Foreign Competition and New Product Creation: Evidence from Trademark Data*

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Abstract
We examine the effect of foreign competition on firms' new product creation. Using a novel dataset on firm-level trademark registrations in the U.S., we document a negative association between import competition in an industry and the registration for product trademarks by firms in the industry. The negative association is more pronounced when firms are operating in more competitive industries, when firms are more financially constrained, and when firms' revenue sources are less diversified. Further analysis indicates that firms tend to reduce low-value trademarks in response to an intense foreign competition. Overall, our paper reveals the real effect of foreign competition on firms' new product development.

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1. Introduction

Defined as one type of innovative activity, corporate product creation refers to firms' development and launch of new goods and services in the product market. Existing academic research (e.g., Faurel et al., 2018; Hsu, Li, and Nozawa, 2018; Hsu, et al., 2018) widely uses firms' registrations for trademarks, particularly product trademarks, as a proxy for firms' product creation. Different from firms' patenting activities, corporate trademarking has two distinct features. First, unlike patents which cluster in certain high patent industries, trademarks are used in a much broader range of industries (Faurel et al. 2018; Hsu et al., 2019). Figure 1 shows the distribution of patents and trademarks granted to U.S. public companies across industries from two digit SIC code 20-30.[1] Second, patents are created in the earlier stages of the innovation process to protect firms' inventions. Trademarks, however, involve the commercialization of these inventions in new products and services, and thus are the output at the end of the innovation process. As such, corporate trademarking is more susceptible to product market conditions.

[Insert Figure 1 about here]

Previous literature documents that trademarks plays an important role in facilitating firms' long-run growth. For example, several studies, e.g., Greenhalgh and Rogers (2006, 2007) and Sandner and Block (2011), show a positive association between firm value and a firm's trademark output. Some studies also find that trademarks improve firms' financial performance (Krasnikov, Mishra, and Orozco, 2009) and productivity and employment (Greenhalgh et al., 2011), and alleviate firms' financial frictions by serving as collaterals for additional debt capacity (Loumioti, 2011; Larkin, 2013; Chiu, Hsu, and Wang, 2019). Although these studies highlight corporate trademarking as an important strategy for firms to maintain product market competitiveness and enhance long-run growth, research on factors that affect corporate trademarking on a large scale

[1] Number of new trademark registration per year ranges from 6.836 for Miscellaneous Manufacturing (SIC code 39) to 0.851 for Primary Metal Industries (SIC code 33) while patents granted per year ranges from 24.030 for Petroleum & Coal Products industry (SIC code 29) to 0.382 for Leather & Leather Products (SIC code 31). Across all 2-digit SIC, trademarks distribute evenly while patents are concentrated in specific industries such like Petroleum & Coal Products (SIC codes 29) Transportation Equipment (SIC code 37), Chemical & Allied Products (SIC code 28). An untabulated result show that top three most patenting industries represent more than 61% of patent sample while the number for top three most trademarking industries is about 27% of trademark sample. In addition, high patent producing industries are not necessarily high trademark producing industries and vice versa. For example, high patent industry like Petroleum & Coal Products (SIC code 29) produce low trademarks while high trademark industry Miscellaneous Manufacturing produce low patents (SIC code 39).

is still scarce due to data limitation. This is in strong contrast with existing research on patents. Since the recent release of the U.S. Patent and Trademark Office (USPTO hereafter) Trademark Case Files Dataset, several studies start to look into this issue.[2] In this paper, we study the effect of foreign competition on U.S. firms' product creation by examining how import penetration into an industry shapes incentives of firms in the industry to trademark. This query is inspired by not only the natural link between product creation and product market conditions but also the rapid expansion of international trade as a result of globalization.[3] To the best of our knowledge, our paper is the first to bridge the literature gap by exploring the effect of product market competition on the output of firms' product development.

[Insert Figure 2 about here]

The relation between foreign competition and firms' product trademark development, however, is unclear ex ante. In this paper, we propose two competing hypotheses concerning the effect of foreign competition and firms' product creation. Our first hypothesis postulates that a higher level of import penetration in an industry enhances product creation of firms in the industry. Previous literature (e.g., Caves and Porter, 1977) shows that intense competitive pressure can motivate firms to adopt more aggressive corporate policies so as to enhance their competitive position and deter the entry or expansion of their competitors. For example, Frésard and Valta (2016) documents that in react to product market threat, firms strategically cut their investments in situations where more investments signal them being soft. Flammer (2015) finds that domestic firms invest more in corporate social response (CSR) in response to foreign competition because CSR could serve as a "soft" trade barrier disadvantaging foreign competitors. Cookson (2018) shows that to deter competitor's entry, incumbent firms in American casino industry increase investment in physical capacity when they are threaten by an entry plan from their competitors.

[2] Many studies investigate factors that affect firms' trademarking activities. For example, the contributes of information technology investments on trademark holdings (Gao and Hitt, 2012), the impact of corporate venture capital funding on trademark output (Uzuegbunam, Ofem, and Nambisan, 2014), the influence of market structure, customer type, and involvement of a venture capitalist on start-up firms' choice of patents versus trademarks (De Vries, Pennings, and Block, 2017), the effect of CEO compensation on firms' trademark creation (Faurel el al., 2018), the effect of mergers and acquisition on trademark registration and cancellation (Hsu, et al., 2019), and the option trading volume on firm's new product trademark activities (Hsu, Li, an Nozawa, 2019).

[3] As Figure 2 demonstrates, global trade has grown substantially over the past 30 years, both in nominal terms and as a percentage of GDP. Specifically, international trade have reached to an amount of $3,000,000 million in 2017 from less than $500, 000 million in 1980, which is a more than 500% increase over less than forty years. In addition, the contribution of trade on GDP is also increasing steadily, as the ratio of total trade to GDP climbs to 0.16 in 2017 from about 0.1 in 1980, highlighting the importance of globalization to world economic growth.

To escape price competition, firms often adopt a product differentiation strategy with a focus on superior product quality and related investments in brand equity (Srinivasan, Lilien, and Rangaswamy 2008; Bloom, Draca, and Van Reenen, 2016; Lie and Yang, 2018). By creating these new products, firms can distinctly signal their innovativeness and competitiveness in the product market and effectively threaten their competitors.

By contrast, our second hypothesis argues that a higher level of foreign competition dampens firms' product creation. Schumpeterian model argues that competition reduces firms' profits and weakens their incentives to invest (Dasgupta and Stiglitz, 1980). For example, Xu (2012) finds that import penetration weakens domestic firms' profitability. Autor et al. (2017) document negative effect of Chinese competition on U.S. firms' global sales, profit growth, R&D expenditure and advertising expenses. Hoberg, Phillips and Prabhala (2014) show that firms reduce payouts and increase cash holding when they face competitive threats from rivals. Moreover, increased product market competition can create greater uncertainties for firms' future prospects (Fudenberg and Tirole, 1984). Gaspar and Massa (2006) show that competition increases firm's profit volatility and uncertainty of firm's cash flow under competitive environment. Similarly, Irvine and Pontiff (2009) finds relation between idiosyncratic stock return volatility and fundamental volatility and connects it with intense economy-wide competition. Evidence provided by Valta (2012) showing that competition has a significant positive effect on firms' bank debt cost, since competition would affect riskiness of their business environment and banks consider it in pricing loans. Hence, the competitive pressure can lead firms to make more conservative corporate decisions. Product creation is a process that involves high risk (Faurel et al., 2018). Specifically, the development of new product is resource demanding and time consuming. However, investments in resources and time do not ensure success of product development. It is highly possible that the product turns out to be a failure during development process, which would may result in huge cost for the developer.[4] Furthermore, even if the product was successfully developed, it is still possible that customers may not be favored for the product thus the product cannot contribute to developer's profits. Faurel et al. (2018) conjecture that new product development is

[4] An anecdotal evidence on innovation of drug suggesting the risk of product development: after years of joined endeavor and large amount of spending, biotechnology giant Biogen Inc. and Eisai Co. claimed on March 21, 2019 that their Alzheimer drug failed to be effective thus they discontinued the development. The day witnessed Biogen's stock price plummeted as much as 29 percent, wiping out about $18 billion of its market value. See: https://www.bloomberg.com/news/articles/2019-03-21/biogen-halts-study-of-alzheimer-s-treatment-as-study-falls-short.

a risky innovation by showing product development contributes to firm's earnings volatility. As such, fierce competition from domestic firms' foreign rivals negatively affects firms' incentives to develop new products.

Furthermore, import penetration by foreign competitors is not expected to have a homogenous effect on all firms. Firms with certain characteristics are more susceptible to foreign competition and hence adopt more conservative corporate policies. First, firms operating in more competitive industries have lower profit margin and cash flows, and thus are less capable of competing against their foreign rivals (Valta, 2012; Hoberg and Phillips, 2010; Hoberg, Phillips, and Prabhala, 2014). Second, prior literature (Frésard and Valta, 2016; Hoberg and Phillips, 2016; Hombert and Matray, 2018) shows that it is difficult for firms in less innovative industries and firms making homogeneous products to distinguish their products from their competitors and hence signal the superior quality of the products. As a result, these firms tend to reduce the fight with their foreign rivals. Third, financially constrained firms are lack of financial resources to support their competition in the product market. This weakens these firms' incentives to make investment, in particular risky investment, which increases firms' operation uncertainties. (Whited and Wu, 2006; Hadlock and Pierce, 2010; Frésard, 2010). Fourth, firms with diversified revenue sources are less likely to be affected by the competitive pressure in one industry (Denis, Denis, and Yost, 2002; Frésard and Valta, 2012). Collectively, to the extent that product creation as a product differentiation strategy involves high risk, the negative effect of import penetration on firms' new product trademark registrations is strengthened by firms in more competitive industries, firms making more similar products, more financially constrained firms, and firms having diversified revenue sources.

Previous studies provide evidence that competitive pressure from the product market plays an important disciplinary role in reducing firms' agency issues. For example, Entering of competitors could provide additional information, thus competition affects managers through relative performance evaluation (Holmstrom, 1982; Nalebuff and Stiglitz, 1983). Additionally, competition disciplines managers through possible liquidation, managers need to work hard to keep their job and avoid liquidation (Schmidt, 1997). Giroud and Mueller (2010) finds evidence supporting that competition reduces opportunity of managers to enjoy quiet life. Dasgupta, Li, and Wang (2017) shows that when foreign competition become more intense, firms will replace low efficient CEOs by higher skill ones and those firms experience subsequent performance improvement. Results in Chhaochharia et al. (2017) indicate that competition could also curb managers' overinvestment, since low competition industries decrease more investments and R&D after Sarbanes–Oxley Act, compare with firms in high competitive industries. In the same vein, we expect that managers of firms facing increased competition due to the entry of their foreign rivals optimize their product development strategy by refocusing on products that can create higher economic value and abandon those associated with lower economic value in the long run. In sum, the effect of foreign competition on firms' product creation reflects the tension among various forces and merits an empirical investigation.

