The Value of Trademarks: Micro Evidence from Chinese Exports to Africa

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Abstract

This paper investigates the role of trademarks in developing countries. I focus on Chinese tire exports to African countries across the continent and exploit a sudden change in the member countries ratifying an international trademark agreement. The findings reveal evidence supporting a reallocation of market shares among incumbent exporters: Exporters with lower market shares decrease their market shares or decide to cease their exports, and the market share moves toward exporters with higher market shares offering further upgraded products with trademarks. A back-of-the-envelope calculation suggests welfare increases by 0.04% through the use of trademarks in the ratifying countries' tire industries.

Keywords: Trademarks, Information frictions, Quality Upgrading, Exports, Market reallocation

JEL Classification: D22, F14, F53, O34

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[†]I am indebted to Oriana Bandiera, Robin Burgess and Rocco Macchiavello for their continuous support throughout this project. I also thank Andrea Alati, Yutaka Arimoto, Tim Besley, Holger Breinlich, Francesco Caselli, Swati Dhingra, Chang-Tai Hsieh, Jota Ishikawa, Amit Khandelwal, Munseob Lee, Isabela Manelici, Veronica Rappoport, Mark Schankerman, Daniel Sturm, Yoichi Sugita, Mari Tanaka, Kensuke Teshima, Catherine Thomas, Gabriel Ulyssea, John Van Reenen, Jose Vasquez, and all the seminar participants at EEA, LSE, Osaka, HKUST, Hitotsubashi, NEUDC, Hitotsubashi Conference on International Trade and FDI, Waseda, GRIPS, Keio and Tohoku. This study has been supported by Grants-in-Aid for Scientific Research (KAKENHI 22K13379) from the Japan Society for the Promotion of Science. All remaining errors are mine.

1. Introduction

Imports of high-quality products play a central role in economic development (Goldberg et al., 2010). Through increased access to previously unavailable inputs, firms can increase productivity, expand the scope of their domestic products, and meet the required standards to export their products. However, sourcing high-quality products in developing countries is plagued with difficulties. In imperfect contract enforcement and asymmetric information settings, firms often struggle to credibly signal product quality, which limits their incentives to invest in quality improvements. Sellers and buyers have sought informal mechanisms and market-oriented behaviors to mitigate this problem. Empirical evidence suggests that firms in emerging markets rely on long-term relationships based on trust or reputation (Macchiavello and Morjaria, 2015) and utilize branding technologies to differentiate their products from other products (Bai, 2018). Considering that empirical evidence on the institutional role in quality upgrading is scarce, policymakers are interested in how best to complement these informal institutions by building and improving the institutional context to address these problems.

For policymakers, a trademark is regarded as a crucial policy tool, representing an intellectual property right that identifies a product of a particular firm. Since the symbol, "®", can be used to indicate the registered trademarks through the intellectual property system, buyers can distinguish goods with trademarks from those without trademarks. Consequently, sellers can brand their products using trademarks. Thus, while a trademark is not a certificate of provided quality per se, in settings where buyers are unable to observe intrinsic product characteristics at the point of purchase, sellers can convey credible signals of their reputation and reliability to buyers. This helps alleviate information frictions in the market.

However, the consequences of introducing a trademark are theoretically mixed. One possibility is that trademark users might upgrade the quality of

their products if a trademark conveys signals regarding their reputation as a signaling device (Grossman and Shapiro, 1988a). An alternative possibility is that a trademark could lead to shifts in the market structure that impedes the entry of new competitors, which allows certain firms to increase their market power and perhaps also reduce quality for trademark users and non-users due to changes in competition (Grossman and Shapiro, 1988b, Aghion et al., 2005 and Amiti and Khandelwal, 2013). Due to these different mechanisms, empirical findings are key to understanding the welfare implications of trademarks.

In this paper, I study the extent to which a trademark improves market efficiency and welfare. Identifying the role of a trademark is key to public policy, but empirical evidence on this question is scarce due to several distinct challenges. First, the institutional settings regarding trademarks are endogenously determined. Second, the role of trademarks requires transaction-level data combined with information about which products are trademarked. Third, within-firm variation in trademark usage is rarely observed, which makes it challenging to isolate its effect from the effects of other firm-specific factors. Fourth, quality information is hardly observable in the usual firm-level data and customs trade statistics.[1]

I tackle these challenges by examining the role of trademarks for Chinese exporters in the African tire industry. This context presents several features that allow my analysis. First, 17 African countries suddenly joined the international system for facilitating the registration of trademarks in 2015. Second, Chinese exporters in the tire industry serve their products across diverse countries in Africa. This allows me to investigate how exports of the same firm with and without a trademark differ. Third, information frictions are salient in international markets when sellers and buyers originate from

[1] In existing studies (Schott, 2004, Hallak, 2006, Fan et al., 2018) the unit price has been employed as a proxy for the quality of the product. However, this might not be an appropriate proxy, as it also incorporates other aspects such as each firm's productivity and markup. Further in-depth discussions of this issue are covered in Khandelwal (2010) and Amiti and Khandelwal (2013).

different countries. Additionally, the tire industry is characterized by high demand for trademarks. Thus, it becomes appropriate to analyze the role of trademarks. Fourth, information on tires is directly accessible. Especially, the tire ply rating plays a pivotal role as a key indicator of a tire's strength and capacity. A higher ply rating on the scale denotes enhanced stability, the ability to withstand heavier loads, and increased durability. Consequently, tires with higher ply ratings exhibit longer tread life and superior resistance to punctures and wear. Thus, I employ this information to identify whether exporters upgrade or downgrade their products with the use of trademarks.

The empirical setting is the African tire market after 17 countries unexpectedly joined the international trademark registration system in 2015. This market is served primarily by Chinese exports with over 1500 Chinese exporters during my investigation period. Exploiting this sudden change in the member countries, I examine how exporters change their behaviors. The results indicate that, on average, a Chinese exporter exports a higher quality tire with the use of a trademark. Moreover, I find out that there are fewer entries and more exits of Chinese exporters in the market and that the effect on exit varies across exporters based on their market shares.

Subsequently, to examine this issue in more details, I also investigate whether the impact of an international trademark agreement differs across Chinese exporters. I identify the heterogeneous impacts on Chinese exporters due to their market shares. While a Chinese exporter with the a market share below the median provides upgraded products, it decreases the market share. On the contrary, a Chinese exporter with the a market share above the median increases the share by offering even further upgraded products. These results, when considered together, suggest a reallocation of total market shares to exporters with higher market shares offering further upgraded products with a trademark in the ratifying countries.

My interpretation of the results is that exporters use a trademark to convey some credible signals of their reputation and reliability, thereby upgrading their products. Yet, there is another hypothesis under which they would

use a trademark: a firm uses a trademark to exclude other firms and hinder the entry of new competitors into the market, thereby enabling the firm to alter its markup. If this alternative hypothesis holds, the increase in the unit price is not derived from the increase in provided quality but from higher markups resulting from the change in the market share (Melitz and Ottaviano, 2008). My empirical findings, on the contrary, are not consistent with this prediction. The results indicate that, on average, a Chinese exporter increases the unit price and quality without a change in the market share. Moreover, a Chinese exporter with a market share below the median increases the unit price and quality regardless of the decrease in the market share. Hence, I believe that the increase in the unit price is associated with the increase in provided quality.

To quantify how a trademark leads to welfare change, I employ a back-of-the-envelope calculation following Hallak and Sivadasan (2013), Hsieh et al. (2020) and Redding and Weinstein (2020). This calculation implies that the tire industry contributes to a 0.04% welfare increase in the ratifying countries. This welfare gain is primarily caused by Chinese exporters' quality upgrading, and it comes from two gains both at the extensive margin and on the intensive margin. Thus, I conclude that a trademark is a welfare-enhancing technology.

My results and interpretations have significant policy implications. If a firm signals its quality with a trademark, the government needs to subsidize a fee for an application. As the cost decreases, more firms use trademarks, and consumers can enjoy products with higher quality. Therefore, information frictions are mitigated, while inducing an increase in total welfare.

This study makes contributions to different strands of literature. First, it builds on the understanding of the significance of quality in international trade. While existing literature has extensively examined the role of quality in international trade theoretically and empirically (Grossman and Helpman, 1991, Verhoogen, 2008, Khandelwal, 2010, Hallak and Schott, 2011, Baldwin and Harrigan, 2011, Kugler and Verhoogen, 2011, Hallak and Sivadasan,

2013, Bastos et al., 2018, and Fieler et al., 2018), evidence on how asymmetric information affects quality and its mitigation through technology adoption is limited. I provide empirical evidence supporting that firms can enhance quality in international trade through the adoption of trademarks.

Second, this study contributes to the literature on information frictions in developing countries. While much of the literature has examined trading practices and environments (Banerjee and Duflo, 2000, Jin and Leslie, 2009, Macchiavello, 2010, Macchiavello and Morjaria, 2015, Bai, 2018 and Startz, 2018), my analysis demonstrates how governments support firms' quality upgrading and offers an important policy implication.

Third, this study contributes to the literature on intellectual property rights, specifically trademarks. While much of the literature has examined intellectual property rights theoretically and empirically (Landes and Posner, 1987, Grossman and Shapiro, 1988a, Grossman and Shapiro, 1988b, Helpman, 1993, Javorcik, 2004, Branstetter et al., 2006, Chaudhuri et al., 2006, Goldberg, 2010, Branstetter et al., 2011, Moser, 2013, Fang et al., 2017 and Heath and Mace, 2020), empirical evidence on trademarks is limited. This study bridges the gap in the existing studies by offering additional empirical findings on how a trademark works in emerging markets. Among the current existing empirical literature, Qian (2008) and Alfaro et al. (2024) are most closely related to my study as both provide empirical evidence on trademarks. Qian (2008) investigates how markets function with less government intellectual property rights enforcement, and Alfaro et al. (2024) examine how trademark institutions affect firm growth, market allocation and consumer welfare. In contrast, I investigate the interplay between quality and trademarks and its consequential impact on welfare within the context of global markets.

The rest of this paper is organized as follows. Section 2. describes the institutional context and sudden changes in the institutional framework governing trademarks at the country level. I present my empirical findings in Section 3.. Section 4. investigates how welfare increases due to the introduction of a trademark. Section 5. concludes.

2. Empirical Settings

2.1. Trademark Background

A trademark is a sign that distinguishes the goods and services of one firm from those of other firms. With a trademark, the owner can pursue legal action against trademark infringement. Similar to other intellectual properties, exported goods are not protected in foreign countries if companies only register their trademarks in their domestic country. As it is cumbersome for exporters to register their logos and brands in each exporting country, there are some regional intellectual property organizations that a firm can apply directly to obtain a trademark in many foreign countries simultaneously.

In Africa, there are two regional intellectual property organizations: the Organisation Africaine de la Propriété Intellectuelle (OAPI)[2], and the African Regional Industrial Property Organization (ARIPO)[3]. Both[4] are in charge of regional trademarks.[5] However, for exporters, there are practical challenges in using these regional systems. An application must be filed by any qualified natural or legal person, either in person or through an authorized representative whom the national industrial property office recognizes as having

[2]The member countries are Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.

[3]The member countries are Botswana, Gambia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mozambique, Namibia, Rwanda, Sao Tome and Principe, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe. The observer countries are Algeria, Angola, Burundi, Egypt, Eritrea, Ethiopia, Libya, Mauritius, Nigeria, Seychelles, South Africa, and Tunisia.

[4]The locations of OAPI and ARIPO member countries are illustrated in Figure 1. OAPI countries are located in West and Central Africa, while ARIPO countries are in Southern, East, and West Africa. Which organization each country belongs to primarily depends on its main language. OAPI mostly includes French-speaking countries, while ARIPO mostly includes English-speaking countries.

[5]There are other regional intellectual property organizations for both developed and developing countries, and these include the Arab States Broadcasting Union Website (ASBU), Benelux Office for Intellectual Property (BOIP), Eurasian Patent Organization (EAPO), European Patent Organisation (EPO), International Union for the Protection of New Varieties of Plants (UPOV), Interstate Council on the Protection of Industrial Property (ICPIP), Office for Harmonization in the Internal Market (OHIM), and Patent Office of the Cooperation Council for the Arab States of the Gulf (GCC Patent Office).

the right to represent the applicant. If the applicant is neither an ordinary resident nor has a principal place of business in the country where it applies for a trademark, it needs to hire a legal practitioner to apply for a trademark. Due to this system, an exporter bears sizable costs for these applications.

The World Intellectual Property Organization (WIPO), which is one of the 15 specialized agencies of the United Nations, was launched in 1967 to encourage creative activity and promote the protection of intellectual property throughout the world. For trademarking, the WIPO introduced the Madrid System, which is a convenient and cost-effective solution for registering and managing trademarks worldwide. With this system, a firm can file a single application for protection in up to 120 countries. Once it submits its application and the WIPO formally examines it, it is sent to the regional intellectual property offices and examined substantially again. If the regional intellectual property office also approves it, a firm is allowed its registered trademark. The term of trademark registration varies and depends on the goods and services, but it usually lasts ten years, and it can be renewed indefinitely upon payment of additional fees. Trademark rights are private rights, and protection is enforced through court orders if needed.

A firm can use this system if the countries where it applies for a trademark have ratified the Madrid Protocol. Each country does not need to be a member of this system, and each local organization makes a decision. In 2015, there was a radical change in the Madrid Protocol member countries in Africa, and the percentage of African countries that were Madrid Protocol members doubled (from 29.8% to 64.9%).[6][7] OAPI countries played a role in this sudden change of the African members. Although OAPI countries in-

[6]Appendix Figure A.1 plots the member countries that ratified the Madrid Protocol in 2000, 2005, 2010 and 2015, respectively. Red-colored countries are member countries while white-colored countries are non-member countries. In 2015, there was a sudden increase in the number of member countries, which was not observed in 2000, 2005 and 2010.

[7]Appendix Figure A.2 shows the cumulative percentage of the member countries ratifying the Madrid Procotol by five regions over the periods, 1995 - 2017: Africa, Oceania, North/South America, Asia, and Europe. From this figure, I find out that the cumulative percentage in Africa suddenly increased in 2015, while the ones had gradually increased over the periods in the other four regions.

troduced the regional intellectual property system, the system was not welcomed by foreign exporters for the reasons mentioned above. To mitigate the hardship faced by foreign exporters and make OAPI countries attractive, OAPI countries agreed to ratify the Madrid Protocol and became the 93rd member of the Madrid System on December 5, 2014. This protocol entered into force on March 5, 2015.

All OAPI countries ratified the Madrid Protocol in 2015 at the same time due to the law system adopted by OAPI countries. ARIPO countries are former British colonies and common law countries, meaning they must modify each country's national laws before ratifying an agreement and becoming member countries. This complicated and time-consuming step prevented ARIPO countries from becoming members at that time. In contrast, OAPI countries are former French colonies and civil law countries, and they did not need to modify their laws before the trademark agreement and easily became the member countries. Ratification of OAPI countries gives a foreign firm potentially more manageable, faster, and cheaper access to trademark registration of a trademark in West African countries. I empirically investigate this sudden change in the number of member countries in Section 3..

2.2. Tire Industry in Africa

In this subsection, I explain how the tire industry in Africa is suited to my research objective. Due to the improvement of roads and public transportation systems,[8] the demand for tires has skyrocketed, and Africa is one of the fastest-growing markets for the global tire industry. The rising demand for tires in this emerging market has attracted new tire manufacturers from around the world.

[8]In urban areas facing rapid population increase policymakers have planned to provide transport facilities and opportunities to improve urban mobility and accessibility. Examples include the construction of the BRT Red Line in Dakar (Senegal), the Dar es Salaam Rapid Transit Project (Tanzania), transport services on the Amasaman Corridor, the Adenta Corridor and Kasoa Corridor in Accra (Ghana), and the completion of the high-capacity light rail network in Lagos (Nigeria).

Traditionally, European tire manufacturers held a monopoly over the African markets, and many European brands were the top-selling tires in many African countries. However, European tire firms have recently lost ground to Chinese and other Asian brands. Chinese tires are gaining popularity in African markets because consumers in these countries prefer to import low-priced Chinese tires rather than expensive European and American brands. Subsequently, China has emerged as a leading exporter of tires in many African countries. While Chinese exporters have undeniably made substantial contributions to African markets, their presence has introduced challenges related to asymmetric information. This issue is particularly pronounced in the markets where informal traders play a substantial role in retail trade. Certain Chinese exporters exacerbate the situation by combining used tires and selling them as new ones, creating a significant challenge in distinguishing these products from genuine ones.

This industry is an industry where the demand for trademark is high. When consumers lack full information about quality, they try to seek information mainly in two ways. According to Nelson (1970), based on the methods used to acquire information about quality, consumer goods are classified as "search goods" or "experience goods". In the first case, consumers gather information by way of search before making a purchase. Conversely, in the second case, when this search procedure is either expensive or inappropriate, consumers obtain information by way of experience instead of search. Nelson (1970) proposes a procedure to distinguish experience goods from search goods, in which tires are classified as "experienced goods". [9]

Considering the pivotal role played by trademarks in mitigating information asymmetry regarding product attributes, there is an anticipated high demand for trademarks, especially for experience goods where information asymmetry is serious. Particularly, this issue becomes more relevant when buyers and sellers originate from different countries and encounter signifi-

[9]Examples of "search goods" and "experience goods" are described in Table 2 of Nelson (1970).

cant communication barriers. Thus, I expect that the tire industry in Africa is suited to my research objective.

