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Chinese Competition and Product Variety of Indian Firms*

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Abstract

Using detailed firm-product-year data across manufacturing industries in India, and exploiting the exogenous nature of China's entry into the WTO in 2001, we investigate the link between the impact of import penetration from China on the product variety of Indian manufacturing firms. We find: (i) robust and significant effects of product drop, with the effect coming only from competitive pressure in the domestic market; (ii) robust evidence of product drop or 'creative destruction' only for firms belonging to the lower-half of the size distribution; (iii) firms drop their peripheral/marginal products and concentrate on the core ones; and (iv) our result is strongest for firms producing intermediate goods. For an average Indian manufacturing firm, a 10 percentage point increase in India's Chinese share of imports in the domestic market reduces the product scope of firms by 1.7–4.4%. In contrast, we find positive effects on product scope when firms are importing intermediate goods. We also find evidence of significant productivity effects and within-firm factor reallocation. Our results are consistent to a battery of robustness checks and IV estimation.

JEL classifications: F1, F14, F61

Keywords: Chinese Competition, Product Drop, Domestic Market, Small Firms

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1 Introduction

China's export performance post-1990, and more so since 2001 (with entry to the WTO), has been nothing short of spectacular! Its exports grew from US$ 62 billion to US$ 1.2 trillion between 1990 and 2007[1]; an average of around 20% per year (Iacovone et al., 2013). In the same period, China's share of GDP more than doubled, from 15.9 to 34.9%. In terms of the sectoral composition, manufacturing exports accounted for 89% of total merchandise exports between 2000 and 2005.[2] On the back of this very strong export performance, China became the world's largest exporter in 2009, and the second largest economy in 2010 (Iacovone et al., 2013).[3] Naturally, this meteoric rise of China to the status of a global exporting giant, particularly in terms of manufactured goods, has induced economists to understand the effects of import competition from low-wage countries, specifically China, on various firm- and industry-level outcomes of developed countries (Bernard et al., 2006; Liu, 2010; Autor et al., 2013; Mion and Zhu, 2013; Martin and Mejean, 2014; Bloom et al., 2016), and to a far lesser extent for developing countries (see for example, Iacavone et al., 2013, and Utar and Ruiz, 2013 for Mexico and; Medina, 2017 for Peru).

Our study adds to this relatively small (but growing) literature by exploring the causal effects of Chinese import competition on developing countries. In particular, we attempt to understand what happens to product mix/scope in India, a large developing country, when it faces competition from another equally large developing country, China. We find that an increase in the import share from China forces Indian manufacturing firms, more so for small and medium-sized firms (lower half of the size distribution) with no effect for big firms, to drop their peripheral products while concentrating on the core ones. Our results also show that the effect is strongest for firms producing intermediate inputs.

Our primary motivation to study the effects of Chinese import competition on the product variety of Indian (manufacturing) firms comes from the following reasons: (i) a recently released research document from the Office of the Economic Advisor, Ministry of Commerce and Industry, Government of India highlights a significant surge in the growth in the share of imports from China, especially in the post-WTO membership (of China) period. The study uses 268 items for the period of 2004-05 to 2010-11 to find that while the import index (for these 268 items) from all countries grew by 1773.1%, in case of imports from China, the index increased by 4618.4% over the same period. Additionally, the share of imports of these 268 items from China in total imports jumped to 41.3% in 2010-11 from 25.3% in 2005-06 (Singh, 2012).

Figure 1 shows a monotonically upward trend in the share of India's manufacturing imports from China

[1] In real terms, exports increased by a factor of 25 between 1990 and 2005 (Hanson and Robertson, 2010).

[2] In 2014, manufacturing exports of China accounted for more than US$ 1.4 trillion of total exports of US$ 2.34 trillion.

[3] Like China, India also experienced a tremendous increase in exports in the post-1990 period: both as a share of GDP and as a share of world exports. For example, total exports as a share of GDP increased from almost 10% in 1995 to approximately 25% in 2013. Over the same period (1995–2013), Indian goods export as a share of world goods export almost tripled to 1.7%, while the share of services exports in world service exports also tripled to over 3% between 2000 and 2013 (Anand et al., 2015). Finally, for the period 1992–2005, manufacturing accounted for 75.3% of India's merchandise exports.

in total manufacturing imports. This share rises by approximately 15 percentage points from roughly 1% of total imports in 1992 to almost 16% in 2007 (this figure increases further to around 26% in 2017). Particularly striking is the dramatic increase in the import share in the post-2001 period i.e., following China's accession to the WTO in December, 2001. Between 1992 and 2001, China's share of Indian imports grew from 1% to around 5.5%, which shot to 16% between 2002-2007; an increase of 10.5 percentage points over a shorter period relative to the pre-2001 period (where the increase was 4.5 percentage points).

Table 1 documents India's trade (both exports and imports) with China and imports from other major regions of the world, including total imports, at three different periods of time: 1992, 2001 and 2007. It shows that China accounted for the largest increase in India's imports relative to the other countries and major regions of the world. India's share of Chinese imports grew by around 9000% between 1992 and 2007.[4] In comparison, imports from ASEAN (one of the biggest trading partners of India), the US and EU increased by 888%, 230% and 132%, respectively. Compared to Mexico[5], where the Chinese share of manufacturing imports increased by a factor of 8, in the case of India it increased by a factor greater than 90 over the same time period (1992 - 2007).

With respect to India's exports to China, there has also been a significant increase but the rate of increase is far lower than the increase in import flows from China; the increase in exports is close to one-third to that of imports. In the process, China became the largest trading partner of India with a total trade of US$ 84.44 billion in 2014-15. India's trade deficit with China also ballooned nine-fold over the past decade to US$ 52.7 billion in 2015-16 (EXIM Bank of India, 2016).[6] Following Iacovone et al. (2013), where the authors argue about the immediate effect of the rise of China on middle-income countries, the effect on the performance of Indian manufacturing firms seems to be of the first order importance. This brings us to our second motivation.

(ii) An online campaign against the Chinese goods started after the national secretary of the current ruling political party (Bharatiya Janata Party or BJP, which came to power in 2014) called for a boycott of the Chinese products in 2014. The online campaign against Chinese goods got further attention as reports started to show that this increase in Chinese imports may hurt India's factories on the background of the 'Make in India' campaign launched by the current Prime Minister of India.[7] The reports also show that cheap imports from China has been a problem area for small Indian businesses.[8] The Commerce Minister

[4] Note that the percentage increase in Chinese imports in case of India is almost 9 times higher when compared to the US during the same time period; the percentage increase for the US was 1156 during 1991-2007 (Autor et al., 2013).

[5] A large number of studies exploring the impact of Chinese import competition on developing countries is focused on Mexico (Iacovone et al., 2013; Utar and Torres-Ruiz, 2013).

[6] In light of this steep increase in the share of Chinese imports in India and a growing trade deficit with China there has been increased calls in India for its policymakers to introduce anti-dumping measures against China (Singh, 2012). Out of the 290 anti-dumping cases investigated by the Director General of Anti-Dumping and Allied Duties against various countries since 1992, 159 cases involve imports from China (PTI, August 12, 2013).

[7] Also see http://www.ndtv.com/india-news/flood-of-cheap-chinese-imports-may-hurt-indias-factories-1738045

[8] In recent years Chinese imports have changed from low-value, low-cost products such as children toys to high-value items like electronic products, engineering goods, auto components, and chemicals.

of India also raised the issue of cheap Chinese goods flooding the Indian market, hurting its traders and manufacturing sectors on her visit to China (after the current ruling party came to power in May 2014).[9] She mentioned that imports of textile machinery (an intermediate good) from China are among the biggest threats to small manufacturers.

Given this as our background, China being currently the biggest trading partner of India and anecdotal evidence of Chinese products hurting the Indian manufacturers, we are interested to know the nature of the response (if any) from Indian manufacturing firms. Whereas trade theory identifies low-wage countries as a likely source of disruption to high-wage countries' manufacturing firms, Krugman (2008) points out that free trade with countries of any income level may affect the dynamics of the domestic market. On the other hand, a large body of empirical evidence demonstrates that import competition, especially from China, significantly affects dynamics of manufacturing firms; the lion's share (of these studies) concentrating on developed countries. Our focus is slightly different in the sense that we investigate the effect (of the rise in Chinese imports) on product variety of Indian firms. In other words, what happens to product mix of manufacturing firms, when there is a significant rise in South-South trade? Do we get same kind of evidence? For example, did the increase in competition from China cause Indian firms to rationalize their product mix by focusing on their core products and drop the peripheral ones? This is the first contribution of our paper.[10]

Next, our aim is to establish a causal link between increase in imports from China and product scope of Indian firms. To understand such, we follow the literature on the rise of Chinese imports and its effect on labour markets in developed countries (Autor et al., 2013), and use one of the most important episodes of world trade in the last two decades: China's membership to the WTO in 2001 as a suitable quasi-natural experiment to investigate how does China's unilateral trade liberalization policies cause Indian firms to alter their product mix.[11] The growth in Chinese exports to India as a result of accession to the WTO that we examine is a result of China's internal reforms to a market-oriented economy. This transition to a market (from central planning) economy resulted in significant productivity growth for Chinese firms, which got further bolstered due to reduction in trade costs as a result of its accession to the WTO. We treat this as a unilateral trade shock and not a mutual trade expansion. All the existing empirical studies, which investigates the effect of Chinese imports on product scope of firms, focus only on the yearly change in Chinese imports.[12]

[9] Please also see https://www.deccanherald.com/content/424157/india-raises-issue-cheap-chinese.html

[10] Another motivation is whether the technological similarity between China and India would yield different results compared to other cases where this is not so. di Giovanni et al. (2014) on examining the global welfare impacts of China's trade integration and technological change ranks ten developing countries in terms of technological similarity to China. Among this group of countries, India is ranked as the country with the closest technological proximity to China; India's technological similarity index being 0.928 to that of China. **Table 10** in **Appendix B** shows all ten countries in decreasing order of technological similarity to China.

[11] There is precedence in the literature to treat the sharp rise in China's share in total imports of countries (both developed and developing) because of its accession to the WTO in 2001 as a quasi-natural experiment (see, Lu and Yu, 2015; Bloom et al., 2016).

[12] Focusing on yearly changes or using first-difference estimator helps to address the problem of omitted variables, especially the unobservable characteristics. But, the efficiency of the first-difference estimator crucially depends on the assumption of the error term being a random walk. Almost all the studies focusing on Chinese participation in the world trade matrix recognizes

We use 2001 as the structural break to compare the product space of Indian firms between 1992-2001 and 2002-2007 through a Bartik-type estimation method. Nonetheless, following the literature we also exploit the yearly change in the share of Chinese imports as our preferred specification when using the IV method to get more economically meaningful estimates.[13] This is the second contribution of our paper.

However, this approach also requires the fact that the import demand shocks in India, especially after 2001 are not the primary cause of China's export surge. While it seems plausible that China's export growth to India during the 2000s is a result of China's internal supply shocks, using accession to the WTO to estimate a difference-in-difference model (comparing the imports before and after 2001) will help us estimate the precise effects by taking care of the unobserved factors. We also adopt an alternative estimation strategy where we use Chinese imports to European countries as an instrument for Chinese imports to India. All approaches yield similar results.

Lastly, India and China are two of the more economically successful BRICS (Brazil, Russia, India, China and South Africa) countries and their interactions in the sphere of international trade and the outcomes are, in our view, worthy of an enquiry. To the best of our knowledge, this is the first study to investigate the effects of import competition on firm performance in relation to two BRICS countries.

We provide a careful investigation of the causal impact of Chinese competition focusing on the extensive margin of Indian firms, using detailed firm-product-level data. Likewise domestic market, we recognize that Indian firms facing Chinese competition is likely to feel the same threat in one of its main export market, the US.[14] We, therefore, evaluate these causal links by not only looking at the threat in the domestic or home market but also for the US. To do so, we use China's WTO accession in 2001 as the quasi-natural experiment and differential increase in competitive pressure of Chinese imports across manufacturing industries to implement a difference-in-differences estimation strategy. In particular, we exploit the average share of Chinese imports across each 4-digit industry (in both India and the US) in the pre-WTO accession period (between 1992 and 2001) and then interact it with a WTO accession dummy (it takes a value 1 if year is greater than or equal to 2002).[15] This interaction term captures the differential effect of Chinese

that there has been a structural change in China's trade after 2001, i.e., after China's participation in the WTO. And, this can possibly violate the assumption of random walk of the error term.

[13] Using a structural break is common (Lu and Yu, 2015) when applying tariffs as the main variable of interest. Since we are using the difference in the share of Chinese imports before and after the year 2001, a Bartik-type RHS variable, it makes the magnitudes hard to interpret, especially in case of an IV analysis. Nevertheless, **Table 17** of **Appendix B** shows the IV estimation using the Bartik-type RHS variable. The results are similar like the usual IV estimation.

[14] We focus on the USA as our preferred export destination because of the following reasons: (i) the USA is the largest trading partner of India in terms of exports. India exported US$ 40.4 billion in 2017; this accounted for about 15.3% of India's total exports. The same figure (percentage of exports to US) was around 16% for 2007. In the case of China, the percentage share of exports to the US was around 19% in 2007. So, for both China and India, the US can possibly be regarded as their primary export market; (ii) the USA is among the very few trade destinations of India with which India maintains a trade surplus; the same is for China; and (iii) the income elasticity of demand for India's exports is estimated to be the highest in case of the USA, which is 2.5, while for global exports, it is 1.9 (UNCTAD, 2009). Nonetheless, we have also used US, EU and ASEAN combined together as an alternate export destination, and the results remain the same.

[15] All the studies which investigate the effect of Chinese competition on industry and firm outcomes in other countries, such as Iacovone et al. (2013), Autor et al. (2013), or in case of imports from low-wage countries, such as Bernard et al. (2006), Liu (2010), use share of imports at the industry-level to measure the extend of import competition. We follow these papers and

competition on firms according to their trade exposure from China prior to 2001. In other words, since we expect shares of Chinese imports to rise across all sectors, more so for sectors with higher share before China's WTO accession, it is the change in imports due to the accession to the WTO, net of the general change post-2001, and net of possible permanent differences across industries.

We find strong heterogeneous effects of Chinese competitive shock on the extensive (product drop or exit) margin. In particular, we find robust evidence of product drop or 'creative destruction' for firms belonging to the lower-half of the size distribution (1st and 2nd quartile), i.e., small and medium-sized firms. All these effects are strictly concentrated due to competitive pressure of Chinese imports in the home and not export market. Our coefficients indicate that a 10 percentage point increase in India's Chinese share of imports reduces the product scope of manufacturing firms by 1.7–4.4% at the mean. Our results also provide significant evidence of product reallocation within firms as competition obliges them to focus on their core competencies; a finding consistent with the 'core-competency' hypothesis of the multi-product firms (Eckel and Neary, 2010). Relatedly, we find that focusing on core-product(s) help firms to upgrade their productivity (Mayer et al., 2014) and within-firm reallocation of other productive factors. The effect of 'creative destruction' in response to Chinese imports is acute in case of (i) both exporters and non-exporters, and (ii) only domestic firms. Our results remain unchanged with instrumental variable (IV) analysis. On the other hand, we find significant positive effects of Chinese competition (at the domestic market), when we look at import of intermediate goods rather than total imports.