Using a large sample of U.S. public firms covered by the USPTO Trademark Case File Dataset, we examine the association between foreign competition and firms' product creation. Specifically, we follow previous literature (e.g., Faurel et al. (2018), Hsu, Li, and Nozawa, 2018 and Hsu, et al., 2018) and measure the output of new product creation using the number of product trademarks registration. We classify a trademark as product trademark according to descriptions of the trademark from the USPTO case file, for example, whether the trademark is designed with test, the number of words of the test, and type of tests[5]. Similar to earlier studies (e.g., Bertrand, 2004; Frésard, 2010; Xu, 2012), we define foreign competition as import penetration into an industry constructed using data from Peter Schott's website and NBER-CES Manufacturing Industry database. Our main results show that import penetration into an industry is negatively associated with firms' product trademark creation in the industry, which is consistent with the view that foreign competition dampens corporate product creation. The association is not only statistically significant but also economically meaningful. For example, an increase in import penetration from the 25th percentile to the 75th percentile leads to a 6.62% reduction in new trademark registrations relative to its mean value. Furthermore, we conduct a battery of checks to ensure our main results are robust to alternative model specifications and to controlling for potential omitted variables related to firm's corporate governance, stock performance and industry shocks.

To establish the causal relation between foreign competition and firms' product creation, we adopt two empirical strategies. In the first strategy, we follow Xu (2012) and perform a two-stage least squares (2SLS) regression using lagged tariff rates and lagged industry specific foreign exchange rates as instruments. Both instrumental variables are orthogonal to individual firm-level

[5] We provide more details in section *3.1. Measuring trademarks*.

characteristics, since they are less likely to reflect individual firm's choice. The baseline results still remain. In the second strategy, we follow Frésard and Valta (2016) and perform a difference-in-differences (DID) test by employing large tariff reductions in an industry as a quasi-natural experiment. Specifically, we examine the effect of major industry-level tariff reduction across the sample period on the number of new trademarks as well as new product trademark registration. We find that firms' product creation significantly declines after an industry experiences a large cut in import tariffs compared to those that have not experienced a large tariff cut. Moreover, to mitigate the reverse causality concern, we also examine the dynamics of firms' product creation around the tariff cut. The results show that the reduction of product creation only appears after the tariff cut. Collectively, these results confirm a causal effect of foreign competition on product creation.

Next, we partition our sample according to a number of industry and firm characteristics to explore how the negative effect of foreign competition on product creation varies across firms. We find that the effect of foreign competition is stronger when firms operate in highly competitive environments (i.e., industries with high level of product market concentration and firms with high level of product fluidity). These results confirm the role of foreign competition in exacerbating firms' competitive threat. We further partitioning our results according to product homogeneity. We find that the negative effect from foreign competition on product creation holds in firms and industries where products are homogeneous. These findings support our arguments that foreign competition leads managers to reduce the development of new products when these products are lack of competitiveness. In addition, we show that the negative effect of foreign competition is more pronounced when firms are more financially constrained and when firms have poorly diversified revenue streams, indicating that firms with limited financial resources and firms highly reliant on domestic markets are less capable of making sufficient investment in the production process to escape fierce competition from their foreign rivals.

Apart from the cross-sectional difference in results, we design several tests to examine the effect of intensified foreign competition on the economic importance of product creation. Previous literature (e.g., Millot, 2009; Hsu, Li, and Nozawa, 2018) show that firms are more (less) likely to renew high (low) value trademarks.[6] We utilize this characteristics of trademark to proxy for product quality and value. Trademarks that are in use after the first 5-year interval and then renewed after the subsequent interval can be defined as valuable and successful. In contrast, trademarks that are cancelled or not renewed can be regarded as not valuable and thus unsuccessful (Millot, 2009; Hsu, Li, and Nozawa, 2018). We examine the effect of import penetration on successful and failed trademarks. Our results show that firms reduce the development of new products that fail to be renewed but not those that are successfully renewed in response to intensified product competition from their foreign rivals. These results suggest that foreign competition incentivizes firms to develop new products with higher economic value but abandon those with lower economic value, resulting in a more focused scope of investment on product development. This finding highlights the beneficial role of foreign competition in improving firms' resource allocation in new product development.

Finally, we examine the impact of the source of the foreign competition on firms' product creation. In doing so, we follow previous literature (e.g., Bernard, Jensen, and Scott, 2006; Lu and Ng (2013); Li and Zhou, 2017) to decompose the import competition from foreign countries into the competition from high wage and low wage countries, respectively. Moreover, we also decompose the important competition into China and other countries, given the significant volume of the Sino-U.S. trade.[7] We then perform a horse-race test and investigate the effects of the two competition measures on firms' product trademarks. The results show that the negative effect is primarily driven by the import competition from high wage countries instead of low wage countries and by the import competition from countries other than China. These results imply that U.S. firms are more likely to change their product development strategy when facing competition from countries with more competitive products but do not seem to adjust their new product development process when imported foreign products are from countries with less product market

[6] The USPTO requires the trademark holder to reaffirm that the trademark is in use after 5 years and then every 10 years. If the trademark is not renewed by the firm, the trademark is cancelled automatically. If the firm renew its trademarks after ten years of trademark registration, the trademarks are considered as successful trademarks.

[7] Total trade amount between U.S. and China reached $734.1 billion in 2018, of which $557.7 billion was imports (both goods and services). Imports from China accounted for 21.2% of total imports in U.S. in 2018. U.S. imported $539.5 billion goods from China in 2018, making China the largest good supplier for U.S. The amount goods imported from China increased 6.7% from 2017, 59.7% from 2008 and up to 427% from 2001. See trade facts between U.S. and China issued by U.S. Trade Representative: https://ustr.gov/countries-regions/china-mongolia-taiwan/peoples-republic-china.

competitiveness or more price competitive mainly as a result of lower labor costs. These results further support our main conclusion that firms only passively adjust their product development strategy when the competition from their foreign rivals is tangible.

Our paper contributes to the existing literature in three important ways. First, our paper adds to the literature on the relation between foreign competition and the corporate investment. Previous literature studies the effects of product market competition on firms' capital expenditures and shows that firms in industries exposed to greater foreign competition reduce their capital expenditures (Frésard and Valta, 2016). In addition to conventional investment, several studies (e.g., Bloom, Draca, and Van Reenen, 2016; Autor et al., 2017; Lie and Yang, 2018) also investigate the impact of foreign competition on firms' patenting activities, and generate mixed results.[8] We extend this literature by showing that product market competition induces firms' disincentives in developing new products, which is an important type of innovative investment but yet underexplored. Our results thus shed light on the role of competitive pressure in shaping firms' product development strategy. Second, our paper contributes to the broader literature on the economic consequences of foreign competition at the corporate level. Some studies show that foreign competition plays an important governance role in disciplining managers' misbehaviors. For example, firms will force low efficient CEOs to leave (Dasgupta, Li, and Wang, 2017), terminate value destroy acquisitions (Alimov, 2017) and payout excess cash as dividend (Grullon, Larkin, and Michaely, 2018). Several studies also reveal the negative externalities of foreign competition in firm policies. For example, foreign competition incentive firms to do conduct tax avoidance (Chen and Lin, 2018), engage in earnings management and financial restatements (Lin, Officer, and Zhan, 2015). In addition to a negative effect on corporate investment, prior studies also show that intense product market competition from foreign rivals decreases domestic firms' management forecasts (Huang, Jennings, and Yu, 2017), exacerbates managers' incentives to withhold bad news (Li and Zhan, 2018), and reduces the information transparency and thus stock liquidity (Atawnah et al., 2018). Different from these papers, although our main results show a

[8] For example, Bloom, Draca, and Reenen (2016) finds that competition from Chinese imports is associated with technological upgrade within European firms. Autor et al. (2017) documents negative impact of Chinese competition on U.S. innovation activities. Chakravorty, Liu and Tang (2017) shows positive effect of Chinese import on U.S. innovation while Lie and Yang (2018) presents that innovation of U.S. firms first increase and then decline after years of competition from China. Li and Zhou (2017) concludes that competition from high wage countries induce more innovation while competition in low wage countries discourage innovation in U.S. firms. Shu and Steinwender (2017) provides a detailed summary for the impact of trade liberalization on firm innovation across countries.

significant reduction in new product creation as a result of more intense foreign competition, further analysis reveals that firms under greater competitive pressure from foreign rivals shift their product development strategy to the one that focuses on high value products. Our paper therefore suggests that foreign competition is associated with enhanced efficiency in firms' resource allocation.

Furthermore, our paper also speaks to the recent literature on the consequences of import competition from emerging countries, in particular China (Autor et al., 2017; Lie and Yang, 2018; Chen, Lin, and Shao, 2018). Prior literature documents the substantial economic dislocations caused by the surge of imports by the U.S. from China, our paper finds that imports from low wage countries, including China, has a negligible impact on corporate product creation, suggesting that import competition from high wage countries is far more consequential in terms of corporate product development strategy.

The remainder of the paper is structured as follows. Section 2 provides the basics of trademarks and related literature. We discuss the sample and variables in Section 3. Section 4 discusses the main empirical findings. Section 5 presents additional results. Section 6 concludes.

2. Trademark basics and related literature

2.1. An introduction of trademarks

The definition of a trademark by United States Patent and Trademark Office (USPTO) is "*a brand name. A trademark or service mark includes any word, name, symbol, device, or any combination, used or intended to be used to identify and distinguish the goods/services of one seller or provider from those of others, and to indicate the source of the goods or services*." The emphasis on product, i.e., good and service, is consistent with a broader definition of innovation provided by Organization of Economic Innovation (OECD).[9] Trademarks are distinct from other forms of intellectual property, as they are legally required to be used in commerce suggesting a close link with new product development. When a firm plans to launch a new product line, it will file and register a new trademark to market the new product line so that it can start to establish a brand name and prevent others from using similar marks to confuse customers (Millot, 2009). Indeed, Gao and Hitt (2012) report that the consensus amongst attorneys who specialize in

[9] See OECD (2005): "*An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*".

trademark law, trademark officers responsible for managing trademarks for their firms, and officers of the U.S. Patent and Trademark Office (USPTO) who they interviewed, is that trademark applications are strongly associated with new product development. Trademarks are therefore more directly related to product development than, for example, patents, which have attracted the vast majority of attention of the empirical literature dealing with product market innovation.

Trademark needs to be renewed with USPTO after five years from its initial registration, and then be renewed periodically for every ten years from its initial registration. To successfully renew his trademark, owner should prove the trademark is in continued use and pay the corresponding renewal fee, otherwise the trademark will be cancelled automatically or expired.

