-level technology industries comes from higher production volumes with unchanged unit prices. The increase in production volumes and values occurs only for domestic market as Column (4) – (6) shows no changes in either variable for export market. Column (7) – (8) shows that Chinese import penetration at domestic market does not change firms' total number of products being manufactured but concurrently increases number of new products that had not been previously manufactured.

Table 5.3. Firms' Production Adjustment: Firms with Standardized Volume

		Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
		(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Low-Tech									
$DImpPen_{it-1}$		.0286	-.0347	.0633	.0095	.0105	-.001	-.0487*	.002
		(.0352)	(.0607)	(.0537)	(.0663)	(.1083)	(.0818)	(.0269)	(.0172)
$FExpComp_{it-1}$		.0001	.0005***	-.0004**	.0002	.0003	-.0001	.0001	-.0001
		(.0001)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0001)	(.0001)
B. Mid-Tech									
$DImpPen_{it-1}$		.0401***	.0301*	.01	.0217	.0375	-.0158	.0046	.0063***
		(.0145)	(.0161)	(.0139)	(.0198)	(.0507)	(.0552)	(.0037)	(.0022)
$FExpComp_{it-1}$		-.0004**	-.0006**	.0002	-.0001	-.0007	.0006	-.0001**	-.0001
		(.0002)	(.0002)	(.0002)	(.0003)	(.0005)	(.0006)	(.0001)	(0)
C. High-Tech									
$DImpPen_{it-1}$		.0564***	.0627*	-.0063	.0458	.0943**	-.0484***	.0059	-.007
		(.0182)	(.0331)	(.0203)	(.0397)	(.0468)	(.0175)	(.0064)	(.005)
$FExpComp_{it-1}$		-.0001	0	-.0001	-.0001	0	-.0001	0	.0001**
		(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(0)	(0)
Instrument Coefficient (First-stage)	Low-Tech		.458***			.323**		.458***	
	Mid-Tech		.810***			.719***		.810***	
	Hi-Tech		.392***			.360***		.392***	
CDW F-stat (First-stage)	Low-Tech		240.75			76.98		240.75	
	Mid-Tech		364.40			336.79		364.40	
	Hi-Tech		100.27			22.90		100.27	
Observation	Low-Tech		994			625		994	
	Mid-Tech		252			99		252	
	Hi-Tech		444			247		444	
Firm FE			Yes			Yes		Yes	
Year FE			Yes			Yes		Yes	

Notes: Values and Unit Prices are in logs (log-linear) measured in USD. Volumes are in logs (log-linear) measured in pieces. Number of Varieties are measured in count of 6-digit HS codes product. All first-stage regressions are statistically significant. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

These adjustments indicate that firms in mid-level technology industries combine product pruning – dropping existing varieties that becomes unprofitable and producing more of the remaining varieties – and product switching – adding new varieties into product mix – to respond increasing Chinese import penetration. There is no indication that these new products have higher quality as unit prices remain unchanged. Two potential channels may explain these adjustments: (i) trade-induced technical change, where firms are able to adopt more sophisticated technology, produce more efficiently, and innovate faster to create new products following increasing import competition (Bloom et.al, 2016); and/or (ii) input-facilitation, where Chinese imports enable firms to access previously unavailable inputs which allow them to manufacture new variety of goods (Goldberg et.al, 2010a). Similar to low-technology industries, Chinese import penetration at export destination market is statistically significant but negligible to firms' production.

Panel C of Table 5.3. provides explanation that Chinese import penetration does not affect firms' production values in high-technology industries due to opposing effects on output volumes and unit prices. This is evident in export markets as shown in Column (4) – (6), where increasing Chinese import penetration at domestic market increases firms' export volume but lowers unit prices of export, nullifying the effects on export values consistent with 'All Firms' findings. An increase of one standard deviation (~23) in the degree of competition at domestic market increases firms' export volumes by 217% and lowers export unit prices by 111.32%. Similar adjustments are observed when examining combined total output for domestic and export markets in Column (1) – (3). Firms scale up production volume following Chinese import penetration at domestic market with lower unit prices, although the latter is statistically insignificant resulting in positive total output values, slightly inconsistent with 'All Firms' findings. An increase of one standard deviation (~23) in the degree of competition at domestic market increases firms' total output volumes and values by 144% and 130% respectively. Column (7) – (8) suggests that Chinese import competition at domestic market has no significant effect to product variety for firms in high-technology industries. The unchanged product variety, combined with narrow product scope shown in Table 5.1., signals that firms in high-technology industries specialize their production on certain product mix that are difficult to prune and switch (Goldberg et.al, 2010b), despite facing higher degree of Chinese import penetration compared to low-technology industries.

The deviation from 'All Firms' findings for total output values might be explained by two possible reasons. First, although balance tests in Table 3.2. suggest no significant differences in observable characteristics between included and excluded firms, these firms respond heterogeneously to Chinese import competition (Melitz, 2003; Helpman et.al., 2004). Excluded firms may reduce prices more sharply, possibly due to less markup power, offsetting positive gains on output volume and cancelling their effects on values. Second, there might be measurement limitation in 'All Firms' scenario since output values are not decomposed into volumes and prices due to unstandardized units of quantity, making sources and magnitudes of adjustments unclear.

Table 5.3. also provides two appealing behaviours across Indonesian manufacturing industries. First, adjustments in scale of production following Chinese import penetration at domestic market mostly occur in domestic market, with expansion of exports limited only to firms in high-technology industries. This is contrary to 'escape competition by exporting' strategy – increasing competition at home encourages firms to look for opportunities in export markets – suggested by Hahn and Pyun (2020) and Medina (2024). This suggests that most firms in Indonesian industries are either focusing on domestic market or unable to further penetrate export markets, of which the exact mechanisms require further research. Second, there exists price rigidity in domestic and export markets, except for exported products in high-technology industries. This signals that firms may adjust their markups following changes in costs after import competition, resulting in rigid final prices. This is in line with De Loecker et.al. (2016) that lower factory-gate costs after trade liberalization is followed by smaller price declines due to rising markups. Despite the early indication, elaborating detailed mechanisms regarding markups and price is beyond the scope of this paper and warrants further research.

5.4. Incumbent Firms

The previous subsections have discussed heterogeneity in firms' production adjustments across industries and decomposed their channels of effects by combining both extensive (entrants and exiting firms) and intensive (incumbent firms) margins. This subsection focuses on intensive margins, analysing firms that continuously operate throughout observation period, to examine whether incumbent firms pursue similar path of adjustments.

Panel A of Table 5.4. uncovers different production adjustments faced by incumbent firms compared to aggregate adjustments in low-technology industries. Column (3) and (7) show that incumbent firms increase total unit prices and have their product variety unaffected following Chinese import penetration at domestic market. These findings provide two implications: (i) higher unit prices with unchanged product variety amidst price rigidity in the industry indicates a quality upgrading for the same set of products; and (ii) aggregate adjustments in these industries are predominantly driven by entrants and exiting firms.

