Access to High-Income Countries and Product Innovation: Evidence from China

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Abstract

Does market access to high-income countries increase product innovation? I investigate this by exploiting variations in firm-level export activities and the removal of externally imposed export quotas following China's accession to the WTO in 2001. I find that improved access to high-income countries significantly causes firms to launch new products, and this effect accounts for 26.35% of the increase in product innovation among firms between 2000 and 2007. Additionally, I find that these gains are driven to a large extent by increased revenue and widened knowledge about the variety of new products from exporting to high-income countries.

Keywords: Trade Liberalization, Product Innovation, New Products, High-Income Countries.

JEL Classification: F13, F14, O14, O31, O53

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I. Introduction

Recent decades have borne witness to several episodes of trade liberalization, which have generated new and economically substantial trade flows between high- and low-income countries. There is a vast literature studying the effects of these liberalizations on outcomes such as firm productivity (Atkin et al., 2017; Bustos, 2011; Harrison and Rodríguez-Clare, 2010) and product quality (Fan et al., 2015; Flach, 2016; Verhoogen, 2008). However, less is known about whether trade liberalization, which exposes firms in low-income countries to more advanced technologies and products, generates product innovation by these firms.[1] This is perhaps a bit surprising, given the role that product innovation plays in driving economic growth in low-income countries during this process.[2] For instance, Goldberg et al. (2010b) document that new products accounted for 25% of the total increase in manufacturing output from 1989 to 2003 in India. In the case of China, new products accounted for about 12% of output growth between 2000 and 2007.[3]

This paper addresses this question by investigating whether improved access to high-income markets encourages firms to introduce new products. To do this, I exploit the accession of China to the World Trade Organization (WTO) in 2001 and the subsequent elimination of externally imposed quotas on Chinese textile and clothing products under the Multifiber Arrangement (MFA). The 2005 revocation of the MFA, which had allowed high-income countries to place quotas on textile and clothing imports from China, improved Chinese firms' access to high-income countries quite significantly.

My research design takes the form of a difference-in-difference strategy, where I compare the change in innovation by firms that were more exposed to the elimination of quotas with that of firms that were less exposed before and after 2005. To measure exposure, I utilize firm-level customs data to create a firm-level measure of exporting activities before the elimination of quotas. This idea is that firms that exported quota-restricted products before 2005 are more affected by the reform than those that did not. I find that improved market access to high-income countries had a substantial, positive, and statistically significant impact on firms' product innovation activities. To analyze the magnitude of the effect, a back-of-the-envelope calculation shows that for a firm with the average level of pre-2005

[1] Existing studies Bustos (2011) and Lileeva and Trefler (2010) studied firms' product innovation and foreign market access when trade liberalization happened between two countries of a similar level of development. They both find that enhanced foreign markets cause domestic firms to innovate new products, and this effect is mainly derived from increased market size. However, factors such as consumer preferences towards product quality and variety and existing technology can differ between developing and developing countries. As a result, the impact of improved access to high-income markets on product innovation in developing countries may differ from existing studies.

[2] Firms in developing countries mainly aim to catch up with the world frontier. Therefore, product innovation considered in this paper includes this catching up and new-to-world innovation. Product innovation and new products are used interchangeably in this paper.

[3] Data source: China's National Bureau of Statistics.

policy exposure, removing the quotas increases its probability of producing new products by 0.015 percentage points, roughly 26.35% of the actual increase in the probability of product innovation per firm from the pre-2005 to the post-2005 period.

My findings indicate that improved access to wealthy countries incentivizes firms to innovate new products. What explains this positive effect? Several factors may be at play, such as increased revenue from exporting to high-income countries, the likelihood of importing advanced technology machinery, and widened knowledge of higher-quality products.

First, the removal of quotas could encourage firms to export to high-income countries. My estimates imply that, for a firm with the average level of pre-2005 policy exposure, removing the quotas increases its probability of exporting to high-income countries by 0.03 percentage points. This change accounts for approximately 37.5% of the actual increase in the probability of exporting to high-income countries per firm from the pre-2005 to the post-2005 period. As firms experience a higher likelihood of exporting to high-income countries, their cash flow, including total exports and total revenue, could increase following the quota removal. This boost in revenue could lead firms to adjust their expectations and adopt a positive attitude toward the profitability of the wealthy markets. Consequently, firms might seek to increase their financial leverage by borrowing from financial institutions and investing in fixed assets, such as machinery, equipment, and buildings. These investments, in turn, foster product innovation. My estimates demonstrate that improved access to high-income countries indeed results in higher levels of debt and investment in fixed assets, thereby contributing to product innovation.

Secondly, in the early 2000s, China-made textile machines lagged behind OECD-made textile machines by nearly 20 years.[4] After the removal of quotas and access to wealthy markets, firms had the opportunity to learn from their OECD counterparts regarding the use of advanced machinery. These firms could import and use OECD-made machinery to produce new products, appealing to customers from OECD countries. I examine whether quota elimination significantly affects the quantity of machinery a firm imports from OECD countries. Surprisingly, my estimate suggests that improved access to high-income countries does not significantly affect the quantity of machinery imported. Based on this analysis, importing high-end machinery does not appear to significantly explain my results.

Finally, the theory of product cycle and technology diffusion suggests that when a high-quality product is initially invented in a high-income country, most countries, particularly low-income countries, lack the knowledge to produce it. When firms gain better access to high-income countries, they

[4]According to the International Textile Machinery Association 2003 Exhibition, the main manufacturers in the weaving machinery industry were Dornier (Germany), Picanol (Belgium), Promatech (Italy), and Sultzer (Switzerland). These OECD-made textile machines often have faster production and superior output quality compare with domestically-made machines.

can learn from their partners in these regions and begin producing new, higher-quality products. To investigate whether producing higher-quality products is a driver for producing new products, I utilize the policy exposure resulting from the relaxation of quotas. I find that improved market access to high-income countries does not have a statistically significant effect on the quality of products that firms export. Consequently, I conclude that enhancing product quality may not be an important channel in explaining the product innovation experienced by firms following the elimination of quotas.

This paper adds to the literature exploring the impact of increased trade with developed countries on firm product innovation in developing countries. Existing literature focuses on import-driven mechanisms. Goldberg et al. (2010a) and Bas and Paunov (2021) highlight the importance of imported inputs in firms' product innovation and find that the lower input tariffs (higher quality inputs) following India's (Ecuador's) WTO accession explain a significant amount of new products introduced by domestic firms. Instead, my paper contributes to the current literature by investigating the export-driven mechanism - whether improved market access to high-income countries affects a firm's product innovation within a major developing country - China.

Additionally, this study complements the existing literature that explores the link between improved market access and product innovation. Existing studies, such as Bustos (2011) and Lileeva and Trefler (2010), find that enhanced foreign markets cause firms to engage in more product innovation when trade liberalization happens between two countries with a similar level of development. For both studies, this positive effect of improved market access to product innovation is mainly derived from increased market size. However, factors such as consumer preferences for product quality and variety and existing technology can differ between developing and developed countries. As a result, the impact of improved access to high-income countries on product innovation in developing countries may differ from the existing findings. My paper contributes to this literature by examining the effect of exporting to high-income countries on product innovation in the world's largest developing country, China.

Finally, my study aligns with a substantial body of literature concerning multiproduct firms in international trade. Bernard et al. (2007) revealed that firms involved in international trade tend to be larger, more skill- and capital-intensive, and produce and export multiple products. In the United States, the top 10% of exporters accounted for 96% of total exports, and firms exporting five or more products represented 25.9% of exporters but contributed to 98% of export values. Other scholars, such as Mayer et al. (2014), found that tougher competitiveness in an export market resulted in firms exporting fewer products in the market. Meanwhile, Bernard et al. (2011) and Eckel and Neary (2010) developed models featuring multi-product firms to estimate the effect of the increased competition on poorly performing products. They found that firms discontinued poorly performed products when trade liberalization occurred between symmetric countries. My contribution to this body of work consists of

two key elements: firstly, I analyze trade liberalization between developing and developed countries, and secondly, I explore whether access to advanced economies motivates firms to diversify their product offerings.