A trademark could act as marketing role for firm's product as well. To highlight trademark's function of identifying new product creation, recent studies (e.g., Faurel et al., 2018; Hsu, Li, and Nozawa, 2018; Hsu, et al., 2018) distinguish product trademarks from marketing trademarks.

3. Data, sample, and variable construction

We obtain data from various sources. Trademark data are collected from the United States Patent and Trademark Office (USPTO) Trademark Case File Dataset (TCFD). Import and export data are downloaded from Peter Schott's webpage, while tariff rate data are obtained from Laurent Frésard's webpage.[10] Finally, financial variables are from Compustat and CRSP. Due to the limited coverage of the import penetration data, our sample is limited to manufacturing industries (SIC codes 2000 to 3999). We keep in our sample firms without trademark registration during the same period, but exclude firm-year observations that are not available. Our final sample consists of 42,265 firms over the period 1977 to 2010.

3.1. Measuring trademarks

We collect data on a firm's trademark registrations from the TCFD. We require that trademarks applied for must be eventually registered with the USPTO and have at least one U.S. listed firm as the owner. Since the TCFD only provides trademark owners' names and locations, we must manually match the names obtained from TCFD to firms in the Compustat database. We employ a name matching algorithm for this purpose, and check the accuracy of these matches manually.

[10] See import and export data from http://faculty.som.yale.edu/peterschott/ and tariff rate data in https://people.lu.usi.ch/fresal/, respectively.

We construct a number of variables capturing the trademark registrations of a given firm. Our firm measure (*TM*) captures the total number of new trademarks that a firm registered in a given year. While this simple and crude measure captures the trademarking activity of a given firm, it does not distinguish between the different types and uses of trademarks. As noted by Faurel et al. (2018), not all trademarks registered by firms are related to product development, with many trademarks being registered exclusively for marketing purposes. Since our study focuses on product development, we need to separate product trademarks and marketing trademarks from total trademarks registered. Our classification scheme follows Faurel et al. (2018) and Hsu et al. (2018).

For the purposes of distinguishing between product trademarks and marketing trademarks, we rely on two variables in the USPTO case file: *mark drawing code* and *mark identification characters*.[11] During classification, there could be several scenarios. To be more specifically, first, for trademarks designed without text, we classify them as marketing trademarks. Second. we attribute trademarks that designed with stylized text or with text that have four or more words to marketing trademarks, as those trademarks are more likely to be an advertising slogan[12]. Third, trademarks that are designed with standard characters with fewer words than four are classified as product trademarks. Fourth, trademarks that have stylized text or designed with text and fewer than four words are classified into product trademarks, if the text of the trademark firstly appears in one trademark class. Then we classify all subsequent trademarks that registered in the same class as marketing trademarks. Finally, trademarks that have standard text and contain four words or more are defined as marketing trademarks.

Following this classification scheme, we define two variables which identify the number of product and marketing trademarks applied for, and subsequently granted to firms in a calendar year. The first variable, defined as *PrdTM*, is the number of product trademarks registered in a given year by a given firm. The second, defined as *MktTM*, is the number of marketing trademarks registered in a given year by a given firm. The sum of *PrdTM* and *MktTM* is always equal to *TM*.

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[11] According to TCFD, *mark drawing code* identifies whether a filed trademark contains standard character, stylized text, with or without text, while *mark identification characters* provides specific letters or any texts for the applied trademarks.

[12] We select the number of words threshold to be four similar to Hsu et al. (2018), who argues that this threshold balances type I and type II errors.

In our empirical analysis, we not only examine the link between import competition and trademark creation, but also examine the eventual value and success of trademarks. For the purposes of capturing the relative value of trademarks, we track the failure and survival rates of newly generated trademarks, since Millot (2009) argues that high value trademarks tend to be renewed. We concentrate on the long term renewal rate when evaluating trademark success or failure, following Crass, Czarnitzki, and Toole (2019) who show that trademark payoff takes over a decade to reach its maximum. For the purposes of determining whether a trademark succeeds or fails, we use trademark cancellation date, renewal date and status code date provided by TCFD. Specifically, for trademarks that registered before November 16, 1989, we define a trademark as failed if the trademark does not get renewal 21 years after its registration. For trademarks registered after November 16, 1989, we treat trademark as failed if the trademark does not get renewal 11 years after registration.[13] For trademarks that are not belong to failed trademarks, we deem them as successful trademarks.

Following the classification scheme, we are able to define three variables that capture whether trademarks produced by a given firm in a given year are valuable or not. The first measure, defined as $PrdTM_{fail}$, captures the number of trademarks that a given firm registered for in a given year that eventually fail (i.e., they are either cancelled or are not renewed). The second measure, defined as $PrdTM_{success}$, captures the number of trademarks that a given firm registered for in a given year that are eventually successful. The third measure, defined as $PrdTM_{fail}$ *rate*, captures the ratio of failed trademarks to total product trademarks registered for by a given firm in a given year.

3.2. Measuring foreign competition

Following Bernard, Jensen and Schott (2006), Lu and Ng (2013) and Li and Zhou (2017), we calculate the import penetration ratio as imports over domestic consumption, which is computed as domestic production plus imports minus exports for each four-digit SIC industry each year and take natural logarithm of one plus calculated import penetration ratio (*ImpPen*). We

[13] We use different cut-off based on 1989 because the second round of renewal period changes from 20 years to 10 years after 1989 (Graham et al., 2013). The Trademark Manual of Examining Procedure (TEMP) reads as follows: "*The Trademark Law Revision Act of 1988, Pub. L. No. 100-667, 102 Stat. 3935, which took effect on November 16, 1989, amended §9 of the Trademark Act of 1946 to reduce both the duration of registration and the term of renewal from twenty to ten years. All registrations issued or renewed on or after November 16, 1989 are issued or renewed for a ten-year period.*"

collect data on U.S. imports and exports from Schott's International Economics Resource Page at the Yale University. The import and export data are available at four-digit SIC (from 2011 to 3999). Domestic production is measured as value of shipment produced domestically. Value of shipment for each industry are obtained from NBER-CES Manufacturing Industry Database (Becker, Gray and Marvakov, 2016).[14]

In our further analysis, we examine whether the origin of import competition is an important factor influencing the way in which firms alter their trademarking activity. For this purpose, we first make distinguish of imports from low-wage and high wage countries and define additional variables that capture the source of import competition. This first alternate measure captures an industry's exposure to imports from low-wage countries as the share of imports from low-wage countries to total imports. Following Bernard, Jensen and Schott (2006), we define countries as low wage if their GDP per capita in a year is less than 5% of the U.S. per-capita GDP. This cutoff captures an average of 50 countries per year, a set of countries that includes China and India, as well as most African nations. Second, as China become increasingly important in international trade and is attracting researcher's attention (Acemoglu et al., 2016; Lie and Yang, 2018 and Hombert and Matray, 2018), we then construct an additional measure of import penetration from China. This variable captures the portion of total industry level imports made up by imports from China.

3.3. Control variables

To isolate the effect of foreign competition on firms' product and marketing development, we control for a large set of firm characteristics that may potentially affect firms' product and marketing development according to prior literature. In particular, Faurel et al. (2018) find that advertising intensity, R&D intensity, firm size, and growth opportunity have a positive and significant impact on trademark creation among S&P 1500 firms. We hence include in the regressions proxies for these determinants, i.e., advertising expenses scaled by total assets (*Adv/Assets*), R&D expenses scaled by total assets (*R&D/Assets*), the natural log of assets (*Ln* (*Assets*)), market-to-book ratio (*MB*) and sales growth (*Sales Growth*). Also included in the regressions are the net plant, property, and equipment over the total assets (*Tangibility*) and capital

[14] This version of The NUBR-CES Manufacturing Industry Database contains U.S. manufacturing sector from 1958 to 2011. The data used come from various sources including U.S. Census Bureau, the Bureau of Economic Analysis (BEA) and the Bureau of Labour Statistics (BLS) (Becker, Gray and Marvakov, 2016).

expenditure over the lag of one period total assets (*Capex*) to account for the effect of capital intensity and capital investment. We also include return on assets (*ROA*) as a proxy for operating profitability. Cash-to-assets ratio (*Cash/Assets*) and the leverage ratio (*Leverage*) are included to account for the effects of cash holdings and capital structure on firms' product and marketing development. To capture the effect of existing industrial competitive status, we include in the regressions the concentration ratio of each four-digit SIC industry (*HHI*). *HHI* is four-digit Compustat Herfindahl-Hirschman Index.

3.4. Descriptive statistics

We present the descriptive statistics for our main variables in Table 1. The average firm in our sample makes 2.735 trademark applications each year, of which 0.333 are marketing trademarks and 2.402 are product trademarks. There is nevertheless substantial variation in trademarking activity across firms, with the standard deviation on total trademarks being 10.412. Turning our attention to the explanatory variables, the average firm spends the equivalent of 1.4% of their assets on advertising and 4.3% of their assets on R&D. The natural logarithm of total assets of the average firm is 5.737, the market-to-book ratio is 2.745, sales growth is 6.3%, and 28.2% of total assets are made up of tangible assets. The average firm has a leverage ratio of 0.221, cash makes up 14.2% of total assets, ROA is 0.048, capital expenditure represents 7% of total assets, and the Compustat Herfindahl-Hirschman Index is 0.377.

[Insert Table 1 about here]

In this section, we explore the trademarking trends and patterns amongst publically listed firms in the manufacturing sector. We are specifically interested in comparing the trends and norms with respect to trademarking activity with patenting activity. In Table 2 we report the average number of trademarks registered for by firms in each 2-digit SIC code industry as well as the average number of patents. We divide trademarks into product trademarks and marketing trademarks. We visually present the descriptive statistics from Table 2 in Figure 1.

[Insert Table 2 about here]

4. Main findings

In this section, we report the baseline results on the association between import penetration and corporate trademarking activity. We supplement our OLS regression analysis with a robust set of additional results addressing endogeneity concerns. Specifically, we first include a battery of potential omitted variables and then we utilize an instrumental variables methodology, where we employ tariff rates and an industry foreign exchange index as our instruments, as well as use large tariff cuts as a quasi-natural experiment.

4.1. The baseline regression

We begin our empirical analysis with a parsimonious OLS model specification. We regress our three measures of trademark activity (*Ln*(1+*TotTM*), *Ln*(1+*PrdTM*), *Ln*(1+*MktTM*)) on *ImpPentration* and the full set of control variables discussed in sub-section 2.2 (denoted as X in equation 1). The regression model is estimated as follows:

$$Ln\left(1 + TM_{i,j,t}\right) = \alpha + \beta ImpPen_{j,t-1} + \gamma X_{i,t-1} + \theta Year_t + \lambda Firm_i + \varepsilon_{i,j,t} \qquad (1)$$

All explanatory variables are lagged by one year. To mitigate the concern that unobserved variables jointly correlated with trademark activity and import penetration are influencing our results, we control for firm and year fixed effects. Firm fixed effects control for all time invariant firm level characteristics, while year fixed effects account for macroeconomic conditions that affect all firms in a given year. We correct standard errors for clustering at the industry level, since our main explanatory variable is measured at the industry level.