Table 5.4. Firms' Production Adjustment: Incumbent Firms

		Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
		(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Low-Tech									
$DImpPen_{it-1}$		.0284	-.1128	.1412*	.0507	.0184	.0323	-.0229	.0325
		(.0309)	(.0793)	(.0751)	(.0629)	(.1193)	(.0948)	(.0412)	(.0297)
$FExpComp_{it-1}$		.0002	.0012**	-.001**	-.0001	.0001	-.0002	.0002	-.0003
		(.0002)	(.0004)	(.0005)	(.0003)	(.0004)	(.0003)	(.0003)	(.0002)
B. Mid-Tech									
$DImpPen_{it-1}$		.0448**	.043**	.0018	-.0601	.0647	-.1249	-.0004	.0038***
		(.0184)	(.0168)	(.0056)	(.044)	(.1171)	(.1338)	(.0005)	(.0011)
$FExpComp_{it-1}$		-.0006**	-.0007*	0	.001	-.0003	.0013	-.0001	0
		(.0003)	(.0003)	(.0004)	(.0007)	(.0013)	(.0017)	(.0001)	(0)
C. High-Tech									
$DImpPen_{it-1}$		-.2461	-.0517	-.1945	-.3076	-.4489	.1413	.3319	.1021
		(.4315)	(.3356)	(.2965)	(.329)	(.3086)	(.0891)	(.6601)	(.233)
$FExpComp_{it-1}$		.0011	.0002	.0009	.0067	.01*	-.0033**	-.0013	-.0004
		(.0018)	(.0014)	(.0013)	(.0053)	(.0047)	(.0012)	(.0028)	(.001)
Instrument Coefficient (First-stage)	Low-Tech		.731***			.773***		.731***	
	Mid-Tech		.899***			-6.748***		.899***	
	Hi-Tech		.062			.113**		.062	
CDW F-stat (First-stage)	Low-Tech		149.99			60.05		149.99	
	Mid-Tech		113.59			21.54		113.59	
	Hi-Tech		.45			.72		.45	
Observation	Low-Tech		349			200		349	
	Mid-Tech		89			25		89	
	Hi-Tech		116			65		116	
Firm FE			Yes			Yes		Yes	
Year FE			Yes			Yes		Yes	

Notes: Values and Unit Prices are in logs (log-linear) measured in USD. Volumes are in logs (log-linear) measured in pieces. Number of Varieties are measured in count of 6-digit HS codes product. All first-stage regressions results are statistically significant, except in non-export related variables in high-technology industries. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

In contrast to low-technology industries, Panel B of Table 5.4. shows that incumbent firms in mid-level technology industries experience similar production adjustments as in previous subsection. Column (1) – (2) and (7) – (8) show that incumbent firms expand their production volume and switch their product mix by pruning existing and adding new varieties following increasing Chinese import penetration at domestic market. The interpretation for incumbent firms behaviour in high-technology industries from Panel C of Table 5.4. is not that straightforward since first-stage IV results are only statistically significant for export variables, Column (4) – (6), despite instrumenting with Vietnam and Thailand. In export market, incumbent firms neither expand export volumes nor lower unit prices as in aggregate adjustments following increasing Chinese import penetration at domestic market. Although IV results could not be directly interpreted; however, considering incumbent firms are smaller in numbers and aggregate adjustments showing no effects to product variety, incumbent firms are expected to have their product variety unaffected following Chinese import penetration.

5.5. Robustness Tests

Table 5.5. presents three robustness tests to support baseline findings, focusing on main variable of interest, $DImpPen_{it-1}$ (see Appendix A5 for extended tables). Robustness tests are conducted using firms with standardized volume as they provide more information from the decomposition of values and given the samples' balanced observable characteristics.

First, to alleviate concerns on different export destinations between Indonesia and China, I rerun regressions with an alternative measure of $FExpComp_{it-1}$ using Indonesia's main export destinations in year 2000 for each HS6 product, $ChinaPen_{kt}^{Main}$. Panel A of Table 5.5. maintains similar results to baseline findings of Table 5.3, that firms in low-technology industries have their product variety diminished (Column 7), firms in mid-level technology industries have their production values increased (Column 1), and firms in high-level technology industries have positive output volumes and negative unit prices (Column 1 – 6). The effects on new products and output volumes in mid-level technology industries remains positive although becoming statistically insignificant.

Second, to alleviate concerns about endogeneity in initial shares, I rerun regressions using only firms operating by 2000, so that initial shares would be less exposed to within-firm adjustments post-ACFTA. Panel B of Table 5.5. presents consistent findings as in baseline regressions and offers additional insights for each industry. In low-technology industries, Column (7) shows the effect on product variety remains negative, although becomes statistically insignificant, indicating that diminishing product variety is experienced by newer and younger firms.

Table 5.5. Robustness Tests (Main Variables)

		Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
		(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Test 1: $FExpComp_{it-1}$ uses $ChinaPen_{kt}^{Main}$									
$DImpPen_{it-1}$	Low-Tech	.0436	.043	.0006	.0331	.0485	-.0153	-.0307*	-.0132
		(.0282)	(.0528)	(.0481)	(.0503)	(.0849)	(.0619)	(.0178)	(.0124)
	Mid-Tech	.0227*	.0017	.021	.0183	.0086	.0096	-.0006	.0027
		(.0131)	(.0165)	(.016)	(.0185)	(.0487)	(.0455)	(.0028)	(.0025)
	Hi-Tech	.0536***	.0681**	-.0145	.0483	.0971**	-.0488***	.0087	-.0039
		(.0197)	(.0291)	(.0147)	(.0382)	(.0431)	(.0164)	(.0074)	(.0041)
Observation / CDW F-stat	Low-Tech		994 / 418.25			625 / 131.80		994 / 418.25	
	Mid-Tech		252 / 372.84			99 / 446.66		252 / 372.84	
	Hi-Tech		444 / 104.85			247 / 23.06		444 / 104.85	
B. Test 2: Using only firms operating by 2000									
$DImpPen_{it-1}$	Low-Tech	.0437	-.0274	.0712	-.003	.01	-.013	-.0353	.0115
		(.0345)	(.069)	(.058)	(.0547)	(.106)	(.0791)	(.0304)	(.0163)
	Mid-Tech	.0435***	.0298*	.0137	.0926**	-.05	.1426**	.0028	.0067**
		(.0158)	(.0174)	(.0159)	(.0354)	(.0576)	(.0579)	(.0037)	(.0029)
	Hi-Tech	.0617***	.0635*	-.0018	.0868***	.1301***	-.0433***	.0006	-.0039
		(.0146)	(.0351)	(.0243)	(.0184)	(.0235)	(.0146)	(.0061)	(.0049)
Observation / CDW F-stat	Low-Tech		801 / 379.01			499 / 220.10		801 / 379.01	
	Mid-Tech		199 / 241.26			76 / 70.84		199 / 241.26	
	Hi-Tech		351 / 80.89			201 / 17.65		351 / 80.89	
C. Test 3: Using only Exporters									
$DImpPen_{it-1}$	Low-Tech	.0286	-.0347	.0633	.0095	.0105	-.001	-.0487*	.002
		(.0352)	(.0607)	(.0537)	(.0663)	(.1083)	(.0818)	(.0269)	(.0172)
	Mid-Tech	.0403***	.0302*	.0101	.0224	.0384	-.016	.0036	.0054**
		(.0145)	(.0165)	(.0142)	(.0194)	(.0502)	(.0546)	(.0039)	(.0021)
	Hi-Tech	.0558***	.062*	-.0062	.0453	.094**	-.0487***	.0056	-.0068
		(.0183)	(.033)	(.0201)	(.0396)	(.0468)	(.0176)	(.0063)	(.005)
Observation / CDW F-stat	Low-Tech		994 / 240.75			625 / 76.98		994 / 240.75	
	Med-Tech		250 / 361.29			101 / 434.91		250 / 361.29	
	Hi-Tech		445 / 100.56			248 / 22.97		445 / 100.56	
Firm & Year FE (All Tests)			Yes			Yes		Yes	

Notes: Values and Unit Prices are in logs (log-linear) measured in USD. Volumes are in logs (log-linear) measured in pieces. Number of Varieties are measured in count of 6-digit HS codes product. Another variable includes $FExpComp_{it-1}$. All first-stage regressions are statistically significant. Clustered standard errors at firm-level are in parentheses.
*** p<.01, ** p<.05, * p<.1

In mid-level technology industries, besides increases in total output volume, values and new products, Column (4) – (6) shows that firms also experience higher export values from higher unit prices, indicating new products may also include higher quality varieties for earlier-established firms. In high-technology industries, Column (4) – (6) shows that firms still face an opposing effect from higher export volume and lower unit prices although a much higher increase in volumes causes export values to remain positive.