Our paper contributes to a vibrant literature that links how import competition affects product scope of firms. Results show (i) that firms alter their product mix by dropping their peripheral products or products with high marginal costs (Baldwin and Gu, 2009; Liu, 2010; Bernard et al., 2011; Iacovone et al., 2013), and (ii) there is substantial heterogeneity in product scope adjustment – firms above a cut-off of size distribution expand product scope, whereas other reduce it (Dhingra, 2013; Qiu and Zhou, 2013; Lopresti, 2016). Within this literature, our paper is most closely related to Iacovone et al. (2013), which investigates the effect of Chinese import competition (for both domestic and export market) on product mix of Mexican firms. While we focus on Chinese import competition and product mix of Indian manufacturing firms, our paper differs from Iacovone et al. (2013) along several other dimensions.

First, methodologically. While they use only yearly changes in Chinese imports (treating emergence of China onto world markets as a quasi-natural experiment), our focus is on the difference between imports before and after 2001 (treating China's accession to the WTO as a quasi-natural). Second, while we focus on the effect of competitive pressure from both domestic and foreign market by putting them together (in all estimations), they estimate the effects separately.[16] Third, our results based on quartile regressions

undertake similar kind of strategy. We discuss this in detail later, specifically in Section 4.1.

[16] Estimating these two effects separately may not reflect the true estimates as a firm is selling products in both these markets simultaneously.

(both OLS and IV) clearly show that it is the firms from the lower-half of the size distribution who drop their peripheral products in response to Chinese competition at the domestic market, whereas their quantile regressions are only focuses on intensive (plant sales) and not on extensive margin (neither on product exit nor core products). Fourth, the context of the rise in India-China trade is significantly different from Mexico-China. The former ones are two of the fastest growing economies of the world and China is currently the largest trading partner of India. Chinese imports in India increased more than 10 times higher than that of Mexico, especially after 2001.

The rest of the paper is organized as follows. We review and discuss both theoretical and empirical literature related to our paper in Section 2. Section 3 describes the datasets we use in the paper, together with some preliminary analyses. We investigate the direct impact of Chinese import competition, in both domestic and export markets, on the product variety of Indian manufacturing firms in Section 4. Section 5 digs deeper to understand the mechanism behind the effect by focusing on core competency, product-sales composition and product exit. We look at within-firm responses by looking at productivity effects, productive factors and sales (intensive margin) in Section 6. We divide the sample of firms according to product, industry and firm characteristics to investigate further heterogeneity in our results in Section 7. Section 8 concludes.

2 Review of Literature

This section discusses the literature that is most closely related to our work, namely, the studies on multi-product firms, more so their responses to trade shocks and our contribution to the literature. Trade economists have developed a range of theoretical models focusing on the behavior of multi-product firms over the last decade or so (Lopresti, 2016).[17] The most common prediction regarding the firm-product-level response to a bilateral reduction in trade cost: all firms reduce their product scope by dropping their peripheral or least popular products (Baldwin and Gu, 2009; Eckel and Neary, 2010; Mayer et al., 2014).[18] One of the earlier studies, which focuses on how firms adjust their product mix (in case of US plants) in response to the import competition from low-wage countries, is by Bernard et al. (2006). They argue that plants are more likely to switch industries when exposure to low-wage countries is high; an average of almost 8% of surviving plants in each five-year period switch industries i.e., change their product mix. Instead, we focus on the impact of import competition from a low-wage country on the product mix of firms in another similar low-wage country. In doing so, we exploit a unilateral trade liberalization shock by China and show

[17] See Lopresti (2016) for a detailed review of some of the more well cited theoretical models of the multi-product firm in the literature.

[18] All these models assume that marginal costs of production vary across products within a firm. In these models, firms each have a core competence, a variety in which the marginal cost of production is lowest, with each additional variety becoming progressively inefficient. As trade costs fall and competition in the domestic market rises, all firms choose to reduce product scope, dropping products with the highest marginal costs. Bernard et al. (2011) proposes a multiproduct Melitz-type model in which the firm-product level response to trade liberalization is ambiguous.

that firms from India reduce their product scope, as a response to higher share of imports from China, by dropping their peripheral products. And, the effect is most acutely felt in intermediate goods industry.

Next, there is a range of papers that predict heterogeneous responses across the firm distribution, with the most productive firms expanding product scope as trade costs fall, while the others contract product scope. Dhingra (2013), categorizing firms as a 'brand', argues that varieties within a brand are closer substitutes than varieties across brands, and a cannibalization effect (eating away of the demand for existing products) happens when there is product expansion. Trade liberalization or import competition reduces the cannibalization effect by dropping products. She also points out a cut-off in the distribution of firms in terms of exports; firms having a larger export share of sales than the cut-off adds products as a result of trade liberalization, while firms below the cut-off drop products. Qiu and Zhou (2013) reach a similar conclusion as Dhingra (2013) but by allowing firms to differ in terms of productivity. Therefore, different theoretical models on multi-product firms proffer very different and contradictory conclusions regarding the way multi-product firms adjust their product mix in response to changes in trade costs.

Following these studies, we create a size distribution in terms of total sales and divides firms' into four different quartiles. We find that only firms belonging to lower-half of the size distribution alter their product mix by re-focusing on their core product in response to Chinese import competition.[19] We find no effect for large firms unlike others. Our empirical findings therefore provide additional support to the theoretical predictions; shedding light on the crucial issue of differential response or heterogeneity is one of the fundamental aims of our paper.

Lopresti (2016) also finds heterogeneous effects, in terms of exposure to foreign markets, as a response to a bilateral fall in trade costs. Nocke and Yeaple (2014) divide firms according to organizational capital and organizational efficiency and explore the effect with a fall in trade costs. Exporters take advantage of the fall in trade costs (in terms of increased access to foreign markets) and increase product scope, whereas, firms which produce strictly for the domestic markets reduce product scope as a result of increased competition from abroad. We investigate import competition effects from both domestic and export market. We find similar results, reduction of product scope, in case of competitive effects from domestic market with limited effect, in terms of product expansion, for the marginally big exporters from competition in the foreign market.

Our paper also contributes to the empirical literature on multi-product firms. Bernard et al. (2011) documents evidence of product-level responses of the U.S. multi-product firms to decline in Canadian tariff rates on U.S. manufacturing imports that accompanied CUSFTA. They find that firms experiencing export tariff reductions greater than the median reduces product scope relative to firms facing tariff reduction less than the median. Iacovone et al. (2013) examines the effect of Chinese import competition on intensive and extensive margins of Mexican firms and conclude that the import competition shock causes selection and

[19] We also use capital intensity as a basis for dividing firms according to size distribution and the results remain the same.

reallocation at both firm- and product-level and that its impact is highly heterogeneous at the intensive and extensive margins. Arkolakis et al. (2015) examine Brazilian exporters and point out that the importance of firm-product extensive margin varies widely across firms of different sizes. We also look at the effect on intensive margin (firm sales), but do not find any effect, except for the small firms (or firms belonging to the 1st quartile). The effect on total sales is completely driven by drop in domestic sales and not exports.

Baldwin and Gu (2009), Liu (2010) and Lopresti (2016), all investigate the responses of multi-product firms to CUSFTA. Baldwin and Gu (2009) and Lopresti (2016) find heterogeneous responses between non-exporters and exporters and within exporters, respectively, while Liu (2010) finds that multi-product firms are more likely to drop peripheral products as import competition rises.[20] We find similar responses by firms within non-exporters and exporters. Both exporters and non-exporters drop products as a response to Chinese import competition in the domestic market; however, the effect continues to be concentrated only for small firms.

In all the theoretical models related to multi-product firms, a fall in trade costs increases within-firm productivity by reallocation of resources within the firm (Eckel and Neary, 2010; Bernard et al., 2011; Mayer et al., 2014). We also find similar evidences of increase in productivity and within-firm factor reallocation in response to Chinese competitive pressure in the domestic market.

A different set of studies also look at the effect of import competition, or competition from China, on different aspects of firms and industries, such as innovation, plant survival, employment growth, total sales, productivity, skill intensity (Bernard et al., 2006; Utar and Ruiz, 2013; Mion and Zhu, 2013; Ashournia et al., 2014; Balsvik et al., 2015; Bloom et al., 2016; Autor et al., 2016). Apart from Iacovone et al. (2013) and Utar and Torres-Ruiz (2013)[21], all the other studies focus on the impact on developed economies (U.S., Belgium, Denmark, Norway, E.U., etc.). We differ from this current cohort of studies by focusing on two most important countries contributing in the rise in South-South trade and explores the effect on product variety of manufacturing firms. Overall, our results conform to the standard theoretical multi-product firm literature with import competition, firms re-focusing more on their 'core competencies', with heterogeneity in effect coming from the product drop by only the least productive or small firms.

There exists another section of studies, which looks at the dynamic aspects of multi-product firms or product churning. Bernard et al. (2010) finds 54% of US manufacturing firms alter their product mix every five years between Manufacturing Censuses. On average, one-third of the output of a given product is produced by firms that either did not produce the product at the time of the previous Census or have dropped the product by the next Census. In short, there is widespread evidence of product churning.

[20] In a similar study, Martin and Mejean (2014) explore the impact of low-wage competition on the product quality of French exporters. Their results show that product quality upgrading is greater in sectors and destinations where firms are exposed to more intense competition from low-wage countries.

[21] Both the studies investigates the effect of Chinese competition on Mexico. The former looks at the product mix, whereas the latter studies the labour market and industry-level changes.

Moreover, this product churning has substantial effects on the aggregate economy because changes in the firms' product mix can account for significant changes in their output over time (Lopresti, 2016; Goldberg et al., 2013). Bernard et al. (2010, 2011) also shows that the contribution of firms' product margin toward output growth exceeds the contribution of firms' entry and exit. Consequently, product mix changes represent a potentially important channel through which resources are reallocated from less to more efficient firms. Iacovone and Javorcik (2010) also shows evidence of product churning by focusing on Mexican manufacturing firms in response to NAFTA. Goldberg et al. (2010c) find no evidence of product churning within Indian manufacturing firms and output-tariff declines following India's episode of trade liberalization in 1991. Our results, in turn, show significant evidence of product churning or 'creative destruction' in case of Indian firms as a result of product market competition from China and the effect is stronger for firms producing intermediate goods.

Lastly, our paper also contributes to a small literature on the effects of trade shocks on product variety of Indian firms. Goldberg et al. (2010b) provides evidence of significant increase in domestic product variety over the period 1989-2003 as a response to India's input-tariff liberalization. They estimate that 25% of the total increase in Indian manufacturing output over this period was accounted for by the net addition of products at the firm-level. In contrast, our study shows that Indian firms reduce their product variety because of competitive pressure in the domestic market and the effect is highest in case of intermediate products. Indian firms started to stop producing intermediate goods when they gained access to wide range of cheap intermediate inputs from China. This finding provides some possible evidence of trade diversion or trade creation effects in case of Indian firms as they were previously importing a large portion of intermediate goods from OECD countries (Kandilov et al., 2017).

3 Data and Preliminary Analysis

3.1 Datasets

3.1.1 Firm-level data (PROWESS)

The foundation of our empirical analysis is based on Indian firm-level data across different manufacturing industries. This dataset gives detailed information on various indicators from the balance sheets of firms, in addition to other important firm-level and industry-level characteristics. We discuss our dataset in detail below.

The primary data source for our analysis is the PROWESS[22] dataset, which is maintained by the Centre for Monitoring the Indian Economy (CMIE); a privately-owned business information company. This dataset contains information primarily from the income statements and balance sheets of the listed (in major stock

[22] Our description of the PROWESS dataset draws heavily, but not exclusively, on the well-known studies of Goldberg et al. (2010a, 2010b) and the recent study of de Loecker et al. (2016). All three studies have utilised manufacturing data from PROWESS to conduct their empirical analyses and have provided excellent descriptions of the data.

exchanges) companies and publicly traded firms. The PROWESS dataset contains information on about 27,400 publicly listed companies, of which almost 11,500 are in the manufacturing sector. We use information for around 8000+ firms for our analysis for the years 1992-2007.[23] Firms in the dataset are placed according to the 5-digit 2008 National Industrial Classification (NIC) level, but are reclassified at the 4-digit 2004 NIC level to facilitate matching with industry-level trade data.

The dataset covers large companies, companies listed on the major stock exchanges and many small enterprises. Data for big companies are worked out from balance sheets, while CMIE periodically surveys smaller companies for their data. Therefore, PROWESS provides a reasonably good aggregate picture in terms of the mix of small and big firms. Further, it includes the set of variables typically found in firm-level production datasets. For example, the dataset reports direct measures on gross value-added, capital employed, total wages, total sales, exports, imports, research and development (R&D) expenditures, royalty payments for technical know-how, assets, firm ownership, etc. The variables are measured in Indian Rupees (INR) Million. Around 20% of the firms in the dataset belong to the Chemical and Pharmaceutical industries, followed by Food Products and Beverages (13.74%), Textiles (10.99%) and Basic Metals (10.46%). We use an unbalanced panel for our estimations.

PROWESS has some features and advantages over other available data sources, such as the Indian Annual Survey of Industries (ASI) dataset, that makes it particularly appealing and relevant for the period and purpose of our study. First, in contrast to the repeated cross-section of earlier versions of the ASI, PROWESS comprises a panel of firms, which enables us to track firms' performance over time.[24] This will enable us to undertake within-firm comparisons over the period of our analysis. Second, the data covers fifteen-year period, which coincides with significant trade and industrial reforms undertaken independently by both India and China.

Third, a unique feature of the dataset, upon which our study is partly based, is that it gives detailed product-level information for each firm. Consequently, we are able to distinguish between single- and multi-product firms and can track changes in firms' product mix over the sample period. In particular, we examine the dynamics of the product mix of firms as a response to Chinese import competition; that is, whether manufacturing firms add or drop products or add and drop products simultaneously or engage in none of the preceding activities. The ability to track a firm's product mix over time is primarily due to the Companies Act of 1956, which requires Indian firms to disclose product-level information on capacities, production and sales in their annual reports. As discussed in Goldberg et al. (2010a, b), product-level information is available for 85% of the manufacturing firms who in turn accounts for more than 90% of PROWESS' manufacturing

[23] Although data are available till 2013, we consciously choose 2007 as the final year in order to avoid any possible effect of the financial crisis of 2008-2009 on our results. As part of the robustness checks on our results, we extend the sample period to 2013. The results remain qualitatively the same.