[Insert Table 3 about here]

The results presented in columns (1) and (2) of Table 3 reveal that the coefficient on *ImpPen* is negative and statistically significant at the 1% level. This result suggests that import competition increases are associated with future decreases in trademarking activity. The effect is not merely statistically significant but also economically meaningful. For example, an increase in import penetration from the 25th percentile to the 75th percentile is associated with an increase in annual trademark applications of 0.18.[15] This represents a decline of 6.62% relative to the sample mean of *TotTM*. Interestingly, import competition is unrelated to *Ln*(1+*MktTM*), as evidenced by the statistically insignificant coefficient on *ImpPen*. Given the relatively small proportion of marketing trademarks compare with product trademarks, this finding is unsurprising. In the remainder of our

[15] Because $d[Ln(1+y)]/d[Ln(1+x)]=[(1+x)/(1+y)]\ dy/dx$, $dy=d[Ln(1+y)]/d[Ln(1+x)]\times[(1+y)/(1+x)]dx$. When quantifying the effect of the change in import penetration on the change in trademark registration, we increase import penetration from its 25th percentile (0.055) to the 75th percentile (0.289), so dx=0.234. The change in trademarks (dy) from its mean value (2.735) is then equal to -0.218×[(1+2.735)/(1+0.055)]×0.234=-0.181, which accounts for 6.62% of its mean value.

analysis, we concentrate exclusively on product trademarks, which the results in Table 3 indicate are the most sensitive to import competition.

4.2. Tests on endogeneity

Although we document a strong and negative association between foreign competition and new product trademark creation, our empirical specification does not consider the potential endogeneity issues. The important endogenous issue in our setting is omitted variable bias. The negative relation between that we observe may be spurious if some important variables that affect both new product creation and import penetration are omitted. To address this endogeneity concern, we first include variables controlling for potential omitted variables. Second, we adopt two strategies trying to address endogeneity issues. The first strategy is to implement a two-stage variable approach. Specifically, we adopt tariff rate and foreign exchange rate index as instrument variables for *ImpPen*. Our second strategy is to adopt difference-in-difference (DID) approach using large tariff reduction as exogenous events.

4.2.1. Controlling for omitted variables

We report a large set of robustness tests in Appendix A. In summary, we find consistent results when we employ alternative model specification and sample period. Specifically, a negative binomial regression with firm fixed effects, after limiting the sample to the post-1989 period. Our results are also unaffected by using aggregated trademarks in future three years as dependent variable. Results remained after excluding firm-years with no trademark registrations, after controlling for past trademark registrations and after controlling for trademark stock. Our results still robust after we control for patents granted, institutional ownership, stock return volatility and stock returns. We still find negative significance when we incorporate 2-digit SIC-year fixed effect to rule out industry shocks over time. Overall, the tests suggest that our main results are robust to alternative model specifications, variable definitions, as well as controlling for potential omitted variables

4.2.2. The instrumental variable approach

In this sub-section, we supplement our baseline results discussed in sub-section 4.1 with an instrumental variables methodology. In our instrumental variables analysis, we follow the extant literature and utilize two instrumental variables to capture the exogenous variations in import competition (Xu, 2012; Atawnah et al., 2018). Specifically, our first instrumental variable is lagged industry specific tariff rate (*Tariff*). Tariff rates are a direct factor influencing the level of foreign competition, since they form an entry barrier for foreign competitors (Helpman and Krugman, 1989; Bernard et al., 2006). At the same time, tariff rates as an instrumental variable meet the exclusion restriction, as they are orthogonal to corporate tax avoidance in the sense that they do not reflect choices by individual firms. Our second instrumental variable is industry specific foreign exchange rate index (*FX Index*). The exchange rate is positively correlated with import penetration, since higher exchange rate makes the goods cheaper in US dollars, which encourages imports. It also satisfies the exclusion restriction because, the dollar's exchange rates are determined by macroeconomic factors that affect its aggregate demand and supply, such as interest rates, inflation and the balances of payments between the US and its trade partners. At the same time, none of these macroeconomic factors is likely to be caused by individual firm-level characteristics.

We follow Feenstra (1996), Feenstra, Romalis, and Schott (2002), and Schott (2010), and calculate the annual ad valorem tariff rate as the duties collected by U.S. custom divided by the total Free on Board custom value of imports. We then calculate annual percentage change of the import tariff rate and compute the median industry change over the sample period. A detailed description of this database can be found in Feenstra et al. (2002) and Schott (2010). To construct the industry-level foreign exchange rate variable, we use the foreign exchange rates, expressed as the amount of foreign currency per US dollar. We first use the exchanging countries' consumer price indices to transform the raw exchange rates to real exchange rate. The exchange rate and consumer price index data are from the International Financial Statistics of the International Monetary Fund (IMF). For each three-digit SIC industry, we compute the source-weighted average of exchange rates across all countries exporting to the US in the base year of 1995. The weights are the share of each exporting country in total US imports in 1995. Finally, we divide the resulting exchange rates by one thousand to obtain the industry exchange rate index variable expressed in thousands.

[Insert Table 4 about here]

We present our instrumental variable results in Table 4. The first stage results are presented in column (2) of Table 4. The coefficient estimate on *Tariff* is positive and significant at the 1% level, while the coefficient estimate on *FX Index* is negative and significant at the 1% level. The positive sign on *Tariff* indicates that higher tariff rate decreases import competition while negative sign on *FX Index* suggests that the higher foreign exchange rate, the cheaper the foreign goods, and the higher level of import competition. The *F*-statistic of 10.87 with *p*-value of 0.00 rejects the null hypothesis that the two instrumental variables are jointly equal to zero. The results suggest that our instrumental variables are significantly associated with import competition and relevance condition for instrumental variables is valid.

We then replace *ImpPen* with predicted value of *ImpPen* in column (2) and conduct second stage regression. The results are presented in column (1) of Table 4. The coefficient estimate on instrumented *ImpPen* is negative and significant at the 1% level.[16] The Hansen *J*-statistic that tests over identifying restriction as well as zero correlation between the IVs and error tem is insignificant, with *p*-value of 0.64. The test indicates that our IVs are uncorrelated with error term of our model, thus satisfying the exclusion condition. In addition, we also conduct Anderson-Rubin (AR) test. The AR chi-square statistic is significant with *p*-value of 0.01, further indicating that our IVs estimates are robust to weak instruments.

Overall, the findings presented in Table 4 support our baseline results from Table 3, and suggests that the negative association between import competition and product trademark creation is causal.

4.2.3. Large tariff cuts as a quasi-natural experiment

Our second identification strategy involves employing large tariff cuts as a quasi-natural experiment, which allows us to more cleanly identify the causal effect of import competition on product trademark creation. Specifically, we follow Frésard and Valta (2016) and define large tariff reductions occurring in an industry-year when the negative tariff reduction is three times larger than the industry's absolute mean tariff change. In addition, to ensure firms that have experienced large tariff reductions (treated firms) are comparable with firms that have not experienced large tariff reductions, we therefore conduct propensity score matching (PSM) and select matched firms based on firm characteristics one year preceding the events. Specifically, for

[16] There are at least two reasons that can explain the fact that the IV estimation has a higher coefficient than the OLS estimate. First, the gap between the two estimators may be caused by the downward bias in the OLS estimates attributable to measurement errors (Li and Zhan, 2018; Angrist and Krueger, 2001). Second, OLS captures the overall average treatment effect (ATE), while the IV estimator captures the local average treatment effect (LATE). With heterogeneous treatment effects, LATE may differ from ATE (Card, 2001; Angrist and Krueger, 2001). For instance, firms with products more susceptible to competitions caused by tariff and exchange rate changes may have a larger effect on crash risk and thus IV estimates are larger. Angrist and Krueger (2001) emphasize that the local effects provide useful insights.

each treated firm, we select, with replacement, its nearest neighbor from the group of all the firms that operate in a different SIC code industry during the same year. Our matching variables follow Frésard and Valta (2016), who conduct matching based on assets, market-to-book ratio, leverage, cash holdings, and cash flow. We define a dummy variable, denoted as *Cut*, which equals to one if a given industry has experienced a tariff cut by time *t*. The regression model is estimated as follows:

$$Ln(1 + TM_{i,j,t}) = \alpha + \beta Cut_{i,t} + \gamma X_{i,t-1} + \theta Year_t + \lambda Firm_i + \varepsilon_{i,j,t} \quad (2)$$

We present the descriptive statistics of key matching for treatment and control firms in Table 5, Panel A. The table highlights that treatment and control firms are comparable with the difference in all firm characteristics not being statistically different.

[Insert Table 5 about here]

We present our DID regression results in Panel B of Table 5. The main result from equation (2) is presented in column (1). Specifically, the coefficient estimate on *Cut* is negative and significant at the 5% level, suggesting that a large cut in the tariff rate, which subsequently results in a substantial increase in import competition, is negatively associated with future trademark creation. This result further supports the notion that the negative association between import competition and product trademark creation reported in Table 3 is causal. In column (2) we replicate the methodology from column (1), however, we create additional indicator variables which capture the time point with respect to the large tariff cut. For example, the variable $Year^{-3}$ is equal to one for a treatment firm three years prior to the large tariff cut and zero otherwise. The variable $Year^{+3}$ is equal to one for a treatment firm three years after the large tariff cut and zero otherwise. The results presented in column (2) of Table 5, Panel B, further highlight the negative effect that large tariff reductions have on product trademark creation. In particular, we find that product trademarks decrease following the tariff cuts, with no decrease observed in the period preceding the tariff cut.

5. Further analyses

5.1. Cross-sectional heterogeneity in results

In this section, we examine the effect that various industry and firm characteristics have on the association between import competition and trademark creation. Specifically, we are interested in whether firms in more competitive environment, firms with less product heterogeneity, firms that are more financially constrained and less diversified firms have a greater proclivity to reduce their product trademarks when faced with more intense import competition. We present our partitioning results in Table 6. The results are based on the parsimonious OLS model specification from Table 3, although we only present the coefficient estimates on *ImpPen* as well as the difference in coefficients between the high and low sub-samples.