Third, I rerun regressions using only exporters to observe consistency in production adjustments for exporting firms which are typically larger and more productive. Nevertheless, Panel C of Table 5.5. presents consistent results with baseline findings for each variable and industry, indicating similar production adjustment for exporters.

5.6.Potential Mechanisms and Policy Implications

The main findings in this paper, elaborated in Firms with Standardized Volume analysis, have empirically confirmed the proposition in Section 2. Firms in low-technology industries adjust their production following an increase in Chinese import penetration by diminishing product variety with no effect on scale of production. Firms in mid-level technology industries adjust both scale of production and product variety by pruning existing product and adding new varieties. Firms in high-technology industries only adjust scale of production, with lower unit prices in the export market, leaving product mix unchanged. While this paper does not pinpoint the exact mechanism; however, this subsection proposes possible mechanisms related to differences in firms' capacity between industries which may explain these adjustments.

Table 5.6. Measures of Firms' Inherent Capacity

	Low-Tech		**Mid-Tech**		**High-Tech**	
	Mean	SD	Mean	SD	Mean	SD
Absorptive Capacity	11,107.72	6,925.89	22,000.37	33,587.36	21,795.31	27,244.72
Capital Intensity	.48	7.22	5.28	183.35	10.07	247.48
Labor Productivity	.0074	.1305	.0145	.1229	.0109	.1350
Fixed HQ Cost	3,285,690	27,452,566	16,574,517	2.175e+08	1.396e+08	3.839e+09

Source: Statistics of Indonesia Manufacturing Industry (2000-2011). Calculated by Author.

Table 5.6. highlights four measures of firms' inherent capacity from 'All Firms' sample: absorptive capacity, capital intensity, labour productivity, and fixed headquarter cost. Absorptive capacity is calculated by average expenditure per worker to measure workers ability to comprehend new technical change. Capital intensity is calculated by total machinery costs over total labour expenses to measure intensity of using physical capital in firms' production. Both absorptive capacity and capital intensity becomes a proxy of firm's ability to comprehend

new technical change and production processes that leads to improved efficiency. Higher expenditure per worker indicates higher investment on labour (wages and training costs) that increases workers' skills and adaptability with new technology and processes (Le and Pomfret, 2011; Sugiharti et.al., 2022). Firms with higher capital intensity accumulate higher technology capital which may induce higher total factor productivity and faster technological adoption to assist for technical progress and/or product innovation (Cammeraat et.al, 2021; Bellocchi et.al, 2023; Massini et.al., 2024). Labour productivity is calculated by firms' output values over total labour expenses to signal productivity level. Fixed headquarter costs are expenses on building, land, and machinery acquired by firms before starting production, resembling f_h in Section II.

Firms in mid-level and high-technology industries have similar absorptive capacity which are twice the level of firms in low-technology industries. This resonates the framework in Section II that firms in higher technology industries require higher labour investment, f_{vi}. In terms of capital intensity, firms in high-technology industries have twice the level of firms in mid-level technology industries, with firms in low-technology industries lagging behind. Higher absorptive capacity and capital intensity may provide firms in higher technology industries with better capacity to capture new technology, adopt new technical processes, and innovate faster when faced with increasing Chinese import penetration (trade-induced technical change), allowing them to produce new varieties as seen in mid-level technology industries.

Similar phenomenon is also observed in labour productivity. Firms in mid-level and high-technology industries have twice the level of firms in low-technology industries. Higher productivity may also be one of the determinants of why firms in mid-level and high-technology industries are able to scale up production following increasing Chinese import penetration, unlike firms in low-technology industries that are much limited in labour productivity, absorptive capacity, and physical capital.

In terms of fixed headquarter costs, firms in high-technology industries incur much higher costs, more than 40 times higher compared to firms in low-technology industries and 8 times to firms in mid-level technology industries. In line with Section II, the exorbitant headquarter costs and high labour investment costs make the additional costs become too expensive for firms to add new products and leave enormous sunk costs if they are laid off due to cutting the product lines. This may explain why firms in high-technology industries produce narrower scope and, while they may experience trade-induced technical change and are able to produce new varieties, prefer to have their product variety unchanged when faced with increasing Chinese import penetration (Goldberg et.al., 2010b).

The elaboration of firms' heterogenous responses across industries and their potential mechanisms highlights the necessity of heterogenous policies for each industry. A 'one-size-fits-all' policy may not be effective since each industry faces different constraints and development focus. Firms in low-technology industries need to improve absorption capacity and labour productivity. The suitable policies would focus on human capital training, labour skill enhancement, and incentives to accumulate more physical capital that may allow them to adopt new technology and processes better, innovate faster, and increase productivity (von Tunzelmann and Acha, 2006; Mason et.al, 2020; Cattani et.al, 2024). Firms in mid-level technology industries do not enter export markets despite higher productivity and absorption capacity, ability to scale up, and produce new varieties. The suitable policies would facilitate export market expansion which, although indirectly related to potential mechanisms, could include providing export incentives and reducing trade costs (Bernard et.al., 2006). Firms in high-technology industries are constrained with expensive headquarter, production and sunk costs. The suitable policies would focus on lowering costs of capital by subsidizing production and research and development (R&D) costs to promote product variety and innovation (Navarro Zapata et.al., 2024). Such policy has been adopted in Indonesia under R&D Super Deduction Tax that could be expanded following successes of similar tax credit policies in several developing countries (Crespi et.al., 2016; Tas and Erdil, 2024).

6. Conclusion

China's manufacturing expansion and market access improvement in the early 2000s has allowed them to penetrate overseas markets and compete with local firms' production in developing and developed countries. While literature has extensively discussed impacts and channels of these trade-induced competition; however, existing research often overlooks the importance of heterogeneity of those effects across industries. This paper provides empirical evidence that trade-induced competition causes heterogenous production adjustments for firms in low-, mid-level, and high-technology intensive industries. Using shift-share instrumental variable as the identification strategy, I examine the effects by observing Indonesia's firm-level data for 2000-2011, disregarding 2006 due to data incompleteness, combined with HS6 product-level trade flows. I utilize China's and Indonesia's involvement in ACFTA 2005 multilateral agreement to capture exogenous increase in Chinese import penetration to Indonesia for causal establishment. Apparel industry represents low-technology, automotive industry represents mid-level technology, and electronics industry represents high-technology industries following OECD industrial technological intensity categories.

I observed that firms have different production adjustments between industry in responding to Chinese import penetration at domestic market, while Chinese import penetration at export destination markets does not affect firms' production in any industry. Firms in low-technology industries adjust by streamlining their product mix, producing more core products and cutting out peripheral product lines, without changing scale of production. Firms in mid-level technology industries adjust by scaling up production in domestic market and producing new varieties which had not been previously manufactured without changing overall product variety. Firms in high-technology industries adjust by increasing output volumes and lowering unit prices in domestic and export markets, nullifying changes in total output values, without changing the product mix, with a signal of heterogeneous response between firms within industries. Both pro-competitive effect – via product pruning, switching, and technical change – and input-facilitation effect may serve as channels of transmission although not homogeneously in each industry. Most adjustments in scale of production occur in domestic market, in contrast with 'escape competition by exporting' strategy, and price rigidity occurs in all industries at domestic market and most industries at export markets. Incumbent firms adjust their production similarly to aggregate adjustments in mid-level technology industries but differently in low-technology industries. Incumbent firms in low-technology industries increases unit prices amidst price rigidity, suggesting an indication of quality upgrading. The results are robust to many tests, including estimates using alternative measures of import penetration at export destination markets, estimates using only firms operating by 2000, and estimates using only exporting firms.