The subsequent sections of this paper are organized as follows. Section II provides background information on the Multifiber Arrangement and the WTO. Section III outlines my identification strategy and baseline specification, while Section IV describes the data. In Section V, I present the estimation results, and Section VI discusses the heterogeneous effects of trade liberalization. Section VII discusses the underlying mechanisms, and section VIII concludes.

II. Background: Multifiber Arrangement and WTO

The Multifiber Arrangement (MFA), established in 1974, provided a systematic mechanism for developed countries to manage perceived "market disruption" in their textile and clothing markets by imposing quotas on imports, particularly from China and other developing countries. Unique to the MFA were bilateral negotiations and the imposition of discriminatory quantitative restrictions that were applied selectively - some exporting countries faced these limitations while others did not. Seven developed high-income parties actively enforced quotas on developing countries under the MFA, which included the European Union, the United States, Canada, Turkey, Norway, Finland, and Austria. By 2000, major players like the European Union, the United States, Canada and Turkey had enforced quotas on textile and clothing imports from China. An interesting facet of the MFA was that it isolated the textile and clothing sector from the broader multilateral trade negotiations conducted under the General Agreement on Tariffs and Trade (GATT).

The Agreement on Textiles and Clothing (ATC), introduced in 1994, aimed to rectify this by phasing out the MFA and integrating textile and clothing products within the purview of WTO rules, primarily by abolishing the quotas. The phase-out was segmented into four stages: 1995, 1998, 2002, and 2005. China was not eligible for quota elimination during Phase I (1995) and Phase II (1998) because it had not yet become a member of the WTO. After joining the WTO in December 2001, China experienced simultaneous quota removals on Phase I, II, and III products in January 2002. By January 2005, all outstanding quotas on Chinese textile and clothing products were lifted. Specifically, 255 and 509 product quotas (at HS 6-digit level) were abolished in January 2002 and January 2005, respectively. It is worth noting that upon entering the WTO, China agreed to special safeguard provisions. These allowed countries, previously enforcing quotas, to introduce new trade restrictions under specific conditions, primarily if increased imports severely threatened domestic industries. However, these new trade restrictions were considerably less restrictive than the pre-existing quotas.

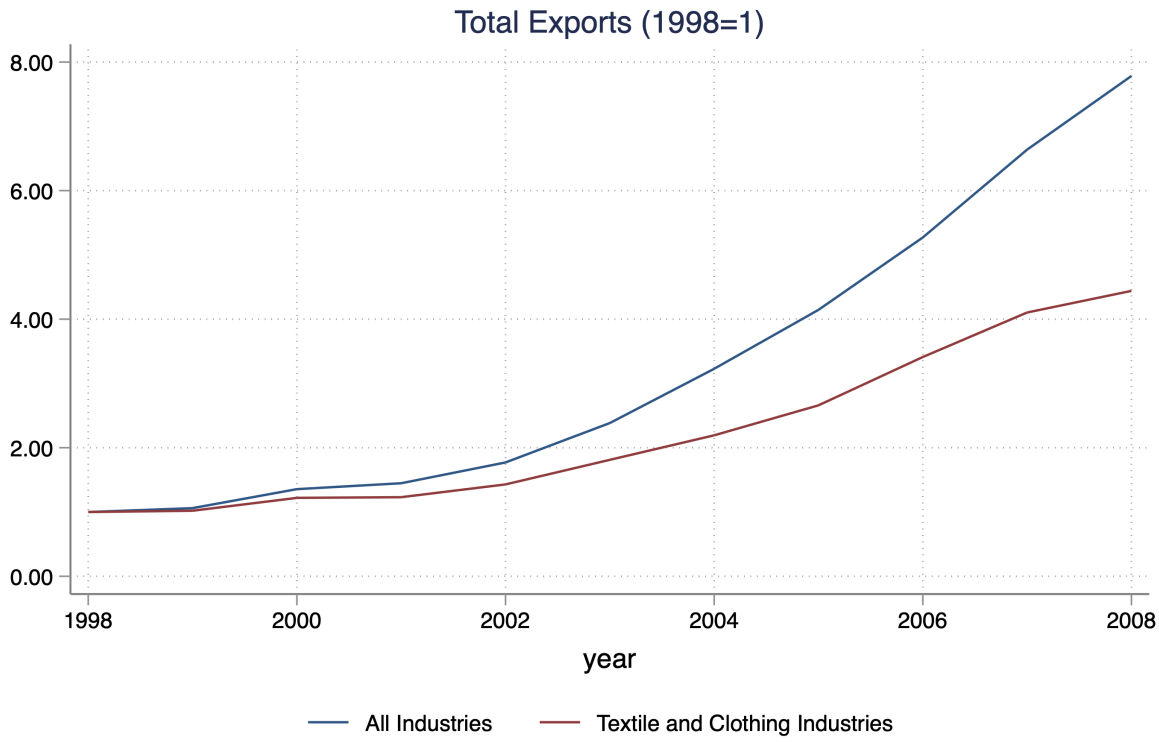

Figure 1: Export growth: 1998-2008. Data Source: World Integrated Trade Solution. Chinese total exports and exports from the textile and clothing industries are expressed as an index number relative to 1998.

Figure 1 plots the growth trajectory of Chinese total exports across all industries, contrasting it with the textile and clothing industries from 1998 and 2008. All values are indexed to 1998 levels. During this period, the nominal value of Chinese total exports from all industries surged nearly eight times. Similarly, the nominal value of Chinese total exports from the textile and clothing industries expanded by almost five-fold. On average, the textile and clothing industries contributed to roughly 15% of China's total exports during this period. This indicates that the increase in total exports from these industries played a significant role in China's export boom in the 2000s. Given the importance of the textile and clothing industries in the Chinese economy, assessing the impact of quota elimination on these sectors provides valuable insight into the remarkable growth of Chinese exports during the 2000s.

Figure 2 shows the number of products at the Harmonized System (HS) 6-digit level that were

under quota restriction during the period from 2000 to 2007 and the growth trajectory of the average firm's probability of producing new products from 2000 to 2007. I can see the average firm's probability of producing new products dropped slightly during 2001 and 2002 and then started to increase in 2003. As the quotas were eliminated in 2002 and 2005, the average firm became more engaged in product innovating activities. By 2007, the average probability of product innovation was more than three times compared with 2000.

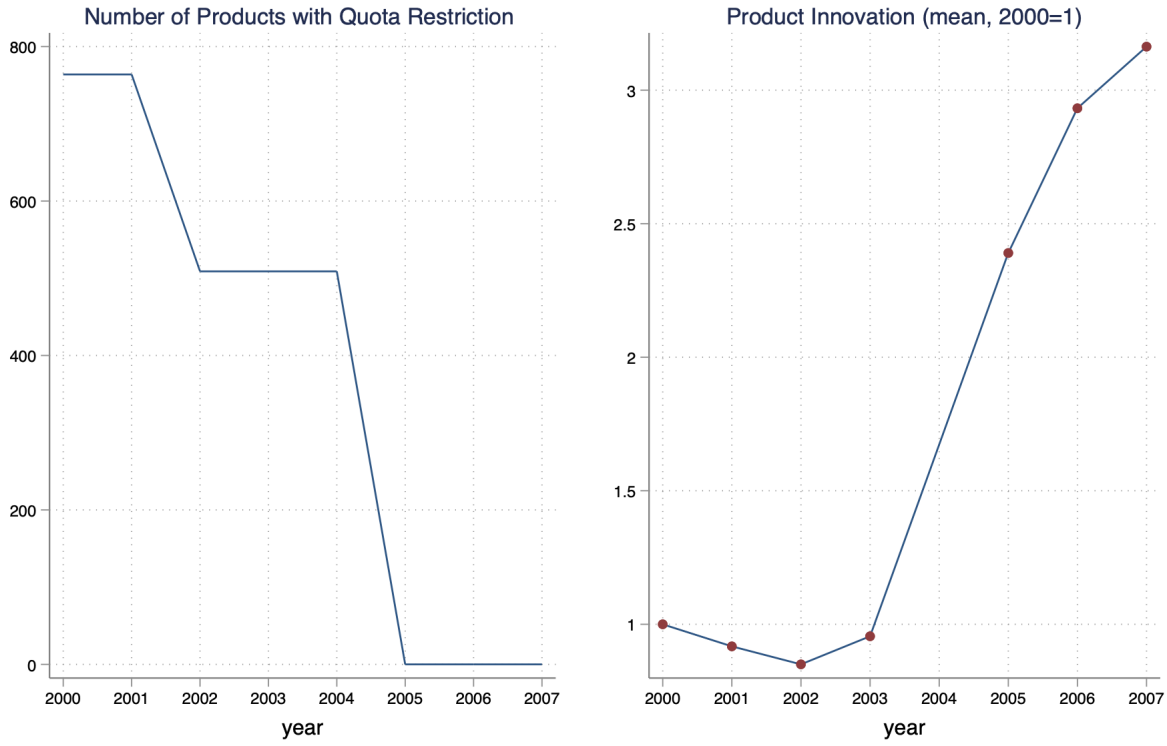

Figure 2: Data Source: The Catalog of Quota in Textile and Clothing Industries, Annual Survey of Industrial Firms.