5.1.1.Competitive environments

In this sub-section, we examine the effect that a firm's competitive environment has on the way in which it adjusts its trademarking activity to changes in import competition. We examine various characteristics and dimensions of the competitive environment that firms face. Firms in highly competitive industries are more likely to lose market share as they have lower profit margin. As a result, they tend to be more fragile when they encounter fierce competition from foreign rivals. Accordingly, we expect that firms in highly competitive industries and firms with less competitive products are more prone to cut product trademark registration in response to more intense import competition. Hence, we partition our sample on Hoberg and Phillips' (2010) test based industry concentration ratio (section A.1.) and Hoberg, Philips and Prabhala's (2014) product market fluidity (section A.2.). We find that firms that the negative association between import penetration and product trademark creation only holds in the sample of firms that are exposed to high levels of competition. Specifically, in Panel A section A.1, we find that the coefficient estimate on *ImpPen* is negative and significant in the low TNIC HHI sub-sample while not significant in the high TNIC HHI sub-sample. Likewise, in Panel A section A.2, we find that the negative association between import competition and product trademark creation only holds in the high product fluidity sub-sample. Overall, the results presented in Panel A suggest that the negative association between import competition and trademark creation is entirely driven by firms operating in high competition environment.

5.1.2.Product heterogeneity

Next, we examine the effect that product heterogeneity has on the association between import competition and product trademark creation. Product heterogeneity is closely associated with product market innovation, since more innovative firms are more likely to produce unique and heterogeneous products. Nevertheless, exploring the conditioning effect of product heterogeneity is a more direct way of testing the effect that product differentiation has on the way in which firms adjust their intellectual property creation in response to increasing competitive threats. When measuring product heterogeneity, in section B.1., we rely on the product similarity score for each firm, as in Hoberg and Phillips (2010) and focus on whether a firm is located in R&D intensity industry in section B.2. Consistently with the approach in Panel A, we partition firms based on their product similarity score, with firms with above median similarity scores being classified as having low product heterogeneity, and firms with below median similarity scores being classified as having high product heterogeneity. We define industries as R&D intensity industry if the industry belongs to pharmaceuticals (SIC code 283), industrial machinery and equipment (SIC code 35), electric equipment (36), transportation equipment (37) or instruments and related product (38), and as non- R&D intensity industry otherwise. The coefficient estimate on *ImpPen* in the high product heterogeneity sub-sample is statistically insignificant, whereas the coefficient estimate on *ImpPen* in the low product heterogeneity sub-sample is negative and significant at the 1% level. The difference is significant in 1% level. The results presented in Panel B reveal that the negative association between import competition and product trademark creation only holds in the sub-sample of firms that produce comparable products to their competition, where firms' product are hard to distinguish from their competitors.

Overall, the results presented in Panels A to B of Table 6, highlight that the competitive environment that a firm is exposed to and its product characteristic prior to the intensification of foreign competition plays a significant role in determining the way in which the firm responds to import competition.

[Insert Table 6 about here]

5.1.3.Financial constraints

In this sub-section, we examine the effect that financial constraints have on the association between import competition and product trademark creation. Financial constraints have a significant constraining effect on corporate investment (Campello, Graham, and Harvey, 2010), meaning that financially constrained firms are plausibly less capable of responding to intensified foreign competition with new products. For the purposes of testing the effect that financial constraints have on the association between import competition and product trademark creation, we utilize the Whited and Wu (2006) and Hadlock and Pierce (2010) proxies of financial constraints. We define a firm to be financially constrained when their financial constraint index is above the sample median, and not constrained otherwise.

The results presented in Panel C of Table 6, reveal that financial constraints are a strong determinant of the association between import competition and product trademark creation. For both measures of financial constraints employed in Panel C, we find that the negative association between import competition and product trademark creation only hold amongst the sample of firms that are financially constrained. In both cases, the coefficient estimate on *ImpPen* is negative and significant in the 'high' financial constraints sub-sample and not statistically significant in the 'low' financial constraints sub-sample. The difference between the coefficients is statistically significant. Overall, the results in Panel C suggest that more constrained firms are less capable of responding to foreign competitive threats, which forces them to curtail new product creation.

5.1.4.Revenue source diversification

In this sub-section, we examine the effect that diversification of revenue sources has on the way in which firms adjust their trademarking activity to increases in import competition. Diversified firms focus not only on single industry or on domestic market but also on multiple industries or markets oversea, making profits from varies channels. Once foreign rivals arrive, those diversified firms do not necessary reduce trademark registration because they could still use profit from aboard or from other industries operating to support their trademark development. We concentrate on geographic diversification of revenue sources as well as diversification of revenue sources across industries. In terms of geographic diversification, we partition the sample according to whether firms' have foreign sales or not (section D.1.). With respect to industry diversification, we partition firms according to the number of segments they operate in (section D.2.). Firms with above median number of segments are defined as highly diversified, while firms with below median number of segments are defined as not being highly diversified.

The results presented in Panel D of Table 6, show that the negative association between import competition and product trademark creation only holds amongst those firms that are not diversified. In section D.1, we find that the coefficient estimate on *ImpPen* is negative and significant at the 1% level for the low diversification sub-sample, while being negative and significant only at the 10% level for the high diversification sub-sample. The difference between the coefficients for the two sub-samples is statistically significant. In section D.2, we find that the coefficient estimate on *ImpPen* is only significant for the low diversification sub-sample, while not being statistically significant for the high diversification sub-sample. These results are intuitive, since firms that have a more diversified revenue streams will be affected to a lesser extent by the competitive changes unique to a specific industry.

5.2. *Foreign competition and product trademarking strategies*

To further understand the effect of import competition on firms' product development innovation, in this section we perform additional analysis to drill down the economic consequences of the results discussed up to this point. First, we examine the effect that import competition has on trademark value, to establish whether import competition induced reductions in trademark activity reflect cuts in valuable or non-valuable trademark creation. Second, we examine whether the negative association between import competition and trademark creation is symmetric, or whether trademarking activity responds differently to low and high levels of import competition. Third, we examine the firm value implications of successful versus failed trademarks, in order to gauge the economic consequences of import competition impacting trademark creation. Finally, we examine the sources of competition that have the greatest effect on trademark creation. In this section, our sample period ends in 2002 since we need at least a ten-year window for our definition of failed or successful trademarks, as well as trademark failed rate.

Previous literatures have shown evidence that import competition increases patent value, i.e., number of patent citations, together with patent creation (Lie and Yang, 2018). Our previous results have already shown that firms reduce trademarking activities under import competition. What is the quality of trademarks reduced? Are they valuable to firms? Answering the questions could help us better understand the role of import competition in shaping firms' product innovation activities. In this sub-section, we account for product trademark value by distinguishing between successful and failed trademarks. Millot (2009) suggests that trademark value can be measured by the renewal rate since high value trademarks are renewed whereas low value trademarks are unlikely to be renewed. We are therefore interested in whether import competition has the same effect on failed trademarks as successful trademarks. Whether or not this is the case has significant implication for the inferences that can be drawn from our baseline analysis.

We report our results in Table 7. The model specification is identical to that in Table 3, except that our dependent variables now capture the number of failed trademarks (Ln(1+ $PrdTM_{fail}$)), the number of successful trademarks (Ln(1+ $PrdTM_{success}$)), and the portion of trademarks that eventually fail ($PrdTM_{fail}$ *rate*). Our sample ends in 2002 since we need at least ten years As in the baseline analysis, we include the full set of control variables as well as firm and year fixed effects and correct standard errors for clustering at the industry level.

[Insert Table 7 about here]

The results presented in Table 7 reveal that import penetration primarily reduces the number of failed trademarks, without having any statistically significant effect on the number of successful trademarks. Specifically, in column (1) of Table 7, where the dependent variable is $Ln(1+ PrdTM_{fail})$, the coefficient on *ImpPen* is negative and significant at the 1% level. In contrast, in column (2), where the dependent variable is $Ln(1+ PrdTM_{success})$, the coefficient estimate on *ImpPen* is not statistically significant. Consistent with these findings, column (3) reveals a negative and statistically significant association between *ImpPen* and the portion of failed trademarks.

The results presented in Table 7 are instructive, as they illustrate the disciplining effect of foreign competition. Although the results presented up to this point suggest that import penetration has a negative effect on firms' development of new products, the results in Table 7 highlight that this is not necessary the case. Instead, it appears that import competition reduces the creation of low value trademarks while not affecting the creation of valuable trademarks. Our results indicate that import competition forces firms to be more focused and ensure that their resources are allocated towards the production of valuable products.

5.3. Import penetration from high and low wage countries

In this final sub-section, we examine whether the origin of import competition is an important factor in determining the impact on product trademark creation. Although we have established a negative effect of foreign competition on firms' new product trademark creation, it is still not clear whether firms' new product trademark development responds differently to competition from high wage and low wage countries. This is an important question since Li and Zhou (2017) find that firms adopt different innovative strategies when facing foreign competition from high wage countries and low wage countries. Specifically, they find that foreign competition from high wage countries intensifies firms' innovative activities, while foreign competition from low wage countries discourages firms' innovative activities. These findings highlight the importance of the origin of foreign competition in affecting firms' incentives to innovate.

To answer this question, we first calculate import penetration by high wage countries and low wage countries separately as well as import penetration from China and countries other than China, and then re-estimate the baseline regression. We present our results in Table 10. In column (1), we present the results after differentiating import competition into import competition from high and low wage countries. In column (2), we present the results after differentiating import competition into import competition from China and import competition from outside China.

[Insert Table 8 about here]

The results presented in Table 10, reveal a negative and significant coefficient on *ImpPen _HWC* and an insignificant coefficient on *ImpPen_LWC*. In column (2), we find a negative and significant coefficient on *ImpPen_Others* and an insignificant coefficient on *ImpPen_China*. The findings suggest that firms reduce their trademarks in react to competition from high wage countries, but their trademarking activities are not affected by import competition from low wage countries, even competition from China. The origin of import competition indeed matters as well in firms' trademarking activities.

What is more, our findings in Table 10 also highlight the importance of dissecting innovation. Specifically, although both trademarking and patenting belong to firm's innovating activity, firms choose to reduce their trademarking while increasing their patenting when they encountering with "neck and neck" foreign competition. However, firms hold still trademarking registration while cut their patenting when they face "laggard" foreign competition.

6. Conclusion

Using a comprehensive trademark database to proxy for product line development amongst a sample of U.S publicly listed manufacturing firms, we document a negative association between import competition and product line development. Our baseline results are robust and economically meaningful. The results are not sensitive to alternate model specifications which account for endogeneity concerns.

We find that the baseline results hold amongst the set of firms which are subject to the greatest domestic competitive threats, face the greatest financial constraints, and have the least diversified revenue sources. Further analysis reveals that the negative association between import competition and product trademark creation is primarily driven by the reduction in low quality product trademarks which are subsequently canceled. In contrast, at moderate levels of foreign competition, we do not observe any association between import competition and successful product trademark creation. Our results highlight that foreign competition induces firms to be disciplined when developing product lines. Finally, we document that import competition from low wage countries, including China, do not affect corporate product line development. In contrast, the negative association document in the baseline analysis is entirely driven by import competition from high wage countries.