This paper does not pinpoint the exact mechanism; however, differences in firms' inherent capacity between industries may become potential mechanisms leading to these findings. The differences in firms' absorptive capacity, capital intensity, labour productivity, and fixed headquarter cost between industries are addressed in this paper. The elaboration of these potential mechanisms also highlights several different constraints and development focus in each industry. In terms of policy, these findings imply the necessity of heterogeneous policies for each industry to address limitations observed in firms' capacities. Policies may be addressed to improve absorption capacity and productivity for firms in low-technology industries, facilitate export market expansion for firms in mid-level technology industries, and lower costs of capital and R&D costs for firms in high-technology industries.

This research presents novelty in terms of heterogeneity in the impact of Chinese import competition to different manufacturing industries based on the intensity of technology use. Nevertheless, I acknowledge limitations in this paper, of which several extensions from this research would benefit the literature. First, the evidence in this paper is limited to selected manufacturing industries in each OECD category. Further research could expand this analysis to include all industries under each OECD category. Second, this paper capture an indication of price rigidity in industries, of which elaborating exact mechanisms goes beyond this paper. Further research could thoroughly examine prices, markups, and cost to price pass-through and provide policy recommendations from pricing aspects. Finally, this research has only measured product quality in each industry using unit prices due to SI data limitations. Further research would benefit from addressing quality upgrading aspect in each industry in more detail and with robust measures which may also be one of the determinants in firms' decision to expand to export markets.

References

Amiti, M., & Khandelwal, A. K. (2013). Import Competition and Quality Upgrading. Review of Economics and Statistics, 95(2), 476–490. https://doi.org/10.1162/rest_a_00271

Amiti, M., & Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. *American Economic Review*, *97*(5). https://doi.org/10.1257/aer.97.5.1611

Autor, D. H., Dorn, D., & Hanson, G. H. (2013). The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review*, *103*(6). https://doi.org/10.1257/aer.103.6.2121

Bas, M., & Strauss-Kahn, V. (2015). Input-trade liberalization, export prices and quality upgrading. *Journal of International Economics*, *95*(2). https://doi.org/10.1016/j.jinteco.2014.12.005

Bellocchi, A., Travaglini, G., & Vitali, B. (2023). How capital intensity affects technical progress: An empirical analysis for 17 advanced economies. Metroeconomica, 74(3). https://doi.org/10.1111/meca.12421

Bernard, A. B., Jensen, J. B., & Schott, P. K. (2006). Trade costs, firms and productivity. Journal of Monetary Economics, 53(5). https://doi.org/10.1016/j.jmoneco.2006.05.001

Bernard, A. B., Redding, S. J., & Schott, P. K. (2007). Comparative advantage and heterogeneous firms. Review of Economic Studies, 74(1). https://doi.org/10.1111/j.1467-937X.2007.00413.x

Bernard, A. B., Redding, S. J., & Schott, P. K. (2010). Multiple-product firms and product switching. *American Economic Review*, *100*(1). https://doi.org/10.1257/aer.100.1.70

Bloom, N., Draca, M., & Van Reenen, J. (2016). Trade induced technical change? The impact of chinese imports on innovation, IT and productivity. *Review of Economic Studies*, *83*(1). https://doi.org/10.1093/restud/rdv039

Brandt, L., Van Biesebroeck, J., & Zhang, Y. (2012). Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing. *Journal of Development Economics*, *97*(2). https://doi.org/10.1016/j.jdeveco.2011.02.002

Cammeraat, E., Samek, L., & Squicciarini, M. (2021). The role of innovation and human capital for the productivity of industries. OECD Science, Technology and Industry Policy Papers, 103(103).

Cattani, L., Savoia, F., & Bullini Orlandi, L. (2024). The kind of things that money just can't buy: The role of potential absorptive capacity in enhancing firm-level employment growth. Technological Forecasting and Social Change, 208. https://doi.org/10.1016/j.techfore.2024.123646

Crespi, G., Giuliodori, D., Giuliodori, R., & Rodriguez, A. (2016). The effectiveness of tax incentives for R&D+i in developing countries: The case of Argentina. Research Policy, 45(10). https://doi.org/10.1016/j.respol.2016.07.006

Crino, R. (2012). Imported inputs and skill upgrading. Labour Economics, 19(6). https://doi.org/10.1016/j.labeco.2012.08.002

Darko, C., Occhiali, G., & Vanino, E. (2021). The Chinese are Here: Import Penetration and Firm Productivity in Sub-Saharan Africa. *Journal of Development Studies*, *57*(12). https://doi.org/10.1080/00220388.2021.1956468

De Loecker, J., Goldberg, P. K., Khandelwal, A. K., & Pavcnik, N. (2016). Prices, Markups, and Trade Reform. Econometrica, 84(2). https://doi.org/10.3982/ecta11042

Eckel, C., & Neary, P. P. (2010). Multi-product firms and flexible manufacturing in the global economy. Review of Economic Studies, 77(1). https://doi.org/10.1111/j.1467-937X.2009.00573.x

Goldberg, P. K., Khandelwal, A. K., Pavcnik, N., & Topalova, P. (2010a). Imported intermediate inputs and domestic product growth: Evidence from India. *Quarterly Journal of Economics*, *125*(4). https://doi.org/10.1162/qjec.2010.125.4.1727

Goldberg, P. K., Khandelwal, A. K., Pavcnik, N., & Topalova, P. (2010b). Multiproduct firms and product turnover in the developing world: Evidence from India. Review of Economics and Statistics, 92(4). https://doi.org/10.1162/REST_a_00047

Hahn, C. H., & Pyun, J. H. (2020). Does Home (output) Import Tariff Reduction Increase Home Exports?: Evidence from Korean Manufacturing Plant-product Data. Economic Research Institute for ASEAN and East Asia.

Helpman, E., Melitz, M. J., & Yeaple, S. R. (2004). Export versus FDI with heterogeneous firms. American Economic Review, 94(1). https://doi.org/10.1257/000282804322970814

Hopenhayn, H. A. (1992). Entry, Exit, and firm Dynamics in Long Run Equilibrium. Econometrica, 60(5). https://doi.org/10.2307/2951541

Hummels, D., Ishii, J., & Yi, K. M. (2001). The nature and growth of vertical specialization in world trade. Journal of International Economics, 54(1). https://doi.org/10.1016/S0022-1996(00)00093-3

Iacovone, L., Rauch, F., & Winters, L. A. (2013). Trade as an engine of creative destruction: Mexican experience with Chinese competition. Journal of International Economics, 89(2). https://doi.org/10.1016/j.jinteco.2012.09.002

Ing, L. Y., Yu, M., & Zhang, R. (2016). Indonesia and China: Friends or foes? Quality competition and firm productivity.

International Labour Organization. (2025). Average Monthly Earnings of Employees by Sex and Economic Activity - Annual [Data set]. https://rshiny.ilo.org/dataexplorer0/

Khandelwal, A. K., Schott, P. K., & Wei, S. J. (2013). Trade liberalization and embedded institutional reform: Evidence from Chinese exporters. *American Economic Review*, *103*(6). https://doi.org/10.1257/aer.103.6.2169

Kugler, M., & Verhoogen, E. (2012). Prices, plant size, and product quality. *Review of Economic Studies*, *79*(1). https://doi.org/10.1093/restud/rdr021

Le, H. Q., & Pomfret, R. (2011). Technology spillovers from foreign direct investment in Vietnam: Horizontal or vertical spillovers? Journal of the Asia Pacific Economy, 16(2). https://doi.org/10.1080/13547860.2011.564746

Lileeva, A., & Trefler, D. (2010). Improved access to foreign markets raises plant-level productivity. . .for some plants. Quarterly Journal of Economics, 125(3). https://doi.org/10.1162/qjec.2010.125.3.1051

Lu, Y., & Ng, T. (2013). Import competition and skill content in U.S. Manufacturing industries. Review of Economics and Statistics, 95(4). https://doi.org/10.1162/REST_a_00311

Mason, G., Rincon-Aznar, A., & Venturini, F. (2020). Which skills contribute most to absorptive capacity, innovation and productivity performance? Evidence from the US and Western Europe. Economics of Innovation and New Technology, 29(3). https://doi.org/10.1080/10438599.2019.1610547

Massini, S., Barrioluengo, M. S., Yu, X., & Salehnejad, R. (2024). Digital transformation in firms: determinants of technology adoption and implications for performance (No. 2024-01). The Manchester Institute of Innovation Research (MIoIR), The University of Manchester.