[24] Recently, a panel dataset containing similar product-level information like PROWESS has been released by the ASI. While this newer version of the ASI has some advantages over PROWESS (see de Loecker et al., 2016), it does not span the entire period during which our study is concerned.

output and exports. Additionally, product-level sales are reported to comprise 99% of the (independently) reported manufacturing sales. To define a product, CMIE uses an internal product classification that is based on the Harmonized System (hereafter, HS) and National Industrial Classification (hereafter, NIC) schedules.[25]

The product-level information (of Indian firms) that we use has previously been used by Goldberg et al. (2010a, b, c). Nevertheless, we also check for a few characteristics regarding whether these firms can be regarded as multi-product or not. First, a vast array of studies find overwhelming dominance of multi-product firms in production and trade. We find the same evidence for Indian firms as well. **Table 11** (**Appendix B**) presents average values for sales, capital intensity, assets, wages, TFP, share of output, share of firms for multi-product and single-product firms. Multi-product firms sell more; are more capital intensive; are bigger; pay higher wages and control an overwhelming proportion (91%) of the total output produced in an industry.[26]

Second, as with any firm-product-level dataset, there is a concern here that these firms may not truly be multi-product firms. For example, a firm reports producing 5 products, but its main product accounts for 95% of its total sales and the remaining products account for 5%. To check whether such is the case, we construct a matrix where we calculate the average share of total sales against each of the product produced by a firm. We present the matrix in **Table 12** in **Appendix B**. As is shown, the firms' product-specific share of sales is much less concentrated towards its core product.[27]

However, there are also a few limitations of PROWESS. First, the dataset does not cover the unorganized sector. Second, because firms are not under any legal obligation to report to the data collection agency, PROWESS is not well suited for studying firm entry and exit.[28] Third, the dataset does not give either the trade (neither export nor import) destinations of the firms or the products traded by firms. To overcome this deficiency, we complement our firm-level dataset with product-level trade data from UN-COMTRADE using the Debroy and Santhanam (1993) industry-trade concordance table. **Table 2** provides summary statistics of all the variables that we use.

[25] As Goldberg et al. (2010c) notes, there are a total of 1,886 products linked to 108 four-digit NIC industries across the 22 manufacturing sectors (two-digit NIC codes) spanning the industrial composition of the Indian economy. In comparison, the U.S. manufacturing data contains approximately 1,500 products, as defined by the Standard Industrial Classification (SIC) codes, thus suggesting that the definition of product in India is slightly more detailed.

[26] One related concern with multi-product firms is that classifying products at the HS6 level is not a very easy task and may lead to firms incorrectly classifying products. For instance, suppose a firm were to incorrectly classify the products it produces in a given year. Then it would spuriously appear that the firm might have increased/decreased my product range. One way to allay fears of such measurement issues is to examine the firm-specific, year-to-year variation in the number of products. To possibly check for this, we have calculated the year-to-year variation in the number of products across the firms. We do not see much evidence of such measurement issues in the data. For example, we do not see many such instances, where a firm's total number of products are 6 in year t, then 10 in year $t+1$, and then back to 6 in year $t+2$.

[27] Our estimates are somewhat similar to what Goldberg et al. (2010c) finds.

[28] As indicated by Goldberg et al. (2010b), entry and exit is not necessarily an important margin for understanding firms in the PROWESS dataset since the dataset contains only the large Indian firms.

3.1.2 UN-COMTRADE

UN-COMTRADE presents destination-wise official foreign trade statistics of all the countries of the world. This is the most comprehensive dataset on trade flows that is collected and maintained by the United Nations (UN). It gives detailed information of every country's trade according to each of their trade destinations. The dataset is detailed up to HS six-digit level of classification. UN-COMTRADE follows the Harmonized System (HS) of Classification and provides both yearly and monthly statistics of countries' trade flows. The dataset provides total quantity, total value and unit value with respect to each of the products exported or imported and their respective destinations. The annual series is available from 1992 onwards until 2012. It also enables a comparative analysis of any country's trade performance in specific markets vis-à-vis its competitors. The trade flows are given in US Dollars (US$).

Our main objective is to create a variable, which reflects the extent of import competition the Indian firms face in the domestic market from China. To overcome the disadvantage of the PROWESS dataset regarding the trade destinations of the firms, we match the firm-level data from PROWESS with the trade-destination based product level UN-COMTRADE dataset. The matching procedure is explained in detail in **Appendix A**.

3.2 Preliminary Analysis: Trends in Chinese Share of India's Imports and Product Variety

In this section, we present a few crucial stylized facts about the share of Chinese imports in India and product scope of Indian firms. First, we show that there is a lot of heterogeneity across industries within the Indian manufacturing sector in terms of the growth of Chinese imports relative to total imports. **Figure 2** plots the share of imports from China across 22 NIC 2-digit industries for 1992-2007. The share of imports from China rose for a large number of industries; remained almost constant for a few others; and declined for a couple of sectors. Unsurprisingly, our plots show a steep increase in the share of imports in some of the labour-intensive industries (e.g., Textiles, Wearing Apparel, and Leather), which is consistent with China's comparative advantage. Interestingly, the figure also points to an increase in the share of imports in capital-intensive industries (e.g., Office, Accounting and Computing Machinery; Electrical Machinery and Apparatus; Communication Equipment). These patterns in the data justify, in our view, the need for further empirical analysis.

Second, we plot the number of products manufactured by a representative Indian manufacturing firm over the period 1992-2007 in **Figure 3**. It points to a clear upward trend over time. The average number of products produced by an average Indian manufacturing firm rises from around 1 during the early 1990s to almost 3 in 2007. The steady increase exhibited in the number of products is consistent with the finding of Goldberg et al. (2013). However, a closer inspection of **Figure 3** points out that the post-2001 period

has exhibited some fluctuations in the number of products produced; a slight drop in the post-2001 period, followed by small increase, and remaining constant afterward. Additionally, the rate of growth in the increase in the number of products also slowed down in the post-2001 period. During the period 1992-2001, the rate of growth of products produced by a firm increased by more than 200%, whereas in the post-2001 period, the increase dropped to a mere 20%.

We also calculate the average share of Chinese imports and average number of products produced by an industry (at the NIC 2004 2-digit level) for two different time periods: 1992-2001 and 2002-2007 in **Table 3**. Columns (1) – (2) show the average share of imports from China relative to total Indian manufacturing imports. For example, the number 1.31% (Row 1, Column 1) is the average share of Food and Beverages (NIC 2004, Sector 15) imports from China for the period 1992-2001. The columns show that for 21 out of 22 industrial categories, the share of imports from China in total imports significantly increased especially after 2001, compared to the period before-2001.[29] For an average Indian manufacturing industry, the number of varieties produced dropped from 5.4 to 5.1, which is a change of about 6%. However, if we look across different industries, the response is a bit mixed. For instance, while for most of the of the industrial categories (16 out of 22) there has been a decrease in the number of product varieties, we find some evidence of a marginal increase for others. This gives us a hint to explore whether (a) there is a causal impact of import competition on the number of product varieties produced or it is due to other factors; and (b) there is some amount of heterogeneity involved in the effect (if any).

The main purpose of dividing the share of Chinese imports for India before and after China's WTO entry in 2001 is to capture the extent of Chinese import penetration, rather than industry variation in trade barriers.[30] We expect that the industries for which there was a high share (greater than 5% of total imports) of Chinese imports before China's entry to the WTO, the share will increase more than the others. For example, let's consider NIC-17 (Textiles), NIC-26 (Non-metallic Mineral Products) and NIC-30 (Office,

[29] Among the industries that experienced phenomenal growth in their share of imports from China are Textiles; Leather Products; Communication Equipment; Non-Metallic Mineral Products; Fabricated Metal Products; and Office, Accounting and Computing Machinery among others. In contrast, only the Food & Beverage industry recorded a decline in its share of Chinese imports. In addition, we also divide the 108 industrial groupings (at NIC 2004 4-digit level) into two major product categories– intermediate and final goods–and calculate the share of Chinese imports and the average number of products produced in **Table 13** (**Appendix B**). We find that imports from China have increased for both types of product categories, with rate of growth higher in case of intermediate goods. On the other hand, product variety of both types of goods decreased over time, with the drop in intermediate products being higher.

[30] The best way to measure the Chinese comparative advantage as China joined WTO is to use tariffs data by industry. Since, we focus on Chinese imports by India, using Chinese import tariffs data would not be useful here. Further, India's import tariffs data will also not be very useful here for two reasons: (a) India had a large trade liberalization program in the 1990s and India's import tariffs were substantially reduced by 2001; and (b) India did not have any preferential tariff agreement with China (e.g., Pakistan has a MFN status for India and vice-versa). One might also argue that we could have used the export tariffs data for China to see whether the fall in export tariffs due to the WTO entry in 2001 has led to an increase in Chinese comparative advantage or not. China started to reduce its export tax from 1980s onward and it is around 3% from 1996 hence (Zhiyuan, 2003). Therefore, looking at the export tariffs in this case would also not make much of a difference. China started to build its economy based on exports almost more than a decade earlier (in late 70s) than India, and reduced its export tax concurrently (much ahead of 2001). China has actually raised its export taxes since January 2004 (Garred, 2018). In addition, all the studies, which looked at the effect of Chinese imports, used share of Chinese imports in their total imports (by industry) as the measure of competition. We do so, by following the literature.

Accounting and Computing Machinery). For these industries, the share of Chinese imports before 2001 was 11.20%, 5.83% and 14.96% respectively. These shares increased to 37.19%, 27.76% and 51.91%: a growth rate of 200-400% after 2001. Similarly, seventeen NIC 2-digit sectors had import share ratios varying between 0-5% before 2001, with only five of them having more than 5% (but less than 15%). In contrast, after 2001 eight industries (out of 22 NIC 2-digit sectors) had more than 15% shares of Chinese imports, with the highest being 51.91% (whereas the highest before 2001 was 14.96%). We calculate the correlation between the import shares from China before and after 2001, it is around 0.9. This shows that Chinese import penetration increased significantly in the post-2001 period for industries where it was already high in the previous period. Using these stylized facts as our background, we now investigate whether the increase in the import share from China is significantly correlated with (or at best caused) variations in the product mix of manufacturing firms in India.

4 Chinese Competition and Product Variety of Indian firms

4.1 Benchmark Results

This section empirically investigates the effect of China's rising share of exports in Indian domestic market and an export destination, on the product variety of Indian manufacturing firms. To establish causality between greater import competition (from China) and the product mix of Indian manufacturing firms, we use China's entry to the WTO on December 11th, 2001[31], as a quasi-natural experiment, together with the differential competitive pressures faced by Indian firms due to this trade shock, as our identification strategy. The accession to the WTO is significantly driven by China's movement towards a more market-oriented economy. This transition to a market-oriented economy is a result of the following internal factors: (a) significant rural-to-urban migration of workers, (b) firms/industries gaining access to foreign technologies, capital and intermediate goods, and (c) allowing multinationals to operate in the country (Autor et al., 2013). These internal reforms had significant positive effects on China's trade, which eventually led to the country's accession to the WTO. In other words, we use China's accession to the WTO as an instrument for the internal reforms in China, which significantly boosted the productivity growth in various industries. We argue that membership to the WTO led to an increase in the import share of Chinese products and thus intensified the competition faced by Indian firms in their domestic market and one of its main export destination.

The economic reforms undertaken by China in the post-1990 period in anticipation of becoming a member of the WTO, and thus getting fully integrated into the global economy, provides an important element of our empirical strategy. Since China's membership to the WTO in 2001 was influenced by factors not related to the activities of Indian firms neither in their domestic nor export markets, therefore its accession to the WTO can be interpreted as an exogenous shock from the standpoint of India. Furthermore, there were no

[31] November 10 was the date approval, but actual joining took place in December.

trade agreements between India and China in the period prior to accession, so there is a little probability that China's visibility in the world trade matrix (in terms of becoming a WTO member) could be confounded with other factors related to the activities of Indian manufacturing firms.

Notwithstanding the assumptions underlying our empirical strategy, there is one important concern that needs to be addressed before getting on to the estimation details: whether the demand for Chinese goods by India, especially after 2001, is due to a change in China's export-supply capability (due to a rise in average productivity) or import demand shocks across industries in India?[32] We treat the rise in export-supply capability of Chinese firms/industries as exogenous, as it is a function of changes in labour costs, trade costs and the number of product varieties made in China. Failure to address this above concern may result in biased coefficient estimates and therefore likely to lead to incorrect inferences drawn from our findings. In order to control for this issue, we use an empirical strategy similar to Guadalupe and Wulf (2010), and Lu and Yu (2015) among others.[33]

To avoid the effects of import demand shocks from India after 2001, we use the share of imports from China prior to its WTO membership. Specifically, we calculate the average share of Chinese imports for each industry at NIC 4-digit level before China's entry to the WTO by taking a simple mean of the share of Chinese imports by India for the years 1992-2001. One rational to use the share of imports from China before 2001 as a proxy for share of imports after 2001 is that we treat Chinese import penetration across industries to be much less before 2001 than after. In order to see whether this is the case, we compute standard deviation for the share of Chinese imports in India across all the NIC 4-digit Indian industries before and after 2001. The value is 4 before 2001, which increased to around 13 for the period 2002-2007; a jump by a factor of more than 3. Therefore, our key variable of interest will capture the extent of the prevailing competition from China for any industrial category, but before the latter's entry to the WTO (when the degree of competition across industries were very similar). We expect industries with high initial import shares to exhibit higher future growth in imports.[34] In other words, our main source of variation in exposure is within-manufacturing specialization in industries subject to different degrees of import competition.

We define $AvgM01_{j,IN}^{China}$ as a measure of Chinese competition that an Indian (IN) industry (j) faces in its domestic market because of the unilateral liberalization policies pursued by China ($China$); it is a 10-year

[32] In case of the US (which we use as a proxy for export destination), Autor et al. (2013) show that the rise in Chinese share of the imports is not due to import demand shocks in the US, but because of an increase in comparative advantage of Chinese goods. Moreover, this increased significantly after 2001.

[33] These studies use reductions in tariff levels as their measure of trade liberalization in contrast to the import share and import penetration ratios used in this paper.

[34] Gudalupe and Wulf (2010) and Lu and Yu (2015) use the pre-tariff liberalization industry-level average of tariffs. In this case, the industries that had previously been more protected (i.e., industries with higher tariffs initially) are expected to experience greater tariff reductions after liberalization and therefore higher degrees of liberalization, whereas previously more open industries (i.e., industries with lower tariffs initially) should experience small changes in tariffs and therefore less liberalization. In our case, we expect the variation in import shares across industries of India (from China) to increase more after China joined WTO in 2001. For example, before 2001, the minimum share is 0.88, whereas the maximum share is 14.96; whereas after 2001, the minimum share is 0.25, whereas the maximum is 51.91. The minimum share remained less than 1%, whereas, the maximum share increased by more than 300%.

average of the share of imports by industry j for the period 1992-2001. To create the $AvgM01^{China}_{j,IN}$ index, we match the Indian firm-level data with the HS six-digit product-level destination-specific data (for China) on import flows to create a ratio that reflects the amount of competition faced by a firm i belonging to industry j. We create this index at the NIC 2004 4-digit level using the concordance table by Debroy and Santhanam (1993). It is defined as the share of imports by an industrial sector, say j, from China in proportion to total imports by that sector. For example, let us consider the Textiles sector (j). The $AvgM01^{China}_{j=Textiles,IN}$ is the total amount of Textile imports from China, relative to the total imports of Textiles from all countries for the years 1992-2001. To elaborate, we write $AvgM01^{China}_{j,IN}$ in the following way:

$$AvgM01^{China}_{j=Textiles,IN} = \sum 1992{-}2001 [\frac{imports^{China}_{j=Textiles,t}}{imports^{Total}_{j=Textiles,t}}]_{IN}$$

$$AvgM01^{China}_{j=Textiles,IN} = \sum 1992{-}2001 [\frac{imports\ from\ China\ for\ 1992{-}2001\ for\ industrial\ category\ j{=}Textiles}{imports\ from\ World\ for\ 1992{-}2001\ for\ industrial\ category\ j{=}Textiles}]_{IN}$$

We use the above ratio and interact this with a year dummy to create the following index of import competition from China in India's domestic market as our variable of interest:

$$DComp^{China}_{IN} = AvgM01^{China}_{j,IN} \times WTO_t$$

WTO_t is a year dummy variable intended to capture the effect of China's entry to the WTO. It takes a value of 1 for the years following the signing of the WTO agreement by China. Therefore, WTO_t equals 1 for the years 2002-2007. So, our variable of interest, $AvgM01^{China}_{j,IN} \times WTO_t$, provides a measure of the amount of competition faced by Indian firms in the domestic market as a result of China becoming a member of the WTO. The interaction of $AvgM01^{China}_{j,IN}$ with WTO_t provides a clear and exogenous measure of import competition from China and represents a difference-in-differences approach to measure the effect of Chinese import competition on the product variety of Indian manufacturing firms. This interaction term captures the differential effect of Chinese competition on firms according to their trade exposure from China prior to 2001, i.e., we use average trade exposure before 2001 as a proxy for post-2001 import exposure. Alternatively, since we expect shares of Chinese imports to rise across all sectors, it is the change in imports due to the WTO, net of the general change post-2001, and net of possible permanent differences across industries.