III. Descriptive Statistics

In this paper, I utilize two comprehensive datasets to investigate the impact of improved market access to wealthy countries on firms' product innovation. The first dataset is the annual survey of industrial firms (ASIF) conducted by China's National Bureau of Statistics (NBS) from 2000 to 2007.

The ASIF covers all state-owned manufacturing firms and non-state-owned manufacturing firms with sales exceeding RMB 5 million (approx. $600,000). It contains information on firm-level outputs and inputs, including capital stocks, employment, sales, and firm characteristics, such as firm ownership structure, location, etc. As outlined in Brandt et al. (2014), the aggregate output for these firms accounts for 90% of China's total manufacturing output. The ASIF dataset contains information on product innovation, which is my variable of interest. It reports the nominal value of new products at the firm level, and a product is defined as a new product if it improves product performance or has substantial additional features compared with products previously produced by the firms. It can be made by new technology/design or substantially improved material or structure (2004 Census of Economy). The second dataset is the Chinese Customs Trade Statistics (CCTS) from 2000 to 2007. This dataset provides annual firm-level trade transactions detailing nominal values of exports/imports, product HS codes (at a ten-digit level), export destinations, and firm characteristics, such as firm name, location, etc.

To ensure data integrity, I follow cleaning protocols from Cai et al. (2009) and Brandt et al. (2012) using the following criteria. First, observations with missing key financial variables (total assets, net value of fixed assets, sales and gross value of firm output) are excluded. Next, firms employing less than eight workers are dropped as they fall under different legal regimes. Finally, trading companies are excluded since they are not involved in production activities.[5] Following this cleaning process, I merge these two datasets. First, I merge the ASIF dataset with the same year NBS dataset. The vast majority of firms (91.67%) are matched by company names, and 8.33% of firms are matched by telephone number and zip code. Secondly, I utilized unique numerical IDs to link firms over time, as described in Brandt et al. (2012). However, some firms were assigned new IDs when restructuring, mergers, or acquisitions occurred. In this case, I use the information on firms' names, industries, and addresses to link firms over time.

The year 2004 was omitted from my estimation results, as it lacked data on my variable of interest, new product innovation.[6] Additionally, given that quotas pertained only to textile and clothing industries and post-2004 market entrants were unaffected by quota removals, my dataset is restricted to textile and clothing firms operational before 2005. It is an unbalanced panel that increased from 1,758 firms in 2000 to 8,195 firms in 2007. [7] Figure 3 illustrates the growth trajectory of an average

[5] In China, pure trading companies are required to register with a name containing Chinese characteristics for "trading company" or "importing and exporting company"

[6] However, I still utilize firms' exporting activities in the year 2004 to obtain firms' policy exposure. See section IV.A for details.

[7] In my data, I observe five ownership types: state-owned firms, collectively owned firms, privately owned firms, and foreign-owned firms. In the paper, I focus on privately-owned firms due to the following rationale: (i) state-owned firms

firm's total export, fixed assets, value-added per worker and product innovation from 2000 to 2007. All values are indexed to 2000 levels. During this period, the average value of total exports surged nearly five times, while the average probability of producing new products surged nearly three times. An average firm's fixed assets and productivity, measured by value-added per worker, also roughly doubled from 2000 to 2007.

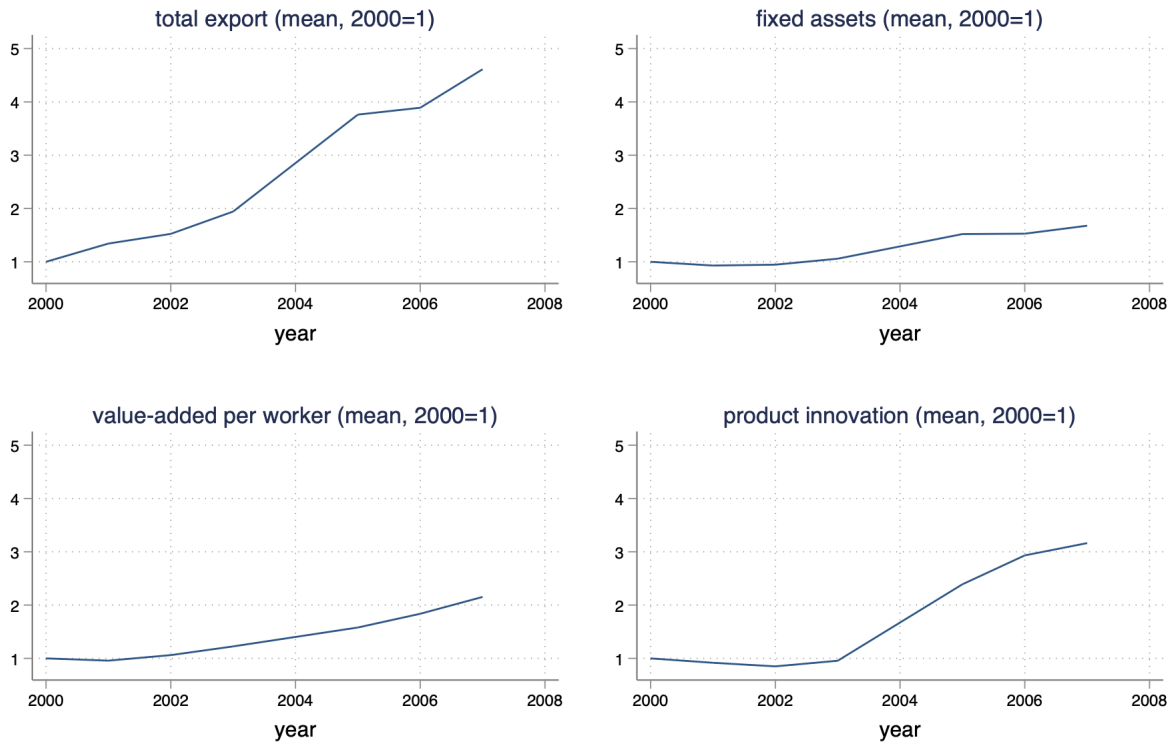

Figure 3: Data Source: Annual Survey of Industrial Firms.

and collectively owned firms may have a different objective function which takes into account government interests, (ii) foreign firms may already be aware of the product variety and advanced technology in the high-income countries, which may result in a small/no effect on product innovation.