Medina, P. (2024). Import Competition, Quality Upgrading, and Exporting: Evidence from the Peruvian Apparel Industry. *Review of Economics and Statistics*, *106*(5). https://doi.org/10.1162/rest_a_01221

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, *71*(6). https://doi.org/10.1111/1468-0262.00467

Melitz, M. J., & Ottaviano, G. I. P. (2008). Market size, trade, and productivity. Review of Economic Studies, 75(1). https://doi.org/10.1111/j.1467-937X.2007.00463.x

Mion, G., & Zhu, L. (2013). Import competition from and offshoring to China: A curse or blessing for firms? *Journal of International Economics*, *89*(1). https://doi.org/10.1016/j.jinteco.2012.06.004

Navarro Zapata, A., Arrazola, M., & de Hevia, J. (2024). Determinants of High-tech Exports: New Evidence from OECD Countries. Journal of the Knowledge Economy, 15(1). https://doi.org/10.1007/s13132-023-01116-z

OECD. (2011). ISIC Rev. 3 Technology Intensity Definition: Classification of manufacturing industries into categories based on R&D intensities. OECD Publishing.

Rodrik, D. (2006). What's so special about China's exports. China and World Economy, 14(5). https://doi.org/10.1111/j.1749-124X.2006.00038.x

Schott, P. K. (2008). The relative sophistication of Chinese exports. Economic Policy, 23(53). https://doi.org/10.1111/j.1468-0327.2007.00195.x

Statistics Indonesia (2025). *Annual Statistics of Indonesia Manufacturing Industry (SI)* 2000 – 2011 [Data set]. Badan Pusat Statistik (BPS - Statistics Indonesia)

Sugiharti, L., Yasin, M. Z., Purwono, R., Esquivias, M. A., & Pane, D. (2022). The FDI Spillover Effect on the Efficiency and Productivity of Manufacturing Firms: Its Implication on Open Innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(2). https://doi.org/10.3390/joitmc8020099

Tas, E., & Erdil, E. (2024). Effectiveness of R&D Tax Incentives in Turkey. Journal of the Knowledge Economy, 15(2). https://doi.org/10.1007/s13132-023-01326-5

Topalova, P., & Khandelwal, A. (2011). Trade liberalization and firm productivity: The case of India. Review of Economics and Statistics, 93(3). https://doi.org/10.1162/REST_a_00095

United Nations (2025). *UN Comtrade Database* [Data set]. United Nations Department of Economic and Social Affairs, Statistics Division. https://comtradeplus.un.org/

Utar, H. (2014). When the floodgates open: "Northern" firms' response to removal of trade quotas on Chinese goods. *American Economic Journal: Applied Economics*, *6*(4). https://doi.org/10.1257/app.6.4.226

Utar, H., & Ruiz, L. B. T. (2013). International competition and industrial evolution: Evidence from the impact of Chinese competition on Mexican maquiladoras. *Journal of Development Economics*, *105*. https://doi.org/10.1016/j.jdeveco.2013.08.004

von Tunzelmann, Nick, and Virginia Acha, ' Innovation In "Low-Tech" Industries', in Jan Fagerberg, and David C. Mowery (eds), The Oxford Handbook of Innovation (2006; online edn, Oxford Academic, 2 Sept. 2009). https://doi.org/10.1093/oxfordhb/9780199286805.003.0015

World Bank (2025). Manufacturing, value added (% of GDP) (World Development Indicator) [Data set]. https://databank.worldbank.org/source/world-development-indicators#

World Bank (2025). Employment in industry (% of total employment) (modeled ILO estimate) (World Development Indicator) [Data set]. https://databank.worldbank.org/source/world-development-indicators#

World Bank (2025). Labor force participation rate for ages 15-24, total (%) (modeled ILO estimate) (World Development Indicator) [Data set]. https://databank.worldbank.org/source/world-development-indicators#

Appendices

Appendix A1. Conversion Table for Units and HS6 Product Representability

Table A1.1. shows the conversion used to standardize the volume in the SI dataset. The conversion is taken from international and Indonesian standardized measure and considers local terminology used in producing and selling manufactured products. The following Table A2.2. shows the representability of using piece (unit) as the main units of quantity for standardized volume scenario.

Table A1.1. Conversion Table for Units of Quantity

Standardized Units	**Units in Data Source**	**Conversion Factor**	**Notes on Conversion**
BUAH (PCS)	GROSS	144	1 gross equals to 144 pcs (standardized measures)
	KODI	20	1 *kodi* equals 20 pcs (standardized Indonesian measures)
	LUSIN	12	1 *lusin* (dozen) equals 12 pcs (standardized measures)
	POTONG	1	1 *potong* (cut) equals 1 pc (terminology used in clothing/textile products)
	PASANG	1	1 *potong* (pair) equals 1 pc (terminology for goods sold in pairs, e.g., shoes, socks)
	SET	1	1 set equals 1 pc (terminology used for goods sold in set, e.g., telephone set)
	BATANG	1	1 *batang* (bar) equals 1 pc (terminology used in piping products and materials)
	LEMBAR	1	1 *lembar* (layer) equals 1 pc (terminology used in layered goods and papers)
KG	GRAM	0.001	1 kg equals 1000 grams (standardized measures)
	TON	1000	1-ton equals 1000 kgs (standardized measures)
METER	YARD	0.9144	1-yard equals 0.9144 m (standardized measures)

Source: Author's calculations from multiple sources (2025).

Table A1.2. Representability of Units of Quantity in the Standardized Volume Analysis

	Low-Tech Industry		**Mid-Tech Industry**		**High-Tech Industry**	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
"*" (undefined)	35	0.98	6	0.36	10	0.45
BALL	20	0.56				
BUAH (PCS)	**3348**	**93.55**	**1648**	**97.75**	**2152**	**96.81**
KG	49	1.37	31	1.84	38	1.71
METER	125	3.49			7	0.31
ROLL	2	0.06			15	0.67
CONES			1	0.06		
MG					1	0.04
TOTAL	3579	100.00	1686	100.00	2223	100.00

Source: Statistics of Indonesia Manufacturing Industry (SI, 2000-2011). Calculated by Author.

Appendix A2. Firm-Year Observation used in Estimation Sample

Table A2.1. shows the number of firms per year for each industry that are used for estimation samples in each scenario. Table A2.2. shows the number of firms based on number of operating years in the SI dataset. Both tables show a relatively balanced number of firms in each year and years of operation, with incumbents having the highest number of firms by slightest margin (however still becomes minority compared to all extensive margins). Table A2.3. divides firms in the sample into exporters and non-exporters, with exporters defined as firms which export for at least one year throughout the observation period. Exporters dominate the low- and high-technology industries in the sample, while mid-level technology industries have more domestic-oriented firms. Both tables have no data for 2006, since the year is discarded due to data incompleteness for firm-level outcomes in SI dataset.