2.3. Data Sources

I use two micro-level data sources for this study: the Chinese Customs Database and the WIPO Global Brand Database. I combine these two datasets for my empirical analysis.

The Chinese Customs Database provides transaction-level trade flow information on the universe of China's exports and imports over the time period. The data were collected and made available by the Chinese Customs Office. The information on the transaction-level trade flow enables me to calculate the unit price for each exported transaction. Additionally, the data also provide information on the value of the ply rating for each transaction. However, compared with other information, this information is missing for certain transactions. To address this missing value for these transactions, I complement the data by incorporating web-scraped information based on the specification of the product.[10] As I focus on Chinese tire exports to Africa, I only use export data for my analysis, and my targeted HS eight-digit code is 40112000 (Passenger or freight cars with new pneumatic rubber tires).

The WIPO Global Brand Database provides comprehensive information on registered international trademarks worldwide. Provided by WIPO, this database includes details such as the name of the registered brand, applicant company, and the dates of registration and expiry. Additionally, it contains information on the address and international classification of goods and services for mark registration by each applicant company. This study focuses on international trademarks registered by Chinese companies in African countries. To merge firm-level observations, I match these datasets using identifying variables such as the name and address of Chinese exporters.

[10] Consequently, I collect the data for about 85% of the total transactions.

3. Empirical Findings

3.1. Overall Analysis

I examine an individual exporter's behavior at an extensive margin and on an intensive margin. For this analysis, I run the following regression:

$$Y_{ict} = \sum_{s} \beta_s OAPI_c \times \mathbb{1}\{t = s\} + \eta_{ic} + \xi_t + \varepsilon_{ict}, \tag{1}$$

where Y_{ict} denotes an outcome of interest of exporter i at country c and time t, including an export dummy variable, market share, and each export transaction's trademark dummy variable, unit price and ply rating. $OAPI_c$ is a dummy variable which takes 1 if country c belongs to OAPI countries and 0 otherwise. η_{ic} is a destination-exporter fixed effect, and ξ_t is a time-fixed effect. As a standard practice, I set the coefficient of the month before the accession of OAPI countries to zero, $\beta_s = 0$ for $s =$ February of 2015.

For the analysis of export status, I consider three observation patterns: (i) all possible combinations of the destination-export pairs, (ii) the set of the destination-export pairs where Chinese exporters exported their products to at least one country before the accession and (iii) the set of destination-exporter pairs existing before March of 2015. Regarding the market share, I calculate the share out of the total Chinese exporters for the set of destination-exporter pairs existing before March of 2015. For the intensive margin analysis, I restrict my observations to the set of destination-exporter pairs where Chinese exporters exported their products before and after March of 2015.

Table 1 reports overall results at the extensive margin and on the intensive margin. In Table 1, a Chinese exporter decreases the probability of exporting by $0.280 - 0.374\%$ in column (1), $0.556 - 0.695\%$ in column (3) and $8.41 - 10.5\%$ in column (3), respectively. Conversely, in column (2), an incumbent Chinese exporter maintains its market share without increases or decreases, indicating no replacement by a new Chinese exporter in the mar-

ket. At the transaction level, Chinese exporters increase the probability of using a trademark by $19.9 - 25.6\%$ in 2016 and 2017. This increased probability corresponds to an increase in the unit price by $7.73 - 7.97\%$ and the ply rating by $20.2 - 23.7\%$, respectively.

These overall difference-in-differences results in Table 1 imply that a Chinese exporter mitigates asymmetric information between sellers and buyers by using a trademark. Therefore, the exporter exports the upgraded tire and sets the higher price owing to the increase in the cost. Finally, while its existence is not replaced by new Chinese exporters, intense competition among incumbent Chinese exporters is triggered, and an incumbent Chinese exporter generally decreases the probability of exporting.

3.2. Entry and Exit of Firms

From Table 1, this study finds that Chinese exporters decrease the probability of export in the OAPI countries after their accession into the Madrid Protocol. However, this result might imply that they primarily switch their operations from frequent exporting to occasional exporting (Kasahara and Tang, 2019).

To alleviate this concern, I examine the entry and exit patterns of Chinese exporters in the market. For this purpose, I aggregate the periods, distinguishing between the period before the accession of the OAPI countries into the Madrid Protocol and the period after the accession. The empirical specification employed for this analysis is as follows:

$$Y_{ict} = \beta OAPI_c \times After_t + \eta_{ic} + \xi_t + \varepsilon_{ict}, \tag{2}$$

where Y_{ict} includes two outcome variables: $Entry_{ict}$ and $Exit_{ict}$. $Entry_{ict}$ denotes a dummy variable which takes 1 if a Chinese exporter i did not export its product to country c before the accession but starts exporting after the accession. $Exit_{ict}$ is a dummy variable which takes 1 if a Chinese exporter i exported its product to country c before the accession but stops exporting

after the accession.

For this analysis, I consider three observation patterns: (i) all observations for entry and exit, (ii) the set of Chinese exporters which did not export their products to any country before the accession for entry, and the set of Chinese exporters which exported their products to at least one country before the accession for exit and (iii) the set of destination-exporter pairs which did not exist before the accession for entry and the set of destination-exporter pairs, which existed before the accession for exit.

The result is reported in Table 2. Regardless of the patterns of the observations, I observe the consistent impacts on the entry and exit. First, fewer Chinese exporters enter into the market in the OAPI countries after the accession. Chinese exporters decrease the probability of entry by 1.06% in column (1), 1.46% in column (3), and 1.11% in column (3), respectively. Second, more Chinese exporters exit from the market in the OAPI countries after the accession. Chinese exporters increase the probability of exit by 0.0991% in column (2), 0.0267% in column (4) and 5.84% in column (6), respectively. Hence, the study finds that few Chinese exporters exist in the OAPI countries after the accession .

To further investigate this issue, I examine by what factor a Chinese exporter is likely to exit from the market. For this purpose, I focus on the competitiveness of the market and examine the heterogeneous impact on the market share of Chinese exporters. In this analysis, to capture different time trends among the two groups, I also control for the above median dummy times time fixed effect. Column (7) in Table 2 presents the result. I observe the heterogeneous responses of Chinese exporters by their market shares. A Chinese exporter with a lower market share is forced to exit from the market. In column (7), a Chinese exporter with a market share below the median increases the probability of exit by 9.74%. Conversely, a Chinese exporter with a higher market share at the destination is shielded from this effect. Column (7) in Table 2 indicates that compared to the Chinese exporter with a market share above the median in the control group country, the one in the

treatment group country decreases the probability of exit by 7.91%. These findings imply that while a Chinese exporter with a lower market share exits from the market, the one with a higher market share is resistant to the accession effect in the OAPI countries.

3.3. Heterogeneous Analysis

In Table 1, I reveal that a Chinese exporter exports the upgraded tire by mitigating asymmetric information with the use of a trademark. Moreover, Table 2 reveals that there are fewer entries and more exits of Chinese exporters in the market and that the effect on exit is different across exporters by their market shares. However, it remains unclear if the effects on other export-related outcomes vary across exporters by their market shares. To extensively examine this issue, I investigate the heterogeneous impacts on the outcomes reported in Table 1.

Table 3 confirms the heterogeneous impacts of the accession in the OAPI countries. First, I document a reallocation of the market share among incumbent Chinese exporters. According to column (1) in Table 3, a Chinese exporter with the market share below the median decreases the market share by 1% in 2016 and 1.24% in 2017, respectively. Conversely, compared to the Chinese exporter with its market share above the median in the control group country, the one in the treatment group country increases the share by 1.83% in 2016 and 2.22% in 2017. Combined with these effects, a Chinese exporter with a market share above the median statistically significantly increases the market share.

This market reallocation is induced by the heterogeneous impacts at the transaction level. Columns $(2)-(4)$ illustrate that a Chinese exporter with a market share below the median increases the probability of using a trademark by $8.15-14.8\%$ in 2016 and 2017. With the increased probability of using a trademark, the exporter also increases the unit price by $4.55-4.80\%$ and the ply rating by $11.1-13.7\%$ in 2016 and 2017, respectively. This pattern

is enhanced by a Chinese exporter with a market share above the median, which further increases the probability of using a trademark by $22.9 - 25.0\%$, the unit price by $5.28 - 6.46\%$ and the ply rating by $16.0 - 19.7\%$ in 2016 and 2017.

These results in Table 3 suggest that the effects of the entry of OAPI countries on export-related outcomes are heterogeneous among exporters owing to their market sizes, which leads to reallocation away from exporters with lower market shares. When the cost of obtaining a trademark in a foreign country declines, exporters are more likely to use a trademark. As asymmetric information between sellers and buyers is mitigated with the use of a trademark, and the demand function is responsive to upgraded quality, sellers have an incentive to offer higher quality to buyers. Given that marginal costs increase as the provided quality increases, they set a higher price. While the higher price is set, buyers are attracted to higher quality, and exporters increase their market shares. Consequently, exporters with lower market shares decrease their market shares or decide to cease their exports because of reallocation. Thus, the market share shifts toward exporters offering upgraded products with a trademark.

3.4. Parallel Trends and Placebo Test

I exploit the sudden change in the number of ratifying countries caused by OAPI countries in a regression framework. However, my specification in the difference-in-differences analyses might capture different macroeconomic trends between OAPI and non-OAPI countries. To assuage this concern arising from my difference-in-differences specification, I examine the dynamic patterns in all coefficients on all dependent variables from regression 1. If different macroeconomic trends contaminate my findings, there are discernible pre-trends in the outcomes of interests before the accession of OAPI countries. Figures 2 and 3 confirm the absence of differential pre-trends in all the five variables in Table 2. In these figures, the coefficients

before OAPI countries join the Madrid Protocol are close to 0, which ensures the validity of the difference-in-differences design. Moreover, these figures reveal a striking feature: the effects on all variables except for market share gradually have increased or decreased at mostly the same periods.

To further strengthen my argument, I also use the fabric industry as a "placebo" to check that different macroeconomic trends show no spurious impact on Chinese exporters. The fabric industry is an ideal industry for a placebo test, as Chinese exporters do not use trademarks in this industry due to the industry's unique characteristics. Fabric is an intermediate good for clothes, and local clothes producers do not need the marks of Chinese producers and the symbol "®" on fabric. Therefore, I focus on the aggregate export value, quantity, and unit price of fabric exported by Chinese exporters and use the following specification to run a placebo test.[11]

$$Y_{jct} = \sum_{s} \beta_s OAPI_c \times \mathbb{1}\{t = s\} + \xi_c + \eta_{jt} + \varepsilon_{jct}, \tag{3}$$

where Y_{jct} is an outcome of interest in an industry j in country c at time t, which includes the aggregate export value, quantity, and unit price. ξ_c is a country fixed effect, and η_{jt} is an industry-time fixed effect to absorb time-varying shocks to industries. These fixed effects allow me to compare differences across different industries in different countries.

Table 4 presents an estimate of equation 3. If unobservable macroeconomic determinants of changes drove Chinese exporters' decisions, then the ratification of the international trademark agreement would exhibit spurious effects. However, the coefficients of the intersection in Table 4 are never statistically different from zero. These figures show the absence of dynamic trends in the aggregate export value, quantity, and unit price. Taken to-

[11]For this placebo analysis, I use the UN COMTRADE database. I restrict the samples to the HS four digit codes in which Chinese exporters continuously exported their products between 2012 and 2017. The four-digit codes for my placebo analysis include the followings: HS5804, HS5806, HS5807, HS5808, HS5810, HS5811, HS5901, HS5902, HS5903, HS5907, HS5909, HS5911, HS6001 and HS6006.

gether, these results suggest that my key results in Tables 1 −3 can be interpreted as a plausibly reliable estimate of the effect of an international trademark agreement.

3.5. Business Environment/Law Enforcement

As I explained in Section 1., a seller uses a trademark to create its brands and to convey credible signals of a firm's reputation and reliability to a consumer. As a trademark is registered and protected by the government, an exporter's decision might depend on the business environment in the exporting country or the government's law enforcement ability. In this subsection, I investigate two questions: (1) whether the effect is heterogeneous due to these two factors, and (2) whether the effect is robust after controlling for them. For an empirical analysis to address these two questions, I use two data sources to obtain proxies: the Doing Business Data by the World Bank and the Ibrahim Index of African Governance Data by the Mo Ibrahim Foundation.[12]

Tables 5 and 6 investigate the heterogeneous effects at the extensive margin and the transaction level. These results indicate that the business environment and the government's law enforcement ability do not have heterogeneous impacts on export-related outcomes at the extensive margin and on the intensive margin. Regardless of the business environment in the exporting country and the government's law enforcement, a Chinese exporter is more likely to employ a trademark. Accompanied by this increased usage of a trademark, the exporter also exports the upgraded tire and sets a higher price because of the increase in the cost. This induces intense competition among incumbent Chinese exporters. Consequently, an incumbent Chinese

[12]Especially, I use the Ease of Doing Business Score on the Doing Business Data for a business environment, and Law Enforcement Score and Property Rights Score on the Ibrahim Index of African Governance Data for the government's law enforcement ability. The Ease of Doing Business Score index measures an economy's performance concerning a measure of regulatory best practice. The Law Enforcement Score Index assesses to which extent the criminal investigation and prosecutorial system are functional. The Property Rights Score index assesses the extent to which private physical and intellectual property rights are guaranteed and enjoyed by citizens.

exporter generally decreases the probability of exporting. Moreover, Table 7 examines the impact with controls. This table shows that my estimates are similar to the ones reported in Table 1, even after controlling for these factors. These two results suggest that such concern is not necessarily serious in my setting.

3.6. Reallocation of Market Shares towards Exporters in Other countries

Table 3 implies that there is a reallocation of the market share among incumbent Chinese exporters. Particularly, when the cost of obtaining a trademark in a foreign country declines, exporters with lower market shares decrease their market shares or cease their exports because of reallocation, and the market share shifts toward exporters with higher market shares offering upgraded products with a trademark. However, there is a concern that the market share also moves from Chinese exporters toward other foreign exporters. This hypothesis predicts that a Chinese exporter with a higher market share might decrease its market share among total exporters. To alleviate this concern, I present the yearly trends of the market share of Chinese exporters in OAPI countries and non-OAPI countries and examine the effect on the market share of Chinese exports.

Figure 4a plots yearly trends of market share of Chinese exports with 95 % confidence intervals in OAPI and non-OAPI countries.[13] In this figure, there are increasing trends in the market shares in these two groups. Chinese exporters accounted for approximately 40% of the total exports in 2012 and had gradually increased to over 50%. This time trend indicates that Chinese exporters had exerted dominant influence on the market. Moreover, Figure 4b illustrates the dynamic patterns in the coefficients on the market share of Chinese exporters. In this figure, the coefficients before and after the accession of OAPI countries are close to zero, suggesting that there are no differ-

[13] To calculate market share of Chinese exports, I use the UN COMTRADE database.

ential pre-trends and no reallocation away from Chinese exporters to other foreign exporters. These two findings indicate that my findings are robust and unlikely to be affected by this issue.[14]

3.7. Ratification of Non-OAPI countries

In my difference-in-differences design, I exploit the sudden change in the number of ratifying countries caused by OAPI countries in Africa in a regression framework. However, a few non-OAPI countries ratified the Madrid Protocol during my investigation period: Algeria, Gambia and Zimbabwe. In my empirical analysis, I assign these countries into the control group countries based on the following two backgrounds. First, in 1972, Algeria had already ratified the Madrid Agreement, which allowed foreign exporters to register their brands through the use of this system. Second, while Gambia and Zimbabwe ratified the Madrid Protocol in 2015, no Chinese exporters registered their trademarks in the two countries during my investigation period.

While exports to the three countries do not comprise a large proportion of the total exports,[15] there is still a concern that my empirical analysis might be biased by the existence of these countries. To thoroughly review this potential problem, I exclude these three countries and re-examined the overall and heterogeneous impacts. Appendix Tables A.1 and A.2 present the estimation results. I obtain estimates similar to the ones in Tables 1 and 3. Hence, I believe that my results are robust and the inclusion of these countries does not necessarily cause a critical problem in my setting.[16]

[14]Considering that South Sudan gained independence from Sudan in 2011 and information on South Sudan is unavailable until 2012, I select the periods starting from 2012. For robustness testing, I exclude these two countries and run the same analysis with the extended periods. Appendix Figures A.3a and A.3b show that the qualitative results are maintained even after excluding these two countries.

[15]In 2017, Algeria, Gambia and Zimbabwe accounted for 6%, 0.009% and 0.09% of the total exports, respectively.

[16]Appendix Figures A.4 and A.5 show the dynamic patterns in all coefficients on all dependent variables in Appendix Table A.1. As observed in Section 3.4., the coefficients before OAPI countries join the Madrid Protocol are close to 0, ensuring the validity of the

3.8. Alternative Possibilities

One might posit that there is a possibility that a Chinese exporter exporting an upgraded tire to OAPI countries after the accession also exports the same tire to other countries as well. This hypothesis predicts that my estimates might be biased by the spillover effect. To address this issue, I run the following regression:

$$Y_{ict} = \sum_{s} \beta_s OAPI_c \times \mathbb{1}\{t = s\} + \eta_{ic} + \xi_{it} + \varepsilon_{ict}, \tag{4}$$

where η_{ic} is a destination-exporter fixed effect, and ξ_{it} is an exporter-time fixed effect that absorbs time-varying shocks to an exporter. These fixed effects allow me to investigate within-firm variation in the outcomes of interest after controlling for exporter-specific time-varying factors.