IV. Empirical Strategy

A. Specification

The main challenges for estimating the causal impact of improved access to high-income markets on firm product innovation are the issues of reverse causality and confounding factors. These factors could bias the OLS estimates in an undetermined direction. To address these concerns and identify the causal effect of improved access to high-income markets on firms' product innovation, I explore the fact that firms that exported quota-restricted products before 2005 are more affected by the quota elimination than those that did not.[8] These differential degrees of firm-level policy exposure and the timing of quota elimination in 2005 allow me to conduct a difference-in-difference estimation, that is, to compare the change in innovation by firms that were more exposed to the elimination of quotas (treatment group) with that of firms that were less exposed (control group) before and after 2005. The baseline difference-in-difference specification is as follows:

$$\text{NP}_{ijt} = \beta \text{Exposure}_i \times \text{After}_{2005} + \rho X_{it} + \Omega_i + \Gamma_{jt} + \nu_{ijt} \tag{1}$$

Here, the indices i, j, and t represent the firm, industry, and year respectively. The dependent variable NP_{ijt} is an indicator variable that equals one if firm i in industry j produced new products at year t. β is my variable of interest and measures the effect of improved access to high-income markets on firms' product innovation. Let $N_{i,2004}$ denote the number of years that firm i existed from 2000 to 2004, and $Quota_{it,2005}$ be an indicator variable that equals to one if firm i exported a product covered by the list of 2005 quota-free products in year t. Then, $\text{Exposure}_i = \frac{1}{N_{i,2004}} \sum_{2000}^{2004} Quota_{it,2005}$ denotes the fraction of years that a firm i exported a product covered by the list of 2005 quota-free products between 2000 and 2004. In other words, Exposure_i represents the firm i's policy exposure regarding the quota elimination in 2005.[9] After_{2005} denotes the post-2005 period, taking a value of 1 from 2005 onward and 0 otherwise. X_{it} incorporates the controls for the 2002 policy change effect.[10] Ω_i accounts

[8] China underwent two phases of quota elimination in the textile and clothing industries: in 2002, the quotas on 255 products were lifted, and in 2005, the quotas on 509 products were abolished. Although I could apply a staggered difference-in-difference strategy, it is less persuasive to verify the identifying assumption for the 2002 policy. This is due to the Chinese customs data only becoming available in 2000. Thus, my main specification explores the 2005 policy change and includes the 2002 policy change as a control variable. As a robustness check, Table A1 presents the regression estimates excluding the 2002 policy. The estimated effects of the 2005 quota removal align closely with those from the main specification.

[9] Table A2 presents the estimates when Exposure_i is defined as a dummy variable. If firm i exported a product covered by the list of 2005 quota-free products between 2000 and 2004, Exposure_i equals 1; otherwise, it equals zero. I find that the estimated effects are smaller but still statistically significant.

[10] The determination of 2002 policy exposure follows a similar approach. Let $N_{i,2001}$ denotes the number of years that

for the firm fixed effect controlling for all time-invariant differences across firms. Γ_{jt} is the industry-year fixed effect, which controls for industry-specific and time-variant unobservables, and ν_{ijt} is the error term.

B. Identifying Assumptions and Checks

The identification assumption is that conditional on the controls, the interaction between the time dummy and a firm's likelihood of being affected by quota changes only affects product innovation through improved access to high-income countries. In other words, if there had been no quota elimination in 2005, more exposed firms' product innovation activities would have followed the same trend as that in the less exposed group, conditional on the controls. The main concerns with this assumption are the timing of quota elimination in 2005 and the potential endogeneity of a firm's policy exposure and other policy changes. First, after China's accession to WTO in December 2001, firms were aware of the elimination of quotas in 2005. To investigate whether firms adjusted their behaviours in light of this forthcoming change, I incorporate additional controls, $\text{Exposure}_i \times \text{Year}_{2000}$, $\text{Exposure}_i \times \text{Year}_{2001}$, and $\text{Exposure}_i \times \text{Year}_{2002}$ in the regression.[11] Year_{2000} is a dummy for the year 2000, Year_{2001} for 2001, and Year_{2002} for 2002.

Secondly, to measure a firm's potential impact from quota elimination in 2005, I calculate the proportion of years that a firm exported quota-lifted products a year before the elimination of quota, the year 2004. This raises the possibility that the treatment and control groups could be systematically different ex-ante. To verify the validity of my policy measure, I construct an alternative measurement as a robustness check using a firm's 2000 and 2001 export activities to measure firms' exposure to quota elimination in 2005.

Thirdly, Lu and Yu (2015) argued that post-China's WTO accession, average unweighted tariffs dropped from 15.3 percent in 2001 to 12.3 percent in 2004. If this tariff reduction affected my treatment and control groups differently, my estimates might capture the effects of tariff reduction. To mitigate these potential confounding influences, my primary specification includes the industry-year fixed effects, capturing the main effect of the tariff reduction. For further validation, I conduct a placebo analysis using pure processing firms. In China, pure processing firms obtain raw materials or intermediate inputs from foreign countries and export value-added final goods after local processing. Since the Chinese government exempts the tariffs on the processing of intermediate goods, the tariff reduction

firm i existed from 2000 to 2001 and $Quota_{it,2002}$ is an indicator variable that equals to one if firm i exported a product covered by the list of 2002 quota-free products in year t. Then, $\text{Exposure}_{i,2002} = \frac{1}{N_{i,2001}} \sum_{2000}^{2001} Quota_{it,2002}$ denotes the fraction of years that a firm i exported a product covered by the list of 2002 quota-free products between 2000 and 2001. Moreover, After_{2002} denotes the post-2002 period, taking a value of 1 from 2002 onward and 0 otherwise.

[11] I use the years 2000, 2001, and 2002 to check for anticipation effect since the data in 2004 is not available.

post-WTO entry should not have impacted processing firms after China's WTO accession. To further check my identifying assumption, I perform a placebo analysis on firms from all other manufacturing industries.[12]

V. Empirical Results

A. Baseline Specification

Table I presents the estimation results of the difference-in-difference regression. In my preferred main specification, which is shown in column (3), I find that improved market access to high-income countries had a substantial, positive, and statistically significant impact on firms' product innovation activities. To analyze the magnitude of the effect, a back-of-the-envelope calculation shows that for a privately owned firm with the average level of pre-2005 policy exposure, removing the quotas increases its probability of producing new products by 0.015 percentage points, roughly 26.35% of the actual increase in the probability of product innovation per firm from the pre-2005 to the post-2005 period.

Table I: Improved Access to Wealthy Countries and Product Innovation

	(1)	(2)	(3)
$\text{Exposure}_i \times \text{After}_{2005}$	0.118***	0.084***	0.080***
	[0.013]	[0.013]	[0.013]
Observations	45,254	45,254	45,254
Quota Elimination in 2002	Yes	Yes	Yes
Year FE	Yes	Yes	No
Firm FE	No	Yes	Yes
Industry-Year FE	No	No	Yes

Notes: Dependent Variable: NP_{it} is an indicator variable that equals one if firm i in industry j produced a new product at year t. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

[12] These other manufacturing industries include food, beverage and tobacco, leather, wood, paper, petroleum, chemical, plastics and coal, non-metallic mineral, primary metal, fabricated metal, machinery, electrical equipment, transportation equipment, and furniture.

B. Pretrends

As previously discussed, my identification assumption is that the interaction between the time dummy and a firm's probability of exporting quota-lifted products prior to the 2005 quota removal only affects innovative product development through improved access to high-income countries, conditional on the controls. To validate this identification assumption, I estimate the leads and lags specification of the difference-indifference regression, interacting a firm's policy exposure with a series of time dummy variables. The dummy variable for 2003 is left out, rendering 2003 the reference year.[13] The specification of interest, represented as equation (2), encompasses the same control variables as in the main specification.

$$NP_{ijt} = \sum_{m=2000,\neq 2003}^{2007} \pi_n \text{Year}_m \times \text{Prob(firm i faced Quota in 2005)} + X_{it} + Z_i + \Gamma_{jt} + \nu_{ijt} \quad (2)$$

The coefficients and the corresponding confidence intervals are presented graphically in Figure 4.[14] My analysis indicates that the coefficients for policy exposure before 2005 are negligible and insignificant. However, following the quota elimination in 2005, the magnitudes of the coefficients increased over the subsequent years, and they are statistically significant. Therefore, these findings are consistent with the hypothesis that the 2005 policy exposure is uncorrelated with any variation in a firm's product innovating activities before 2005, conditional on the control variables.

C. Robustness Checks

In this subsection, I present a series of robustness checks regarding my difference-in-difference specification, with the corresponding estimates detailed in Table II. First, to assess the sensitivity of the baseline estimate, I introduce an alternative measure of policy exposure. Columns 1-3 in Panel A of Table II present the baseline estimates for comparison, while columns 4-6 in Panel A of Table II show the estimates using an alternative measure of policy exposure. Specifically, rather than relying on a firm's export activity spanning 2000-2004 to measure the degree of its policy exposure, I utilize its 2000 and 2001 export activities to assess its exposure to the 2005 quota removal. The alternative policy exposure is quantified as: $\text{Exposure}_i = \frac{1}{N_{i,2001}} \sum_{2000}^{2001} Quota_{it,2005}$. $N_{i,2001}$ denotes the number of years that firm i existed in my sample period from 2000 to 2001, and $Quota_{it,2005}$ equals one if a firm exported a product listed under 2005 quota-free category in year t and zero otherwise. The regression results imply that improved access to wealthy markets has a statistically significant positive impact on firms' willingness to produce new products even though the estimates using alternative measures

[13] The dummy variable for the year 2004 is also omitted due to missing data.