Appendix A: Robustness checks

The sample consists of firms with newly registered product trademarks jointly covered by the United States Patent and Trademark Office (USPTO) Trademark Case File Database (TCFD), the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. *TotTM* is total number of trademarks registration. *PrdTM* is the number of product trademarks registration. $TotTM_{t\ to\ t+2}$ is total number of trademarks registration from year t to year t+2. $PrdTM_{t\ to\ t+2}$ is the number of product trademarks registration from year t to year t+2. *ImpPen* is the nature logarithm of one plus import penetration ratio which is defined as imports over domestic consumption. *PastTotTM* is total number of trademarks registration in the previous year. *PastPrdTM* is total number of product trademarks registration in previous year. *StockTotTM* is total number of active trademarks held by firm. *StockPrdTM* is total number of active product trademarks held by firm. *Lnpat* is natural logarithm of patent granted. *IO* is institutional ownership. *StockReturn* is accumulated monthly stock returns in year t. *StockVolatility* is monthly stock return volatility during year t. All regressions include the same control variables as those in Table 3, but their coefficients are not tabulated. Detailed variable definitions are in the legend of Table 3. The *t*- or *z*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic-consistent errors, which are clustered by industry. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

(a): *Negative binomial regressions with firm fixed effects* (N_{TotTm} = 32,658; N_{PrdTM} = 32,081)		
	TotTM	*PrdTM*
ImpPen	-0.163**	-0.221***
	(-2.1)	(-2.8)
(b): *Post* 1989 (N = 25,346)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.168*	-0.175**
	(-1.9)	(-2.1)
(c): *Trademark registered from year t to t*+2 (N = 41,676)		
	$Ln(1+TotTM_{t\ to\ t+2})$	$Ln(1+PrdTM_{t\ to\ t+2})$
ImpPen	-0.321***	-0.331***
	(-2.9)	(-3.2)
(d): *Exclude zero trademarks* (N = 32,658)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.251***	-0.253***
	(-2.7)	(-3.0)
(e): *Control for past trademark registration* (N = 42,265)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.158***	-0.157***
	(-2.6)	(-2.8)
PastTotTM	0.333***	
	(21.1)	
PastPrdTM		0.322***
		(19.7)
(f): *Control for active trademark stock* ($N_{Ln(1+TotTm)}$ = 41,217; $N_{Ln(1+PrdTM)}$ = 40,543)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.191**	-0.205***
	(-2.4)	(-2.9)
StockTotTM	0.184***	
	(9.8)	
StockPrdTM		0.181***
		(9.5)
(g): *Control for patent granted* (N = 42,265)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.245***	-0.246***

	(-3.0)	(-3.3)
Lnpat	0.079***	0.077***
	(7.1)	(7.3)
(h): *Control for institutional ownership* (N = 42,265)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.219***	-0.221***
	(-2.7)	(-2.9)
IO	0.072*	0.069*
	(1.9)	(1.9)
(i): *Control for stock return and stock volatility* (N = 37,762)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.230***	-0.230***
	(-2.6)	(-2.8)
StockReturn	0.008	0.007
	(1.4)	(1.4)
StockVolatility	-0.089	-0.189
	(-0.4)	(-1.0)
(j): *Control for stock industry shocks* (N = 42,265)		
	Ln(1+*TotTM*)	*Ln*(1+*PrdTM*)
ImpPen	-0.1690**	-0.191***
	(-2.3)	(-2.8)
StockReturn	0.008	0.007
	(1.4)	(1.4)
StockVolatility	-0.089	-0.189
	(-0.4)	(-1.0)

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Figure 1: Trademarks and patents across industries

The figure shows number of trademark registration and number of patents granted across 2-digit SIC. The vertical axis denotes the number of trademark registration. The horizontal axis denotes the names of 2-digit SIC. *PrdTM* is the average number of product trademarks registration for each 2-digit SIC. *MktTM* is the average number of marketing trademarks registration for each 2-digit SIC. *Patent* is the average number of patents granted for each 2-digit SIC industry.

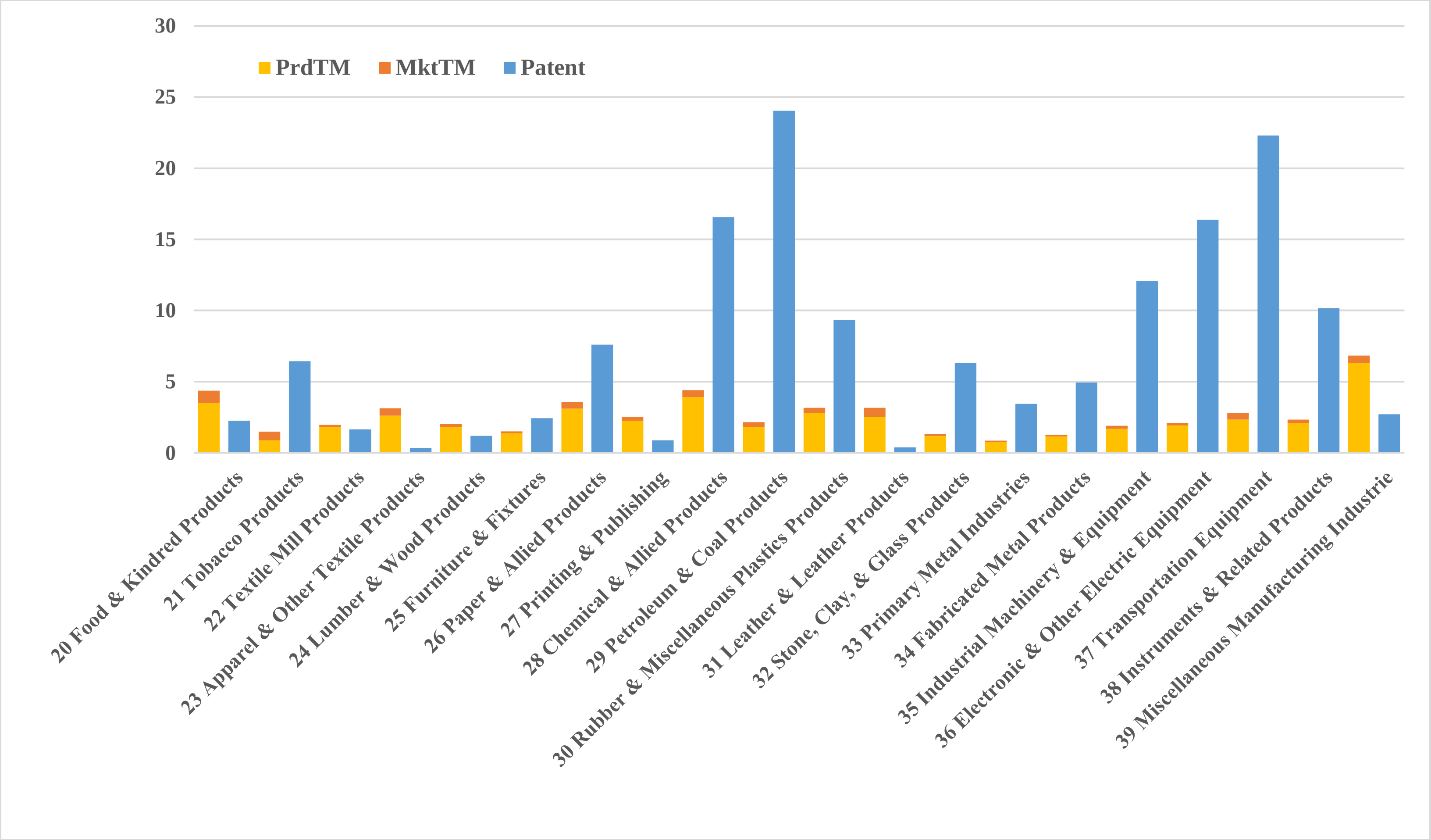

Figure 2: US Trade with the rest of the world

This figure shows the time series of the total trade that the US conducts with the rest of the world. International trade is represented as total trade (imports plus exports) as well as the total trade to GDP in percentage terms.

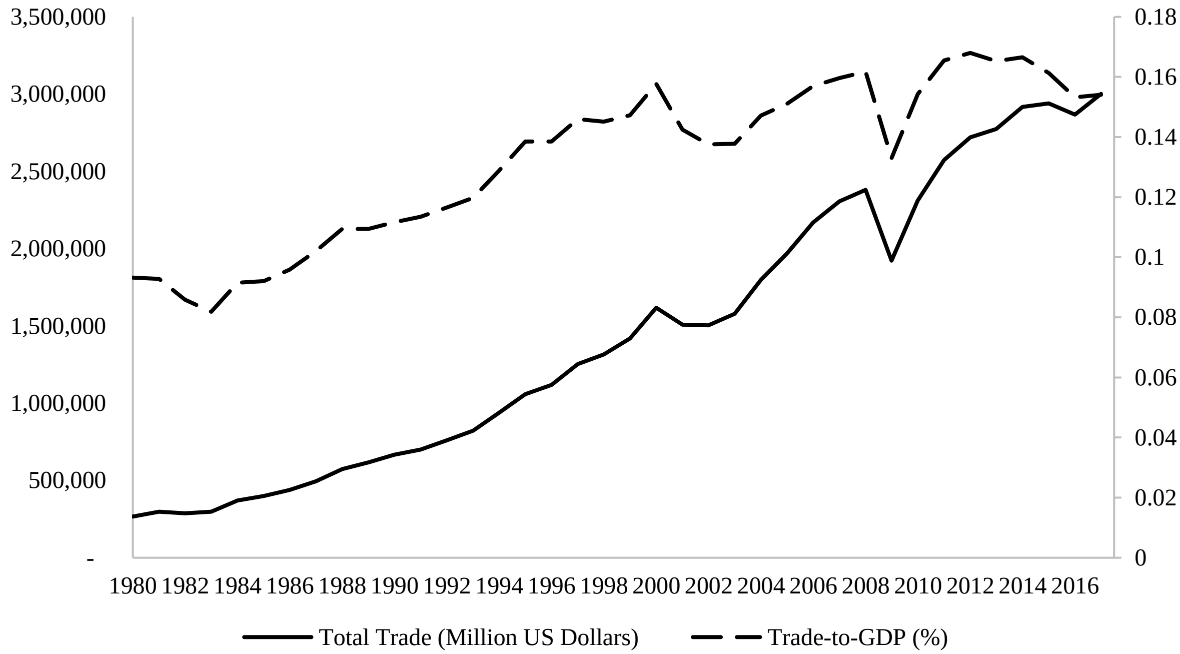

Table 1: Descriptive statistics

The sample consists of firms with newly registered product trademarks jointly covered by the United States Patent and Trademark Office (USPTO) Trademark Case File Database (TCFD), the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. *Panel A* is summary statistics. *TotTM* is the total number of trademarks registration. *PrdTM* is the total number of product trademarks registration. *MktTM* is the number of marketing trademarks registration. *ImpPene* is the natural logarithm of one plus ratio of import penetration ratio defined as imports over domestic consumption. *Advertising/Assets* is advertising expenses scaled by total assets. *R&D/Assets* is R&D expenses scaled by total assets. *Ln* (*Assets*) is the natural logarithm of assets. *MB* is the market-to-book ratio. *Sales Growth* is the log of one plus the change in net sales scaled by lagged net sales. *Tangibility is* property, plant and equipment divided by total assets. *Leverage* is total debt over total assets. *Cash/Assets* is cash-to-assets ratio. *ROA* is return on assets. *Capex* is capital expenditure scaled by lagged total assets. *HHI* is the concentration ratio from the Compustat.