The result reported in Appendix Table A.3 indicates that even with the exporter-time fixed effect similar estimates are obtained. According to Appendix Table A.3, a Chinese exporter decreases the probability of export by $0.280 - 0.374\%$, $0.556 - 0.695\%$ and $0.883 - 0.910\%$ in 2016 and 2017. This decreased probability of exporting is not associated with an increase or decrease in the market share. At the transaction level, a Chinese exporter increases the probability of using a trademark by $9.96 - 16.4\%$, the unit price by $5.71 - 7.47\%$ and the ply rating by $10.5 - 18.1\%$ in 2016 and 2017, respectively. Given that my estimates are comparable to those reported in Table 1, I believe that my results are robust and unlikely to be biased by the spillover effect.[17]

My interpretation of the results is that exporters use a trademark to up-

difference-in-differences design. Moreover, these figures reveal a striking feature: the effects on all variables except for market share gradually have increased at mostly the same periods.

[17]Appendix Figures A.6 and A.7 show the dynamic patterns in all coefficients on all dependent variables in Appendix Table A.3. As observed in Section 3.4., the coefficients before OAPI countries join the Madrid Protocol are close to 0, ensuring the validity of the difference-in-differences design. Moreover, these figures reveal a striking feature: the effects on all variables except for market share gradually have increased at mostly the same periods.

grade the quality of their products. However, there is another hypothesis under which they would use a trademark. This alternative hypothesis is that a firm uses a trademark to exclude other firms and hinder the entry of new competitors into the market, thereby enabling the firm to alter its markup. According to Melitz and Ottaviano (2008), which incorporates the endogenous markup, each firm in the market determines its unit price due to its market size. Subsequently, this hypothesis predicts that the increase in the unit price is not derived from the increase in provided quality but from higher markups resulting from the change in the market share. However, my empirical results are not consistent with this prediction. The result in Table 1 shows that, on average, a Chinese exporter increases the unit price and the ply rating without a change in the market share. Moreover, in Table 3, a Chinese exporter with a market share below the median increases both regardless of the decrease in the market share. Thus, I believe that the increase in the unit price is associated with the increase in provided quality.

4. Welfare Analysis

From the previous section, it is observed that when the cost of obtaining a trademark for exports declines, (i) an exporter is more likely to use a trademark, (ii) the least productive firm ceases its export to a foreign country owing to the reallocation mechanism, and (iii) an exporter with higher market share further increases its unit price and quality. However, at the current stage, it is not clear whether a trademark is a welfare-enhancing technology. In this section, to address this question, I estimate the gains from trade, following Hallak and Sivadasan (2013), Hsieh et al. (2020) and Redding and Weinstein (2020).

4.1. The Gains from Trade

In this subsection, I assume a country j takes the Cobb-Douglas aggregate of real consumption of multiple sectors utility:

$$ln(U_j) = \sum_{s \in S} \eta_{js} ln(C_{js}) \quad s.t. \quad \sum_{s \in S} \eta_{js} = 1, \tag{5}$$

where s denotes a sector, S is the set of sectors, $C_{js} = [\sum_{i \in N} \int_{\omega \in \Omega_{ijs}} (q_{ijs}(\omega)\lambda_{ijs}(\omega))^{\frac{\sigma_s - 1}{\sigma_s}} d\omega]^{\frac{\sigma_s}{\sigma_s - 1}}$ is an aggregate consumption index for sector s, i is a serving country, σ_s is an elasticity of substitution in sector s and η_{js} is the share of expenditure on sector s in country j. In the aggregate consumption index for sector s, ω indexes product varieties and Ω_{ijs} is the set of varieties served by country i in country j's sector s. $q_{ijs}(\omega)$ and $\lambda_{ijs}(\omega)$ are, respectively, the quantity and quality of variety ω. In this setting, product quality is interpreted as any attribute that buyers value.

From the utility maximization problem in sector s, the aggregate welfare, W_j, is described in the following way:

$$ln(W_j) = \sum_{s \in S} \eta_{js} ln(\frac{\eta_{js} w_j L_j}{P_{js}}), \tag{6}$$

where $P_{js} = [\sum_{i \in N} \int_{\omega \in \Omega_{ijs}} p_{ijs}(\omega)^{1-\sigma_s} \lambda_{ijs}(\omega)^{\sigma_s - 1} d\omega]^{\frac{1}{1-\sigma_s}}$ is an aggregate quality-adjusted price index in sector s. Therefore, the welfare change in country j caused by the accession of OAPI countries can be measured by:

$$ln(\frac{W'_j}{W_j}) = \sum_{s \in S} \eta_{js} [ln(\frac{w'_j L'_j}{w_j L_j}) - ln(\frac{P'_{js}}{P_{js}})], \tag{7}$$

where $'$ denotes after the accession. I estimate how the aggregate quality-adjusted price index in sector s, P_{js}, changes, following Redding and Weinstein (2020). When I apply Shepard's lemma to the aggregate quality-adjusted price index in sector s, P_{js}, I obtain the demand system in which the expen-

diture share $\kappa_{ijs}(\omega)$ for each variety ω is:

$$\kappa_{ijs}(\omega) = \frac{p_{ijs}(\omega)q_{ijs}(\omega)}{\sum_{i\in N}\int_{\omega\in\Omega_{ijs}} p_{ijs}(\omega)q_{ijs}(\omega)d\omega} = \frac{\left(\frac{p_{ijs}(\omega)}{\lambda_{ijs}(\omega)}\right)^{1-\sigma_s}}{P_{js}^{1-\sigma_s}}. \tag{8}$$

Rearranging this expenditure share in expression (8), I obtain the following equivalent expression for the unit expenditure function that must hold for each variety $\omega \in \Omega_{ijs}$:

$$P_{js} = \frac{p_{ijs}(\omega)}{\lambda_{ijs}(\omega)}\kappa_{ijs}(\omega)^{\frac{1}{\sigma_s-1}}. \tag{9}$$

To allow for the entry and exit of varieties over time, we define the set of varieties by incumbent firms (Ω_{ijs}^I). Summing expenditures across these varieties, I obtain the following expression for the aggregate share of varieties by incumbent firms among Chinese exporters (μ_{ijs}^I):

$$\mu_{ijs}^I = \frac{\int_{\omega\in\Omega_{ijs}^I} p_{ijs}(\omega)q_{ijs}(\omega)d\omega}{\int_{\omega\in\Omega_{ijs}} p_{ijs}(\omega)q_{ijs}(\omega)d\omega}. \tag{10}$$

Using these expressions, the share of an individual variety in total expenditure ($\kappa_{ijs}(\omega)$) can be rewritten as its share of expenditure on incumbent firms ($\kappa_{ijs}^I(\omega)$), the aggregate share of incumbent firms among Chinese firms (μ_{ijs}^I) and the aggregate share of Chinese firms in total expenditure (ψ_{ijs}):

$$\psi_{ijs} = \frac{\int_{\omega\in\Omega_{ijs}} p_{ijs}(\omega)q_{ijs}(\omega)d\omega}{\sum_{i\in N}\int_{\omega\in\Omega_{ijs}} p_{ijs}(\omega)q_{ijs}(\omega)d\omega}, \tag{11}$$

$$\kappa_{ijs}(\omega) = \psi_{ijs} \times \mu_{ijs}^I \times \frac{p_{ijs}(\omega)q_{ijs}(\omega)}{\int_{\omega\in\Omega_{ijs}^I} p_{ijs}(\omega)q_{ijs}(\omega)d\omega} = \psi_{ijs} \times \mu_{ijs}^I \times \kappa_{ijs}^I(\omega). \tag{12}$$

Substituting this expression into equation (9), I obtain the following change in the aggregate quality-adjusted price index:

$$ln\frac{P'_{js}}{P_{js}} = ln\frac{p'_{ijs}(\omega)}{p_{ijs}(\omega)} - ln\frac{\lambda'_{ijs}(\omega)}{\lambda_{ijs}(\omega)} + \frac{1}{\sigma_s-1}(ln\frac{\psi'_{ijs}}{\psi_{ijs}} + ln\frac{\mu_{ijs}^{I\prime}}{\mu_{ijs}^I} + ln\frac{\kappa_{ijs}^{I\prime}(\omega)}{\kappa_{ijs}^I(\omega)}). \tag{13}$$

From the findings in Table 1, I find out how the price and quality, $p_{ijs}(\omega)$ and

$\lambda_{ijs}(\omega)$, change after the accession of OAPI countries. Thus, to calculate the change in the aggregate quality-adjusted price index, I estimate changes in ψ_{ijs}, μ^I_{ijs} and κ^I_{ijs}.

Then, to account for the gains from trade in details, I consider the specification on the supply side, following Hallak and Sivadasan (2013) and Hsieh et al. (2020). Each firm chooses quality to produce outputs. There are two costs required to produce quality λ_j: variable and fixed costs. Each firm has productivity heterogeneity, φ, regarding the variable costs' given quality, and the cost function to produce q_j units with quality λ_j is given as:

$$c_{ijs}(\varphi) = \frac{w_i \tau_{ijs}}{\varphi} \lambda^{\beta}_{ijs} q_{ijs}, \qquad 0 \leq \beta < \frac{\sigma_s - 1}{\sigma_s}, \tag{14}$$

where w_i is the wage rate in country i and $\tau_{ijs} > 1$ are the iceberg trade costs. The condition that β is less than $\frac{\sigma_s - 1}{\sigma_s}$ is sufficient for $0 \leq \beta < 1$ and it ensures concavity of the profit function. Marginal costs are assumed to be independent of scale and increasing in product quality λ_j. On the other hand, the fixed costs include endogenous sunk costs:

$$F = F_{ijs} + \frac{f}{\xi} \lambda^{\alpha}_{ijs}, \qquad \alpha > (1 - \beta)(\sigma_s - 1), \tag{15}$$

where F_{ijs} is the fixed cost for each firm to set up its variety and $\frac{f}{\xi}\lambda^{\alpha}_{ijs}$ is the fixed cost to produce quality, λ_{ijs}. The condition that $\alpha > (1 - \beta)(\sigma_s - 1)$, which is imposed to ensure the concavity, implies that the fixed costs grow sufficiently fast with quality.

Each firm chooses its price and quality to maximize its profits, π_{ijs}. However, the firm faces one constraint after the entry: it needs to provide at least a certain level of quality, $\underline{\lambda}$, to sell its variety in the market. This threshold, $\underline{\lambda}$, can be interpreted as the level of quality required by the government. With this constraint, each firm's profit maximization problem is as follows.

$$\pi_{ijs}(\varphi) = \max_{p_{ijs} \in (0,\infty), \lambda_{ijs} \in [\underline{\lambda}, \infty)} p^{1-\sigma_s}_{ijs} \lambda^{\sigma_s - 1}_{ijs} P^{\sigma_s - 1}_{js} \eta_{js} w_j L_j - \frac{w_i \tau_{ijs}}{\varphi} \lambda^{\beta + \sigma_s - 1}_{ijs} p^{-\sigma_s}_{ijs} P^{\sigma_s - 1}_{js} \eta_{js} w_j L_j - F_{ijs} - \frac{f}{\xi} \lambda^{\alpha}_{ijs}. \tag{16}$$

Solving this problem, I obtain:

$$p_{ijs}(\varphi) = \frac{\sigma_s}{\sigma_s - 1}\frac{w_i \tau_{ijs}}{\varphi}\lambda_{ijs}^{\beta}. \tag{17}$$

$$q_{ijs}(\varphi) = (\frac{\sigma_s - 1}{\sigma_s}\frac{\varphi}{w_i \tau_{ijs}})^{\sigma_s}\lambda_{ijs}^{(1-\beta)\sigma_s - 1}P_{js}^{\sigma_s - 1}\eta_{js}w_j L_j. \tag{18}$$

With this specification, the value of bilateral trade flows in sector s can be written as:

$$X_{ijs} = \int_{\varphi \in \Phi_{ijs}} M_{ijs}(\frac{\sigma_s}{\sigma_s - 1}\frac{w_i \tau_{ijs}}{\varphi})^{1-\sigma_s}\lambda_{ijs}^{(1-\beta)(\sigma_s - 1)}P_{js}^{\sigma_s - 1}\eta_{js}w_j L_j dG_i(\varphi|\varphi \in \Phi_{ijs}), \tag{19}$$

where M_{ijs} is the number of firms from country i serving county j in sector s, Φ_{ijs} is the set of productivities corresponding to all country i firms serving country j in sector s, and $dG_i(\varphi|\varphi \in \Phi_{ijs})$ is the cumulative distribution. These bilateral trade flows can be rewritten as $X_{ijs} = M_{ijs}(\frac{\sigma_s}{\sigma_s - 1}w_i \tau_{ijs})^{1-\sigma_s}\widetilde{\lambda\varphi}_{ijs}^{\sigma_s - 1}P_{js}^{\sigma_s - 1}\eta_{js}w_j L_j$, where $\widetilde{\lambda\varphi}_{ijs} = [\int_{\varphi \in \Phi_{ijs}} \lambda_{ijs}^{(1-\beta)(\sigma_s - 1)}\varphi^{\sigma_s - 1}dG_i(\varphi|\varphi \in \Phi_{ijs})]^{\frac{1}{\sigma_s - 1}}$ is the measure of quality-adjusted productivity. From this specification,

$$ln\frac{P'_{js}}{P_{js}} = -\frac{1}{\sigma_s - 1}ln\frac{M'_{ijs}}{M_{ijs}} + ln\frac{w'_i}{w_i} + ln\frac{\tau'_{ijs}}{\tau_{ijs}} - ln\frac{\widetilde{\lambda\varphi}'_{ijs}}{\widetilde{\lambda\varphi}_{ijs}} + \frac{1}{\sigma_s - 1}ln\frac{s'_{ijs}}{s_{ijs}}, \tag{20}$$

where $s_{ijs} = \frac{X_{ijs}}{\eta_{sj}w_j L_j}$. Summing up all source countries using the Sato-Vartia weights $\tilde{s}_{ijs} = (\frac{s'_{ijs} - s_{ijs}}{lns'_{ijs} - lns_{ijs}})/(\sum_{m=1}^{N}\frac{s'_{mjs} - s_{mjs}}{lns'_{mjs} - lns_{mjs}})$,

$$ln\frac{P'_{js}}{P_{js}} = \sum_{i=1}^{N}\tilde{s}_{ijs}[-\frac{1}{\sigma_s - 1}ln\frac{M'_{ijs}}{M_{ijs}} + ln\frac{w'_i}{w_i} + ln\frac{\tau'_{ijs}}{\tau_{ijs}} - ln\frac{\widetilde{\lambda\varphi}'_{ijs}}{\widetilde{\lambda\varphi}_{ijs}}]. \tag{21}$$

To make it explicit that $\widetilde{\lambda\varphi}_{ijs}$ can change because of changes in the quality-adjusted average of continuing firms or because of changes in the composition of firms, I separately define the quality-adjusted average productivity of continuing firms $\widetilde{\lambda\varphi}^{c}_{ijs}$ and expand $ln\frac{\widetilde{\lambda\varphi}'_{ijs}}{\widetilde{\lambda\varphi}_{ijs}} = ln\frac{\widetilde{\lambda\varphi}^{c\prime}_{ijs}}{\widetilde{\lambda\varphi}^{c}_{ijs}} + (ln\frac{\widetilde{\lambda\varphi}'_{ijs}}{\widetilde{\lambda\varphi}_{ijs}} - ln\frac{\widetilde{\lambda\varphi}^{c\prime}_{ijs}}{\widetilde{\lambda\varphi}^{c}_{ijs}})$.