We use the above measure of Chinese import competition in the following basic empirical specification of a fixed effects linear regression shown in Equation (1) to estimate the impact on product variety of Indian firms:

$$\ln(x_{ijt}) = \beta_D DComp^{China}_{IN} + \beta_F FComp^{China}_{IN} + firmcontrols_{t-1} + \varphi_j + \eta_t + \theta^j_t + \epsilon_{ijt} \qquad (1)$$

where our dependent variable, x_{ijt}, is the number of product varieties produced by an Indian manufacturing firm i belonging to sector j at time t.[35] $FComp_{IN}^{China}$ is a measure of import competition from China faced by Indian firms in an export destination.[36] We follow the same method as outlined above in constructing the index of competition that Indian firms face in the US from Chinese imports:

$$FComp_{IN}^{China} = AvgM01_{j,US}^{China} \times WTO_t{}^{37}$$

$AvgM01_{j,US}^{China}$ is the average share of imports from China by the US industries at NIC 2004 4-digit level for the years on or before 2001.[38] $firmcontrols_{t-1}$ is a vector of variables that includes firm size, age, age squared, an indicator for domestic or foreign ownership and a proxy for the extent of a firm's technology adoption.[39] We use total sales of a firm as its size indicator. The extent of technology adoption is measured as the share of R&D expenditure plus royalty payments for technical know-how in gross value-added (GVA) of a firm. This variable captures technology differences between firms, which can potentially affect production of a new product. All the variables are used at $(t-1)$ period. Since our main variable of interest is at the industry-level, we follow (i) Moulton (1990) and include industry fixed effects φ_j in Equation (1); (ii) the literature on the effect of import competition on firm-level changes, where a large proportion of the studies uses industry-level fixed effects (Bernard et al., 2006; Liu, 2010; Iacovone and Javorcik, 2010; Iacovone, et al., 2013; Li and Yu, 2015; Liang, 2017) in their estimation.[40]

Product variety of a firm can also be influenced by many other concurrent policy shocks. One such is the effect of tariff liberalization. This facilitates a firm to either import higher quality intermediate goods (when there is a drop in input tariffs) to produce more products or directly import finished products (with a decrease in output tariffs). To control for such events, we include measures of input and output tariffs in our estimations. Other types of shocks (such as change in labour policy or availability of more finance, etc.) at the industry-level, which vary over time, may also influence the product choice of a firm. All these effects are captured by θ_t^j. It refers to either interactions between industry fixed effects and a time trend or interactions of industry and year fixed effects. We use the specification that controls for unobserved

[35] Since the dependent variable is logged, we add 1 to account for single product firms.

[36] PROWESS gives the total number of varieties produced by each firm, but does not mention the number of products exported by a firm. Since a sizeable percentage of these products produced by a firm are exported as well, export market competition may also affect the product mix of the firms.

[37] Autor et al. (2013) shows that Chinese imports in the US increased significantly after China became a member of the WTO. As mentioned previously, we also combine US, EU and ASEAN to construct the export market competition index.

[38] We use UN-COMTRADE for data on imports by the US industries from World and China at the 4-digit level. We then match the US industries along with Indian industries using the International Standard Industrial Classification (ISIC) of all economic activities by the UN.

[39] We allow these controls to vary with the WTO dummy variable, WTO_t, but the results do not change.

[40] We also use firm fixed-effects, but the results remain the same.

industry characteristics (at 4-digit level), year fixed effects and the interaction between industry fixed effects (at 4-digit level) and a time trend as our preferred one.[41] η_t proxies for year fixed effects which control for any time-specific shocks that affect all firms equally. We cluster our standard errors at the industry-level.

We start by estimating Equation (1), for which results are shown in **Table 4**. Overall, our results show no effect of Chinese competition (both in domestic and export markets) on product variety of Indian firms. Columns (1) – (8) show the results for the natural logarithm of the number of products produced by an Indian manufacturing firm in a year regressed on $DComp_{IN}^{China}$, $FComp_{IN}^{China}$, a bunch of firm controls, along with industry or firm fixed effects, year fixed effects and interactions of either industry fixed effects with year trends or industry with year fixed effects. We start by using a simple measure of import competition (both for the domestic and export markets): lagged share of Chinese imports in total imports of India, $\frac{imports_{jt-1,IN}^{China}}{imports_{jt-1,IN}^{Total}}$ and lagged share of Chinese imports in total imports of the US, $\frac{imports_{jt-1,US}^{China}}{imports_{jt-1,US}^{Total}}$.

Columns (2) - (10) use our preferred measures of import competition, $DComp_{IN}^{China} = AvgM01_{j,IN}^{China} \times WTO_t$ and $FComp_{IN}^{China} = AvgM01_{j,US}^{China} \times WTO_t$, where we use interaction between average Chinese imports (by industry at 4-digit level) before 2001 ($AvgM01_{j,IN}^{China}$ for domestic market and $AvgM01_{j,US}^{China}$ for export market) and year dummy of China's accession to the WTO (WTO_t). In addition to year fixed effects and interactions of industry fixed effects (at 4-digit level) with year trends, we interchange industry and firm fixed effects in columns (2) and (3). The result for our variables of interest do not change: we do not find any effect of Chinese import competition on product mix of the Indian firms at the aggregate. Column (4) replaces interactions of industry fixed effects and year trends with industry fixed effects (at 2-digit level) with year fixed effects, but our benchmark finding does not alter.

One common problem that is often associated with multiproduct firms is that the firms often drop products for reasons not related to their production activities and this may affect our findings. To counter such an issue, we use a balanced panel (of around 1000 firms) in column (5) to check whether this is true or not. We do not find any evidence of such a case.[42] Another issue that might also affect our results is that there is a lot of correlation over time for a given firm. We counter this by running a long difference specification in column (6). We use 1994 as the base year and compare the outcome with 2007. We find significant negative effect of Chinese import competition in the domestic market on the product mix of Indian manufacturing firms with no effect for export market competition. In other words, a rise in Chinese import competition in the Indian domestic market significantly induces Indian firms to produce less products in 2007 compared to what they were producing in 1994.

One factor that might be affecting our findings is the way we look at total imports: Chinese exports might have a positive effect if we use imports of intermediate inputs by Indian firms (Iacavone et al., 2013).[43] To

[41] We also use interaction of industry (at 2-digit level) with year fixed effects; results do not change.

[42] We have also used a balanced panel using 1 year before and after China's membership to the WTO to check for any immediate effect. Column (1) in **Table 14** of **Appendix B** reports the result. We continue to find no significant effect.

[43] For example, imported intermediate inputs may be cheaper and of higher quality than locally sourced inputs thus lowering

account for this possibility, we generate a measure of the share of imported inputs from China by Indian firms using Indian input-output (I-O) tables in column (7).[44] We weight the I–O coefficient of each sector (at NIC 4-digit level) as an input by its import share, and then by the Chinese share in imports for that sector. By summing these measures, we arrive at a measure, $ShInputs_{IN}^{China}$, that gives the average weighted sum of intermediate goods imported from China at a sectoral level, where the weights are given by the coefficients of the I-O table. We continue to find no effect of Chinese import competition, both for intermediate goods and the general index. However, we find some weak evidence of foreign competition negatively affecting firms' product scope.

Looking only at Chinese imports by the US as a proxy for export market competition may not reveal the true competitive effects faced by Indian firms face in export market(s). To address this possible shortcoming, we construct an index that aggregates the shares of Chinese imports in two other primary export markets for India firms, namely the EU and ASEAN, with that of the US. We then substitute the original foreign competition index with the composite index based on these three export market destinations (where Indian firms might face challenge from Chinese products) in column (8). In other words, $FComp_{IN}^{China}$ now equals $AvgM01_{j,US,EU,ASEAN}^{China} \times WTO_t$. As the coefficients demonstrate, our benchmark results remain the same - we do not find any average effect of Chinese competition from either domestic or foreign markets affecting the product scope of Indian firms. In column (9), we use the number of product varieties produced by a firm as the dependent variable (without its logarithmic form).[45] As the estimates demonstrate, changing the dependent variable and method of estimation does not induce any change in our finding.

Following Iacovone et al. (2013) and Liu (2010), we replace our dependent variable with a binary variable – product exit in column (10). We use firm-product-level data to define product exit. Consequently, our panel data analysis is now three-dimensional in contrast to the two-dimensional approach adopted in our earlier estimations. Product exit is defined as:

$$x_{ipt} = \begin{Bmatrix} 1 \\ 0 \end{Bmatrix}$$

where, x_{ipt} is a firm-product specific outcome of interest for firm i or firm-product ip at time t. It takes a value 1 in the year when the firm or firm-product is last observed in the sample. Like, Iacovone et al. (2013), we also drop the last year of the sample (2007) in the exit regressions, since for this year we cannot distinguish between firms (products) that exit from those that did not. To undertake such an analysis, we employ a probit estimation and run the regression at the firm-product-year-level. The statistical significance (or lack thereof) of our coefficient of interest does not change; we find no significant effect of Chinese competition on

the production costs of the firms and making it possible to produce a greater number of products of possibly higher quality.

[44] We use the 1999 I-O table to choose input coefficients for each of the 2004 NIC 4-digit sector. We additionally test for the robustness by substituting with 1993 I-O table, but the results remain the same.

[45] We estimate the regression using Poisson method as estimating a count variable by OLS may produce inconsistent estimates.

the product mix of Indian firms at the aggregate level. Lastly, we run a first-differenced equation in column (11); the outcome remains the same.[46] This leads us to undertake the following exercise – divide the firms according to their size and see whether there is any variation in effect across the size distribution.

Heterogeneous Effects: Following Lopresti (2016) on the issue of heterogeneity in the effects of trade shocks on multi-product firms, we divide the set of firms into different size distributions based on their total sales.[47] Heterogeneous effects may be masked when such allowance is not made for across the sample of firms. In other words, given that a majority of the recent studies point out that firms which are at the right tail of the productivity distribution significantly drive economy-wide welfare changes, it is imperative to understand whether these firms behave differently from others.

To do so, we divide the entire sample of firms into four different quartiles according to the total sales of a firm. The different size categories of firms are indicated by a dummy variable. For example, if the total sales of a particular firm is below the 25th percentile of the total sales of the corresponding industry, then the firm belongs to the first quartile and the variable would indicate 1 for that particular firm, and zero otherwise. Likewise, if a firm's total sales lie between the 25th percentile and the 50th percentile; the 50th percentile to the 75th percentile; and above the 75th percentile of the total sales of the corresponding industry, the firm belongs to the categories of second, third and fourth quartile, respectively. In each case, the variable measuring the different size category takes a value of 1 for the firms that meet the respective measurement criterion and zero otherwise. We then interact different quartile dummies with our variables of interest, $AvgM01_{j,IN}^{China} \times WTO_t$ and $AvgM01_{j,US}^{China} \times WTO_t$, to measure the effect of competition from Chinese imports on that particular quartile of firms. Since, firms can change quartiles over the period of analysis we use the average rank of the firms across the years in our sample.[48]. Our modified equation for estimating the effects on the different quartiles of the firms is specified as Equation (2) below:

[46] We perform additional estimations by controlling for other possible factors that might affect product mix, using alternative indices of import competition, and changing the dependent variable. Results are reported in **Table 14** of **Appendix B**. Our aggregate findings are same as before: no effect of Chinese competition at the aggregate level. Following Goldberg et al. (2010) and Liu (2010), we use input tariffs and imports from other low-wage countries (we use the defintion by the World Bank to classify the low-wage countries) as possible factors affecting the product variety in columns (2) and (3). We find some weak evidence of Chinese import competition in the domestic market negatively affecting the product scope of Indian firms. On the contrary, we find that imports from other low-wage countries positively affecting product scope of Indian firms. This shows that the Chinese imports did not simply replace imports from other low-wage economies. In column (4), we re-define the WTO_t dummy. It takes a value 1 if the year is greater than or equal to 2000. This is to reduce possibility of a firm's anticipation of China's accession to the WTO and therefore causing firms to change their behaviour. We use import competition indices by Liu and Rosell (2013), Mion and Zhu (2013) and Acemoglu et al. (2016) to check for robustness of our results in columns (5), (6), and (7), respectively. Another issue that often mentioned in case of counting the number of products produced by a manufacturing firm is that there is likely to be some measurement issues with the data. We run a robustness check in column (8) where the dependent variable is an indicator, which takes a value 1 for firms that produce more than one product and 0 otherwise. Such a binary variable might be less vulnerable to measurement error compared to the ones that we use. The change of dependent variable does not alter our benchmark finding.

[47] We also divide firms based on their capital intensity and the results are similar. **Table 16** in **Appendix B** presents those results.

[48] We also use rank of the firms in the base year of the sample; the results remain the same.

$$\ln(x_{ijt}) = \beta_D^r \sum_{r=1}^{4}(DComp_{IN}^{China} \times Q_{it}^r) + \beta_F^r \sum_{r=1}^{4}(FComp_{IN}^{China} \times Q_{it}^r) + firmcontrols_{t-1} + \varphi_j + \eta_t + \theta_t^j + \epsilon_{ijt}{}^{49} \quad (2)$$

Columns (1) – (11) in **Table 5** present the results from our estimation of Equation (2). Unlike our previous results, where no distinction was made based on firm size, we now unearth robust evidence of within-firm reallocation of products by Indian firms. In particular, we find significant negative effects of Chinese import competition (in the domestic market) on the product scope of Indian manufacturing firms across the size distribution; firms, irrespective of their size drop products in response to a rise in Chinese share of imports. On the other hand, we find a robust positive effect of Chinese competition in the foreign market on the product scope of firms belonging to the 3rd quartile (the marginally big firms). Our finding is consistent with the standard theoretical predictions of the response of multi-product firms to import competition or trade liberalization (Eckel and Neary, 2010; Bernard et al., 2011; Mayer et al., 2014).