[14] Table A3 presents the regression analogues to these results.

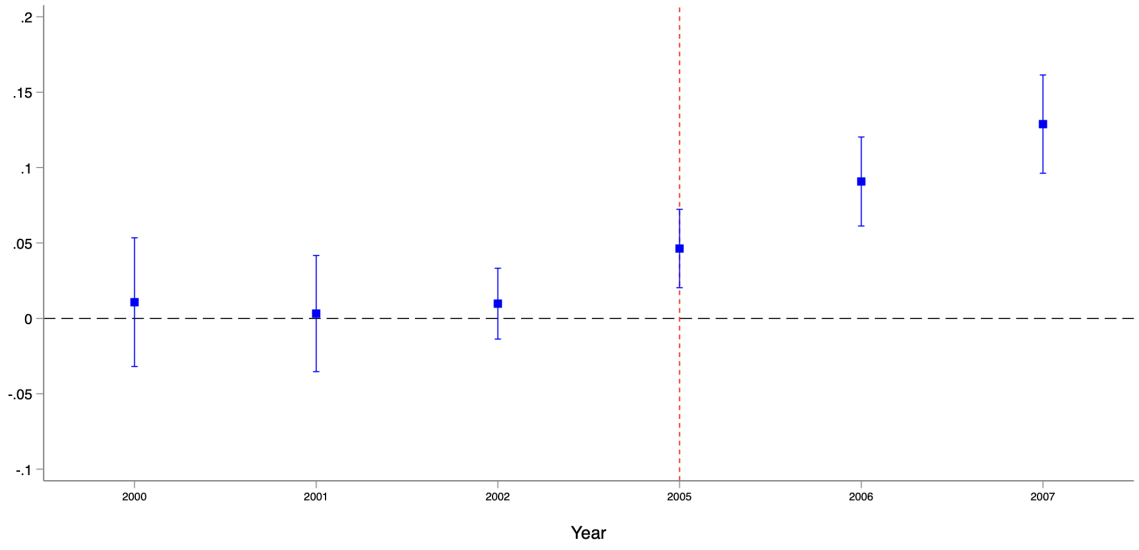

Figure 4: The Estimated Coefficients and 95% Confidence Intervals

of policy exposure are smaller than the baseline estimates. However, a limitation of this approach is that the sample size was significantly reduced due to the exclusion of post-2001 market entrants.

Next, I check the robustness of my estimates to changes of ownership. China's government announced its SOEs' restructuring programs in the late 1990s. In my sample period, about 12.35% (7157 out of 50,797) of firms' ownership switched from one type to another. Chen et al. (2021) suggests that privately owned firms are 53% more productive on average than state-owned firms. Columns 1- 3 in Panel B of Table II show the estimates when I use a firm's first-year ownership type as its' ownership type throughout the sample period.[15] My estimates are slightly smaller than the baseline estimate. Thus, my results are not specific to my choice of definition of ownership.

Furthermore, the baseline analysis includes industry-time fixed effects to control for time-variant industry factors. However, the import tariff dropped disproportionately across imported products after China joined the WTO in December 2001. To check the robustness of my estimates to the changes in import tariffs, I rerun the difference-in-difference specification on pure processing firms. In China, pure processing firms obtain raw materials or intermediate inputs from foreign countries and export value-added final goods after local processing. Since the Chinese government exempts the tariffs on

[15]Specifically, if a firm existed in my sample in 2000, then its ownership type in 2000 will be treated as its ownership type throughout the sample period. Similarly, if a firm started to show up in my sample in 2002, then its ownership type in 2002 will be treated as its ownership type throughout the sample period.

the processing of intermediate goods, the changes in tariffs should not affect pure processing firms. As reported in columns 4-6 in Panel B of Table II, I continue to estimate the positive effects of improved access to high-income countries on firms' product innovation. Even though the estimated effects are slightly smaller for pure-processing exporters, the effects are statistically significant.

Up until this point, I have relied on self-reported firm-level data to measure whether a firm produces new products. To check the robustness of my results, I experiment with an alternative measure of product innovation. In the customs data, I observe all the products a firm exports to all foreign countries from 2000 to 2007. Utilizing this information, I use the number of products a firm exports to measure whether a firm produces new products. For example, if the number of products a firm exported two products in 2000 and six products by 2006, it would be flagged as engaging in product innovation activities. I rerun the difference-in-difference regression on the number of products a firm exported from 2000 to 2007. The estimation in Panel C of Table II shows that the quota elimination in 2005 induces a firm to export new products to OECD countries, while the change in the number of products that a firm exports to non-OECD countries is not statistically significant after the elimination of quotas. These findings suggest that exporting to OECD countries encourages firms to innovate new products designed for OECD markets.

Finally, I conduct a placebo analysis by considering firms in other types of industries which are not affected by the elimination of quotas for placebo analysis. I randomly assign the policy exposure to each firm in each industry and run the difference-in-difference regression for each industry. Figure 5 shows the estimation results and the corresponding 95% confidence intervals for each industry. I find no statistically significant effects for industries other than the textile and clothing industries, and this evidence further supports the validity of my estimates.

Table II: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A			
	Baseline Estimation			Alternative Policy Exposure		
$\text{Exposure}_i \times \text{After}_{2005}$	0.118***	0.084**	0.08***	0.076***	0.047***	0.041**
	[0.013]	[0.013]	[0.013]	[0.020]	[0.021]	[0.021]
Observations	45,254	45,254	45,254	21,883	21,883	21,883
			Panel B			
	First Year Ownership			Processing Firms		
$\text{Exposure}_i \times \text{After}_{2005}$	0.100***	0.073***	0.068***	0.105***	0.054***	0.052***
	[0.013]	[0.012]	[0.012]	[0.017]	[0.020]	[0.020]
Observations	41,440	41,440	41,440	39,918	39,918	39,918
			Panel C			
	OECD Countries			Non-OECD Countries		
$\text{Exposure}_i \times \text{After}_{2005}$	8.756***	2.731***	2.901***	7.913***	0.394	0.577
	[0.577]	[0.591]	[0.587]	[0.642]	[0.557]	[0.553]
Observations	45,254	45,254	45,254	45,254	45,254	45,254
			Controls (for all panels)			
Quota Elimination in 2002	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes	No
Firm FE	No	Yes	Yes	No	Yes	Yes
Industry-Year FE	No	No	Yes	No	No	Yes

Notes: Dependent Variable in Panel A and B: NP_{it} is an indicator variable that equals one if firm i in industry j produced a new product at year t. Dependent Variable in Panel C is the number of products that firm i in industry j exports to OECD countries or Non-OECD countries at time t.Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