Table A2.1. Firm-Year Observation based on Industries

Year	**All Firms**				**Standardized Volume**				**Incumbents (Standardized Volume)**			
	LT	MT	HT	**Total**	LT	MT	HT	**Total**	LT	MT	HT	**Total**
2000	345	140	101	**586**	185	86	87	**358**	54	27	24	**105**
2001	389	176	145	**710**	215	113	126	**454**	54	30	21	**105**
2002	406	171	156	**733**	219	113	133	**465**	54	28	23	**105**
2003	426	184	161	**771**	234	127	141	**502**	54	29	22	**105**
2004	426	189	175	**790**	238	126	150	**514**	54	27	24	**105**
2005	429	204	180	**813**	249	139	156	**544**	54	27	24	**105**
2007	396	186	204	**786**	212	133	171	**516**	54	28	23	**105**
2008	406	185	201	**792**	216	132	168	**516**	54	27	24	**105**
2009	386	183	184	**753**	205	132	149	**486**	54	28	23	**105**
2010	382	164	175	**721**	198	121	135	**454**	54	28	23	**105**
2011	332	172	169	**673**	176	123	140	**439**	54	29	22	**105**
Total	4,323	1,954	1,851	**8,128**	2,347	1,345	1,556	**5,248**	594	308	253	**1,155**

Source: Statistics of Indonesia Manufacturing Industry (SI, 2000-2011). Calculated by Author.

Table A2.2. Number of Firms based on Years of Operation

Years of Operations	**All Firms**				**Standardized Volume**			
	LT	MT	HT	**Total**	LT	MT	HT	**Total**
5	570	305	315	**1,190**	295	201	284	**780**
6	558	255	249	**1,062**	294	191	247	**732**
7	532	190	265	**987**	273	107	215	**595**
8	448	198	210	**856**	192	155	205	**552**
9	450	180	207	**837**	279	151	164	**594**
10	720	375	275	**1,370**	420	230	190	**840**
11	1045	451	330	**1,826**	594	310	251	**1,155**
Total	4,323	1,954	1,851	**8,128**	2,347	1,345	1,556	**5,248**

Source: Statistics of Indonesia Manufacturing Industry (SI, 2000-2011). Calculated by Author.

Table A2.3. Number of Exporting Firms

Exporter?	**All Firms**				**Standardized Volume**				**Incumbents (Standardized Volume)**			
	LT	MT	HT	**All**	LT	MT	HT	**All**	LT	MT	HT	**All**
No	1360	1154	775	**3,289**	535	787	619	**1,941**	44	142	34	**220**
Yes	2963	800	1076	**4,828**	1812	558	937	**3,307**	550	166	219	**935**
All	4,323	1,954	1,851	**8,128**	2,347	1,345	1,556	**5,248**	594	308	253	**1,155**

Source: Statistics of Indonesia Manufacturing Industry (SI, 2000-2011). Calculated by Author.

Appendix A3. First-Stage Shift-Share Instrumental Variable Results

Table A3.1. shows full results of the first-stage shift-share instrumental variable for each industry and scenario. The dependent variable is $DImpPen_{it-1}$ and the independent variable – also the instrument variable – are Chinese import penetration to Thailand, $(DImpPen\_Thai_{it-1})$ for low- and mid-level technology industries, Chinese import penetration to Vietnam $(DImpPen\_Viet_{it-1})$ for high-technology industries, and $FExpComp_{it-1}$. Vietnam is used as an instrument for high-technology industries due to its similarities with Indonesia in high-technology manufacturing trade flows and value added (Section 4, Table 4.1.), whereas Thailand violates the relevance condition as an instrument in all scenarios for high-technology industries (Panel D), making it an invalid instrument. All instruments provides good predictive power in all samples and passes weak instrument tests using Cragg-Donald Wald F-statistics, except in incumbent analysis for high-technology industries which are weak instruments overall and only statistically significant in export variables.

Table A3.1. First-Stage SSIV Regression

		All Firms		**Standardized Volume**		**Incumbents**	
		(1) All Non-Export Samples	(2) Export-Related Samples	(3) All Non-Export Samples	(4) Export-Related Samples	(5) All Non-Export Samples	(6) Export-Related Samples
A. Low-Tech							
$DImpPen\_Thai_{it-1}$		.454***	.320**	.458***	.323**	.731***	.773***
		(.1096)	(.1412)	(.1107)	(.1430)	(.0640)	(.2006)
$FExpComp_{it-1}$		.002***	.002***	.002***	.0015**	.002***	.003
		(.0004)	(.0005)	(.0004)	(.0005)	(.0006)	(.0016)
B. Mid-Tech							
$DImpPen\_Thai_{it-1}$		.765***	.718***	.810***	.719***	.899***	-6.748***
		(.0600)	(.0410)	(.0602)	(.0444)	(.0699)	(.9003)
$FExpComp_{it-1}$		-.002**	-.000	-.002**	-.000	-.003***	.011***
		(.0010)	(.0010)	(.0009)	(.0011)	(.0012)	(.0011)
C. High-Tech (using Vietnam)							
$DImpPen\_Viet_{it-1}$		1.087***	.398***	.392***	.360***	.062	.113**
		(.3022)	(.0638)	(.0288)	(.0387)	(.0972)	(.0543)
$FExpComp_{it-1}$		.000	.000	.000	.000	.004	.016*
		(.0009)	(.0003)	(.0003)	(.0003)	(.0009)	(.0080)
D. High-Tech 2 (using Thailand)							
$DImpPen\_Thai_{it-1}$		.042	.207**	.063	.201*	.196	.255
		(.0552)	(.0846)	(.0562)	(.1030)	(.1955)	(.2026)
$FExpComp_{it-1}$		.004	-.001**	.000	-.001**	.003*	.009
		(.0025)	(.0006)	(.0008)	(.0006)	(.0015)	(.0049)
CDW F-stat	LT	242.71	77.82	240.75	76.98	149.99	60.05
	MT	464.44	594.47	364.40	336.79	113.59	21.54
	HT (Viet)	858.73	31.77	100.27	22.90	.45	.72
Observation	LT	1015	643	994	625	349	200
	MT	360	141	252	99	89	25
	HT (Viet)	481	266	444	247	116	65
Firm and Year FE		Yes	Yes	Yes	Yes	Yes	Yes

Notes: All Non-Export Samples are for Total Output Value, Output Volume, Unit Price, and Number of Varieties (All and New Products) analysis. Export-Related samples are for Export Value, Export Volume, and Export Unit Price analysis. Clustered standard errors at firm level are in parentheses. *** p<.01, ** p<.05, * p<.1

Appendix A4. Comparison of OLS vs Shift-Share Instrumental Variable Estimation

This appendix shows the comparison of regression results using shift-share instrumental variable and OLS. Table A4.1. shows results for All Firms scenario, Table A4.2. shows results for Firms with Standardized Volume scenario, Table A4.3. shows results for Incumbent Firms scenario. Overall, OLS and SSIV results show relatively consistent results in terms of directions of effect albeit smaller in magnitudes due to biases from endogeneity as raised by Bloom et.al. (2016) and Medina (2024).

Table A4.1. Firms' Strategic Adjustment (OLS and SSIV): All Firms

	Firms' Revenue		Number of Varieties	
	(1)	(2)	(3)	(4)
	Output Value (D+X)	Export Value (X)	All Product	New Product
A. Low-Tech				**OLS**
$DImpPen_{it-1}$	-.0127	-.0282*	-.0168	-.0059
	(.0147)	(.0169)	(.0129)	(.0091)
$FExpComp_{it-1}$	.0002**	.0002**	.0000	.0000
	(.0001)	(.0001)	(.0000)	(.0000)
				SSIV
$DImpPen_{it-1}$	.0261	.0103	-.0496*	.0038
	(.0359)	(.0687)	(.0267)	(.0192)
$FExpComp_{it-1}$	.0002	.0002	.0001	-.0001
	(.0001)	(.0002)	(.0001)	(.0001)
B. Mid-Tech				**OLS**
$DImpPen_{it-1}$	.0276**	.0285	.0009	.0018
	(.0134)	(.0195)	(.0026)	(.0033)
$FExpComp_{it-1}$	-.0001	-.000	-.0002**	-.000
	(.0001)	(.0003)	(.0000)	(.0003)
				SSIV
$DImpPen_{it-1}$	.0381***	.0189	.0028	.0044*
	(.014)	(.021)	(.0042)	(.0026)
$FExpComp_{it-1}$	-.0002	0	-.0002**	0
	(.0002)	(.0003)	(.0001)	(0)
C. High-Tech				**OLS**
$DImpPen_{it-1}$	.0032	.0097	-.0005	-.0012
	(.0021)	(.0043)	(.0005)	(.0010)
$FExpComp_{it-1}$	.0000	-.0000	.0000	.0000
	(.0000)	(.0000)	(.0000)	(.0000)
				SSIV
$DImpPen_{it-1}$	.0095	.0386	-.0002	-.0017
	(.0086)	(.0379)	(.001)	(.0015)
$FExpComp_{it-1}$	-.0001	-.0001	0	0
	(.0001)	(.0001)	(0)	(0)
Firm and Year FE	Yes	Yes	Yes	Yes