Like **Table 4**, we start by using a simple lagged measure of import share from China in column (1). We interchange industry and firm fixed effects in columns (2) and (3), use interactions of industry and year fixed effects in column (4), restrict our sample to a balanced panel in column (5), specify a long difference in column (6), construct an index of imported inputs in column (7), and use a different index for foreign competition in column (8). Results across all these specifications remain the same – firms across the size distribution drop products. However, the effect is most robust for firms in the lower-half of the size distribution. In addition, we find that the effect is highest when we control for imported inputs. Share of imported inputs from China, on the other hand, induces a strong positive effect on the product scope of Indian firms. This suggests that firms having access to cheap and large variety of intermediate products from China use them to produce their final products rather than sourcing them domestically. The report by the Ministry of Commerce, Government. of India also points out that the growth in the intermediate inputs from China is the highest among all other types of goods (Singh, 2012). Our finding in the case of intermediate inputs is similar to that of Iacovone et al. (2013) for Mexican firms.

Columns (9), (10), and (11) exploit different estimation methods like in **Table 4** - Poisson (without transforming our dependent variable using log), Probit (using a binary variable in case a product is dropped), and first-difference, respectively. Again, a change in the estimation methods does little to change our main finding. The estimates remain stable – we find firms irrespective of size drop products as Chinese exports to India rise.[50] In short, our results across various specifications and techniques to evaluate the heterogeneous

[49] The regressions contain all other terms (double and individual) of the interaction.

[50] When we use the count of product varieties as the dependent variable in column (8), we find a significant positive effect of export market competition on product varieties of Indian firms. This particular result provides support to the findings of Nocke and Yeaple (2014): exporters tend to increase product scope in response to product market competition, whereas firms producing for the domestic market reduce it. However, the effect is not robust across specifications.

effects of import competition from China on the manufacturing firms of India remains robust. Our coefficients indicate that a 10 percentage point increase in Chinese share of imports by India in the domestic market reduces the product scope of manufacturing firms by 0.5–43% at the mean.[51] We also use other types of specifications, for example, shortening the time period, other measures for import competition, changing the dependent variable, etc., to check for the robustness our benchmark findings in **Table 15** (**Appendix B**). Our robustness checks also show heterogeneous effects of rising threat from Chinese competition on Indian manufacturing firms in the domestic market; with the result most robust in case of the small firms (firms belonging to 1st and 2nd quartile).[52] Overall, our results show significant evidence of 'creative destruction' in case of Indian manufacturing firms belonging to the lower-half of the size distribution because of import competition from China.[53]

IV Analysis: While in principle it is useful to use pre-trade shock (signing the WTO agreement in 2001) data (using average of the 'share of Chinese imports' for the years 1992-2001) as a proxy for the contemporaneous 'import competition index', this could be more of a measure of long-term trade patterns rather than a meaningful reflection of import competition shocks after the signing of the WTO agreement itself. If this is true, then concerns regarding whether our results may be biased are legitimate. Also, if there is an increase in the demand for particular kinds of products in India after 2001, which triggers a disproportionate increase in Chinese imports in those categories, such as labour-intensive products, then it is likely to have the same effect on Indian firms in those categories. This could be also true for some unobserved technology shocks, say innovations on labour cost saving technology, which is common to both the countries (Utar and Torres-Ruiz, 2013). These types of biases or unobservable shocks can make the effect of Chinese competition on product variety of Indian firms endogenous.

To address the issues outlined above, we undertake an instrumental variable (IV) analysis. We follow the current literature and use the Chinese share of imports by the EU as the instrument for import competition in the domestic market, $DComp_{IN}^{China}$ (see Iacovone et al., 2013). We define it the following way:

$$ShM_{jt,EU}^{China} = \frac{imports_{jt,EU}^{China}}{imports_{jt,EU}^{Total}}.$$

In case of $FComp_{IN}^{China}$, we follow Utar and Torres-Ruiz (2013) and use

[51] Between 1992 and 2001, the mean share of India's imports from China was 3.81%. This increased to 12.89% between 2002 and 2007. This implies that for a firm, in an industry that exhibited this mean level of change in imports from China, contracted its product scope between (12.89-3.81) × 0.005 and (12.89-3.81) × 0.471. To understand the change in the coefficient due to change in 10 percentage points change in imports, one has to multiply it by 10.

[52] Same in the case when we use capital intensity as the measure of size in **Table 16** of **Appendix B**.

[53] The results are also the same as when we control for initial number of products. Additionally, we examine other possible channels of influence by incorporating additional controls, both at the industry- (skill-intensity, factories, domestic production and management technology) and firm-level (sales, export share, productivity and Herfindahl index), and interacting those with our variable of interest, $DComp_{IN}^{China}$ and $FComp_{IN}^{China}$, in our estimations. Our primary result continues to hold.

$$ShM^{China}_{jt,World} = \frac{imports^{China}_{jt,World}}{imports^{Total}_{jt,World} - imports^{Total}_{jt,US} - imports^{Total}_{jt,EU} - imports^{Total}_{jt,India}}$$ [54]

The Chinese share of EU imports and world imports must be exogenous from the perspective of Indian firms as it is expected to be driven by China itself. We use a simple first-difference model, i.e., we regress year-to-year change in Chinese share of EU imports on year-to-year change in product scope of Indian firms. Results from IV estimations along with their first-stages[55] are presented in **Table 6**. The IV estimations confirm our initial findings, with an exception. We do not find any effect of the Chinese import competition on the product variety of large firms, i.e., firms belonging to 4th quartile. In fact, only in the case of small firms (firms belonging to the 1st quartile) the effect significantly robust across all specifications. Our IV results show that the contraction of the Indian manufacturing firms' product mix, in response to Chinese imports, varies between 1.7–4.4%. Our results are partially similar to Iacovone et al. (2013) for Mexican firms: Chinese import competition affects small firms.[56]

5 Untangling the Puzzle: Core Competency, Product Composition and Product Exit

This section seeks to investigate the reason(s) behind our benchmark finding: product drop in case of small Indian firms because of Chinese import competition in the domestic market. Results appear in **Table 7**. Following Liu (2010), we start by analyzing the core competency of a firm. In other words, we check out whether this is a case of re-focusing to the core product(s), at the expense of the peripheral products, by the Indian firms because of import competition from China. Specifically, we use the following equation at the firm-product-year level to explore whether dropping of peripheral products can explain our previous result on creative destruction:

$$\ln(x_{ipjt}) = \beta_D DComp^{China}_{IN} \times Core_{ip} + \beta_F FComp^{China}_{IN} \times Core_{ip} + firmcontrols_{t-1} + \varphi_j + \eta_t + \gamma_p + \theta^j_t + \epsilon_{ijt} \quad (3)$$

Our dependent variable is now at the firm-product-year level, x_{ipjt}. $Core$ is a dummy variable, which defines the core product of a firm. It takes a value 1 for that product, for which the average sales (over

[54] We do not report the coefficients for foreign competition due to space constraints. Even with the IV results, we do not find any significant effect of export market competition on product variety of Indian firms.

[55] The 1st-stage estimations show significant correlation between our variable of interest and IV with the F-stat consistently greater than 10. The coefficients for four different quartiles in the 1st-stage (i.e., the coefficients in the bottom panel in columns (3), (4), (7) and (8)) are taken from four different 1st stage regressions. We report the coefficient respective to the regression of that quartile.

[56] We also carry out IV estimations using China's membership in the WTO in the year 2001 as structural break. In other words, using a Bartik-type of estimation method (the method that we use primarily in **Tables 4** and **5**). We continue to use the EU's share of Chinese imports as an instrument for India's import share from China. Qualitatively, the results remain the same: Chinese import competition in the domestic market induces small Indian manufacturing firms to drop their products.

time) is maximum and 0 otherwise. We interact the core product dummy with our indices of Chinese import competition, $DComp_{IN}^{China}$ and $FComp_{IN}^{China}$, to measure the required effect. In addition to industry and year, we now use product fixed effects, γ_p, to control for the unobservable product characteristics in all of our regressions.

Column (1) distinguishes the core product, i.e. the product that generates the largest share of sales within a firm from the rest (the peripheral products), and interacts it with the import competition measures. The coefficient of the interaction term, $DComp_{IN}^{China} \times Core$ is negative and statistically significant with no effect in case of foreign competition. The negative sign indicates that the Indian manufacturing firms drop their peripheral products in the face of rising import competition from China in the domestic market. Column (2) does the same estimation, but by dividing the firms by size (based on their sales, as done previously). The coefficients on the four different quartiles point out that the aggregate effect (firms dropping their peripheral products) comes from the effect of domestic market import competition on the lower-half of the size distribution, which is consistent with our earlier results. That is, import competition induces small and medium-sized firms to refocus on their core products by dropping their peripheral products.

Bernard et al. (2006, 2011) contend that import competition leads not only to dropping of marginally viable products but also to a shift in the distribution of firms' output towards high-profitable products. Additionally, Dhingra (2013) also points out that import competition from foreign brands induces firms to lower product innovation through within-brand cannibalization.

Following this literature, we use the following equation to capture the compositional change of a firm's output (with change in the sales share of core product as a share of total sales of a firm as the dependent variable) in response to import competition:

$$\Delta SalesShare_{ipt} = \beta_D DComp_{IN}^{China} \times Core_{ip} + \beta_F FComp_{IN}^{China} \times Core_{ip} + firmcontrols_{t-1} + \varphi_j + \eta_t + \gamma_p + \theta_t^j + \epsilon_{ijt} \quad (4)$$

$\Delta SalesShare_{ipt}$ is the change in the sales share of firm i for product (core) p at time t. Column (3) shows a positive and significant relationship between the interaction of the Chinese import competition measure (domestic market) and the core product dummy, and the change in sales share for the core product. It indicates that an increase in import competition from China in the domestic market resulted in growth in the share of sales for the firms' core products. Once we allow for heterogeneity based on firm size, our results in column (4) clearly indicates that our finding in column (3) is driven mainly by the firms belonging to 1st and 2nd quartiles of the size distribution. Increase in sales share for a core product of a firm due to Chinese competitive pressure is to the tune of 5.3–6.5%. Overall, our finding suggests considerable support for the core competency hypothesis i.e., higher levels of import competition from China in the domestic market

causes multi-product firms to drop their peripheral products and instead focus on the production of their core products. We now directly test this hypothesis.

Columns (5) and (6) consider the likelihood of product exit based on a firm's core product by exploiting the following equation:

$$x_{ipt} = \beta_D DComp_{IN}^{China} \times Core_{ip} + \beta_F FComp_{IN}^{China} \times Core_{ip} + firmcontrols_{t-1} + \varphi_j + \eta_t + \gamma_p + \theta_t^j + \epsilon_{ijt} \quad (5)$$

where, x_{ipt} is a firm-product specific outcome of interest for firm i or firm-product ip at time t. It takes a value 1 in the year when the firm or firm-product is last observed in the sample. We run probit regressions and report the marginal effects. As shown in column (6), the coefficient for the interaction of the import competition measure (for domestic market) with core product dummy is negative and significant for all but firms belonging to the 4th quartile. The negative sign indicates that the probability of product exit is relatively higher for peripheral products in the face of rising import competition from China. And, the likelihood of effect (dropping of peripheral products) falls as firm size increases with no effect for large firms. A 10-percentage point increase in Chinese share of imports decreases the probability of dropping a core product by around 4.5% at the mean. Our estimates are less than when compared to Liu (2010) for the US firms, which is 6.7%. We find uniform evidence that rising import competition from China in the Indian domestic market is associated with an increasing share of core products and a decreasing share of peripheral products. Thus, our results are indicative of more centralized distribution of production being related to the rising import competition faced by the Indian firms. This is very consistent with the case of the U.S. firms (Liu, 2010) and Mexican firms (Iacovone et al., 2013).[57]

6 Within-Firm Responses

In this section, we check for within-firm responses of Indian firms as a result of Chinese import competition. Given the fact that we find strong evidence of product drop (as a result for import competition in the domestic market) for certain section of firms, how does then import competition affect productivity, use of productive factors and total sales revenue (further divided into domestic and exports) of those firms?

Mayer et al. (2014) builds a theoretical model to show that tougher competition in an export market induces a firm to skew its export sales toward its best performing products. This within-firm change in product mix driven by trading environment has important repercussions on firm productivity. Since our

[57] We additionally use the index of the share of imported intermediate goods from China, $ShInputs_{IN}^{China}$, and interact with the core product dummy. The coefficients increase further, but only for firms in the lower-half of the size distribution. These results suggest that small firms now make better use of the cheaper Chinese intermediate inputs to improve the competitiveness (sales from the core products increases) of their core products.

results point toward significant within-firm change in product mix of Indian firms as result of Chinese import competition in the domestic market, we follow Mayer et al. (2014) and start by checking for productivity effects for those firms in column (1). We measure productivity following Levinshon and Petrin (2003) methodology and regress on the interaction between the Chinese import competition measure and size dummy. Results are reported in **Table 8**. We find very strong confirmation of the competitive effect (in the domestic market) on the productivity of the firms. The effects increase as firm size increases. Competitive pressures from China in the domestic market induces a productivity gains for Indian firms in the range of 0.9–1.6%. Our results provide strong support to the theoretical predictions of Mayer et al. (2014). Other studies (Schoar, 2002; Aw and Lee, 2008) have also shown that multi-product firms improve their efficiencies after re-focusing on core products.

We follow Medina (2017) and look at three important productive factors in columns (2) – (4) that might be affected due to within-firm changes in product mix – labour expenditure, capital expenditure, and R&D expenditure (a significant part of it is used for product innovation or branding of products). No strong significant effect is found in any of these cases. In particular, our estimates show that import competition does not lead firms to adjust the use of their productive factors, except for some negative effects for small firms in case of R&D expenditure. Since firms are changing their product mix, these findings suggest that factors are being reallocated within the firm. Firms keep employing the same amount of productive factors, but use them more intensively on their core products. These results suggest that trade-induced competition (especially at the domestic market) leads firms to re-focus on their core activities through within-firm factor reallocation. These results are consistent with previous empirical findings on within-firm responses to negative shocks of import competition (Iacovone and Javorcik, 2010; Iacovone et al., 2013).

Lastly, we use total sales, export and domestic sales as dependent variables in columns (5) – (7), respectively. The estimates show that Chinese import competition in the Indian domestic market has very limited impact on the total revenue of firms. Only small firms experience a drop in their total sales. When we divide total sales into exports and domestic sales in columns (6) and (7), we find that the entire decrease in total sales is a result of domestic sales of the firms belonging to the 1st quartile. Increase in Chinese imports in the domestic market of India reduces earnings of Indian firms by around 2.5%.

7 Additional Heterogeneity – Product Categories, Export Orientation and Ownership

We now seek to explore additional sources of heterogeneity in our findings by breaking down the sample of firms by different product categories according to end-use classification, export orientation and ownership. We start by classifying the manufacturing sector into different categories of goods (by end use) utilizing the user-based classification of Nouroz (2001). First, we match the NIC 2004 codes with the Input-Output (I-O)

classifications, then arrange the matched NIC categories into user-based products at 2004 NIC 4-digit level. Finally, we categorize the entire manufacturing sector into two major sub-sectors: (1) Final goods, which comprise of consumer durable and non-durable goods; and (2) Intermediate goods, which contain capital, intermediate and basic goods. We do so to examine the compositional effect of Chinese import competition i.e., how the effect varies across different types of industrial products (by end use). Results are shown in **Table 9**.