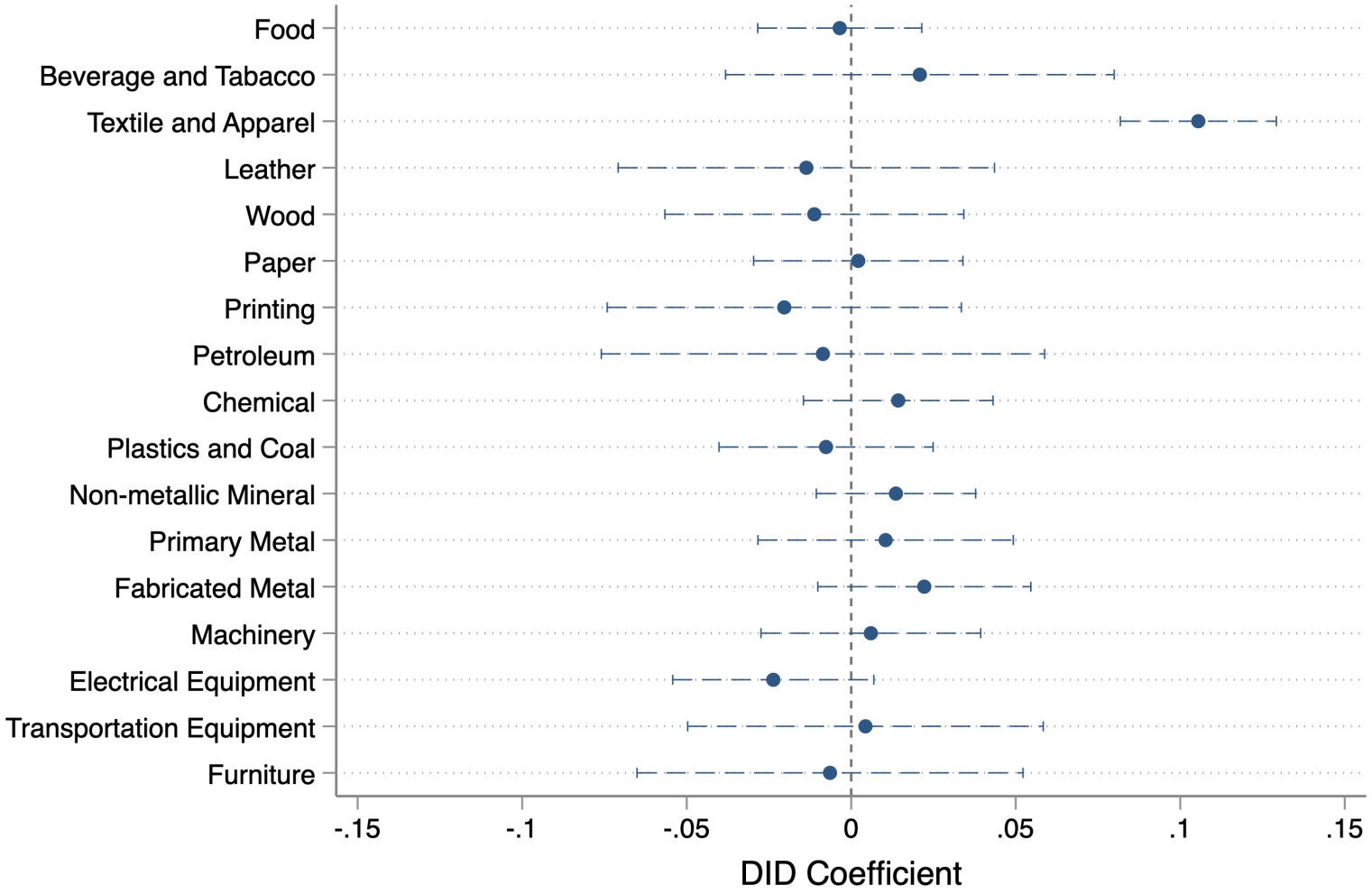

Figure 5: The Estimated Coefficients and 95% Confidence Interval

VI. Heterogeneous Effects of Trade Liberalization

In this section, I examine whether the effects of the removal of externally imposed quotas are heterogeneous across different contexts. I first investigate how the elimination of externally imposed quotas on product innovation varies based on specific firm characteristics, such as size, location, and profitability. The firm's characteristics are denoted as I_i. To account for this heterogeneity, my difference-in-difference regression can be shown as follows:

$$\begin{aligned} NP_{ijt} = {} & \pi_1 \text{Exposure}_i \times \text{After}_{2005} \times I_i \\ & + \pi_2 \text{Exposure}_i \times \text{After}_{2005} + \pi_3 \text{After}_{2005} \times I_i \\ & + X_{it} + \Gamma_{jt} + \epsilon_{ijt} \end{aligned} \tag{5}$$

I_i measures a firm's characteristics prior to 2005, such as size, location and profitability. Table III presents the heterogeneous effects of exporting to wealthy countries on firms' product innovation, with column 1 showing the baseline estimation for comparison. In column 2, the first row reports the estimated coefficient for $\text{Exposure}_i \times \text{After}_{2005}$, which is the effect of quota elimination for large firms whose total assets were larger than the sample average total assets prior to 2005. The estimated coefficient is statistically significant. The second row of column (2) shows the estimated effect for small firms, which is the sum of coefficients for $\text{Exposure}_i \times \text{After}_{2005}$ and $\text{Exposure}_i \times \text{After}_{2005} \times I_i$. The estimate implies that quota elimination has a slightly small but statistically significant effect on small firms' product innovation. In column 3, I allow for heterogeneity by location, as measured by whether a firm is located far away from the sea. I_i equals one if a firm is located away from the sea and zero if it is near the sea. The estimated coefficient means that quota elimination increases a coastal firm's likelihood of product innovation. In contrast, the removal of quotas does not have a statistically significant impact on inland firms' product production. Finally, I examine whether quota elimination affects firms with high and low profits differently. I define a high-profit firm as one with profits higher than the sample average profit prior to 2005. The estimates in column 4 of Table III indicate that improved access to wealthy countries increases a high-profit firm's likelihood of producing new products. The combined effect indicates that improved access to wealthy countries also increases a low-profit firm's probability of production innovation but to a smaller degree. To sum up, these results imply the innovation response is most pronounced among large coastal firms and those that were already profitable before the reform.

Table III: Heterogeneous Effects of Exporting to Wealthy Countries on Product Innovation

	(1)	(2)	(3)	(4)
	Baseline Estimates	Indicator for: Small Firms	Indicator for: Inland Firms	Indicator for: Low Profitable Firms
$\text{Exposure}_i \times \text{After}_{2005}$	0.082***	0.086***	0.090***	0.099***
	[0.013]	[0.018]	[0.013]	[0.019]
$\text{Exposure}_i \times \text{After}_{2005}$ $+\text{Exposure}_i \times \text{After}_{2005} \times I_i$		0.061***	0.015	0.057***
		[0.018]	[0.034]	[0.016]
Quota Elimination in 2002	Yes	Yes	Yes	Yes
Year FE	X	X	X	X
Firm FE	X	X	X	X
Industry-Year FE	X	X	X	X
Observations	45,254	45,254	45,254	45,254

Notes: Dependent Variable: NP_{it} is an indicator variable that equals one if firm i in industry j produced a new product at year t. Independent variable: Prob(firm i faced Quota in 2005) represents the policy exposure of firm i in response to the quota elimination in 2005. I_i is firm characteristics, such as size, location and profitability. Control variables: Prob(firm i faced Quota in 2002) represents the policy exposure of firm i in response to the quota elimination in 2002. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

Moreover, the clothing industry is generally considered more technology-intensive than the textile industry. I then investigate whether the effects of improved access to high-income countries vary between the textile and clothing sectors. Specifically, I run the difference-in-difference regression on firms in the textile and clothing industries separately. It is possible that firms in the clothing industry are more likely to initiate product innovation activities after the elimination of quotas in high-income countries, given their tech-intensive nature. However, the estimates presented in Table IV contradict this hypothesis. I find that access to high-income markets has a higher effect on firms' product innovation activities in the textile industry compared with firms in the clothing industry. This is possible if firms in textile industries increase their product diversity by producing new products similar to existing ones.

Table IV: Improved Access to Wealthy Countries and Product Innovation

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Textile Industry			
$\text{Exposure}_i \times \text{After}_{2005}$	0.170***	0.101***	0.093***	0.143***	0.102	0.093***
	[0.016]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]
Observations	28,620	28,620	28,620	28,620	28,620	28,620
			Panel B: Clothing Industry			
$\text{Exposure}_i \times \text{After}_{2005}$	0.085***	0.071***	0.072***	0.071***	0.067***	0.069***
	[0.019]	[0.021]	[0.022]	[0.019]	[0.013]	[0.022]
Observations	16,191	16,191	16,191	16,191	16,191	16,191
			Controls (for all panels)			
Quota Elimination in 2002	No	No	No	Yes	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes	No
Firm FE	No	Yes	Yes	No	Yes	Yes
Industry-Year FE	No	No	Yes	No	No	Yes

Note: This table shows the regression estimates for the textile and clothing industries separately. I find that the impact of improved access to wealthy markets has a higher effect on the textile industry compared with the clothing industry. Dependent Variable: NP_{it} is an indicator variable that equals one if firm i in industry j produced a new product at year t. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

VII. Discussion

In this section, I discuss several factors that might explain why privately owned firms become more innovative following the removal of quotas. Additionally, I examine whether accessing high-income markets induces single-product exporters to become multi-product exporters.