Notes: Output and Export Values are in logs (log-linear) measured in USD. Number of Varieties are in linear form measured in count of 6-digit HS codes product. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

Table A4.2. Firms' Strategic Adjustment (OLS and SSIV): Firms with Standardized Volume

	Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
	(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Low-Tech								**OLS**
$DImpPen_{it-1}$	-.0127	-.0719***	.009	-.0292*	-.0552*	-.0003	-.0147	-.0057
	(.0146)	(.0261)	(.007)	(.0165)	(.0316)	(.0012)	(.013)	(.0088)
$FExpComp_{it-1}$	.0002**	.0006***	-.0001*	.0003*	.0004***	0*	0	-.0001
	(.0001)	(.0002)	(0)	(.0001)	(.0002)	(0)	(.0001)	(.0001)
								SSIV
$DImpPen_{it-1}$	.0286	-.0347	.0633	.0095	.0105	-.001	-.0487*	.002
	(.0352)	(.0607)	(.0537)	(.0663)	(.1083)	(.0818)	(.0269)	(.0172)
$FExpComp_{it-1}$	.0001	.0005***	-.0004**	.0002	.0003	-.0001	.0001	-.0001
	(.0001)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0001)	(.0001)
B. Mid-Tech								**OLS**
$DImpPen_{it-1}$	.0309**	.0166	.5373	.0421**	.0375	-.0879	.0036*	.0038
	(.0143)	(.0148)	(.5663)	(.0202)	(.041)	(.0914)	(.0019)	(.0043)
$FExpComp_{it-1}$	-.0004**	-.0006**	-.0012	-.0002	-.0007	.001	-.0001**	-.0001
	(.0002)	(.0002)	(.0027)	(.0003)	(.0004)	(.0011)	(.0001)	(0)
								SSIV
$DImpPen_{it-1}$	.0401***	.0301*	.01	.0217	.0375	-.0158	.0046	.0063***
	(.0145)	(.0161)	(.0139)	(.0198)	(.0507)	(.0552)	(.0037)	(.0022)
$FExpComp_{it-1}$	-.0004**	-.0006**	.0002	-.0001	-.0007	.0006	-.0001**	-.0001
	(.0002)	(.0002)	(.0002)	(.0003)	(.0005)	(.0006)	(.0001)	(0)
C. High-Tech								**OLS**
$DImpPen_{it-1}$	.012***	.0222***	-.0523**	.0113**	.0266***	-.0843***	.0008	-.0041**
	(.0038)	(.0071)	(.0238)	(.0051)	(.0054)	(.0315)	(.0016)	(.0016)
$FExpComp_{it-1}$	-.0001	0	.0001	-.0001	0	0	0	.0001**
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(0)	(0)
								SSIV
$DImpPen_{it-1}$	.0564***	.0627*	-.0063	.0458	.0943**	-.0484***	.0059	-.007
	(.0182)	(.0331)	(.0203)	(.0397)	(.0468)	(.0175)	(.0064)	(.005)
$FExpComp_{it-1}$	-.0001	0	-.0001	-.0001	0	-.0001	0	.0001**
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(0)	(0)
Firm FE & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Output and Export Values and Unit Prices are in logs (log-linear) measured in USD. Output and Export Volumes are in logs (log-linear) measured in pieces. Number of Varieties are in linear form measured in count of 6-digit HS codes product. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

Table A4.3. Firms' Strategic Adjustment (OLS and SSIV): Incumbent Firms

	Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
	(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Low-Tech								**OLS**
$DImpPen_{it-1}$	-.0119	-.107**	.0281	-.0243	-.0483	.0012	-.0269	.0178
	(.0146)	(.0421)	(.0204)	(.0178)	(.0403)	(.0007)	(.0276)	(.0163)
$FExpComp_{it-1}$	.0004**	.0012***	-.0002	.0003	.0005	0	.0002	-.0002
	(.0002)	(.0004)	(.0001)	(.0003)	(.0005)	(0)	(.0002)	(.0002)
								SSIV
$DImpPen_{it-1}$	.0284	-.1128	.1412*	.0507	.0184	.0323	-.0229	.0325
	(.0309)	(.0793)	(.0751)	(.0629)	(.1193)	(.0948)	(.0412)	(.0297)
$FExpComp_{it-1}$	.0002	.0012**	-.001**	-.0001	.0001	-.0002	.0002	-.0003
	(.0002)	(.0004)	(.0005)	(.0003)	(.0004)	(.0003)	(.0003)	(.0002)
B. Mid-Tech								**OLS**
$DImpPen_{it-1}$	.0291	.0306	.0034	.0882	.1467	-.0209	.0006	.0043
	(.0194)	(.0173)	(.0161)	(.1048)	(.0864)	(.0296)	(.0007)	(.0046)
$FExpComp_{it-1}$	-.0006*	-.0006*	-.0005	-.0006	-.0012	-.0004	-.0001	0
	(.0003)	(.0003)	(.0018)	(.0014)	(.0012)	(.0004)	(.0001)	(0)
								SSIV
$DImpPen_{it-1}$	.0448**	.043**	.0018	-.0601	.0647	-.1249	-.0004	.0038***
	(.0184)	(.0168)	(.0056)	(.044)	(.1171)	(.1338)	(.0005)	(.0011)
$FExpComp_{it-1}$	-.0006**	-.0007*	0	.001	-.0003	.0013	-.0001	0
	(.0003)	(.0003)	(.0004)	(.0007)	(.0013)	(.0017)	(.0001)	(0)
C. High-Tech								**OLS**
$DImpPen_{it-1}$	.0159	.0385	.0095	.0479	.0556	.0024	.018	.0024
	(.0098)	(.0268)	(.0281)	(.0323)	(.0493)	(.0016)	(.0197)	(.0103)
$FExpComp_{it-1}$	0	-.0001	0	.0011	.002	-.0001	-.0001	0
	(0)	(.0001)	(.0001)	(.002)	(.0022)	(.0001)	(.0001)	(0)
								SSIV
$DImpPen_{it-1}$	-.2461	-.0517	-.1945	-.3076	-.4489	.1413	.3319	.1021
	(.4315)	(.3356)	(.2965)	(.329)	(.3086)	(.0891)	(.6601)	(.233)
$FExpComp_{it-1}$	.0011	.0002	.0009	.0067	.01*	-.0033**	-.0013	-.0004
	(.0018)	(.0014)	(.0013)	(.0053)	(.0047)	(.0012)	(.0028)	(.001)
Firm FE & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Output and Export Values and Unit Prices are in logs (log-linear) measured in USD. Output and Export Volumes are in logs (log-linear) measured in pieces. Number of Varieties are in linear form measured in count of 6-digit HS codes product. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

Appendix A5. Extended Table of Robustness Tests Results

This appendix shows the extended tables of three robustness tests results shown in Table 5.5, with the following tables:

Table A.5.1.: Results of Robustness Test 1 – Regression using alternative measures of Import Competition at Export Destination Market variable ($FExpComp_{it-1}$) using Indonesia's main export destinations in year 2000 ($ChinaPen_{kt}^{Main}$)

Table A.5.2.: Results of Robustness Test 2 – Regression using only firms operating by 2000

Table A.5.3.: Results of Robustness Test 3 – Regression using only Exporters

As described in Subsection 5.5., all robustness tests are conducted using firms with standardized volume as they provide more information from the decomposition of values and given samples' balanced observable characteristics. See next pages for all robustness tests extended tables.