Columns (1) – (2) measure the effects of Chinese import competition on the firms producing final and intermediate goods, respectively. Our estimated coefficients show us: (i) small firms or firms belonging to 1st quartile drop both intermediate and final goods, with the effect for intermediate goods larger by around 1.5 times; (ii) firms of other quartiles (2nd and 3rd) drop only intermediate goods. Our estimated coefficients from column (2) provide additional support to our earlier result that access to wide range of intermediate goods from China induce Indian firms to drop products at a much higher rate.

Combining our result on intermediate goods from this table with **Table 5**, one can certainly infer that the Indian firms have a higher probability of dropping intermediate goods, when faced with Chinese competition, rather than final goods. Our finding of 'creative destruction' in case of Indian firms is certainly stronger in case of intermediate goods than final goods. This result (higher incidence of drop in case of intermediate goods) is consistent with a research report from Ministry of Commerce, Govt. of India (Singh, 2012). The report also finds that the intermediate goods sector of India is severely affected because of rise in imports of intermediate goods/inputs from China. Goldberg et al. (2010a, b) show that trade reforms undertaken by India during the 1990s helped Indian manufacturing firms, especially the large ones, to import cheap, high-quality intermediate goods. Kandilov et al. (2017) points out that 82% of those import of intermediate goods came from 10 OECD countries. Our results show that China's internal trade reforms and eventual accession to the WTO in 2001 may have possibly resulted in a trade creation effect from the perspective of Indian firms: small manufacturing firms now imports a large fraction of its intermediate inputs from China to produce new products. We also find that export market competition induces firms across size distribution to produce more intermediate goods with no effect on final goods.

Next, we utilize an important firm-level characteristic: export orientation. We use this to investigate how exporters are differentially affected than non-exporters. Columns (3) and (4) report that small firms, whether or not it is an exporter, drop its products in the face of rising import competition from China in the domestic market. Additionally, we find evidence of an adverse effect of Chinese import competition on product variety of firms belonging to 2nd and 3rd quartile, but only in case of non-exporters. On other hand, we find significant evidence of product addition, across the size distribution of firms, by exporters when facing threat from Chinese imports in the export market. This result draws support from the findings of Baldwin and Gu (2009) in the case of Canadian and Lopresti (2016) in case of the US firms. Lastly, columns

(5) – (6) divide firms according to ownership – domestic and foreign. The coefficients demonstrate strong evidence of only domestic firms in the lower-half of the size distribution drop their products in response to import competition from China. In addition, we find some positive evidence on the product mix of the foreign firms, but only for firms of 2nd quartile.

8 Conclusion

The substantial rise of China as the biggest trade partner of India, especially after 2001, along with the increase in sentiments against Chinese goods in India provides us the platform to investigate the impact of the increase in Chinese competitive pressure on product variety of Indian firms. Using detailed product-firm-level data, which reports product-level information for firms across all manufacturing sectors in India spanning over two decades, we analyze the impact of such competitive pressures on Indian manufacturing firms on both the domestic market and the export (US) market at product-level (extensive margin). We find consistent evidence of product drop by firms belonging to lower-half of the size distribution. Our estimates point out that for an average Indian manufacturing firm, a 10% increase in India's Chinese share of imports reduces the product scope by 1.7-4.4%. Small and medium-sized firms drop their peripheral or marginal products and focus on core products. This effect is entirely concentrated due to competitive pressures in the domestic and not export market. Next, we find significant evidences of within-firm reallocation of resources. Lastly, Chinese competition at the domestic market helps firms in access to cheaper and diverse set of intermediate inputs. We show firms of all sizes increase product scope from such expanded access to imported Chinese intermediates. Intermediate inputs from China also help firms, small and medium-sized firms, to gain more from their core products. Such increased use of Chinese imported inputs suggest a trade diversion or trade creation effect as Indian firms were supposedly importing intermediate inputs from OECD countries during the 1990s.

Our results are consistent with both the theoretical (Eckel and Neary, 2010; Dhingra, 2013; Mayer, 2014) and empirical literature (Liu, 2010; Lopresti, 2016). These patterns are observed among both exporters and non-exporters, with significantly higher effect in case of the latter and domestic private firms. We also find that higher Chinese competition forces firms to drop both intermediate and final goods, with the effect on the former larger. Finally, our results are consistent across a battery of robustness checks and IV analysis, where we control for endogeneity of the import competition index using a third country's share of imports from China (EU imports from China) as an instrument.

These results show that rise of China as one of the important trade partners of India has significantly influenced production patterns for firms in India (a similar country in terms of income and wage). This finding could potentially be relevant for policy makers and firms in India and worldwide. Chinese competitive pressure at the domestic market forces smaller firms to drop their products, reallocates their productive

factors toward its best product(s), which in turn increases average productivity. This increase in aggregate productivity can contribute to higher income and economic welfare in the long-run. Use of productive factors efficiently and increase in average productivity can contribute toward consumers' benefits and other distributional consequences. However, this is outside the scope of the current paper and we cannot comment on how the Chinese competitive pressure has affected overall economic welfare in India.

Despite growing trade deficit with China and understandable domestic political and public resistance, insulating the domestic market from competition from China may likely to be harmful to productivity, as it would benefit less productive firms and marginal products. It could only be a partial solution to local economic distress. Policy should aim to accommodate reallocation as a key to productivity growth and facilitate the regional economic stresses, while recognizing the possible distributional effects of product market competition.

References

Acemoglu, D., Autor, D., Dorn, D., Hanson, G. H., Price, B., 2016. Import competition and the Great US employment sag of the 2000s. Journal of Labor Economics 34 (S1), S141-S198

Anand, R., Kochhar, K., Mishra, S., 2015. Make in India: Which exports can drive the next wave of growth? IMF Working Paper No. 119. International Monetary Fund

Arkolakis, C., Ganapati, S., Muendler, M-A., 2016. The extensive margin of exporting products: A firm-level analysis. Mimeo, Dartmouth College

Ashournia, D., Munch, J., Nguyen, D., 2014. The effect of Chinese import competition on Danish firms and workers. Oxford Discussion Paper No. 703. University of Oxford

Autor, D., Dorn, D., Hanson, G. H., 2013. The China syndrome: local labor market effects of import competition in the United States. American Economic Review 103 (6), 2121-2168

Autor, D., Dorn, D., Hanson, G. H., Pisano, G., Shu, P., 2016. Foreign competition and domestic innovation: evidence from U.S. Patents. Mimeo, MIT

Aw, B-Y., Lee, Yi., 2009. Product choice and market competition: The case of multiproduct electronic plants in Taiwan. Scandinavian Journal of Economics 111 (4), 711-740

Baldwin, J., Gu, W., 2009. The impact of trade on plant scale, production-run length, and diversification. In: Dunne, T., Jensen, J. B., Roberts, M. J., (Eds.), Producer Dynamics: New Evidence from Micro Data, Chicago: University of Chicago Press, pp. 557–592

Balsvik, R., Jensen, S., Salvanes, K. G., 2015. Made in China, sold in Norway: local labour market effects of an import shock. Journal of Public Economics 127 (1), 137-144

Bernard, A. B., Jensen, B. J., Schott, P. K., 2006. Survival of the best fit: exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants. Journal of International Economics 68 (1), 219-237

Bernard, A. B., Redding, S. J., Schott, P. K., 2010. Multiple-product firms and product switching. American Economic Review 100 (1), 70-97

–, 2011. Multiproduct firms and trade liberalization. The Quarterly Journal of Economics 126 (3), 1271-1318

Bloom, N., Draca, M., Van Reenen, J., 2016. Trade induced technical change: the impact of Chinese imports on innovation, IT and productivity. The Review of Economic Studies 83 (1), 87-117

Debroy, B. Santhanam, A.T., 1993. Matching trade codes with industrial codes. Foreign Trade Bulletin 24 (1), 5-27

de Loecker, J., Khandelwal, A., Goldberg, P., Pavcnik, N., 2016. Prices, markups and trade reform. Econometrica 84 (2), 445-510

Dhingra, S., 2013. Trading away wide brands for cheap brands. American Economic Review 103 (6), 2554-2584

di Giovanni, J., Levchenko, A., Zhang, J., 2014. The global welfare impact of China: trade integration and technological change. American Economic Journal: Macroeconomics 6 (3), 153-183

Eckel, C., Neary, P. J., 2010. Multiproduct firms and flexible manufacturing in the global economy. The Review of Economic Studies 77 (1), 188-217

Export-Import Bank of India, 2016. Presentation on India's international trade and investment. EXIM Bank of India, July 2016

Garred, J., 2018. The persistence of trade policy in China after WTO accession. Journal of Internatonal Economics 114, 130-142

Goldberg, P. K., Khandelwal, A., Pavcnik, N., Topalova, P., 2010a. Trade liberalisation and new imported inputs. American Economic Review P&P 99 (2), 494-500

–, 2010b. Imported intermediate inputs and domestic product growth: evidence from India. The Quarterly Journal of Economics 125 (4), 1727-1767

–, 2010c. Multiproduct firms and product turnover in the developing world: evidence from India. The Review of Economics and Statistics 92 (4), 1042-1049

Goldberg, P. K., Khandelwal, A., Pavcnik, N., 2013. Variety in, variety out: imported input and product scope expansion in India. In: Bhagwati, J., Panagariya, A., (Eds.), Reforms and Economic Transformation in India, Oxford University Press

Guadalupe, M., Wulf, J., 2010. The flattening firm and product market competition: the effect of trade liberalization on corporate hierarchies. American Economic Journal: Applied Economics 2 (4), 105-127

Hanson, G., Robertson, R., 2010. China and the manufacturing exports of other developing countries. In: Feenstra, R., Wei, Shang Jin, (Eds.), China's Growing Role in World Trade, Chicago: University of Chicago Press and the NBER, pp. 137-159

Iacovone, L., Javorcik, B. S., 2010. Multi-product exporters: product churning, uncertainty and export discoveries. The Economic Journal 120 (544), 481-499

Iacovone, L., Rauch, F., Winters, L. A., 2013. Trade as an engine of creative destruction: Mexican experience with Chinese competition. Journal of International Economics 89 (2), 379-392

Kandilov, I., Leblebicioglu, A., Manghnani, R., 2017. Trade liberalization and investment in foreign capital goods: a look at the intensive margin. Mimeo, North Carolina State University

Krugman, P., 2008. Trade and wages, reconsidered. Brookings Papers on Economic Activity 2008 (1), 103–38

Levinsohn, J., Petrin, A., 2003. Estimating production functions using inputs to control for unobservables. The Review of Economic Studies 70 (2), 317-341

Liang, Y., 2018. Job Creation and Job Destruction: The effect of trade shocks on U.S. manufacturing employment. Mimeo, Syracuse University

Liu, R., 2010. Import competition and firm refocusing. Canadian Journal of Economics 43 (2), 440-466

Liu, R., Rosell, C., 2013. Import competition, multiproduct firms, and basic innovation. Journal of International Economics 91 (2), 220-234

Lopresti, J., 2016. Multiproduct firms and product scope adjustment in trade. Journal of International Economics 100, 160-173

Lu, Y., Yu, L., 2015. Trade liberalisation and markup dispersion: evidence from China's WTO accession. American Economic Journal: Applied Economics 7 (4), 221-253

Martin, J., Meajean, I., 2014. Low-wage country competition and the quality content of high-wage country exports. Journal of International Economics 93 (1), 140-152

Mayer, T., Melitz, M. J., Ottaviano, G. I. P., 2014. Market size, competition, and the product mix of exporters. American Economic Review 104 (2), 495-536

Medina, P., 2017. Import competition, quality upgrading and exporting: evidence from the Peruvian apparel industry. Mimeo, University of Toronto

Mion, G., Zhu, L., 2013. Import competition from offshoring to China: a curse or blessing for firms? Journal of International Economics 89 (1), 202-215

Moulton, B. R., 1990. An illustration of a pitfall in estimating the effects of aggregate variables on micro units. The Review of Economics and Statistics 72 (2), 334-338

Nouroz, H., 2001. Protection in Indian manufacturing: An empirical study, MacMillan India Ltd., New Delhi

Qiu, L. D., Zhou, W., 2013. Multiproduct firms and scope adjustment in globalization. Journal of International Economics 91 (1), 142-153

Schoar, A., 2002. The effect of diversification on firm productivity. Journal of Finance LVII (6), 2379–403

Singh, J., 2012. Impact of surge of Chinese import on Indian manufacturing sector. Mimeo, Department of Industrial Policy and Promotion. Ministry of Commerce and Industry, Govt. of India., New Delhi, India

United Nations on Conference on Trade and Development (UNCTAD), 2009. Impact of global slowdown on India's exports and employment. Prepared under UNCTAD-Govt. of India-DFID Project Strategies and Preparedness for Trade and Globalization in India. UNCTAD India, India

Utar, H., Torres-Ruiz, L. B., 2013. International competition and industrial evolution: evidence from the impact of Chinese competition on Mexican maquiladoras. Journal of Development Economics 105 (1), 267-287

Zhiyuan, C., 2003. China's export rebate policy. China: An International Journal 1 (2), 339-349

Figure 1: Share of Imports from China by Indian Manufacturing Industries, 1992-2007
Notes: Figures represent the average share of Chinese imports in total imports across manufacturing industries in a given year.

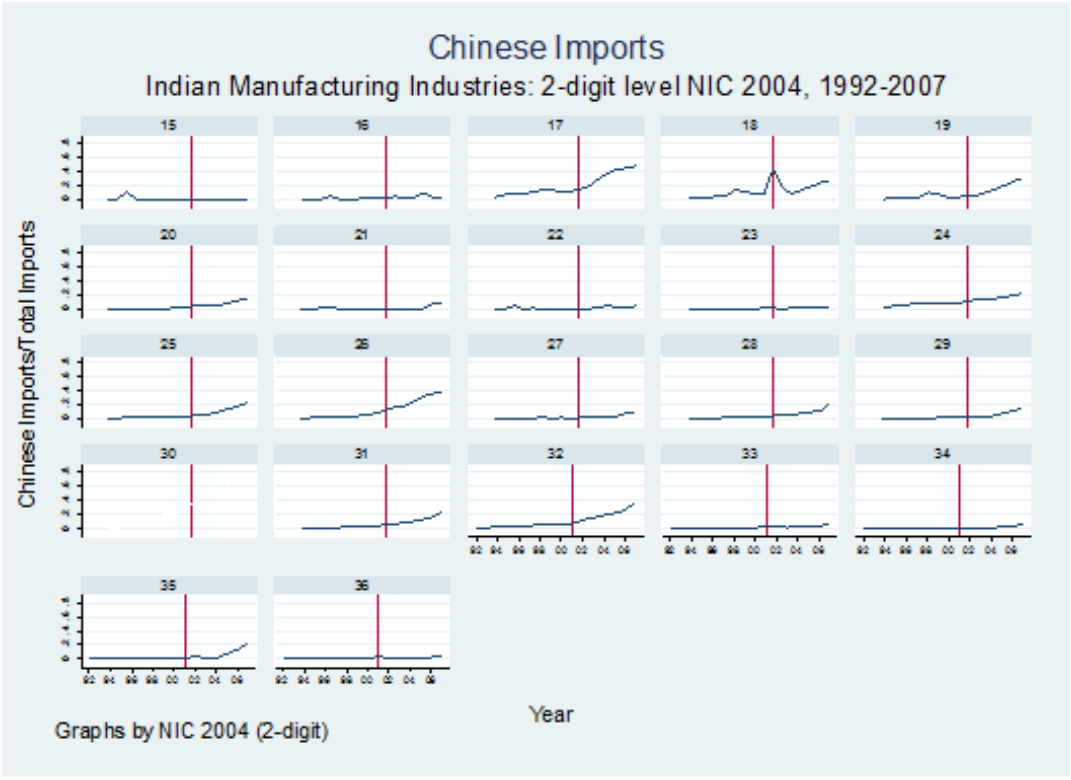

Figure 2: Share of Chinese Imports across 2-digit Manufacturing Industries, 1992-2007
Notes: Figures represent the average share of Chinese imports in total imports across each 2-digit manufacturing industry (at NIC 2004) in a given year.