A. Potential Mechanism

The removal of quotas likely elevates a firm's propensity to export to high-income countries. In Panel A of Table V, column 1 indicates that the elimination of quotas encourages firms to export to high-income countries. For a firm with the average level of pre-2005 policy exposure, my estimate implies that removing the quotas would increase a firm's likelihood of exporting to high-income countries by 0.03 percentage points, accounting for approximately 37.5% of the actual increase in the probability of exporting to high-income countries per firm from the pre-2005 to the post-2005 period. As firms experience a higher likelihood of exporting to high-income countries, their cash flow, including total exports and total revenue, could increase following the quota removal. Columns 2 and 3 of Panel A in Table V report the estimated results when treating total exports and total revenue as dependent variables in my difference-indifference regression. For a firm with the average level of policy exposure, the estimate means that the removal of quotas increases a firm's total exports by $1,003,000, while the average total exports among exporters was $440,000 during the pre-2005 period. Similarly, exporting to wealthy markets positively affects firms' total revenue. This boost in revenue could lead firms to adjust their expectations and adopt a positive attitude toward wealthy markets. Consequently, firms might seek to increase their financial leverage by borrowing from financial institutions and investing in fixed assets, such as machinery, equipment, and buildings. These investments, in turn, foster product innovation. Indeed, my estimates show that firms' fixed assets increase significantly following the removal of quotas. Additionally, I find that firms become more profitable after removing quotas, as shown in column (1) of Table VI. To sum up, these results suggest that the elimination of quotas encourages firms to export to wealthy markets, leading to higher revenue. Given this higher revenue and a positive attitude toward the wealthy markets, firms borrow more money from financial institutions and their investment increases, which leads to a higher level of product innovation.

In the early 2000s, China-made textile machines lagged two decades behind their OECD counterparts. [16] Post-quota and with better access to high-income countries, firms could bridge this technological gap by learning from and importing OECD machinery. As a result, these Chinese firms can

[16] According to the International Textile Machinery Association 2003 Exhibition, the main manufacturers in the weaving machinery industry were Dornier (Germany), Picanol (Belgium), Promatech (Italy), and Sultzer (Switzerland).

produce new products to attract customers from OECD countries. However, as column (2) of Table VI reveals, this anticipated uptick in machinery imports from OECD countries is statistically insignificant. Based on this analysis, importing high-end machinery does not appear to be a significant factor explaining my results.

Finally, the product cycle and technology diffusion theory suggests that a new product is typically born in a high-income country. Most countries, particularly low-income countries, do not know how to make it. When firms' access to high-income countries increased after the quota elimination, they could learn from their partners in high-income countries and start producing new, higher-quality products. To test whether producing higher quality products is a driver for producing new products, I utilize the policy exposure resulting from the relaxation of quotas. As shown in column (3) of Table VI, I find that improved market access to high-income countries does not statistically affect the quality of products that firms export. I conclude that improving product quality is not an important channel in explaining the product innovation activities that firms experienced after the quota elimination.

B. Multiproduct Exporters

Multiproduct exporters play a predominant role in global production and trade. As reported in Bernard et al. (2007), the top 10% of multiproduct exporters accounted for 96% of total exports. Similar concentrations of multiproduct exporters in markets are noted across various countries as summarised in Bernan (2008). On the other hand, (Eaton et al., 2007; Iacovone and Javorcik, 2010) argue that new exporters tend to start exporting a single product. What are the factors that drive single-product exporters to become multiproduct exporters? In this subsection, I explore whether widened access to high-income countries is one of the drivers. Exporting to wealthy markets increases firms' total revenue, and firms adjust their expectations about their profitability in wealthy markets accordingly. Given the increased revenue and updated expectations towards the wealthy markets, firms start to produce and export new products to the high-income markets. Utilizing the policy exposure resulting from the relaxation of quotas, I find that improved access to wealthy markets encourages firms to export multiple products by 0.36 percentage points, as is shown in Table VII. The implied effect is that for a firm with an average level of policy exposure, the removal of quotas increases a firm's probability of exporting multi-products by 0.013 percentage points, constituting around 23% of the actual increase in becoming multiproduct exporters per firm from the pre-2005 to the post-2005 periods.

Table V: Improved Acces to High-income Countries on Firm Performance

	(1)	(2)	(3)	(4)
		Panel A		
	Export	Total Export	Total Revenue	Capital
$\text{Exposure}_i \times \text{After}_{2005}$	0.145***	1,003***	18,404***	5,548***
	[0.020]	[48]	[2014]	[526]
Dependent Variable (Mean)	0.124	1,233	39,632	9,788
Observations	45,254	45,254	45,254	45,173
		Panel B		
	Short-Term Liability	Long-Term Liability	Total Interest	Fixed Assets
$\text{Exposure}_i \times \text{After}_{2005}$	15,106***	279**	570***	5,493***
	[942]	[114]	[37]	[491]
Dependent Variable (Mean)	13,491	852	367	8445
Observations	45,254	45,254	45,254	45,254
Quota Elimination in 2002	Yes	Yes	Yes	
Firm FE	Yes	Yes	Yes	
Industry-Year FE	Yes	Yes	Yes	

Notes: Dependent Variable: In panel A, Export is a binary variable that equals one if firm i exports to quota-restricted countries at year t. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. For variables - total exports, total revenue capital, short-term liability, long-term liability, total interest, and fixed assets are deflated and winsorized at the 5 percent level. Moreover, total export is in thousands of $ while total revenue capital, short-term liability, long-term liability, total interest, and fixed assets are in thousands of ¥. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

Table VI: Improved Acces to High-income Countries on Firm Performance - Continued

	(1)	(2)	(3)
	Profit	Machinery	Quality
$\text{Exposure}_i \times \text{After}_{2005}$	510***	-43.5	-0.043
	[126]	[28.73]	[0.056]
Dependent Variable (Mean)	1,310		
Observations	45,254	45,254	45,254
Quota Elimination in 2002	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes

Notes: Dependent Variable: The variable profit - is deflated and winsorized at the 5 percent level. Moreover, the variable profit is in thousands of ¥. Machinery represents the number of machinery that firm i imported from OECD countries at year t. Quality represents firm i's average quality of exported products at year t. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

VIII. Conclusion

Product innovation plays an important role in spurring economic growth in low-income countries during the trade liberalization process. However, little is known about whether trade liberalization, which exposes firms in low-income countries to more advanced technologies and products, generates product innovation by these firms. In this paper, I use rich firm-level data to casually identify the effect of quota elimination in 2005, a policy change that significantly improved firms' access to high-income markets, on firms' product innovation in China. The identification strategy exploits variation across Chinese firms' exposure to the elimination of quotas in the textile and clothing industries in 2005.

The estimated results suggest that a firm that benefited most from the quota elimination shows a high level of product innovation. The back-of-the-envelope calculation shows that for a firm with the average exposure, removing the quotas would increase its probability of producing new products by 0.014 percentage points, roughly 26.35% of the actual increase in the probability of product innovation per firm from pre-2005 to post-2005 period. However, the quality of products that firms export was not statistically significantly affected by the quota elimination. It suggests that firms tend to increase

Table VII: Improved Access to Wealthy Countries and Multiproduct Exporter

Dependent Variable: Multiproduct Exporter$_{ijt}$	(1)	(2)	(3)
Exposure$_i$ × After$_{2005}$	0.47***	0.36***	0.36***
	[0.03]	[0.03]	[0.03]
Observations	40,766	40,766	40,766
Quota Elimination in 2002	Yes	Yes	Yes
Year FE	Yes	Yes	No
Firm FE	No	Yes	Yes
Industry-Year FE	No	No	Yes

Notes: Independent Variable: Exposure$_i$ represents the policy exposure of firm i in response to the quota elimination in 2005. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

product diversification horizontally rather than vertically. In addition, I find that the improved access to wealthy markets on Chinese firms' product innovation has a larger estimated effect on large, coastal and more profitable firms than small, inland and less profitable firms. These effects are induced by the rise in revenue and investment in fixed assets produced by exporting to wealthy countries. This evidence highlights the importance of improved access to high-income markets for developing countries.