Substituting the price index decomposition and this productivity decomposition yields the welfare decomposition:

$$
\begin{aligned}
ln(\frac{W_j'}{W_j}) = & \underbrace{\sum_{s\in S}\eta_{sj}\sum_{i=1}^{N}\tilde{s}_{ijs}(\frac{1}{\sigma_s-1}ln\frac{M_{ijs}^c}{M_{ijs}}+ln\frac{\widetilde{\lambda\varphi}_{ijs}^c}{\widetilde{\lambda\varphi}_{ijs}})}_{\text{loss from exit at the extensive margin}} \\
& + \underbrace{\sum_{s\in S}\eta_{sj}\sum_{i=1}^{N}\tilde{s}_{ijs}(\frac{1}{\sigma_s-1}ln\frac{M_{ijs}'}{M_{ijs}^c}+ln\frac{\widetilde{\lambda\varphi}_{ijs}'}{\widetilde{\lambda\varphi}_{ijs}^{c\prime}})}_{\text{gain from entry at the extensive margin}} \\
& + \underbrace{\sum_{s\in S}\eta_{sj}\sum_{i=1}^{N}\tilde{s}_{ijs}(ln\frac{\widetilde{\lambda\varphi}_{ijs}^{c\prime}}{\widetilde{\lambda\varphi}_{ijs}^{c}}-ln\frac{\tau_{ijs}'}{\tau_{ijs}}-ln\frac{w_i'}{w_i}+ln\frac{w_j'L_j'}{w_jL_j})}_{\text{gain on the intensive margin}}.
\end{aligned}
\tag{22}
$$

The gains from trade are divided into three parts. I call the first part "loss from exit at the extensive margin", the second part "gain from entry at the extensive margin" and the third part "gain at the intensive margin." The gain and loss at the extensive margin describe the gain and loss that only arise if there are changes in the set of firms serving county j, while the gain at the intensive margin describes the gain that also arises if there are no changes in the set of firms serving country j. I estimate the gain and loss at the extensive margin by expressing them as simple sufficient statistics based on $X_{ijs} = M_{ijs}(\frac{\sigma_s}{\sigma_s-1}w_i\tau_{ijs})^{1-\sigma_s}\widetilde{\lambda\varphi}_{ijs}^{\sigma_s-1}P_{js}^{\sigma_s-1}\eta_{js}w_jL_j$. Especially, I consider the total sales from country i to country j associated with continuing firms and incumbent firms, $X_{ijs}^c = M_{ijs}^c(\frac{\sigma_s}{\sigma_s-1}w_i\tau_{ijs})^{1-\sigma_s}(\widetilde{\lambda\varphi}_{ijs}^c)^{\sigma_s-1}P_{js}^{\sigma_s-1}\eta_{js}w_jL_j$ and $X_{ijs}^I = M_{ijs}^I(\frac{\sigma_s}{\sigma_s-1}w_i\tau_{ijs})^{1-\sigma_s}(\widetilde{\lambda\varphi}_{ijs}^I)^{\sigma_s-1}P_{js}^{\sigma_s-1}\eta_{js}w_jL_j$. With these specifications, I obtain my basic measurement equation for the gain and from trade at the extensive margin:

$$
-\frac{1}{\sigma_s-1}ln(\frac{X_{ijs}^{c\prime}/X_{ijs}^{I\prime}}{X_{ijs}^c/X_{ijs}^I}) = \frac{1}{\sigma_s-1}ln\frac{M_{ijs}^c}{M_{ijs}}+ln\frac{\widetilde{\lambda\varphi}_{ijs}^c}{\widetilde{\lambda\varphi}_{ijs}},
\tag{23}
$$

$$-\frac{1}{\sigma_s-1}ln(\frac{X^{I\prime}_{ijs}/X'_{ijs}}{X^{I}_{ijs}/X_{ijs}}) = \frac{1}{\sigma_s-1}ln\frac{M'_{ijs}}{M^c_{ijs}} + ln\frac{\widetilde{\lambda\varphi}'_{ijs}}{\widetilde{\lambda\varphi}^{c\prime}_{ijs}}, \tag{24}$$

$$\frac{1}{\sigma_s-1}ln(\frac{X^{c\prime}_{ijs}}{X^{c}_{ijs}}) = ln\frac{\widetilde{\lambda\varphi}^{c\prime}_{ijs}}{\widetilde{\lambda\varphi}^{c}_{ijs}} - ln\frac{\tau'_{ijs}}{\tau_{ijs}} - ln\frac{w'_i}{w_i} + ln\frac{P'_{js}}{P_{js}} + \frac{1}{\sigma_s-1}ln\frac{w'_jL'_j}{w_jL_j}. \tag{25}$$

Thus, to identify gain and loss both at the extensive margin and on the intensive margin, I examine changes in $\frac{X^I_{ijs}}{X_{ijs}}$, $\frac{X^c_{ijs}}{X^I_{ijs}}$ and X^c_{ijs}. Lastly, as assumed in Hsieh et al. (2020), given that $Y_j \propto w_jL_j$, I also analyze changes in gross domestic product.

The results are reported in Table 8.[18] There are statistically significant impacts on $\frac{X^I_{ijs}}{X_{ijs}}$ and κ^I_{ijs}. According to column (2) in Table 8, $\frac{X^I_{ijs}}{X_{ijs}}$ decreases by 14.8% in 2016 and 15.4% in 2017, respectively. Moreover, column (4) reports that κ^I_{ijs} decreases by 0.530% in 2016 and 0.550% in 2017. These two findings imply that the aggregate quality-adjusted price index decreases due to change in κ^I_{ijs} and there is a positive gain from entry at the extensive margin. Conversely, no impacts on $\frac{X^c_{ijs}}{X^I_{ijs}}$, X^c_{ijs}, ψ_{ijs} and Y_j exist in 2016 and 2017. These results offer two important implications: (i) there is no loss from exit at the extensive margin, (ii) gain on the intensive margin and welfare change is proportional to change in the aggregate quality-adjusted price index.[19][20]

For the welfare analysis described in equations (13), (22), (23), (24) and (25), I need the values of σ_s, η_{sj} and $\tilde{s}_{ijs}$. For the value of σ_s, I assume $\sigma_s = 2.5$; this is the elasticity across new pneumatic rubber tires in Africa, as reported

[18] In this analysis, I aggregate the dependent variables at the quarterly level in columns (1)-(4) and at the annual level in columns (5) and (6). In addition, since the dependent variables take 0 at some quarters, I use the inverse hyperbolic sine instead of the logarithm to avoid missing values in columns (1)-(5). For the values of and ψ_{ijs} and Y_j, I use the UN COMTRADE database and the IMF database.

[19] Appendix Figures A.8 and A.9 and show the dynamic patterns in all coefficients on all dependent variables in Table 8. As I see in Section 3.4., the coefficients before OAPI countries join the Madrid Protocol are close to 0, which ensures the validity of the difference-in-differences design.

[20] Since Sudan gained independence from Sudan in 2011 and information on South Sudan had been unavailable until 2012, I choose the periods starting from 2012 in columns (5) and (6) of Tables 8. For robustness testing, I exclude these two countries and run the same analysis with the extended periods. Appendix Figures A.10a and A.10b show that the qualitative results are maintained even after excluding these two countries.

by Soderbery (2018). To calculate η_{js} and $\tilde{s}_{ijs}$, I also use the UN COMTRADE database and the IMF database. With these values of σ_s, η_{sj} and $\tilde{s}_{ijs}$, I estimate the gains from trade.

Table 9 describes an overall welfare gain based on my reduced-form results in Table 8 and my calculated values of σ_s, η_{sj} and $\tilde{s}_{ijs}$. The effect on welfare change caused by the accession in my investigated industry is positive. Hence, the welfare increases by 0.0412% in 2016 and 0.0460% in 2017. Chinese exporters contribute to almost all of this welfare gain, accounting for 0.0438% and 0.0476% of the welfare gain in 2016 and 2017, respectively.

When I examine the welfare gains by Chinese exporters separately, we find the welfare gains both at the extensive margin and on the intensive margin. Since the least productive firm exits the market at the extensive margin and the quality-adjusted productivity increases, the welfare increases by 0.0179-0.0186%. Furthermore, as the continuing firms upgrade the quality of their products, the welfare gain on the intensive margin is positive and it increases by 0.0259-0.0290%.

Table 10 lists each OAPI country's welfare gain separately. The contribution of the tire industry to OAPI countries is quite heterogeneous. For example, in countries such as the Central African Republic, Chad, and Comoros, welfare only increases by less than 0.005%. Conversely, Togo receives large welfare gains and increases its welfare by over 0.15%.

5. Conclusion

Improving product and service quality has been a significant focus in developing countries, given challenges related to information frictions. Policymakers have debated the effectiveness of public policies in facilitating quality upgrades among sellers, with trademarks identified as a crucial policy tool. Despite this, empirical findings regarding the role of trademarks in international markets, particularly in developing countries, are limited. This study empirically examines the impact of trademarks in the African tire in-

dustry, providing insights into this underexplored area.

The study's analysis yields the following findings. First, on average, a Chinese exporter exports the higher quality tire with the increased use of a trademark. Second, this results in a decrease in the number of entries and an increase in exits among Chinese exporters in the market. Third, consistent with these findings, I find evidence supporting the reallocation of market share among incumbent exporters: those with lower market shares tend to decrease their market shares or cease exports, leading to a shift in market share toward exporters with higher market shares offering higher quality products with a trademark.

Moreover, the study obtains empirical insights into the net welfare gain in Africa resulting from the tire industry. Particularly, I conduct a back-of-the-envelope calculation based on the reduced form estimates, following Hallak and Sivadasan (2013), Hsieh et al. (2020) and Redding and Weinstein (2020). This calculation suggests that the African tire industry contributes to a 0.04% welfare increase. This gain is primarily caused by Chinese exporters' quality upgrading, manifesting in both extensive and intensive margin gains. The impact of the industry's contribution varies considerably among the ratifying countries.

This evidence, addressing the effect of trademarks and the underlying mechanism, suggests a policy implication that holds a particular essence for trade in and between developing countries. A strategic intervention aimed at decreasing the cost of trademark applications may be an effective means of enhancing welfare, particularly in markets where no other methods, such as long-term relationships, are feasible.

However, it is crucial to acknowledge potential limitations in my study. First, generalizing the results from the tire industry, which is the focus of this study, to other industrial sectors requires careful consideration. Second, my focus on CES preferences to estimate the welfare gains, while tractable and widely used in international trade, macroeconomics and economic geography, might introduce potential bias. This might be particularly important

when I consider alternative demand systems including ignored factors such as nonhomotheticity, different elasticity of substitution between and within varieties, and endogenous markups. Lastly, considering the diverse informal mechanisms addressing information frictions, an exploration of how trademarks interact with these mechanisms need to be examined. I believe these issues are beyond the scope of the current paper and leave them as future investigations.

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Table 1: Extensive and Intensive Margins

Dependent Variables	Export Dummy			Market Share	Trademark Dummy	ln(Price)	ln(Ply Rating)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OAPI x January 2014 - January 2015	-0.0000913	-0.000246	0.0126	0.00108	0.0171	0.00579	-0.00302
	(0.000605)	(0.00163)	(0.0236)	(0.00151)	(0.0204)	(0.0148)	(0.0256)
OAPI x February 2015	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	-0.000571	-0.000826	0.00394	-0.000319	0.0203	-0.00847	0.0333
	(0.000668)	(0.00172)	(0.0239)	(0.00195)	(0.0283)	(0.0215)	(0.0324)
OAPI x January 2016 - December 2016	-0.00280***	-0.00556***	-0.0841***	-0.000969	0.199***	0.0797***	0.202***
	(0.000744)	(0.00191)	(0.0238)	(0.00220)	(0.0545)	(0.0187)	(0.0642)
OAPI x January 2017 - December 2017	-0.00374***	-0.00695***	-0.105***	-0.00143	0.256***	0.0773***	0.237***
	(0.000911)	(0.00186)	(0.0232)	(0.00244)	(0.0574)	(0.0153)	(0.0672)
Destination X Exporter FE	X	X	X	X	X	X	X
Time FE	X	X	X	X	X	X	X
Observations	4318272	1604448	113856	113856	156188	156188	137347

Note: Country-clustered standard errors are presented in parentheses. In Columns (1)-(4), I consider three observation patterns: (i) all possible combinations of the destination-export pairs in Column (1), (ii) the set of the destination-export pairs on which Chinese exporters exported their products to at least one country before accession in Column (2), and (iii) the set of destination-exporter pairs, which existed before March of 2015 in Columns (3) and (4). In Columns (5)-(7), the observations are the set of destination-exporter pairs in which Chinese exporters exported their products before and after March 2015. Export dummy is a dummy variable which takes 1 if exporter i exports its product to country c at time t. Market share represents the share of exporter i in country c at time t, out of the total Chinese exporters. Trademark dummy is a dummy variable which takes 1 if exporter i uses a trademark in the transaction exported to country c at time t. Price is the unit price of the transaction exported to country c at time t by exporter i. Ply Rating is the ply rating of the transaction exported to country c at time t by exporter i. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 2: Entry and Exit after Ratification of the Trademark Agreement

Categorization	All		Non-Expoters/Exporters		Non-Existing/Existing Destination-Exporter Pairs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variables	Entry	Exit	Entry	Exit	Entry	Exit	Exit
OAPI x After	-0.0106*	0.000991**	-0.0146*	0.00267**	-0.0111*	0.0584***	0.0974***
	(0.00612)	(0.000479)	(0.00804)	(0.00129)	(0.00642)	(0.0112)	(0.0191)
OAPI x After x Above Median							-0.0791***
							(0.0229)
Destination X Exporter FE	X	X	X	X	X	X	X
Time FE	X	X	X	X	X	X	
Above Median X Time FE							X
Observations	179928	179928	113076	66852	175184	4744	4744

Note: Country-clustered standard errors are presented in parentheses. I consider three observation patterns: (i) all observations for entry and exit in Columns (1) and (2), (ii) the set of Chinese exporters who did not export their products to any country before the accession for entry and the set of Chinese exporters which exported their products to at least one country before the accession for exit in Columns (3) and (4), and (iii) the set of destination-exporter pairs which did not exist before March of 2015 for entry and the set of destination-exporter pairs which existed before March of 2015 for exit in Columns (5), (6) and (7). Entry is a dummy variable which takes 1 if exporter i did not export its product to country c before accession but starts exporting after accession. Exit is a dummy variable which takes 1 if a Chinese exporter i exported its product to country c before the accession but stopped exporting after accession. The Above Median is a dummy variable which takes 1 if market share of exporter i at country c in 2014 is above the median by each country. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 3: Heterogeneous Impacts of Chinese Exporters by Their Market Shares

Categorization	Market Share			
	(1)	(2)	(3)	(4)
Dependent Variables	Market Share	Trademark Dummy	ln(Price)	ln(Ply Rating)
OAPI x January 2014 - January 2015	-0.000540	0.00612	0.0211	0.00465
	(0.00450)	(0.0162)	(0.0189)	(0.0433)
OAPI x January 2014 - January 2015 X Above Median	0.00331	0.0444	-0.0299	0.00716
	(0.00840)	(0.0423)	(0.0252)	(0.0559)
OAPI x February 2015	0	0	0	0
	(.)	(.)	(.)	(.)
OAPI x February 2015 X Above Median	0	0	0	0
	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	-0.00269	-0.0232	0.00663	-0.00513
	(0.00416)	(0.0192)	(0.0229)	(0.0482)
OAPI x March 2015 - December 2015 X Above Median	0.00481	0.102**	-0.0354	0.0702
	(0.00794)	(0.0401)	(0.0396)	(0.0493)
OAPI x January 2016 - December 2016	-0.0100**	0.0815***	0.0455**	0.111**
	(0.00416)	(0.0191)	(0.0187)	(0.0468)
OAPI x January 2016 - December 2016 X Above Median	0.0183**	0.250**	0.0646*	0.160**
	(0.00796)	(0.116)	(0.0354)	(0.0728)
OAPI x January 2017 - December 2017	-0.0124***	0.148***	0.0480**	0.137**
	(0.00406)	(0.0325)	(0.0206)	(0.0519)
OAPI x January 2017 - December 2017 X Above Median	0.0222**	0.229*	0.0528*	0.197**
	(0.00857)	(0.126)	(0.0268)	(0.0787)
p-value for the sum of coefficients in 2016	0.097	0.004	0.001	0.002
p-value for the sum of coefficients in 2017	0.092	0.002	0.000003	0.0003
Destination X Exporter FE	X	X	X	X
Time FE	X	X	X	X
Above Median X Time FE	X	X	X	X
Observations	113856	156188	156188	137347

Note: Country-clustered standard errors are presented in parentheses. In Column (1), I consider the set of the destination-export pairs on which Chinese exporters exported their products to at least one country before accession. In Columns (2)-(4), the observations are the set of destination-exporter pairs in which Chinese exporters exported their products before and after March of 2015. Market share represents the share of exporter i in country c at time t, out of the total Chinese exporters. Trademark dummy is a dummy variable which takes 1 if exporter i uses a trademark in the transaction exported to country c at time t. Price is the unit price of the transaction exported to country c at time t by exporter i. Ply Rating is the ply rating of the transaction exported to country c at time t by exporter i. The Above Median is a dummy variable which takes 1 if market share of exporter i at country c in 2014 is above the median by each country. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 4: Placebo Test

	(1)	(2)	(3)
Dependent Variables	ln(Value)	ln(Quantity)	ln(Price)
OAPI x Year = 2012	0.113	0.0687	0.0187
	(0.212)	(0.200)	(0.146)
OAPI x Year = 2013	0.241	0.0210	0.155
	(0.165)	(0.184)	(0.122)
OAPI x Year = 2014	0	0	0
	(.)	(.)	(.)
OAPI x Year = 2015	-0.117	0.176	-0.227
	(0.181)	(0.190)	(0.145)
OAPI x Year = 2016	0.00227	0.0341	-0.0379
	(0.230)	(0.228)	(0.165)
OAPI x Year = 2017	-0.0925	0.269	-0.267
	(0.221)	(0.192)	(0.186)
p-value for the sum of coefficients	0.658	0.323	0.370
Destination X HS 4 Digit Code FE	X	X	X
HS 4 Digit Code X Time FE	X	X	X
Number of HS 4 Digit Codes	14	14	14
Observations	4530	4530	4530

Note: Standard errors are presented in parentheses. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo. The four-digit codes for this placebo analysis include the followings: HS5804, HS5806, HS5807, HS5808, HS5810, HS5811, HS5901, HS5902, HS5903, HS5907, HS5909, HS5911, HS6001 and HS6006.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 5: Heterogeneous Extensive Impacts of Chinese Exporters by Business Environments, Law Enforcement and Property Rights