Figure 3: Number of product varieties produced by an Indian Manufacturing Firm,1992-2007
Notes: Figures represent the average number of product varieties produced by a representative Indian manufacturing firm in a given year.

Table 1: India's Trade with China and Others

	Trade with China		Imports from Other Countries			
	Imports from China	Exports to China	ASEAN excluding China	US	EU27	World
1992	2.32	2.60	18.95	38.27	124.42	402.50
2001	20.51	10.35	48.88	36.21	116.11	568.70
2007	218.80	84.51	187.24	126.48	288.42	1946.65
Growth (1992-2007)	9339.34%	3150.38%	888.07%	230.49%	131.81%	383.64%

Notes: Real trade values (deflated using Wholesale Price Index of the entire manufacturing sector in India).

Table 2: Descriptive Statistics

	Mean	Median	Std. Dev.	Min	Max
Panel A: Dependent Variables					
Product Scope	6.93	5	8.51	1	84
Productivity	0.21	0	1.14	0	309.85
Labour Expenditure (Total Wages)	100.14	14.6	692.2	0.1	57612.9
Capital Expenditure	1275.62	169.5	9996.28	0.1	891409
R&D Expenditure	33.46	3.2	195.6	0.1	7968.6
Total Sales	1840.63	268.8	21580.62	0.1	2000000
Exports	423.41	44.8	4514.27	0.1	585313
Domestic Sales	1651.25	226.1	20207.41	0.1	1922751
Panel B: Independent Variables					
(Chinese Imports/Total Imports)$_{IN}$	8.99	3.77	11.67	0	93.25
(Chinese Imports/Total Imports)$_{US}$	8.12	3.18	11.43	0	79.58
(Chinese Imports/Total Imports)$_{EU}$	3.03	1.23	4.42	0	47.09
(Chinese Imports/Total Imports)$_{World}$	11.48	4.19	35.40	0.012	69.04
$InputTariff_{t-1}$	59.83	42.62	41.97	17.34	198.71
(Imports from Other Low-Wage Countries/Total Imports)$_{IN}$	0.033	0.003	0.98	$7.03e-09$	79.38
Technology Adoption/GVA	0.34	0.01	22.61	$2.20e-06$	2163
GVA	994.99	108.4	13388.73	0.1	1200000
Age	17.12	13	18.81	5	128

Notes: Annual data at the firm-level, covering the period 1992-2007. Monetary values are in real INR (Indian Rupees) Millions. 'Product Scope' is the number of products manufactured by each firm in a single year. 'Productivity' is measured using Levinshon and Petrin (2003) methodology. 'Labour Expenditure' is the total labour wages of a firm. 'Capital Expenditure' is the total amount of capital employed in a firm. 'R&D Expenditure' is the total amount of expenditure on Research and Development activities. 'Total Sales' is the total sales (domestic + exports) by a firm. 'Exports' is the amount of exports revenue earned by a firm. 'Domestic Sales' is the amount of revenue earned by a firm from domestic sales. 'Technology Adoption/GVA' is the total amount of technological adoption share of gross value-added (GVA) of a firm. Technology Adoption = R&D expenditure + Royalty payments for technical knowhow. 'Age' is the age of a firm.

Table 3: Chinese Imports and Product Variety of Indian Firms - Before and After 2001

Industry Code	Industry Name	Chinese Imports/ World Imports		Product Variety	
NIC 2004 2-digit		1992–2001	2002–2007	1992–2001	2002–2007
		(1)	(2)	(3)	(4)
15	Foods Products and Beverages	1.31	0.25	5.33	5.33
16	Tobacco Products	1.99	4.42	6.97	6.42
17	Textiles	11.20	37.19	3.78	4.09
18	Wearing Apparel	11.46	18.13	3.89	3.52
19	Leather	4.53	17.98	5.29	4.51
20	Wood and Wood Products	1.70	9.68	6.06	5.76
21	Paper and Paper Products	0.81	3.35	3.87	3.79
22	Recorded Media	1.03	3.62	3.94	2.82
23	Coke, Refined Petroleum, Nuclear Fuel	1.01	2.25	6.10	5.94
24	Chemical and Chemical Products	7.96	17.79	6.49	6.05
25	Rubber and Plastics	2.71	13.73	4.32	4.42
26	Non-metallic Mineral Products	5.83	27.76	4.36	4.25
27	Basic Metals	1.43	4.61	4.80	4.87
28	Fabricated Metal Products	2.14	10.10	4.13	4.55
29	Machinery and Equipment	1.67	8.21	5.79	5.27
30	Office, Accounting & Computing Machinery	14.96	51.91	6.70	7.03
31	Electrical Machinery and Apparatus	3.08	13.64	7.09	6.97
32	Communication Equipment	4.96	22.60	7.51	6.83
33	Medical, Precision and Optical Instruments	1.23	3.85	6.15	6.00
34	Motor vehicles, Trailers and Semi-Trailers	0.38	2.82	6.50	7.44
35	Other transport equipment	1.14	8.07	5.23	5.20
36	Furniture; Manufacturing n.e.c	1.29	1.56	4.41	3.52
	Average	3.81	12.89	5.36	5.09

Notes: Numbers represent average across multi-product firms belonging to each industrial category according to National Industrial Classification (NIC) 2004 2-digit level. 'Chinese Imports/World Imports' is the share of Chinese imports in total imports of India. 'Product Variety' is the average number of products produced by a multi-product firm in each of these industrial categories.

Table 4: Chinese Competition and Product Variety of Indian Firms: Aggregate level

	Ln(Product Scope + 1)								Product Scope	Product Exit = 1	ΔL (PS +
	Lagged	WTO Membership							WTO Membership	WTO Membership	
		Industry FE	Firm FE	Industry × Year FE	Balanced Panel	Long Difference	Imported Inputs	FComp US, EU, ASEAN	Firm FE		Firs Diff
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11
$DComp_{IN}^{China}$	0.001	0.002	0.002	0.004	0.004	-0.054^{a}	0.070	0.004	0.001	0.002	−0.0
	(0.001)	(0.004)	(0.004)	(0.004)	(0.003)	(0.017)	(0.045)	(0.004)	(0.001)	(0.003)	(0.00
$FComp_{IN}^{China}$	−0.0004	−0.002	−0.002	0.00004	0.002	0.003	-0.002^{c}	−0.003	−0.0004	0.0004	−0.0
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.001)	(0.002)	(0.007)	(0.001)	(0.00
$ShInputs_{IN}^{China}$							−0.066				
							(0.044)				
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.19	0.19	0.71	0.20	0.32	0.09	0.19	0.19	n/a	0.06	0.0
N	60,979	60,979	60,979	60,979	10,648	7,609	60,979	58,783	54,555	261,681	55,7
Industry FE	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Firm FE	No	No	Yes	No	No	No	No	No	Yes	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE(2-digit)*Year FE	No	No	No	Yes	No	No	No	No	No	No	No

Notes: The dependent variable in columns (1) - (8) is the natural logarithm of number of products manufactured by a firm in each year plus 1. Column (9) uses a poisson regression, where the dependent variable is the number of product varieties produced. Column (10) is a probit specification where the dependent variable takes a value 1 if there is a product drop. Column (11) uses first difference of the natural logarithm of product scope of a firm in each year plus 1 as the dependent variable. '$DComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in the domestic market. '$FComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in an export destination (US) in columns (1) - (7), (9) and (10). In column (8), '$FComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in US, EU and ASEAN. '$ShInputs_{IN}^{China}$' is the index of share of imported intermediate inputs from China. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), 'TechAdop/GVA' and size (sales) of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain other terms of the interaction. ^{c},^{a} denotes 10%, 5% and 1% level of significance.

Table 5: Chinese Competition and Product Variety of Indian Firms: Size (=Sales) Heterogeneity

	Ln(Product Scope + 1)								Product Scope	Product Exit = 1	ΔI (PS
	Lagged	WTO Membership							WTO Membership	WTO Membership	
		Industry FE	Firm FE	Industry × Year FE	Balanced Panel	Long Difference	Imported Inputs	FComp US, EU, ASEAN	Firm FE		Fir Di
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(1
$DComp_{IN}^{China} \times Qr_1$	−0.003	−0.016^a	−0.015^a	−0.016^a	−0.007^c	−0.016^c	−0.149^c	−0.017^a	−0.017^a	−0.005	−0.0
	(0.003)	(0.003)	(0.002)	(0.003)	(0.004)	(0.010)	(0.090)	(0.003)	(0.003)	(0.008)	(0.0
$DComp_{IN}^{China} \times Qr_2$	−0.007^b	−0.007^b	−0.005^c	−0.008^b	−0.011^c	−0.042^c	−0.285^a	−0.009^b	0.001	−0.016^b	−0.0
	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)	(0.023)	(0.097)	(0.004)	(0.003)	(0.007)	(0.0
$DComp_{IN}^{China} \times Qr_3$	−0.004	−0.021^a	−0.019^a	−0.021^a	0.005	−0.003	−0.377^a	−0.020^a	−0.022^a	−0.021^b	−0.0
	(0.005)	(0.004)	(0.004)	(0.004)	(0.011)	(0.026)	(0.117)	(0.005)	(0.003)	(0.009)	(0.0
$DComp_{IN}^{China} \times Qr_4$	−0.007	−0.013^a	−0.012^a	−0.013^a	0.006	0.009	−0.471^b	−0.014^a	−0.011^a	−0.023^a	−0.
	(0.008)	(0.004)	(0.004)	(0.004)	(0.008)	(0.024)	(0.203)	(0.004)	(0.003)	(0.008)	(0.0
$FComp_{IN}^{China} \times Qr_1$	0.003	0.001	0.001	0.001	−0.006	0.009^c	0.002	0.003	−0.003	−0.007	−0.
	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.005)	(0.002)	(0.003)	(0.003)	(0.006)	(0.0
$FComp_{IN}^{China} \times Qr_2$	0.007^c	0.002	0.003	0.001	−0.011	0.013^b	0.005	0.001	−0.006^b	−0.007	−0.
	(0.004)	(0.002)	(0.002)	(0.003)	(0.007)	(0.006)	(0.003)	(0.003)	(0.003)	(0.005)	(0.0
$FComp_{IN}^{China} \times Qr_3$	0.006	0.007^b	0.008^a	0.006^b	−0.004	0.015^a	0.011^a	0.007^c	−0.0003	−0.002	−0.
	(0.005)	(0.003)	(0.002)	(0.003)	(0.009)	(0.006)	(0.004)	(0.004)	(0.003)	(0.005)	(0.0
$FComp_{IN}^{China} \times Qr_4$	0.003	0.003	0.004	0.004	−0.004	0.019^a	0.009^c	0.009^b	−0.001	−0.007	−0.
	(0.008)	(0.003)	(0.003)	(0.003)	(0.008)	(0.006)	(0.005)	(0.005)	(0.003)	(0.005)	(0.0
$ShInputs_{IN}^{China} \times Qr_1$							0.133				
							(0.092)				
$ShInputs_{IN}^{China} \times Qr_2$							0.276^a				
							(0.095)				
$ShInputs_{IN}^{China} \times Qr_3$							0.354^a				
							(0.115)				
$ShInputs_{IN}^{China} \times Qr_4$							0.456^b				
							(0.198)				
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Ye
R-Square	0.12	0.12	0.60	0.12	0.25	0.19	0.12	0.12	n/a	0.03	0.0
N	119,229	119,229	119,229	119,229	13,703	14,623	119,229	114,569	111,951	327,305	116,
Industry FE	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Ye
Firm FE	No	No	Yes	No	No	No	No	No	Yes	No	N
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	N
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Ye
Industry FE(2-digit)*Year FE	No	No	No	Yes	No	No	No	Yes	No	No	N

Notes: The dependent variable in columns (1) - (8) is the natural logarithm of number of products manufactured by a firm in each year plus 1. Column (9) uses a poisson regression, where the dependent variable is the number of product varieties produced. Column (10) is a probit specification where the dependent variable takes a value 1 if there is a product drop. Column (11) uses first difference of the natural logarithm of product scope of a firm in each year plus 1 as the dependent variable. '$DComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in the domestic market. '$FComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in an export destination (US) in columns (1) - (7), (9) and (10). In column (8), '$FComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in US, EU and ASEAN. '$ShInputs_{IN}^{China}$' is the index of share of imported intermediate inputs from China. Quartiles ($Qr_{i=1,2,3,4}$)are defined according to the total sales of a firm. A firm belongs to 1st quartile if the total sales of that firm is $\langle$ 25th percentile of the total sales of the corresponding industry and so on. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), and 'TechAdop/GVA' of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c,b,a} denotes 10%, 5% and 1% level of significance.