A. Appendix

A.I Appendix Figures and Tables

Table A1: Improved Access to Wealthy Countries and Product Innovation

	(1)	(2)	(3)
$\text{Exposure}_i \times \text{After}_{2005}$	0.141***	0.086***	0.082***
	[0.013]	[0.013]	[0.013]
Observations	45,254	45,254	45,254
Year FE	Yes	Yes	No
Firm FE	No	Yes	Yes
Industry-Year FE	No	No	Yes

Note: This table shows the regression estimates when the 2002 policy was excluded in the regression for the robustness check. Dependent Variable: NP_{it} is an indicator variable that equals one if firm i in industry j produced a new product at year t. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Significant at *** 1%, ** 5%, and * 10%.

Table A2: Improved Access to Wealthy Countries and Product Innovation

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Exposure}_i \times \text{After}_{2005}$	0.093***	0.051***	0.049***	0.078***	0.05***	0.048**
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
Observations	45,254	45,254	45,254	45,254	45,254	45,254
Quota Elimination in 2002	No	No	No	Yes	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes	No
Firm FE	No	Yes	Yes	No	Yes	Yes
Industry-Year FE	No	No	Yes	No	No	Yes

Note: This table shows the regression results when dummy policy exposure is used in the regression for robustness check. Dependent Variable: NP_{it} is an indicator variable that equals one if firm i in industry j produced a new product at year t. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Significant at *** 1%, ** 5%, and * 10%.

Table A3: Improved Access to Wealthy Countries and Product Innovation - Pretrend

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Exposure}_i \times \text{Year}_{2001}$	0.05***	-0.004	-0.005	0.05***	-0.004	-0.005
	[0.015]	[0.019]	[0.019]	[0.015]	[0.02]	[0.019]
$\text{Exposure}_i \times \text{Year}_{2002}$	0.059***	0.008	0.008	0.04***	0.002	0.001
	[0.013]	[0.022]	[0.02]	[0.01]	[0.02]	[0.02]
$\text{Exposure}_i \times \text{Year}_{2003}$	0.057***	-0.001	0.001	0.04***	-0.007	-0.005
	[0.01]	[0.023]	[0.023]	[0.009]	[0.02]	[0.022]
$\text{Exposure}_i \times \text{Year}_{2005}$	0.104***	0.047*	0.043*	0.083***	0.04*	0.036
	[0.014]	[0.025]	[0.025]	[0.014]	[0.024]	[0.024]
$\text{Exposure}_i \times \text{Year}_{2006}$	0.141***	0.09***	0.088***	0.121***	0.083***	0.081***
	[0.015]	[0.025]	[0.025]	[0.015]	[0.024]	[0.024]
$\text{Exposure}_i \times \text{Year}_{2007}$	0.181***	0.130***	0.126***	0.160***	0.124***	0.119***
	[0.016]	[0.026]	[0.026]	[0.017]	[0.025]	[0.025]
Observations	45,254	45,254	45,254	45,254	45,254	45,254
Quota Elimination in 2002	No	No	No	Yes	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes	No
Firm FE	No	Yes	Yes	No	Yes	Yes
Industry-Year FE	No	No	Yes	No	No	Yes

Note: This table shows the estimates for the leads and lags specification of the difference-in-difference regression. Dependent Variable: NP_{it} is an indicator variable that equals one if firm i in industry j produced a new product at year t. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

Table A4: Improved Access to Wealthy Countries and Product Innovation

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Exposure}_i \times \text{After}_{2005}$	1.218***	1.203***	1.173***	1.106***	1.178***	1.146***
	[0.108]	[0.122]	[0.121]	[0.109]	[0.119]	[0.119]
Observations	45,254	45,254	45,254	45,254	45,254	45,254
Quota Elimination in 2002	No	No	No	Yes	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes	No
Firm FE	No	Yes	Yes	No	Yes	Yes
Industry-Year FE	No	No	Yes	No	No	Yes

Note: This table shows the estimates for intensive margins where the dependent variable is the nominal value of new products that firm i produced at time t. The dependent variable has been deflated and winsorized at the 5 percent level. Independent Variable: Exposure_i represents the policy exposure of firm i in response to the quota elimination in 2005. Standard errors are clustered by firm. Significant at *** 1%, ** 5%, and * 10%.

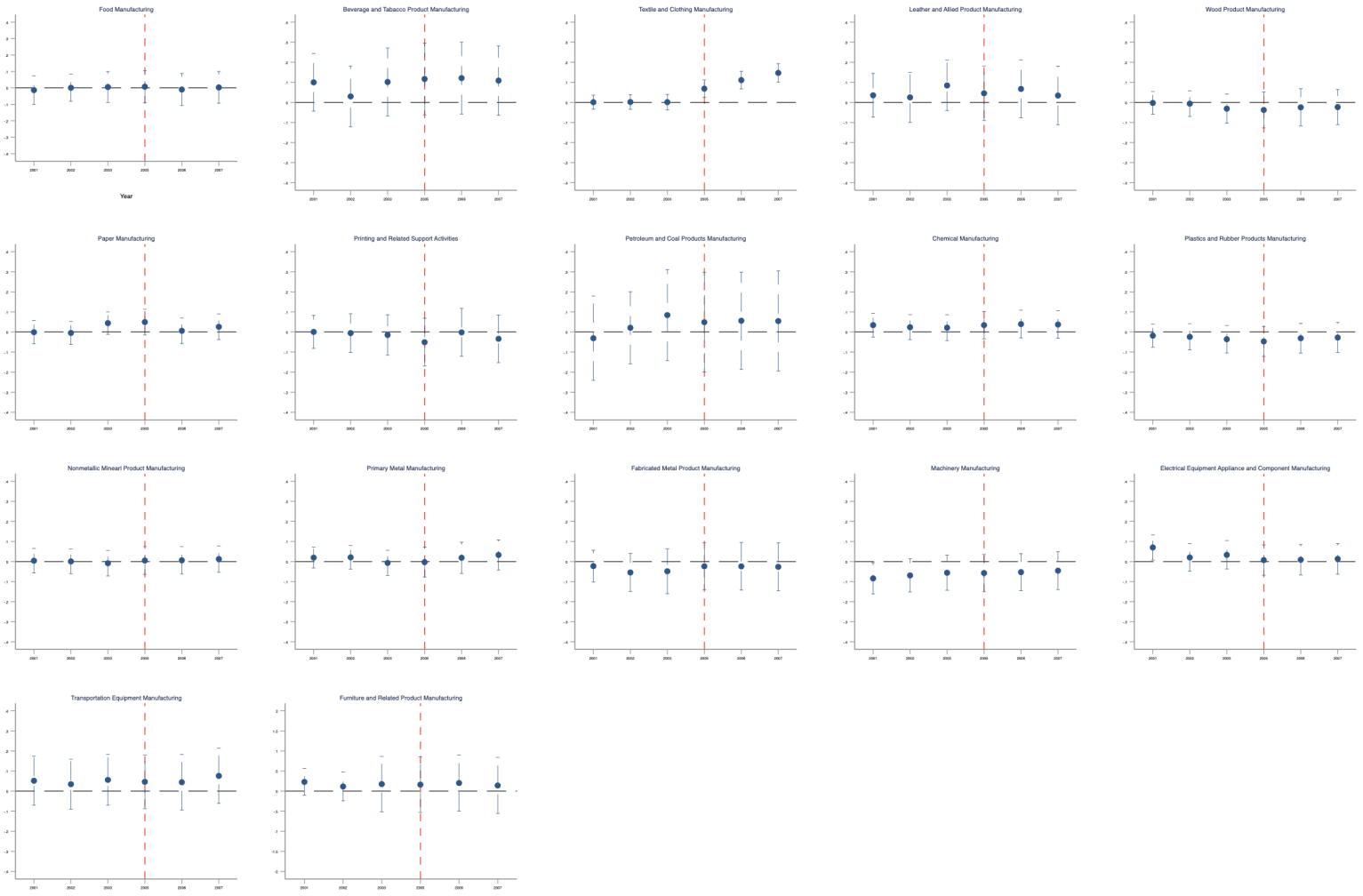

Figure A1: Estimated Coefficients and 95% Confidence Interval

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