Categorization	Ease of Doing Business		Law Enforcement		Property Rights	
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variables	Export	Market Share	Export	Market Share	Export	Market Share
OAPI x January 2014 - January 2015	-0.0236	0.00290	0.00826	0.00295	0.00286	0.00209
	(0.0252)	(0.00294)	(0.0299)	(0.00397)	(0.0270)	(0.00278)
OAPI x January 2014 - January 2015 X Above Median	0.0649	-0.00328	0.00176	-0.00252	0.0146	-0.00183
	(0.0400)	(0.00337)	(0.0445)	(0.00402)	(0.0421)	(0.00320)
OAPI x February 2015	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x February 2015 X Above Median	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	-0.0283	-0.00149	-0.00334	-0.00121	-0.00683	-0.000493
	(0.0328)	(0.00394)	(0.0268)	(0.00451)	(0.0238)	(0.00365)
OAPI x March 2015 - December 2015 X Above Median	0.0567	0.00197	0.00144	0.00199	0.0146	0.000320
	(0.0412)	(0.00433)	(0.0415)	(0.00475)	(0.0388)	(0.00413)
OAPI x January 2016 - December 2016	-0.104***	-0.00523	-0.0984***	-0.00549	-0.0974***	-0.00372
	(0.0352)	(0.00512)	(0.0279)	(0.00532)	(0.0247)	(0.00446)
OAPI x January 2016 - December 2016 X Above Median	0.0330	0.00736	0.0117	0.00774	0.0194	0.00511
	(0.0434)	(0.00530)	(0.0402)	(0.00555)	(0.0385)	(0.00477)
OAPI x January 2017 - December 2017	-0.133***	-0.00510	-0.130***	-0.00499	-0.128***	-0.00307
	(0.0327)	(0.00553)	(0.0314)	(0.00542)	(0.0267)	(0.00453)
OAPI x January 2017 - December 2017 X Above Median	0.0519	0.00617	0.0364	0.00622	0.0401	0.00303
	(0.0432)	(0.00579)	(0.0418)	(0.00581)	(0.0398)	(0.00513)
Destination X Exporter FE	X	X	X	X	X	X
Time FE	X	X	X	X	X	X
Above Median X Time FE	X	X	X	X	X	X
Observations	113184	113184	113856	113856	113856	113856

Note: Country-clustered standard errors are presented in parentheses. In Columns (1)-(6), the observations are the set of destination-exporter pairs which existed before March of 2015. Export dummy is a dummy variable which takes 1 if exporter i exports its product to country c at time t. Market share represents the share of exporter i in country c at time t, out of the total Chinese exporters. In Columns (1)-(2), the Above Median equals 1 if the Ease of Doing Business Score index of country c in 2014 is above the country-level median. In Columns (3)-(4), the Above Median equals 1 if the Law Enforcement Score index of country c in 2014 is above the country-level median. In Columns (5)-(6), the Above Median equals 1 if the Property Rights Score index of country c in 2014 is above the country-level median. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 6: Heterogeneous Intensive Impacts of Chinese Exporters by Business Environments, Law Enforcement and Property Rights

Categorization	Ease of Doing Business			Law Enforcement			Property Rights		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variables	Trademark Dummy	ln(Price)	ln(Ply Rating)	Trademark Dummy	ln(Price)	ln(Ply Rating)	Trademark Dummy	ln(Price)	ln(Ply Rating)
OAPI x January 2014 - January 2015	0.00446	0.0298	-0.00578	-0.0103	0.0389	-0.0140	-0.00216	0.0263	0.0175
	(0.0202)	(0.0249)	(0.0246)	(0.0233)	(0.0263)	(0.0329)	(0.0207)	(0.0283)	(0.0301)
OAPI x January 2014 - January 2015 X Above Median	0.0240	-0.0370	0.00364	0.0378	-0.0620	0.0298	0.0273	-0.0418	-0.0194
	(0.0388)	(0.0298)	(0.0455)	(0.0358)	(0.0405)	(0.0358)	(0.0348)	(0.0427)	(0.0347)
OAPI x February 2015	0	0	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x February 2015 X Above Median	0	0	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	0.0137	0.00338	0.0554	-0.00166	0.0838*	-0.0321	0.0114	0.0596	0.0233
	(0.0105)	(0.0283)	(0.0389)	(0.00800)	(0.0480)	(0.0401)	(0.00744)	(0.0478)	(0.0421)
OAPI x March 2015 - December 2015 X Above Median	0.0146	-0.0179	-0.0363	0.0318	-0.0721	0.0375	0.0120	-0.0379	-0.0473
	(0.0513)	(0.0412)	(0.0603)	(0.0402)	(0.0607)	(0.0463)	(0.0418)	(0.0601)	(0.0498)
OAPI x January 2016 - December 2016	0.204***	0.112***	0.231**	0.214***	0.294**	0.0928**	0.203***	0.223*	0.126***
	(0.0542)	(0.0213)	(0.0913)	(0.0796)	(0.123)	(0.0370)	(0.0746)	(0.116)	(0.0291)
OAPI x January 2016 - December 2016 X Above Median	-0.00224	-0.0517	-0.0467	-0.0143	-0.124	-0.0129	-0.00550	-0.0312	-0.0668*
	(0.102)	(0.0341)	(0.125)	(0.104)	(0.141)	(0.0412)	(0.104)	(0.136)	(0.0381)
OAPI x January 2017 - December 2017	0.231***	0.108***	0.238***	0.207***	0.271***	0.0828**	0.195***	0.217**	0.100***
	(0.0234)	(0.0225)	(0.0623)	(0.0404)	(0.0864)	(0.0347)	(0.0437)	(0.0897)	(0.0300)
OAPI x January 2017 - December 2017 X Above Median	0.0421	-0.0503*	-0.00453	0.0665	-0.0537	-0.00879	0.0838	0.0262	-0.0334
	(0.100)	(0.0281)	(0.119)	(0.0870)	(0.119)	(0.0371)	(0.0932)	(0.125)	(0.0346)
Destination X Exporter FE	X	X	X	X	X	X	X	X	X
Time FE	X	X	X	X	X	X	X	X	X
Above Median X Time FE	X	X	X	X	X	X	X	X	X
Observations	154806	154806	135978	156188	137347	156188	156188	137347	156188

Note: Country-clustered standard errors are in parentheses. In Columns (1)-(9), the observations are the set of destination-exporter pairs in which Chinese exporters exported their products before and after March 2015. Trademark dummy is a dummy variable which takes 1 if exporter i uses a trademark in the transaction exported to country c at time t. Price is the unit price of the transaction exported to country c at time t by exporter i. Ply Rating is the ply rating of the transaction exported to country c at time t by exporter i. In Columns (1)-(3), the Above Median equals 1 if the Ease of Doing Business Score index of country c in 2014 is above the country-level median. In Columns (4)-(6), the Above Median equals 1 if the Law Enforcement Score index of country c in 2014 is above the country-level median. In Columns (7)-(9), the Above Median equals 1 if the Property Rights Score index of country c in 2014 is above the country-level median. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 7: Extensive and Intensive Margins with Law Controls

Dependent Variables	Export Dummy			Market Share	Trademark Dummy	ln(Price)	ln(Ply Rating)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OAPI x January 2014 - January 2015	-0.0000601	-0.000268	0.0114	0.000840	0.0124	-0.00674	0.00345
	(0.000603)	(0.00164)	(0.0241)	(0.00155)	(0.0236)	(0.0303)	(0.0161)
OAPI x February 2015	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	-0.000571	-0.000826	0.00394	-0.000319	0.0205	0.0332	-0.00839
	(0.000668)	(0.00172)	(0.0239)	(0.00195)	(0.0283)	(0.0326)	(0.0214)
OAPI x January 2016 - December 2016	-0.00276***	-0.00558***	-0.0832***	-0.00112	0.203***	0.205***	0.0784***
	(0.000741)	(0.00191)	(0.0238)	(0.00235)	(0.0546)	(0.0645)	(0.0189)
OAPI x January 2017 - December 2017	-0.00370***	-0.00695***	-0.103***	-0.00164	0.259***	0.240***	0.0729***
	(0.000911)	(0.00185)	(0.0238)	(0.00261)	(0.0597)	(0.0698)	(0.0145)
Destination X Exporter FE	X	X	X	X	X	X	X
Time FE	X	X	X	X	X	X	X
Law Controls	X	X	X	X	X	X	X
Observations	4318272	1604448	113856	113856	156188	156188	137347

Note: Country-clustered standard errors are in parentheses. In Columns (1)-(4), I consider three observation patterns: (i) all possible combinations of the destination-export pairs in Column (1), (ii) the set of the destination-export pairs on which Chinese exporters exported their products to at least one country before accession in Column (2), and (iii) the set of destination-exporter pairs, which existed before March of 2015 in Columns (3) and (4). In Columns (5)-(7), the observations are the set of destination-exporter pairs in which Chinese exporters exported their products before and after March 2015. Export dummy is a dummy variable which takes 1 if exporter i exports its product to country c at time t. Market share represents the share of exporter i in country c at time t, out of the total Chinese exporters. Trademark dummy is a dummy variable which takes 1 if exporter i uses a trademark in the transaction exported to country c at time t. Price is the unit price of the transaction exported to country c at time t by exporter i. Ply Rating is the ply rating of the transaction exported to country c at time t by exporter i. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 8: Welfare Analysis

Dependent Variables	$IHS(\frac{X^c_{ijs}}{X^I_{ijs}})$	$IHS(\frac{X^I_{ijs}}{X_{ijs}})$	$IHS(X^c_{ijs})$	$IHS(\kappa^I_{ijs})$	$IHS(\psi_{ijs})$	$ln(Y_j)$
	(1)	(2)	(3)	(4)	(5)	(6)
OAPI x 1st-3rd Quarter 2014	-0.0238	-0.0537	-0.135	-0.00204		
	(0.0695)	(0.0661)	(0.505)	(0.00158)		
OAPI x 4th Quarter 2014	0	0	0	0		
	(.)	(.)	(.)	(.)		
OAPI x Year = 2012					0.0193	0.00538
					(0.0404)	(0.0586)
OAPI x Year = 2013					0.0372	-0.00394
					(0.0402)	(0.0502)
OAPI x Year = 2014					0	0
					(.)	(.)
OAPI x Year = 2015	-0.0208	-0.000878	-0.117	-0.000536	-0.00163	-0.0984**
	(0.0687)	(0.0657)	(0.491)	(0.00204)	(0.0394)	(0.0445)
OAPI x Year = 2016	-0.0417	-0.148**	0.308	-0.00530*	0.0356	-0.0361
	(0.0661)	(0.0641)	(0.504)	(0.00303)	(0.0371)	(0.0576)
OAPI x Year = 2017	-0.0735	-0.154**	-0.173	-0.00550*	0.0458	0.0135
	(0.0659)	(0.0651)	(0.510)	(0.00291)	(0.0427)	(0.0690)
Destination FE	X	X	X		X	X
Destination X Exporter FE				X		
Quarter FE	X	X	X	X		
Year FE					X	X
Observations	864	864	864	36032	324	324

Note: Standard errors are presented in parentheses. I aggregate the dependent variables at the quarterly level in Columns (1)-(4) and at the annual level in Columns (5) and (6). Since the dependent variables take 0 at certain quarters, I use the inverse hyperbolic sine instead of the logarithm to avoid missing values in Columns (1)-(5). For the values of and ψ_{ijs} and Y_j, I use the UN COMTRADE database and the IMF database. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table 9: Welfare Analysis: The Gains from Trade

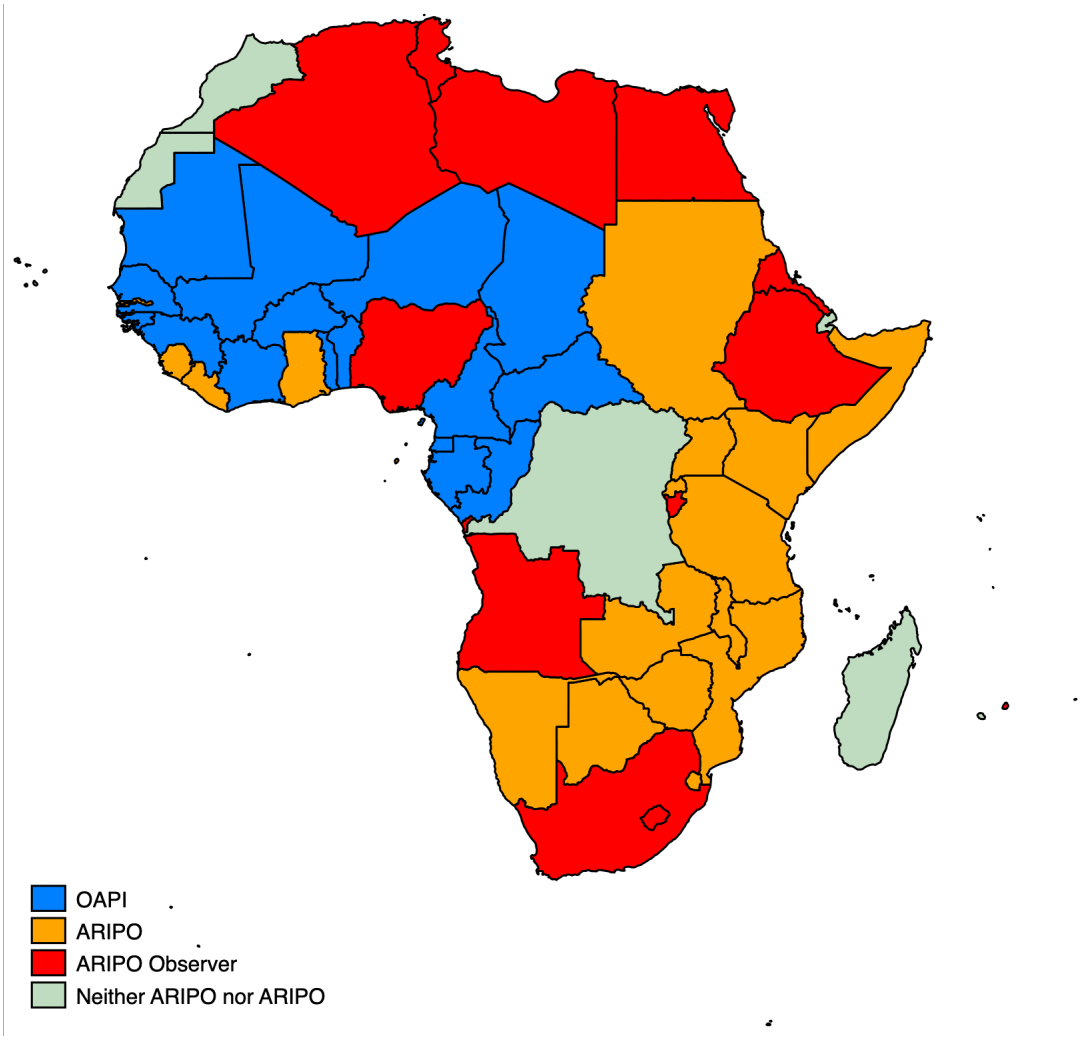
Year = 2016	Welfare Increase (%)
All Exporters in the tire Industry	0.0412
Chinese Exporters in the tire Industry	0.0438
Gain by Chinese Exporters from Entry at the Extensive Margin	0.0179
Gain by Chinese Exporters on the Intensive Margin	0.0259

Year = 2017	Welfare Increase (%)
All Exporters in the Tire Industry	0.0460
Chinese Exporters in the Tire Industry	0.0476
Gain by Chinese Exporters from Entry at the Extensive Margin	0.0186
Gain by Chinese Exporters on the Intensive Margin	0.0290

Table 10: Individual Welfare Analysis

	(1)	(2)
Welfare Increase from Chinese Exporters (%)	Year = 2016	Year = 2017
Benin	0.0588	0.0638
Burkina Faso	0.0156	0.0169
Cameroon	0.0751	0.0815
Central African Republic	0.00344	0.00373
Chad	0.00317	0.00344
Comoros	0.00127	0.00137
Congo	0.0503	0.0546
Cote d'Ivoire	0.0310	0.0337
Equatorial Guinea	0.0310	0.0337
Gabon	0.0286	0.0311
Guinea	0.0755	0.0819
Guinea-Bissau	0.00688	0.00747
Mali	0.0256	0.0278
Mauritania	0.0833	0.0904
Niger	0.00617	0.00670
Senegal	0.0638	0.0692
Togo	0.186	0.202

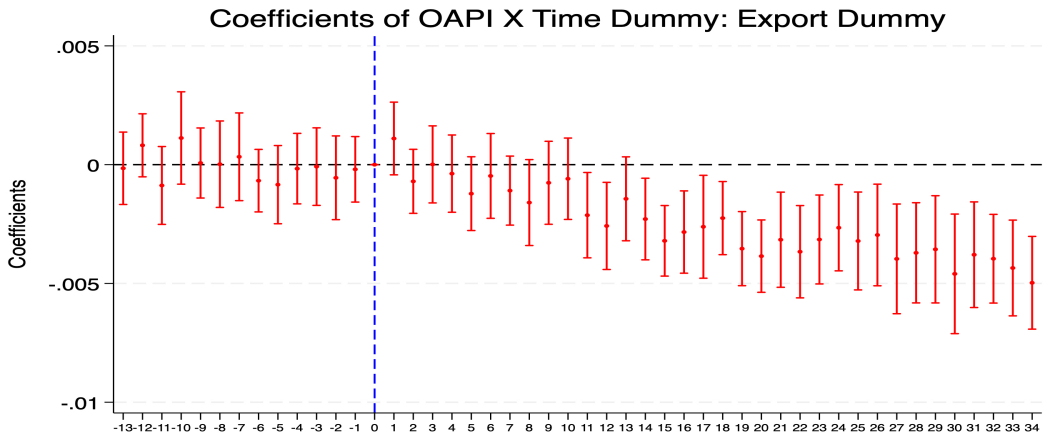
Figure 1: OAPI and ARIPO Member Countries in Africa