Table A5.1. Robustness Test 1: Regressions with Alternative Measures of $FExpComp_{it-1}$ using $ChinaPen_{kt}^{Main}$

		Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
		(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Low-Tech									
$DImpPen_{it-1}$		.0436	.043	.0006	.0331	.0485	-.0153	-.0307*	-.0132
		(.0282)	(.0528)	(.0481)	(.0503)	(.0849)	(.0619)	(.0178)	(.0124)
$FExpComp\_Main_{it-1}$		.3373	-.0473	.3846	.3946	.7585	-.3639	-.3056	.1119
		(.5748)	(1.1083)	(.7102)	(.6175)	(.9767)	(.8122)	(.2774)	(.3019)
B. Mid-Tech									
$DImpPen_{it-1}$		.0227*	.0017	.021	.0183	.0086	.0096	-.0006	.0027
		(.0131)	(.0165)	(.016)	(.0185)	(.0487)	(.0455)	(.0028)	(.0025)
$FExpComp\_Main_{it-1}$		-1.4073	1.2698	-2.6772*	1.3714	.0766	1.2948	.1596	.6977
		(.9643)	(1.0364)	(1.3944)	(2.6146)	(3.5024)	(2.5889)	(.2763)	(.4509)
C. High-Tech									
$DImpPen_{it-1}$		.0536***	.0681**	-.0145	.0483	.0971**	-.0488***	.0087	-.0039
		(.0197)	(.0291)	(.0147)	(.0382)	(.0431)	(.0164)	(.0074)	(.0041)
$FExpComp\_Main_{it-1}$		1.0427	2.7728**	-1.7301	.9425	2.1246	-1.1822	.7933	.1061
		(.7272)	(1.177)	(1.1778)	(1.0144)	(1.4011)	(1.7114)	(.8033)	(.2564)
Instrument	Low-Tech		.590***			.431**		.590***	
Coefficient	Mid-Tech		.749***			.699***		.749***	
(First-stage)	Hi-Tech		.399***			.362***		.399***	
	Low-Tech		418.25			131.81		418.25	
CDW F-stat	Mid-Tech		372.84			446.66		372.84	
	Hi-Tech		104.86			23.06		104.86	
	Low-Tech		994			625		994	
Observation	Mid-Tech		252			99		252	
	Hi-Tech		444			247		444	
Firm FE			Yes			Yes		Yes	
Year FE			Yes			Yes		Yes	

Notes: Output and Export Values and Unit Prices are in logs (log-linear) measured in USD. Output and Export Volumes are in logs (log-linear) measured in pieces. Number of Varieties are in linear form measured in count of 6-digit HS codes product. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

Table A5.2. Robustness Test 2: Regressions using only firms operating by Year 2000

		Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
		(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Low-Tech									
$DImpPen_{it-1}$		.0437	-.0274	.0712	-.003	.01	-.013	-.0353	.0115
		(.0345)	(.069)	(.058)	(.0547)	(.106)	(.0791)	(.0304)	(.0163)
$FExpComp\_Main_{it-1}$		.0001	.0005***	-.0004**	.0003	.0003	0	.0001	-.0001
		(.0001)	(.0002)	(.0002)	(.0002)	(.0002)	(.0001)	(.0001)	(.0001)
B. Mid-Tech									
$DImpPen_{it-1}$		.0435***	.0298*	.0137	.0926**	-.05	.1426**	.0028	.0067**
		(.0158)	(.0174)	(.0159)	(.0354)	(.0576)	(.0579)	(.0037)	(.0029)
$FExpComp\_Main_{it-1}$		-.0004**	-.0006**	.0001	-.0003	-.0004	.0001	-.0001*	-.0001
		(.0002)	(.0003)	(.0003)	(.0003)	(.0004)	(.0005)	(.0001)	(0)
C. High-Tech									
$DImpPen_{it-1}$		.0617***	.0635*	-.0018	.0868***	.1301***	-.0433***	.0006	-.0039
		(.0146)	(.0351)	(.0243)	(.0184)	(.0235)	(.0146)	(.0061)	(.0049)
$FExpComp\_Main_{it-1}$		-.0001	0	-.0001	0	.0001	-.0001	0*	.0001*
		(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(0)	(0)
Instrument	Low-Tech		.716***			.837***		.716***	
Coefficient	Mid-Tech		.837***			1.039***		.837***	
(First-stage)	Hi-Tech		.399***			.362***		.399***	
CDW F-stat	Low-Tech		379.01			220.10		379.01	
	Mid-Tech		241.26			70.84		241.26	
	Hi-Tech		80.89			17.65		80.89	
Observation	Low-Tech		801			499		801	
	Mid-Tech		199			76		199	
	Hi-Tech		351			201		351	
Firm FE			Yes			Yes		Yes	
Year FE			Yes			Yes		Yes	

Notes: Output and Export Values and Unit Prices are in logs (log-linear) measured in USD. Output and Export Volumes are in logs (log-linear) measured in pieces. Number of Varieties are in linear form measured in count of 6-digit HS codes product. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1

Table A5.3. Robustness Test 3: Regressions using only Exporters

		Total Revenue (D+X)			Export Revenue (X)			Number of Varieties	
		(1) Output Value	(2) Output Vol	(3) Unit Price	(4) Export Value	(5) Export Vol	(6) Exp Unit Price	(7) All Product	(8) New Product
A. Low-Tech									
$DImpPen_{it-1}$		.0286	-.0347	.0633	.0095	.0105	-.001	-.0487*	.002
		(.0352)	(.0607)	(.0537)	(.0663)	(.1083)	(.0818)	(.0269)	(.0172)
$FExpComp\_Main_{it-1}$		.0001	.0005***	-.0004**	.0002	.0003	-.0001	.0001	-.0001
		(.0001)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0001)	(.0001)
B. Mid-Tech									
$DImpPen_{it-1}$		.0403***	.0302*	.0101	.0224	.0384	-.016	.0036	.0054**
		(.0145)	(.0165)	(.0142)	(.0194)	(.0502)	(.0546)	(.0039)	(.0021)
$FExpComp\_Main_{it-1}$		-.0004**	-.0006**	.0002	-.0001	-.0007	.0006	-.0001*	-.0001
		(.0002)	(.0002)	(.0002)	(.0003)	(.0004)	(.0006)	(.0001)	(0)
C. High-Tech									
$DImpPen_{it-1}$		.0558***	.062*	-.0062	.0453	.094**	-.0487***	.0056	-.0068
		(.0183)	(.033)	(.0201)	(.0396)	(.0468)	(.0176)	(.0063)	(.005)
$FExpComp\_Main_{it-1}$		-.0001	0	-.0001	-.0001	0	-.0001	0	.0001**
		(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(0)	(0)
Instrument	Low-Tech		.458***			.323**		.458***	
Coefficient	Mid-Tech		.807***			.722***		.807***	
(First-stage)	Hi-Tech		.393***			.360***		.393***	
	Low-Tech		240.75			76.98		240.75	
CDW F-stat	Mid-Tech		361.29			434.91		361.29	
	Hi-Tech		100.56			22.97		100.56	
	Low-Tech		994			625		994	
Observation	Mid-Tech		250			101		250	
	Hi-Tech		445			248		445	
Firm FE			Yes			Yes		Yes	
Year FE			Yes			Yes		Yes	

Notes: Output and Export Values and Unit Prices are in logs (log-linear) measured in USD. Output and Export Volumes are in logs (log-linear) measured in pieces. Number of Varieties are in linear form measured in count of 6-digit HS codes product. Clustered standard errors at firm-level are in parentheses. *** p<.01, ** p<.05, * p<.1