Summary statistics					
Variables	Mean	SD	Q1	Median	Q3
Panel A: *Measures of trademarks* (*N*= 42,265)					
TM	2.735	10.412	0.000	0.000	2.000
Ln(1+*TM*)	0.607	0.892	0.000	0.000	1.099
PrdTM	2.402	9.424	0.000	0.000	2.000
Ln(1+*PrdTM*)	0.565	0.852	0.000	0.000	1.099
MktTM	0.333	1.702	0.000	0.000	0.000
Ln(1+*MktTM*)	0.128	0.355	0.000	0.000	0.000
Panel B: *Explanatory variables* (*N* = 42,265)					
ImpPen	0.180	0.164	0.054	0.138	0.253
Advertising/Assets	0.014	0.034	0.000	0.000	0.013
R&D/Assets	0.043	0.098	0.000	0.012	0.045
Ln(*Assets*)	5.737	2.251	4.096	5.645	7.358
MB	2.745	4.480	0.965	1.609	2.792
SalesGrowth	0.063	0.369	-0.033	0.072	0.177
Tangibility	0.282	0.174	0.152	0.258	0.384
Leverage	0.221	0.167	0.082	0.209	0.329
Cash/Assets	0.142	0.185	0.023	0.068	0.182
ROA	0.048	0.227	0.028	0.087	0.141
Capex	0.070	0.075	0.026	0.049	0.086
HHI	0.377	0.266	0.163	0.311	0.514

Table 2: Sample distribution by industry

The sample consists of firms with newly registered trademarks jointly covered by the USPTO TCFD, the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. *TotTM* is the average total number of trademarks registration within each 2-digit SIC. *PrdTM* is the average number of product trademarks registration within 2-digit SIC. *MktTM* is average number of marketing trademarks registration for each 2-digit SIC. *Patent* is average number of patents granted for each 2-digit SIC. *ImpPenetration* is the average natural logarithm of import penetration ratio defined as imports over domestic consumption for each 2-digit SIC.

		(1)	(2)	(3)	(4)	(5)	(6)
SIC	SIC description	N	*TotTM*	*PrdTM*	*MktTM*	*Patent*	*ImpPen*
20	Food & Kindred Products	2,787	4.366	3.494	0.872	2.250	0.075
21	Tobacco Products	267	1.479	0.876	0.603	6.446	0.030
22	Textile Mill Products	625	1.968	1.821	0.147	1.654	0.123
23	Apparel & Other Textile Products	1,018	3.123	2.615	0.508	0.349	0.269
24	Lumber & Wood Products	813	2.020	1.822	0.198	1.189	0.101
25	Furniture & Fixtures	601	1.514	1.374	0.140	2.439	0.087
26	Paper & Allied Products	1,170	3.579	3.104	0.475	7.608	0.153
27	Printing & Publishing	1,234	2.511	2.267	0.244	0.867	0.024
28	Chemical & Allied Products	6,177	4.410	3.916	0.493	16.560	0.129
29	Petroleum & Coal Products	1,031	2.152	1.801	0.351	24.030	0.085
30	Rubber & Miscellaneous Plastics Products	801	3.172	2.788	0.385	9.312	0.149
31	Leather & Leather Products	508	3.163	2.533	0.630	0.382	0.427
32	Stone, Clay, & Glass Products	1,076	1.318	1.178	0.140	6.305	0.088
33	Primary Metal Industries	1,833	0.851	0.750	0.101	3.446	0.185
34	Fabricated Metal Products	2,498	1.262	1.148	0.114	4.945	0.109
35	Industrial Machinery & Equipment	4,953	1.896	1.683	0.213	12.067	0.238
36	Electronic & Other Electric Equipment	6,671	2.087	1.915	0.172	16.381	0.282
37	Transportation Equipment	2,824	2.812	2.342	0.469	22.309	0.184
38	Instruments & Related Products	4,216	2.339	2.107	0.232	10.171	0.196
39	Miscellaneous Manufacturing Industry	1,162	6.836	6.312	0.524	2.707	0.308

Table 3: Import penetration and trademark registration

The sample consists of firms with newly registered trademarks jointly covered by the USPTO TCFD, the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. *TotTM* is total number of trademarks registration. *PrdTM* is the number of product trademarks registration. *MktTM* is the number of marketing trademarks registration. *ImpPen* is the nature logarithm of one plus import penetration ratio which is defined as imports over domestic consumption. *Advertising/Assets* is advertising expenses scaled by total assets. *R&D/Assets* is R&D expenses scaled by total assets. *Ln*(*Assets*) is the natural logarithm of assets. *MB* is the market-to-book ratio. *SalesGrowth* is the natural logarithm of one plus the change in net sales scaled by lagged net sales. *Tangibility* is property, plant and equipment divided by total assets. *Leverage* is total debt over total assets. *Cash/Assets* is cash-to-assets ratio. *ROA* is return on assets. *Capex* is capital expenditure scaled by lagged total assets. *HHI* is the concentration ratio from the Compustat. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic-consistent errors, which are clustered by industry. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables	*Ln*(1+*TotTM*)	*Ln*(1+*PrdTM*)	*Ln*(1+*MktTM*)
	(1)	(2)	(3)
ImpPen	-0.218***	-0.220***	0.004
	(-2.6)	(-2.9)	(0.1)
Advertising/Assets	0.967***	0.849**	0.214
	(2.6)	(2.3)	(1.1)
R&D/Assets	0.173*	0.169*	0.056**
	(1.8)	(1.9)	(2.0)
Ln(*Assets*)	0.147***	0.137***	0.042***
	(11.6)	(10.4)	(8.0)
MB	0.003***	0.003***	0.002***
	(3.2)	(2.8)	(2.8)
SalesGrowth	0.005	0.007	-0.001
	(0.8)	(1.2)	(-0.2)
Tangibility	-0.139**	-0.134**	-0.061*
	(-2.0)	(-2.1)	(-1.8)
Leverage	-0.060	-0.052	0.003
	(-1.2)	(-1.1)	(0.1)
Cash/Assets	-0.148***	-0.154***	-0.024
	(-3.4)	(-3.6)	(-1.3)
ROA	-0.082***	-0.079***	-0.002
	(-2.8)	(-2.9)	(-0.2)
Capex	-0.060	-0.067	0.024
	(-1.2)	(-1.5)	(1.1)
HHI	-0.013	-0.010	-0.008
	(-0.3)	(-0.2)	(-0.4)
Year and firm fixed effects	Yes	Yes	Yes
Observation	42,265	42,265	42,265
R-squared	0.69	0.68	0.45

Table 4: The instrumental variable approach

The sample consists of firms with newly registered product trademarks jointly covered by the USPTO TCFD, the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. This table summarizes results from the IV regressions. *PrdTM* is the number of product trademarks registration. *ImpPen* is the nature logarithm of one plus import penetration ratio which is defined as imports over domestic consumption. Columns (1) presents second-stage regression results and column (2) reports first-stage regression results using both tariff (*Tariff*) and foreign exchange rate (*FX Index*) as instruments. The instrument variables are lagged by two years. χ^2-statistics and *p*-values are for the Anderson-Rubin test. The *F*-statistic and *p*-value in Column (2) are for the test of the null hypothesis that the coefficients on the IVs are jointly zero. The Control variables are the same as in Table 3. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are clustered by industry. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables	*Ln*(1+*PrdTM*)	*ImpPen*
	(1)	(2)
ImpPen	-1.708***	
	(-2.7)	
Tariff		0.030***
		(3.6)
FX Index		-0.004***
		(-2.7)
Advertising/Assets	0.857**	0.007
	(2.3)	(0.1)
R&D/Assets	0.146*	-0.016
	(1.9)	(-1.2)
Ln(*Assets*)	0.133***	-0.003
	(10.5)	(-1.2)
MB	0.002*	-0.001***
	(1.8)	(-2.9)
SalesGrowth	0.004	-0.002
	(0.7)	(-1.4)
Tangibility	-0.157**	-0.005
	(-2.2)	(-0.3)
Leverage	-0.065	-0.007
	(-1.4)	(-1.0)
Cash/Assets	-0.137***	0.009
	(-3.0)	(1.2)
ROA	-0.096***	-0.010*
	(-3.6)	(-1.7)
Capex	-0.060	0.008
	(-1.2)	(0.9)
HHI	-0.033	-0.016
	(-0.8)	(-1.4)
Year and firm fixed effects	Yes	Yes
Observation	41,579	41,579
Hansen J-statistic (*p*-value)	0.64	
Weak instrument robust test		
χ^2-statistic	9.99	
p-value	0.01	
Test of IVs jointly equal to zero		
F-statistic		10.87
p-value		0.00
R-squared	0.67	0.86

Table 5: Large tariff cuts as quasi-natural experiment

The sample consists of firms with newly registered product trademarks jointly covered by the USPTO TCFD, the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. *PrdTM* is the number of product trademarks registration. *ImpPen* is the nature logarithm of one plus import penetration ratio which is defined as imports over domestic consumption. This table presents results of the difference-in-differences tests on the effect of competition on trademark registration using large tariff cuts as quasi-natural experiment. The sample comprises treated and matched firms that experience a significant import tariff reduction between 1977 and 2010. In the year before large tariff cuts, treated firms are matched with controlled firms by *Ln*(*Assets*), *MB*, *Leverage*, *Cash/Assets* and *Cash flow*. *Panel A* presents the matched results. *Panel B* shows the effect of large tariff cuts on product trademark registration in column (1) and dynamics of trademark registration around large tariff cuts in column (2). *Cut* is an indicator equals to one if a given industry has experienced a tariff cut at time t. $Year^{-3}$ ($Year^{-2}$, $Year^{-1}$) is a binary variable that takes value of one if a firm is treated and is three (two, one) years prior to large tariff cut events and zero otherwise. $Year^{+1}$ ($Year^{+2}$, $Year^{+3}$) is a binary variable that equals one if a firm is treated and is one (two, three) year after large tariff cut events and zero otherwise. Control variables are the same as those in Table 3. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are clustered by industry. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The matched results