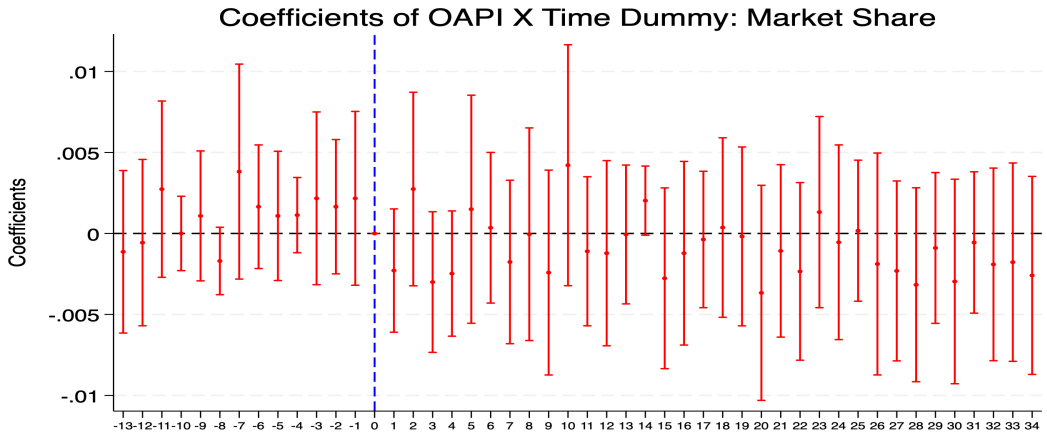
Note: Figure 1 shows the location of OAPI and ARIPO member countries in Africa. The OAPI member countries are Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo. The ARIPO member countries are Botswana, Eswatini, Gambia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mozambique, Namibia, Rwanda, Sao Tome and Principe, Sierra Leone, Somalia, Sudan, Tanzania, Uganda, Zambia and Zimbabwe. The observer countries are Algeria, Angola, Burundi, Egypt, Eritrea, Ethiopia, Libya, Mauritius, Nigeria, Seychelles, South Africa and Tunisia. Which organization each country belongs to mainly depends on its used language. In OAPI, they are former French colonies and mostly French-speaking countries while they are former British colonies and mostly English-speaking countries in ARIPO.

Figure 2: Impacts of Agreement on Export Dummy and Market Share at the Extensive Margin

(a) Export Dummy



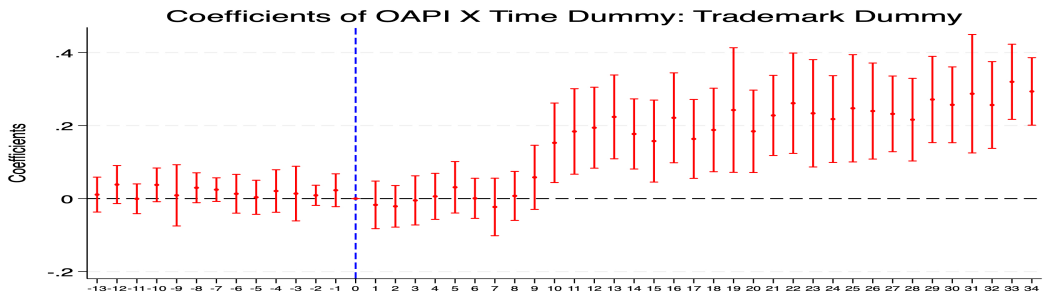
(b) Market Share



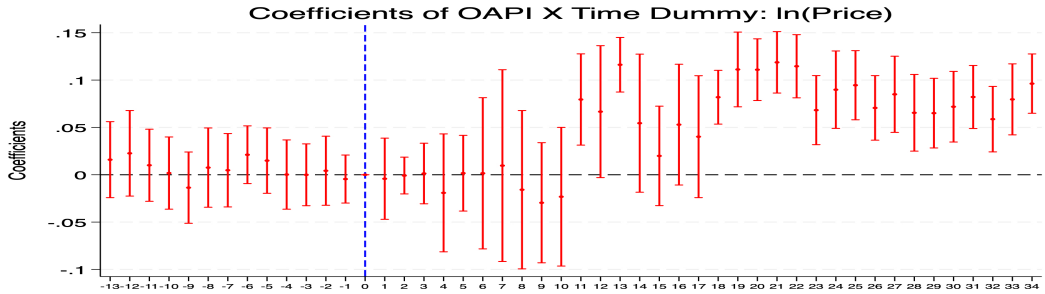
Note: Figures 2a and 2b investigate pre-trends for outcomes at the extensive margin: an export dummy and market share. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement. These figures illustrate the absence of differential trends in the months preceding the agreement.

Figure 3: Impacts of Agreement on Trademark Dummy, Price and Ply Rating on the Intensive Margin

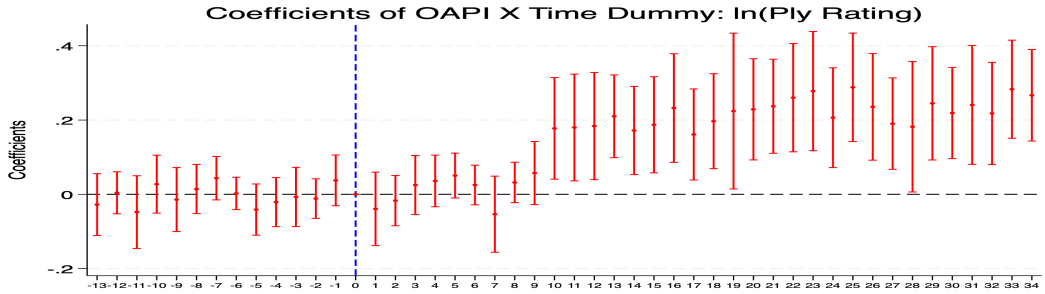
(a) Trademark Dummy



(b) log Unit Price



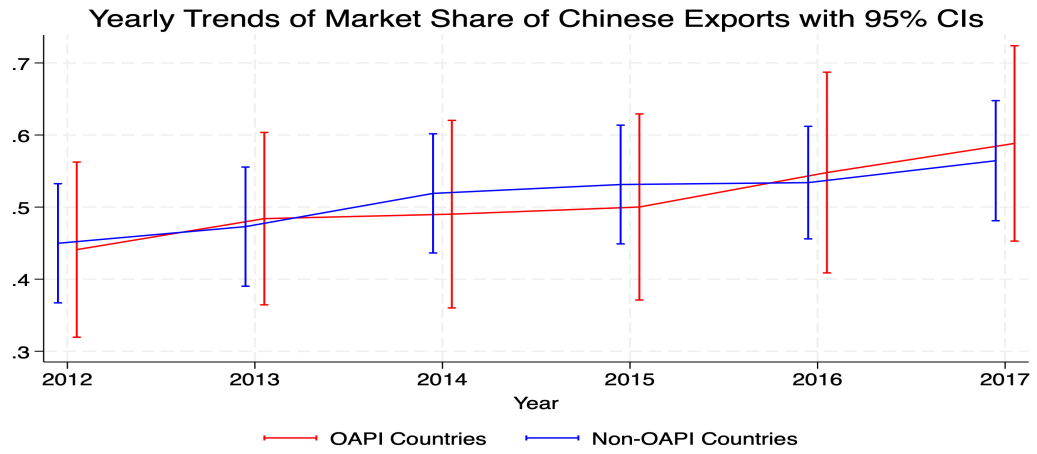
(c) log Ply Rating



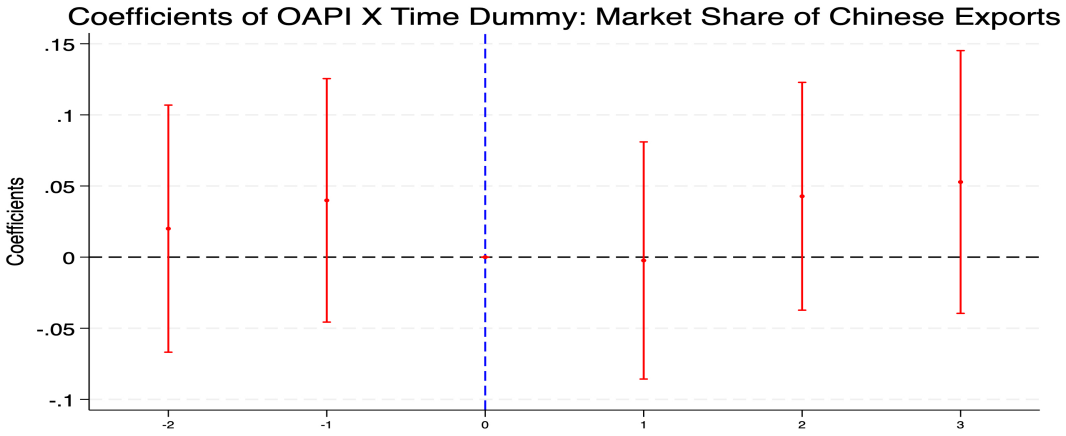
Note: Figures 3a, 3b and 3c investigate pre-trends for outcomes on the intensive margin: a trademark dummy, log unit price, and log ply rating. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement. These figures show the absence of differential trends in the months preceding the agreement.

Figure 4: Yearly Trends of Market Share of Chinese Exports and Impact of Agreement on Market Share of Chinese Exports

(a) Yearly Trends of Market Share of Chinese Exports with 95% CIs



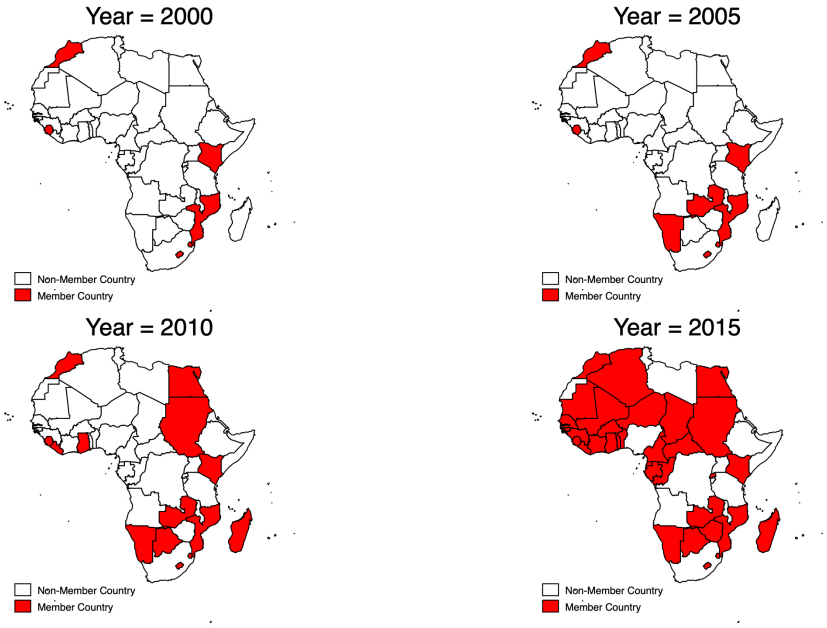
(b) Market Share of Chinese Exports



Note: Figure 4a illustrates the yearly trends of market share of Chinese exports with 95% confidence intervals in OAPI and non-OAPI countries, respectively. The red line depicts the yearly trends of the market share of Chinese exports with 95% confidence intervals in OAPI countries, while the blue line shows the yearly trends of the market share of Chinese exports with 95% confidence intervals in non-OAPI countries. Figure 4b investigates pre-trends for market share of Chinese exports. To mitigate typical concerns arising in the difference-in-differences design, this figure investigates dynamic patterns around the time when the OAPI countries ratified the international trademark agreement. The figure demonstrates the absence of differential trends in the months preceding the agreement.

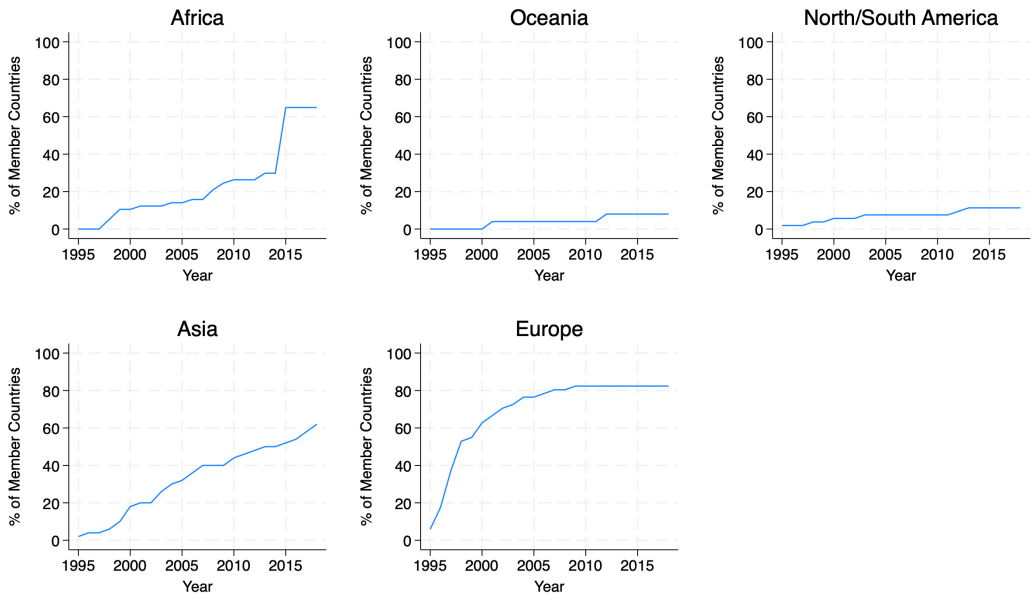
A Appendix Figures and Tables: For Online Publication Only

Figure A.1: History of Entry into the Madrid Protocol



Note: Figure A.1 plots the member countries that ratified the Madrid Protocol in 2000, 2005, 2010, and 2015, respectively. Red-colored countries are member countries while white-colored countries are non-member countries. In 2000, member countries were Eswatini, Kenya, Lesotho, Morocco, Mozambique, and Sierra Leone. In 2005, member countries were Eswatini, Kenya, Lesotho, Morocco, Mozambique, Namibia, Sierra Leone and Zambia. In 2010, member countries were Eswatini, Botswana, Egypt, Ghana, Kenya, Lesotho, Liberia, Madagascar, Morocco, Mozambique, Namibia, Sao Tome and Principe, Sierra Leone, Sudan and Zambia. In 2015, member countries were Algeria, Benin, Botswana, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Egypt, Equatorial Guinea, Eswatini, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Sudan, Togo, Zambia and Zambia.

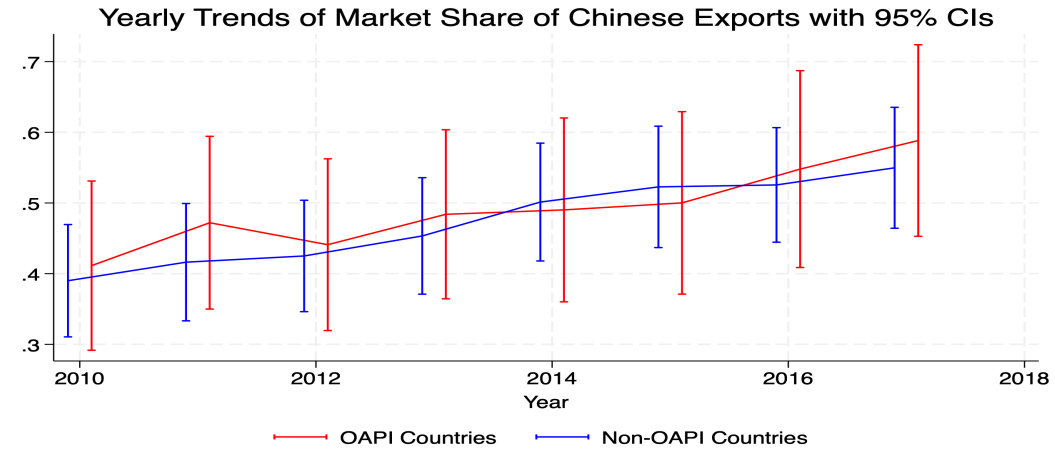
Figure A.2: History of Entry into the Madrid Protocol by Five Regions



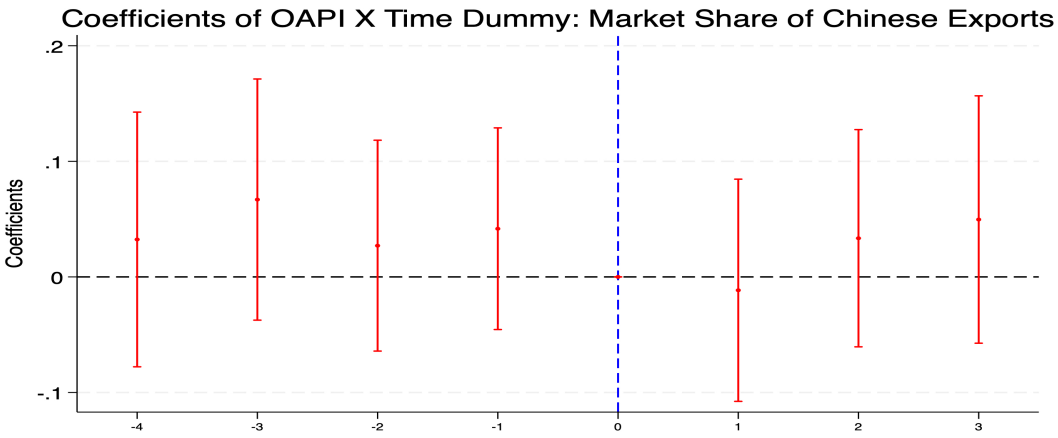
Note: Figure A.2 shows the cumulative percentage of the member countries ratifying the Madrid Procotol by five regions over the periods, 1995–2017. The five regions are Africa, Oceania, North/South America, Asia, and Europe.

Figure A.3: Yearly Trends of Market Share of Chinese Exports Excluding Two Countries and Impact of Agreement on Market Share of Chinese Exports

(a) Yearly Trends of Market Share of Chinese Exports with 95% CIs



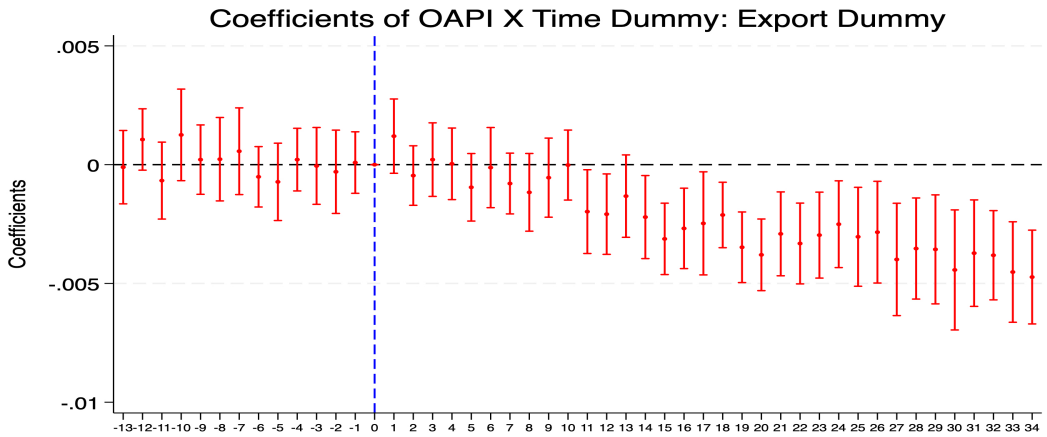
(b) Market Share of Chinese Exports



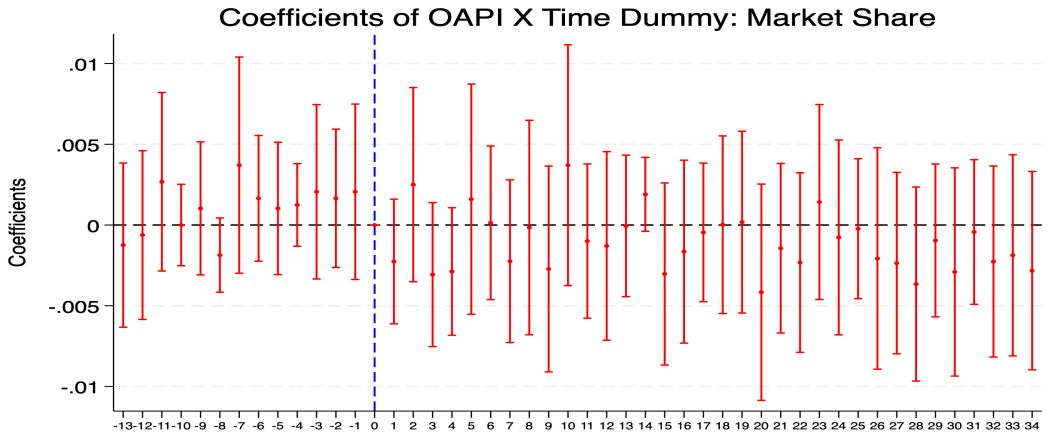
Note: Figure 4a illustrates the yearly trends of market share of Chinese exports with 95% confidence intervals in OAPI and non-OAPI countries excluding two countries: Sudan and South Sudan. The red line shows the yearly trends of market share of Chinese exports with 95% confidence intervals in OAPI countries while the blue line demonstrates the yearly trends of market share of Chinese exports with 95% confidence intervals in non-OAPI countries. Figure A.3b investigates pre-trends for the market share of Chinese exports in the countries excluding two countries: Sudan and South Sudan. To mitigate typical concerns arising in the difference-in-differences design, this figure investigates dynamic patterns around the time when the OAPI countries ratified the international trademark agreement. The figure demonstrates the absence of differential trends in the months preceding the agreement.

Figure A.4: Impacts of Agreement on Export Dummy and Market Share at the Extensive Margin excluding Three Countries

(a) Trademark Dummy



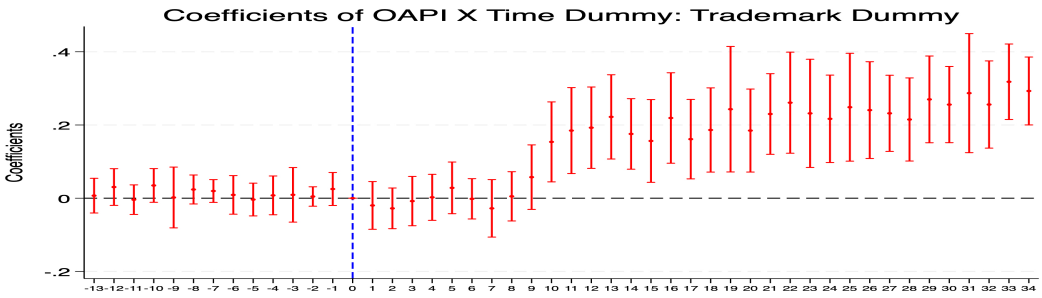
(b) Market Share



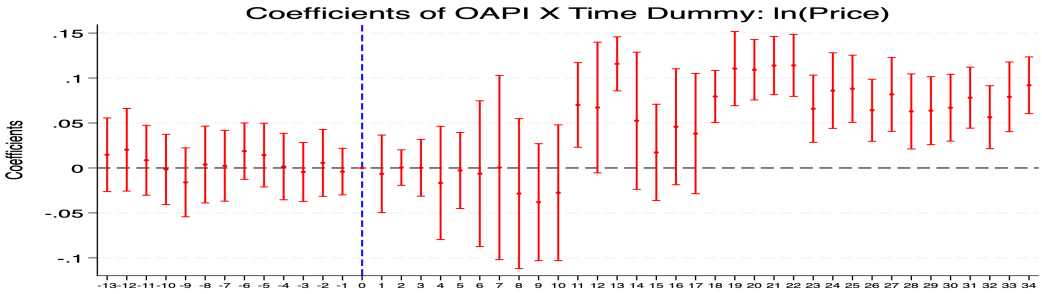
Note: Figures A.4a and A.4b investigate pre-trends for outcomes at the extensive margin (an export dummy and market share) in countries excluding Algeria, Gambia, and Zimbabwe. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries' ratification of the international trademark agreement, revealing the absence of differential trends in the months preceding the agreement.

Figure A.5: Impacts of Agreement on Trademark Dummy, Price and Ply Rating on the Intensive Margin excluding Three Countries

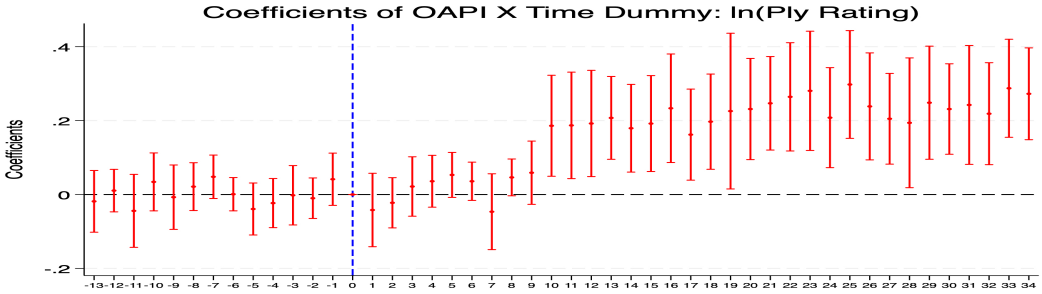
(a) Trademark Dummy



(b) log Unit Price



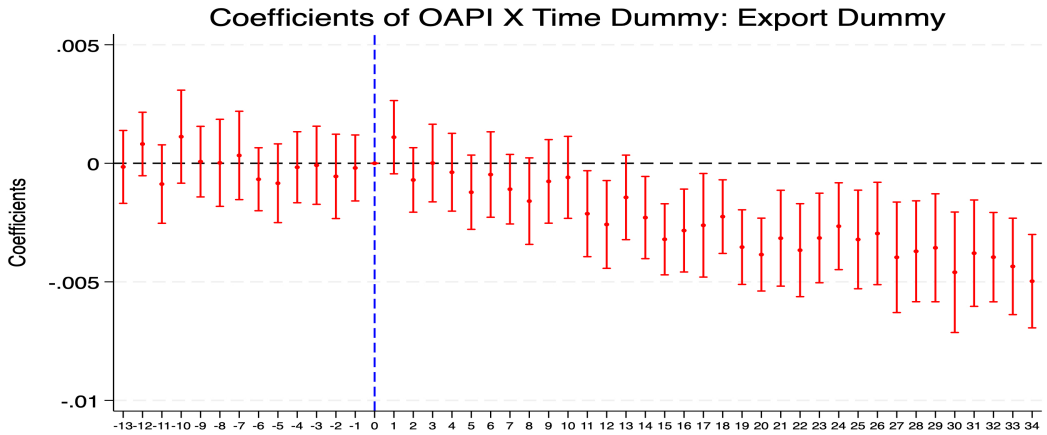
(c) log Ply Rating



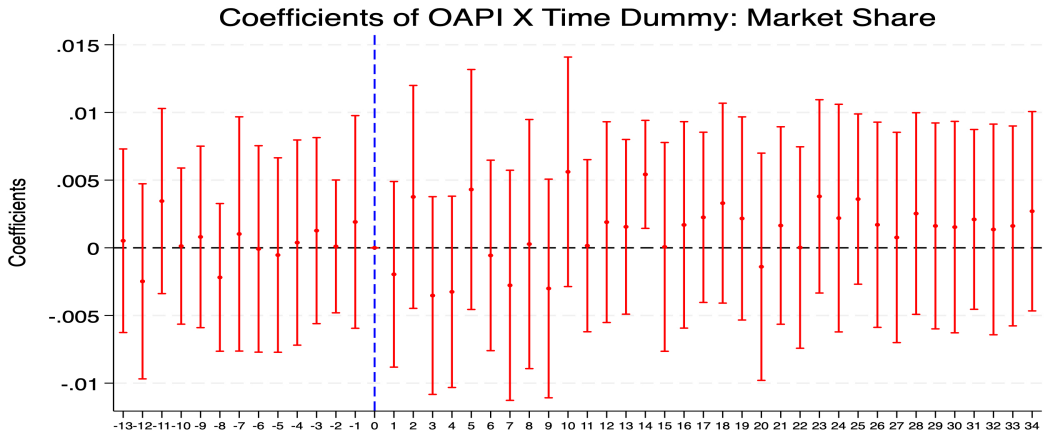
Note: Figures A.5a, A.5b and A.5c investigate pre-trends for outcomes on the intensive margin: a trademark dummy, log unit price, and log ply rating, in the countries excluding three countries. The excluded countries are Algeria, Gambia, and Zimbabwe. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement. These figures reveal the absence of differential trends in the months preceding the agreement.

Figure A.6: Impacts of Agreement on Export Dummy and Market Share at the Extensive Margin with Exporter X Year Fixed Effect

(a) Trademark Dummy



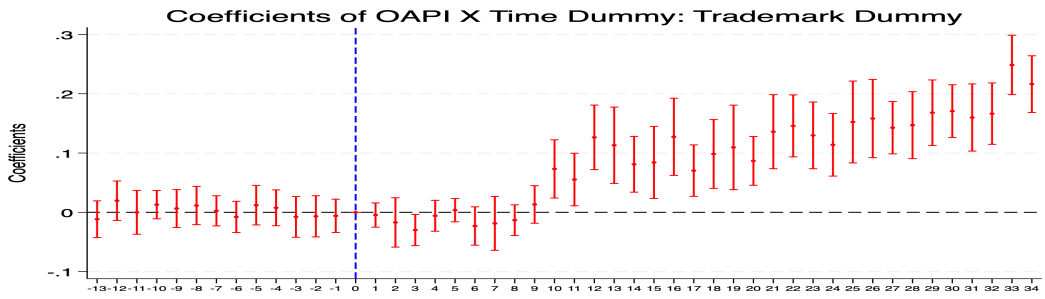
(b) Market Share



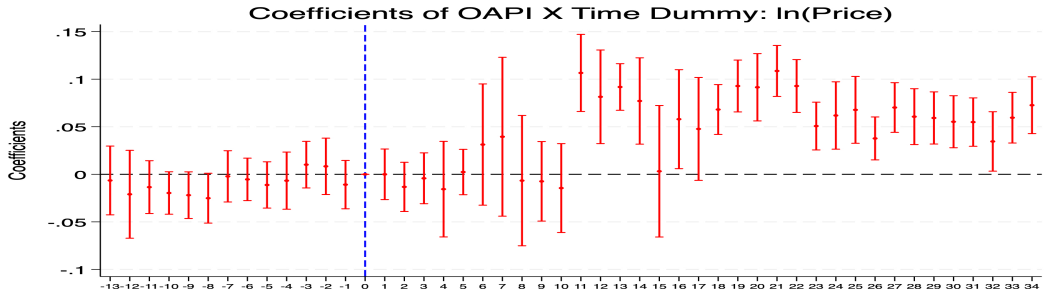
Note: Figures A.6a and A.6b investigate pre-trends for outcomes at the extensive margin: an export dummy and market share. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement. These figures demonstrate the absence of differential trends in the months preceding the agreement.

Figure A.7: Impacts of Agreement on Trademark Dummy, Price and Ply Rating on the Intensive Margin with Exporter X Year Fixed Effect

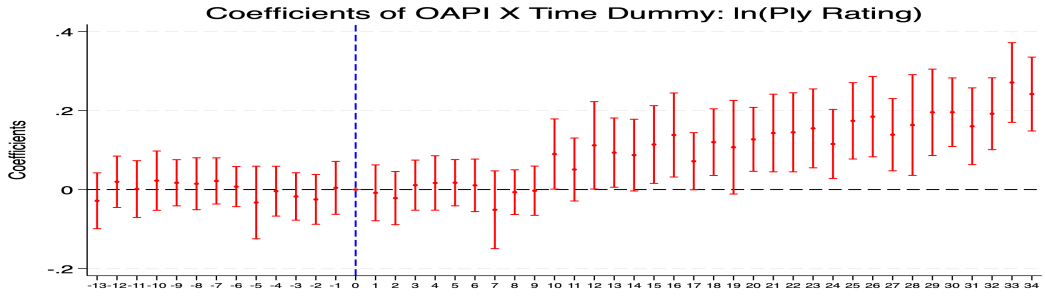
(a) Trademark Dummy



(b) log Unit Price



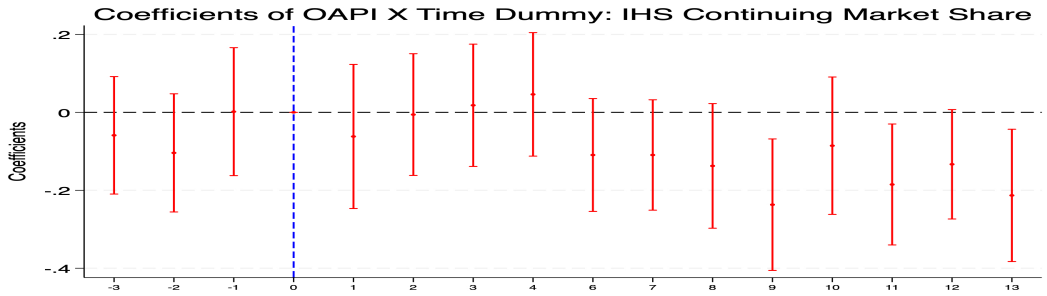
(c) log Ply Rating



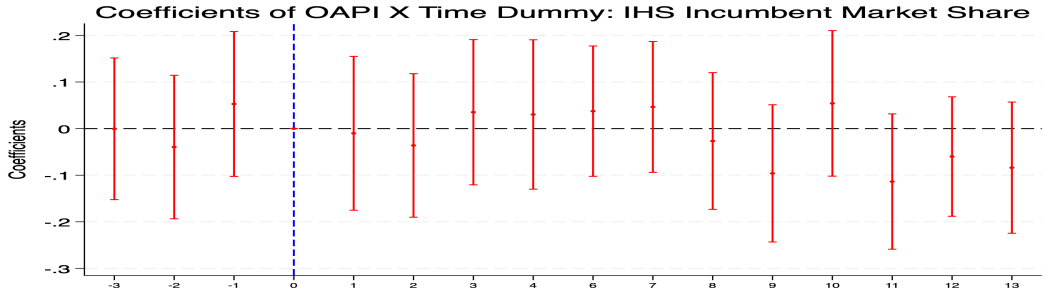
Note: Figures A.7a, A.7b and A.7c investigate pre-trends for outcomes on the intensive margin: a trademark dummy, log unit price, and log ply rating. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement, revealing the absence of differential trends in the months preceding the agreement.