Variables	N	Treated	Control	Difference	*t*-statistic
Ln (Assets)	1,069	4.67	4.67	0.00	-0.05
MB	1,069	2.91	3.09	-0.18	-0.96
Leverage	1,069	0.18	0.18	0.00	-0.25
Cash/Assets	1,069	0.18	0.17	0.01	0.69
Cash flow	1,069	-0.02	-0.01	-0.01	-0.95
Propensity score	1,069	0.22	0.22	0.00	0.01

Table 5: (cont'd)

Panel B: The effect of large tariff cuts on trademark applications		
Dependent variables	*Ln*(1+*PrdTM*) (1)	*Ln*(1+*PrdTM*) (2)
Cut	-0.036**	
	(-2.3)	
$Year^{-3}$		-0.050
		(-1.2)
$Year^{-2}$		-0.063
		(-1.5)
$Year^{-1}$		-0.059
		(-1.4)
$Year^{+0}$		-0.074
		(-1.6)
$Year^{+1}$		-0.085**
		(-2.1)
$Year^{+2}$		-0.080**
		(-2.1)
$Year^{+3}$		-0.101**
		(-2.1)
Advertising/Assets	0.787**	0.778**
	(2.1)	(2.0)
R&D/Assets	0.091	0.097
	(0.6)	(0.7)
Ln(*Assets*)	0.074***	0.076***
	(3.7)	(3.9)
MB	-0.001	-0.001
	(-0.7)	(-0.7)
SalesGrowth	-0.015	-0.015
	(-1.5)	(-1.5)
Tangibility	-0.242**	-0.235**
	(-2.1)	(-2.1)
Leverage	-0.011	-0.014
	(-0.1)	(-0.2)
Cash/Assets	-0.107*	-0.107*
	(-1.9)	(-2.0)
ROA	-0.099***	-0.099***
	(-2.8)	(-2.7)
Capex	0.072	0.072
	(0.9)	(0.9)
HHI	0.011	0.001
	(0.1)	(0.0)
Year and firm fixed effects	Yes	Yes
Observations	13,081	13,081
R-squared	0.70	0.70

Table 6: Cross-sectional difference in results

The sample consists of firms with newly registered product trademarks jointly covered by the USPTO TCFD, the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. *PrdTM* is the number of product trademarks registration. *ImpPen* is the nature logarithm of one plus import penetration ratio which is defined as imports over domestic consumption. In *Panel A*, *TNICHHI* is Herfindahl index based on text-based network industry classifications (TNIC) from Hoberg and Phillips Data Library. *Fluidity* from Hoberg and Phillips Data Library measures similarity between a firm's products and the aggregate changes in the competitors' products. A firm operates in a high (low) competitive environment if its *TNICHHI* is lower (higher) than the sample median or its *Fluidity* is higher (lower) than the sample median. In *Panel B*, A firm is defined as high (low) product heterogeneity if its product similarity score is below (above) the sample median or it operates in a R&D intensive industry. We define industries as R&D intensity industry if the industry belongs to pharmaceuticals (SIC code 283), industrial machinery and equipment (SIC code 35), electric equipment (36), transportation equipment (37) or instruments and related product (38), and as non-R&D intensity industry otherwise. In *Panel C*, a firm is defined as financial constrained (unconstrained) if its Whited and Wu's (2006) financial constrained index or Hadlock and Pierce's (2010) index is above (below) the sample median within a 3-digit SIC in a given fiscal year. In *Panel D*, *foreign sale* and *number of segments* are from Compustat's Geographic Segment files. *Foreign sale* is an indicator equals to one if a firm realizes positive sales abroad, and zero otherwise. *Number of segments* is the number of geographic segments reported. A firm is considered as more (less) diversified if it has realized foreign sales or its number of segments is more (less) than sample median. Control variables are the same as those in Table 3. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are clustered by industry. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Partitioning the sample according to competition environment

	(1)	(2)
Dependent variables	*Ln*(1+*PrdTM*)	
	High competition	Low competition
A.1. Partitioning the sample according to Hoberg and Phillips TNICHHI ($N_{\text{High competition}}$ = 6,041; $N_{\text{Low competition}}$ = 6,045)		
ImpPen	-0.315**	0.100
	(-2.0)	(0.9)
Difference: High-Low	-0.414***	
p-value	0.00	
A.2. Partitioning the sample according to product market fluidity ($N_{\text{High competition}}$ = 5,971; $N_{\text{Low competition}}$= 6,116)		
ImpPen	-0.311**	0.032
	(-2.2)	(0.3)
Difference: High-Low	-0.342**	
p-value	0.02	

Panel B: Partitioning the sample according to product heterogeneity

	(1)	(2)
Dependent variables	*Ln*(1+*PrdTM*)	
	Heterogeneous	Homogeneous
B.1. Partitioning the sample according to similarity score ($N_{\text{Heterogeneous}}$ = 6,411; $N_{\text{Homogeneous}}$ = 6,411)		
ImpPen	0.064	-0.298***
	(0.5)	(-3.0)
Difference: High-Low	0.364***	
p-value	0.00	
B.2. Partitioning the sample according to R&D intensity industry ($N_{\text{Heterogeneous}}$ = 21,414; $N_{\text{Homogeneous}}$ = 20,251)		
ImpPen	-0.136	-0.360***
	(-1.4)	(-2.6)
Difference test	0.219***	
p-value	0.00	

Panel C: Partitioning the sample according to financial constrain

	(1)		(2)
Dependent variables		*Ln*(1+*PrdTM*)	
	High constrain		Low constrain
C.1. Partitioning the sample according to Whited and Wu index ($N_{High\ constrain}$ = 18,757; $N_{Low\ constrain}$ = 18,842)			
ImpPen	-0.268***		-0.148
	(-3.3)		(-1.1)
Difference: High-Low		-0.120**	
p-value		0.02	
C.2. Partitioning the sample according to Hadlock and Pierce index ($N_{High\ constrain}$ = 19,457; $N_{Low\ constrain}$= 19,742)			
ImpPen	-0.249***		-0.115
	(-3.3)		(-0.9)
Difference: High-Low		-0.140***	
p-value		0.00	

Panel D: Partitioning the sample according to whether firm could diversify revenue

	(1)		(2)
Dependent variables		*Ln*(1+*PrdTM*)	
	High diversified		Low diversified
D.1. Partitioning the sample according to whether the firm have foreign sales ($N_{High\ diversified}$ = 20,654; $N_{Low\ diversified}$ = 16,844)			
ImpPen	-0.196*		-0.449***
	(-1.8)		(-3.2)
Difference: High-Low		-0.253***	
p-value		0.00	
D.2. Partitioning the sample according to number of segments ($N_{High\ diversified}$ = 13,779; $N_{Low\ diversified}$= 27,750)			
ImpPen	-0.219		-0.348***
	(-1.6)		(-3.5)
Difference: High-Low		0.129***	
p-value		0.00	

Table 7: Import penetration and successful/failed trademark

The sample consists of firms with newly registered product trademarks jointly covered by the USPTO TCFD, the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2002. *ImpPen* is the nature logarithm of one plus import penetration ratio which is defined as imports over domestic consumption. $PrdTM_{fail}$ is the total number of product trademarks that are not renewed after 11(21) years from its registration, if the trademark is registered after (before) November 16, 1989. $PrdTM_{success}$ is the total number of product trademarks that are renewed after 11(21) years from its registration, if the trademark is registered after (before) November 16, 1989. $PrdTM_{fail}$ *rate* is the ratio calculated as $PrdTM_{fail}$ divided by total number of product trademarks. Control variables are the same as those in Table 3. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are clustered by industry. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables	$Ln(1+PrdTM_{fail})$	$Ln(1+PrdTM_{sucess})$	$PrdTM_{fail}$ *rate*
	(1)	(2)	(3)
ImpPen	-0.466***	-0.139	-0.137**
	(-2.9)	(-1.1)	(-2.0)
Advertising/Assets	1.090*	0.278	0.144
	(1.9)	(0.6)	(0.6)
R&D/Assets	0.330	0.087	-0.001
	(1.1)	(0.3)	(-0.0)
Ln(*Assets*)	0.152***	0.075***	0.022*
	(4.9)	(3.2)	(1.7)
MB	-0.003	0.002	-0.000
	(-0.9)	(0.9)	(-0.3)
SalesGrowth	0.032	0.034	0.010
	(0.9)	(1.1)	(0.5)
Tangibility	-0.246	-0.217	-0.007
	(-1.3)	(-1.1)	(-0.1)
Leverage	-0.124	0.191	-0.100**
	(-0.9)	(1.6)	(-2.1)
Cash/Assets	-0.291**	-0.224**	0.002
	(-2.6)	(-2.2)	(0.0)
ROA	0.010	0.053	-0.015
	(0.1)	(0.6)	(-0.2)
Capex	-0.235	0.015	-0.092
	(-1.6)	(0.1)	(-0.9)
HHI	0.013	0.036	-0.033
	(0.2)	(0.5)	(-0.9)
Year and firm FE	Yes	Yes	Yes
Observations	10,294	10,294	10,294
R-squared	0.60	0.50	0.31

Table 8: The effects of import penetration from high and low wage countries

The sample consists of firms with newly registered product trademarks jointly covered by the USPTO TCFD, the U.S. industry-level import and export data from Schott (2010) and the Compustat between 1977 and 2010. *PrdTM* is the total number of product trademarks registration. *ImpPen_HWC* is import penetration ratio calculated using imports from high wage countries. *ImpPen_LWC* is the import penetration ratio calculated using imports from low wage countries. *ImpPen_Others* is the import penetration ratio calculated using imports from countries other than China. *ImpPen_China* is the import penetration ratio calculated using imports from China. Control variables are the same as those in Table 3. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are clustered by industry. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables	*Ln*(1+*PrdTM*) (1)	*Ln*(1+*PrdTM*) (2)
ImpPen_HWC	-0.212**	
	(-2.5)	
ImpPen_LWC	-0.154	
	(-1.1)	
ImpPen_Others		-0.196**
		(-2.3)
ImpPen_China		-0.188
		(-1.3)
Advertising/Assets	0.850**	0.849**
	(2.3)	(2.3)
R&D/Assets	0.170*	0.169*
	(1.9)	(1.9)
Ln (*Assets*)	0.137***	0.136***
	(10.4)	(10.3)
MB	0.003***	0.003***
	(2.8)	(2.8)
Sales Growth	0.007	0.007
	(1.2)	(1.2)
Tangibility	-0.134**	-0.134**
	(-2.1)	(-2.1)
Leverage	-0.052	-0.052
	(-1.1)	(-1.1)
Cash/Assets	-0.154***	-0.154***
	(-3.6)	(-3.6)
ROA	-0.078***	-0.078***
	(-2.9)	(-2.9)
Capex	-0.067	-0.068
	(-1.5)	(-1.5)
HHI	-0.010	-0.009
	(-0.3)	(-0.2)
Year and firm FE	Yes	Yes
Observations	42,265	42,265
R-squared	0.68	0.68