Figure A.8: Impacts of Agreement on Incumbent and Continuing Chinese Exporters

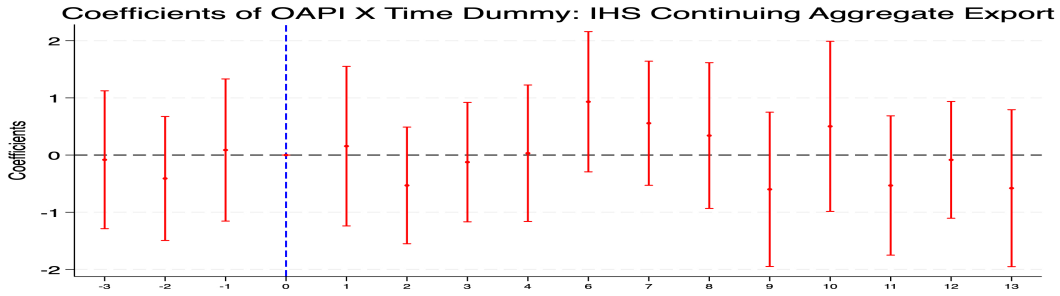
(a) IHS Continuing Market Share: $IHS(\frac{X^c_{ijs}}{X^I_{ijs}})$



(b) IHS Incumbent Market Share: $IHS(\frac{X^I_{ijs}}{X_{ijs}})$



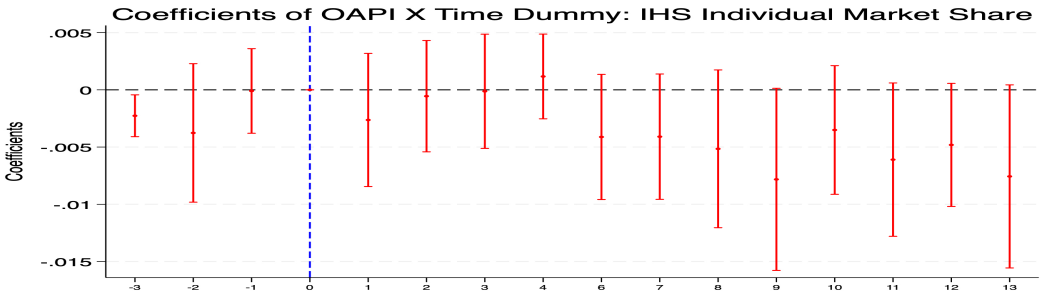
(c) IHS Continuing Aggregate Export: $IHS(X^c_{ijs})$



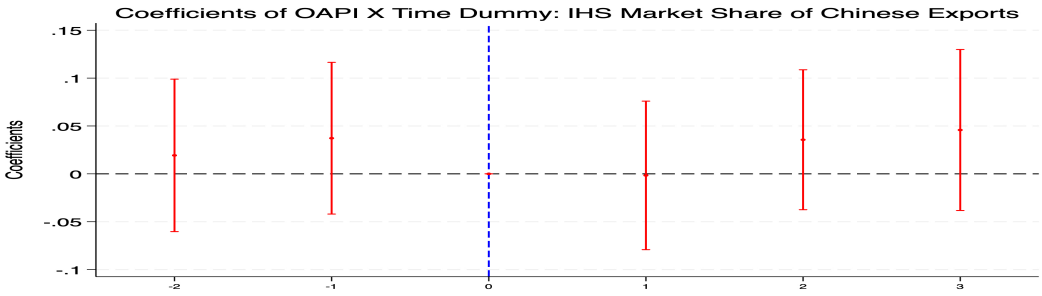
Note: Figures A.8a and A.8b investigate pre-trends for three outcomes: inverse hyperbolic sine of market share for both continuing and incumbent Chinese exporters, and the aggregate export value of continuing Chinese exporters. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement, demonstrating the absence of differential trends in the months preceding the agreement.

Figure A.9: Impacts of Agreement on Market Share and GDP

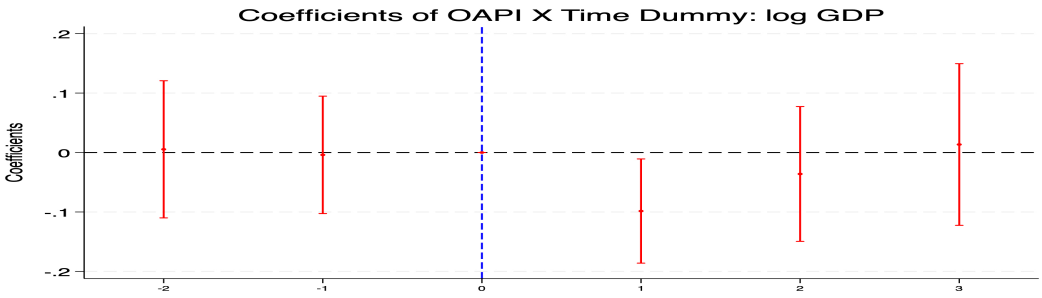
(a) IHS Individual Market Share: $IHS(\kappa^{I}_{ijs})$



(b) IHS Market Share: $IHS(\psi_{ijs})$



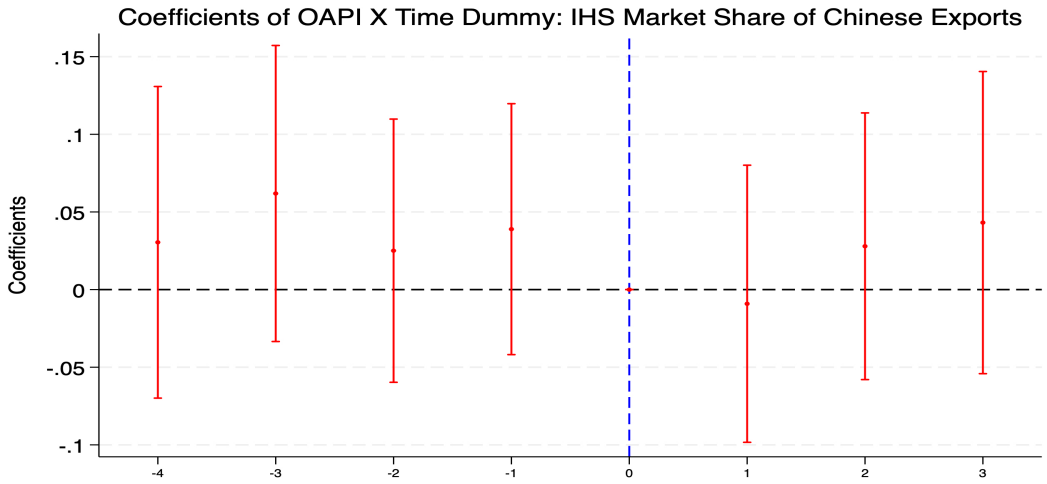
(c) log GDP: $ln(Y_j)$



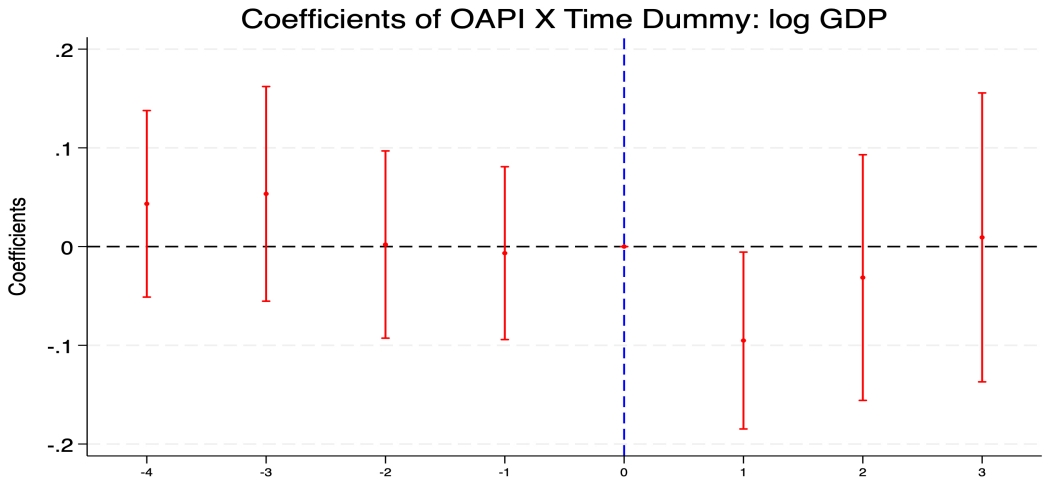
Note: Figures A.9a, A.9b and A.9c investigate pre-trends for inverse hyperbolic sine of market share of individual and aggregate Chinese exporters and log GDP. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement, indicating no differential trends in the months preceding the agreement.

Figure A.10: Impacts of Agreement on Market Share and GDP excluding Two countries

(a) IHS Market Share of Chinese Exports: $IHS(\psi_{ijs})$



(b) log GDP: $ln(Y_j)$



Note: Figures A.10a and A.10b investigate pre-trends for inverse hyperbolic sine of the market share of Chinese exports and log GDP in countries excluding Sudan and South Sudan. To mitigate typical concerns arising in the difference-in-differences designs, these figures investigate dynamic patterns around the time when the OAPI countries ratified the international trademark agreement, revealing no differential trends in the months preceding the agreement.

Table A.1: Extensive and Intensive Margins excluding Three Countries

Dependent Variables	Export Dummy			Market Share	Trademark Dummy	ln(Price)	ln(Ply Rating)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OAPI x January 2014 - January 2015	0.0000964	0.000260	0.0188	0.00103	0.0122	0.00409	0.000733
	(0.000569)	(0.00153)	(0.0227)	(0.00154)	(0.0199)	(0.0152)	(0.0258)
OAPI x February 2015	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	-0.000261	-0.0000380	0.0124	-0.000539	0.0175	-0.0128	0.0358
	(0.000593)	(0.00155)	(0.0223)	(0.00197)	(0.0282)	(0.0218)	(0.0323)
OAPI x January 2016 - December 2016	-0.00262***	-0.00510***	-0.0782***	-0.00111	0.198***	0.0766***	0.205***
	(0.000694)	(0.00181)	(0.0227)	(0.00222)	(0.0545)	(0.0193)	(0.0642)
OAPI x January 2017 - December 2017	-0.00364***	-0.00662***	-0.101***	-0.00158	0.255***	0.0738***	0.243***
	(0.000918)	(0.00184)	(0.0230)	(0.00245)	(0.0575)	(0.0156)	(0.0672)
Destination X Exporter FE	X	X	X	X	X	X	X
Time FE	X	X	X	X	X	X	X
Observations	4078368	1515312	106368	106368	140925	140925	122777

Note: Country-clustered standard errors are in parentheses. In Columns (1)-(4), I consider three observation patterns: (i) all possible combinations of the destination-export pairs in Column (1), (ii) the set of the destination-export pairs on which Chinese exporters exported their products to at least one country before accession in Column (2), and (iii) the set of destination-exporter pairs, which existed before March of 2015 in Columns (3) and (4). In Columns (5)-(7), the observations are the set of destination-exporter pairs in which Chinese exporters exported their products before and after March 2015. Export dummy is a dummy variable which takes 1 if exporter i exports its product to country c at time t. Market share represents the share of exporter i in country c at time t, out of the total Chinese exporters. Trademark dummy is a dummy variable which takes 1 if exporter i uses a trademark in the transaction exported to country c at time t. Price is the unit price of the transaction exported to country c at time t by exporter i. Ply Rating is the ply rating of the transaction exported to country c at time t by exporter i. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table A.2: Heterogeneous Impacts of Chinese Exporters by Their Market Shares Excluding Three Countries

Categorization	Market Share			
	(1)	(2)	(3)	(4)
Dependent Variables	Market Share	Trademark Dummy	ln(Price)	ln(Ply Rating)
OAPI x January 2014 - January 2015	-0.000182	-0.00308	0.0223	0.00847
	(0.00458)	(0.0137)	(0.0192)	(0.0433)
OAPI x January 2014 - January 2015 X Above Median	0.00248	0.0538	-0.0360	0.00657
	(0.00854)	(0.0414)	(0.0253)	(0.0558)
OAPI x February 2015	0	0	0	0
	(.)	(.)	(.)	(.)
OAPI x February 2015 X Above Median	0	0	0	0
	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	-0.00237	-0.0284	0.00224	-0.00345
	(0.00423)	(0.0187)	(0.0228)	(0.0482)
OAPI x March 2015 - December 2015 X Above Median	0.00371	0.107***	-0.0351	0.0712
	(0.00804)	(0.0399)	(0.0409)	(0.0485)
OAPI x January 2016 - December 2016	-0.00940**	0.0810***	0.0432**	0.113**
	(0.00422)	(0.0193)	(0.0187)	(0.0471)
OAPI x January 2016 - December 2016 X Above Median	0.0168**	0.249**	0.0629*	0.164**
	(0.00801)	(0.116)	(0.0365)	(0.0728)
OAPI x January 2017 - December 2017	-0.0123***	0.148***	0.0436**	0.142***
	(0.00412)	(0.0326)	(0.0205)	(0.0516)
OAPI x January 2017 - December 2017 X Above Median	0.0216**	0.228*	0.0551**	0.199**
	(0.00865)	(0.126)	(0.0272)	(0.0781)
p-value for the sum of coefficients in 2016	0.139	0.004	0.002	0.002
p-value for the sum of coefficients in 2017	0.108	0.002	0.00001	0.0003
Destination X Exporter FE	X	X	X	X
Time FE	X	X	X	X
Above Median X Time FE	X	X	X	X
Observations	106368	140925	140925	122777

Note: Country-clustered standard errors are presented in parentheses. In Column (1), I consider the set of the destination-export pairs on which Chinese exporters exported their products to at least one country before accession. In Columns (2)-(4), the observations are the set of destination-exporter pairs in which Chinese exporters exported their products before and after March 2015. Market share represents the share of exporter i in country c at time t, out of the total Chinese exporters. Trademark dummy is a dummy variable which takes 1 if exporter i uses a trademark in the transaction exported to country c at time t. Price is the unit price of the transaction exported to country c at time t by exporter i. Ply Rating is the ply rating of the transaction exported to country c at time t by exporter i. Above Median is a dummy variable which takes 1 if market share of exporter i at country c in 2014 is above the median by each country. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.

Table A.3: Extensive and Intensive Margins with Exporter × Time FE

Dependent Variables	Export Dummy			Market Share	Trademark Dummy	ln(Price)	ln(Ply Rating)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OAPI x January 2014 - January 2015	-0.0000913	-0.000246	0.000285	0.000332	0.00109	-0.00973	-0.00180
	(0.000610)	(0.00164)	(0.0265)	(0.00259)	(0.0117)	(0.0104)	(0.0266)
OAPI x February 2015	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)
OAPI x March 2015 - December 2015	-0.000571	-0.000826	-0.0107	-0.000113	-0.00178	-0.000790	0.00779
	(0.000674)	(0.00174)	(0.0268)	(0.00329)	(0.00827)	(0.0121)	(0.0271)
OAPI x January 2016 - December 2016	-0.00280***	-0.00556***	-0.0883***	0.00156	0.0996***	0.0747***	0.105**
	(0.000751)	(0.00193)	(0.0243)	(0.00303)	(0.0232)	(0.0149)	(0.0426)
OAPI x January 2017 - December 2017	-0.00374***	-0.00695***	-0.0910***	0.00213	0.164***	0.0571***	0.181***
	(0.000920)	(0.00188)	(0.0238)	(0.00320)	(0.0222)	(0.0115)	(0.0439)
Destination X Exporter FE	X	X	X	X	X	X	X
Exporter X Time FE	X	X	X	X	X	X	X
Observations	4318272	1604448	113856	113856	156188	156188	137347

Note: Country-clustered standard errors are presented in parentheses. In Columns (1)-(4), I consider three observation patterns: (i) all possible combinations of the destination-export pairs in Column (1), (ii) the set of the destination-export pairs on which Chinese exporters exported their products to at least one country before accession in Column (2), and (iii) the set of destination-exporter pairs, which existed before March of 2015 in Columns (3) and (4). In Columns (5)-(7), the observations are the set of destination-exporter pairs in which Chinese exporters exported their products before and after March 2015. Export dummy is a dummy variable which takes 1 if exporter i exports its product to country c at time t. Market share represents the share of exporter i in country c at time t, out of the total Chinese exporters. Trademark dummy is a dummy variable which takes 1 if exporter i uses a trademark in the transaction exported to country c at time t. Price is the unit price of the transaction exported to country c at time t by exporter i. Ply Rating is the ply rating of the transaction exported to country c at time t by exporter i. OAPI member countries include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Togo.
* Significant at the 10%. ** Significant at the 5%. *** Significant at the 1%.