Table 6: Chinese Competition and Product Variety of Indian Firms: IV Results

	ΔLn(Product Scope + 1)				ΔProduct Scope			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta DComp_{IN}^{China}$	−0.004	−0.009			−0.019	−0.029		
	(0.003)	(0.006)			(0.016)	(0.023)		
$\Delta DComp_{IN}^{China} \times Qr_1$			-0.018^{c}	-0.018^{b}			-0.044^{c}	-0.044^{c}
			(0.010)	(0.008)			(0.026)	(0.025)
$\Delta DComp_{IN}^{China} \times Qr_2$			-0.017^{c}	-0.017^{b}			−0.018	−0.018
			(0.010)	(0.008)			(0.029)	(0.025)
$\Delta DComp_{IN}^{China} \times Qr_3$			-0.018^{c}	-0.018^{b}			−0.039	−0.039
			(0.011)	(0.009)			(0.036)	(0.029)
$\Delta DComp_{IN}^{China} \times Qr_4$			−0.011	−0.011			−0.019	−0.019
			(0.009)	(0.008)			(0.032)	(0.028)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.06	0.02	0.06	0.06	0.04	0.03	0.04	0.04
N	45,661	55,739	116,340	116,340	45,661	55,739	116,340	116,340
F-Stat	29.09	43.19	88.34	96.75	29.09	35.68	61.63	23.24
Industry FE	Yes	No	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes	No	Yes
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1st Stage								
	$\Delta DComp_{IN}^{China}$							
$\Delta DComp_{EU}^{China}$	0.212^{a}	0.308^{b}			0.212^{***}	0.308^{**}		
	(0.040)	(0.140)			(0.040)	(0.140)		
$\Delta DComp_{EU}^{China} \times Qr_1$			0.680^{a}	0.680^{a}			0.680^{b}	0.680^{a}
			(0.283)	(0.050)			(0.283)	(0.050)
$\Delta DComp_{EU}^{China} \times Qr_2$			0.706^{b}	0.706^{a}			0.707^{b}	0.707^{a}
			(0.299)	(0.050)			(0.299)	(0.050)
$\Delta DComp_{EU}^{China} \times Qr_3$			0.647^{b}	0.645^{a}			0.647^{b}	0.647^{a}
			(0.296)	(0.051)			(0.296)	(0.051)
$\Delta DComp_{EU}^{China} \times Qr_4$			0.670^{b}	0.670^{a}			0.671^{b}	0.670^{a}
			(0.323)	(0.054)			(0.323)	(0.054)

Notes: The dependent variable in columns (1) - (4) and (5) - (8) is the change in natural logarithm of number of products plus 1 and change in the number of product varieties manufactured by a firm, respectively. '$\Delta DComp_{IN}^{China}$' is the change in the Chinese import share of total imports by India at NIC 2004 4-digit level. '$\Delta DComp_{EU}^{China}$' is the change in the Chinese import share of total imports by European Union (EU). We use '$DComp_{EU}^{China}$' as an instrument for '$DComp_{IN}^{China}$'. Quartiles ($Qr_{i=1,2,3,4}$)are defined according to the total sales of a firm. A firm belongs to 1st quartile if the total sales of that firm is $\langle$ 25th percentile of the total sales of the corresponding industry and so on. All the regressions controls for Chinese import competition measure faced by Indian firms in an export destination (US), '$FComp_{IN}^{China}$'. We do not report the coefficients for the effects of Chinese competition in the export market due to space constraints. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), 'TechAdop/GVA', and size (sales; only for columns (1), (2), (3) and (4)) of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.

Table 7: Chinese Competition and Product Variety of Indian Firms: Core Competency, Product Composition and Product Exit

	Core Competency		Product Composition		Product Drop	
	Ln(Product Scope + 1)		ΔSales Share		Product Exit = 1	
	(1)	(2)	(3)	(4)	(5)	(6)
$DComp_{IN}^{China} \times Core$	-0.005^{c}		0.002^{a}		-0.001	
	(0.003)		(0.000)		(0.004)	
$DComp_{IN}^{China} \times Qr_1 \times Core$		-0.142^{c}		0.011^{b}		-0.047^{a}
		(0.087)		(0.005)		(0.013)
$DComp_{IN}^{China} \times Qr_2 \times Core$		-0.109^{c}		0.009^{b}		-0.042^{a}
		(0.068)		(0.004)		(0.012)
$DComp_{IN}^{China} \times Qr_3 \times Core$		-0.130^{c}		0.009^{c}		-0.032^{b}
		(0.078)		(0.005)		(0.017)
$DComp_{IN}^{China} \times Qr_4 \times Core$		0.024		0.006		-0.034
		(0.064)		(0.005)		(0.026)
$FComp_{IN}^{China} \times Core$	-0.000		0.000		-0.001	
	(0.003)		(0.004)		(0.002)	
$FComp_{IN}^{China} \times Qr_1 \times Core$		-0.043		0.004		-0.010
		(0.050)		(0.003)		(0.008)
$FComp_{IN}^{China} \times Qr_2 \times Core$		-0.031		-0.0002		-0.005
		(0.050)		(0.003)		(0.007)
$FComp_{IN}^{China} \times Qr_3 \times Core$		0.007		-0.002		-0.001
		(0.041)		(0.003)		(0.009)
$FComp_{IN}^{China} \times Qr_4 \times Core$		0.113^{c}		-0.003		-0.008
		(0.059)		(0.003)		(0.010)
$Core$	-0.264^{a}	-1.897^{a}	0.654^{a}	0.517^{a}	-0.466^{a}	-0.467^{a}
	(0.053)	(0.386)	(0.013)	(0.011)	(0.024)	(0.025)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.37	0.37	0.72	0.30	0.05	0.06
N	281,945	297,093	234,835	188,907	257,245	272,002
Product FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in columns (1) and (2), (3) and (4), (5) and (6) is the natural logarithm of number of products manufactured by a firm in each year plus 1, change in the sales share of a firm per product and 'Product Exit' (takes a value 1 or 0). '$DComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in the domestic market. '$FComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in an export destination (US). Quartiles ($Qr_{i=1,2,3,4}$) are defined according to the total sales of a firm. A firm belongs to 1st quartile if the total sales of that firm is $\langle$ 25th percentile of the total sales of the corresponding industry and so on. '$Core$' is defined as the core product of a firm. It takes a value 1 for that product, for which the average sales (over time) is maximum. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), 'TechAdop/GVA' and size (sales; only for columns (1) and (5)) of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.

Table 8: Chinese Competition and Product Variety of Indian Firms: Within-Firm Responses

	Productivity	Factors of Production			Sales		
		Labour Expenditure	Capital Expenditure	R&D Expenditure	Total	Exports	Domestic Sales
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$DComp_{IN}^{China} \times Qr_1$	0.009^a	-0.093	-0.004	-0.013^b	-0.027^b	-0.162	-0.027^b
	(0.002)	(0.067)	(0.019)	(0.006)	(0.011)	(0.123)	(0.011)
$DComp_{IN}^{China} \times Qr_2$	0.014^a	-0.095	0.012	-0.0004	0.002	-0.185	0.002
	(0.002)	(0.068)	(0.017)	(0.001)	(0.014)	(0.116)	(0.013)
$DComp_{IN}^{China} \times Qr_3$	0.014^a	-0.098	-0.010	0.003	-0.009	-0.200^c	-0.010
	(0.003)	(0.067)	(0.018)	(0.003)	(0.012)	(0.118)	(0.012)
$DComp_{IN}^{China} \times Qr_4$	0.016^a	-0.099	0.014	0.021	-0.009	-0.165	-0.016
	(0.003)	(0.070)	(0.023)	(0.021)	(0.017)	(0.116)	(0.014)
$FComp_{IN}^{China} \times Qr_1$	0.003^a	0.0002	-0.008	0.0001	-0.001	0.005	0.002
	(0.001)	(0.025)	(0.006)	(0.0004)	(0.004)	(0.041)	(0.005)
$FComp_{IN}^{China} \times Qr_2$	0.005^a	0.011	-0.001	-0.0005	0.009	0.018	0.009
	(0.002)	(0.025)	(0.007)	(0.0004)	(0.007)	(0.038)	(0.006)
$FComp_{IN}^{China} \times Qr_3$	0.007^b	0.015	0.013^b	-0.002^c	0.016^c	0.014	0.015
	(0.003)	(0.024)	(0.006)	(0.001)	(0.009)	(0.041)	(0.010)
$FComp_{IN}^{China} \times Qr_4$	0.008^a	0.009	-0.002	-0.009	0.003	0.012	0.000
	(0.002)	(0.026)	(0.011)	(0.008)	(0.009)	(0.039)	(0.008)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.21	0.62	0.30	0.22	0.37	0.35	0.37
N	119,229	40,297	117,403	125,200	119,229	31,053	118,068
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in columns (1) - (2) is the logarithm of total productivity of a firm. We measure total productivity using Levinshon and Petrin (2003) methodology. Columns (3), (4), (5), (6) and (7) use logarithm of labour expenditure, capital expendiure, R&D expenditure, exports, and domestic sales as dependent variable, respectively. '$DComp_{IN}^{China}$, is the measure of Chinese import competition faced by Indian firms in the domestic market. '$FComp_{IN}^{China}$, is the measure of Chinese import competition faced by Indian firms in an export destination (US). Quartiles ($Qr_{i=1,2,3,4}$)are defined according to the total sales of a firm. A firm belongs to 1st quartile if the total sales of that firm is $\langle$ 25th percentile of the total sales of the corresponding industry and so on. 'Firm Controls' include age of a firm, age squared, ownership dummy (domestic or foreign owned), and 'TechAdop/GVA' of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. In case of column (4) we drop 'TechAdop/GVA' from 'Firm Controls'. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.

Table 9: Chinese Competition and Product Variety of Indian Firms: Industry and Firm Characteristics

	Ln(Product Scope + 1)					
	Product Categories		Export Orientation		Ownership	
	Final Goods	Intermediate Goods	Exporters	Non-Exporters	Domestic	Foreign
	(1)	(2)	(3)	(4)	(5)	(6)
$DComp_{IN}^{China} \times Qr_1$	-0.016^a	-0.025^b	-0.027^c	-0.016^a	-0.016^a	-0.024
	(0.005)	(0.013)	(0.016)	(0.003)	(0.003)	(0.021)
$DComp_{IN}^{China} \times Qr_2$	-0.002	-0.020^b	-0.003	-0.008^b	-0.008^b	0.035^c
	(0.007)	(0.012)	(0.029)	(0.004)	(0.004)	(0.019)
$DComp_{IN}^{China} \times Qr_3$	-0.011	-0.015^a	-0.022	-0.021^a	-0.021^a	0.004
	(0.007)	(0.004)	(0.029)	(0.006)	(0.004)	(0.019)
$DComp_{IN}^{China} \times Qr_4$	-0.004	-0.006	-0.010	-0.009	-0.012	0.002
	(0.007)	(0.004)	(0.028)	(0.006)	(0.009)	(0.020)
$FComp_{IN}^{China} \times Qr_1$	0.000	0.007^b	0.033^a	0.001	0.001	0.005
	(0.002)	(0.003)	(0.009)	(0.002)	(0.002)	(0.019)
$FComp_{IN}^{China} \times Qr_2$	-0.003	0.009^a	0.032^a	0.0004	0.001	0.033^c
	(0.003)	(0.002)	(0.009)	(0.002)	(0.002)	(0.019)
$FComp_{IN}^{China} \times Qr_3$	0.0003	0.018^a	0.031^a	0.006^c	0.006^b	0.030^c
	(0.003)	(0.003)	(0.008)	(0.003)	(0.003)	(0.018)
$FComp_{IN}^{China} \times Qr_4$	-0.0001	0.012^a	0.031^a	0.004	0.002	0.015
	(0.005)	(0.003)	(0.008)	(0.004)	(0.004)	(0.017)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.10	0.14	0.31	0.11	0.12	0.19
N	55,893	63,336	31,053	88,176	113,347	5,882
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in columns (1) - (6) is the natural logarithm of number of products manufactured by a firm in each year plus 1. '$DComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in the domestic market. '$FComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in an export destination (US). Quartiles ($Qr_{i=1,2,3,4}$)are defined according to the total sales of a firm. A firm belongs to 1st quartile if the total sales of that firm is $\langle$ 25th percentile of the total sales of the corresponding industry and so on. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), and 'TechAdop/GVA' of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.

Appendix

A Matching PROWESS data with UN-COMTRADE data

The classification of the firms in the PROWESS dataset is at NIC level[58], whereas data in UN-COMTRADE is given in HS Code. To facilitate the matching between trade flows and firm-level data, Debroy and Santhanam (1993) provides a document which matches the HS code items with the industrial groups (classified according to NIC). However, the concordance table by Debroy and Santhanam (1993) uses 1987 NIC classification to match the industrial groups with the HS code items. Therefore, prior to matching the firm-level with trade flows data, we do the following: first match 1987 NIC codes with the NIC 1998 codes, which is the next revision of the industrial group classification, and then match the NIC 1998 codes with NIC 2004 classification, which is the version we use to analyze the data.

We then proceed as follows: first, using the concordance of Debroy and Santhanam (1993), we match all the relevant product lines (HS six-digit level) for each of the industrial categories at 2004 NIC 4-digit level. Our goal is to create a region-specific, in our case China, import competition index which we can use to explore the effects on the product variety of Indian manufacturing firms. To construct such an index, we first sum the values of all the HS code items belonging to each of the industrial group (let's say Textile Garments) to obtain the amount of imports by that particular industrial group (Textile Garments) with respect to China. In other words, the product level import flows data is aggregated to the industry-level (4-digit NIC) to understand how much an industrial category (4-digit NIC 2004) imports from China.

We then follow the same procedure for the total imports of India. At the end, we are able to match around 90-95% of the HS six-digit level products with each of the 2004 NIC four-digit level industrial chapters. These industry level measures are then matched with firms in the firm-level dataset, PROWESS, based on the identified industry of the firms. An average industrial sector of India imports around 8.5% of its total imports from China (over the period 1992-2007), whereas the maximum is 93.25%, pointing out a significant amount of heterogeneity across different industrial sectors. Therefore, the estimations that we will eventually run will use the number of firm-level product varieties as reported in PROWESS to see if the industry-level measure of import competition influences the product scope at the firm-level.

We acknowledge that it would be ideal to have firm-level information on imports from different countries, as our industry-level import competition measure is likely to leave a lot of intra-industry heterogeneity unexplained. However, in the absence of any such dataset (as in the case of India), which gives firm-level trade information by countries, ours is a workable second-best option that is commonly used in the literature. Iacovone et al. (2013) and Utar and Torres-Ruiz (2013) also uses this kind of industry-level

[58] As described earlier, we reclassify our firm level data at 4-digit NIC 2004 from 5-digit NIC 2008 to facilitate matching with trade data and other datasets.

import competition index to measure the effect of import competition on Mexican firm- and industry-level outcomes.

B Tables

Table 10: Technological Similarity with China

	Technological Similarity Index Top Ten
India	0.928
Turkey	0.907
Indonesia	0.904
Hungary	0.897
Brazil	0.896
Philippines	0.889
Mexico	0.879
Egypt, Arab Rep.	0.873
Vietnam	0.868
Korea, Rep.	0.862

Notes: The table reports the top ten countries in terms of technological similarity with China. Source: Julian di Giovanni et al. (2014).

Table 11: Mutliproduct and Single-product Firms

	Multi-Product Firms	Single-Product Firms
	(1)	(2)
Sales	2108.26	730.62
Capital Intensity	1335.49	561.71
Assets	1999.03	780.22
Wages	46.06	34.01
TFP	0.30	0.23
Share of Output	91%	9%
Share of Firms	74%	26%

Notes: Numbers represent average values across manufacturing firms in India in a year. Values are in INR Million.

Table 12: Distribution of Products Within a Firm

	Number of Products Produced by a Firm									
Average Share of Product in Firm Sales	1	2	3	4	5	6	7	8	9	10+
1	100	86	77	67	63	61	60	58	54	47
2		14	20	24	21	19	20	17	23	20
3			3	7	10	9	10	8	11	11
4				3	4	6	5	7	5	8
5					2	3	3	5	3	4
6						2	1	3	2	3
7							1	1	1	2
8								1	1	2
9									1	1
10+										2

Notes: The columns indicate the number of products produced by a firm. The rows indicate the share of products in total firm sales. Each cell is a simple average across all the relevant firm products in the sample (1992-2007).

Table 13: Chinese Imports and Product Variety of Indian Firms: Product Categories (Intermediate and Final Goods)

	Share of Imports from China (%)		Product variety	
	1992-2001	2002-2007	1992-2001	2002-2007
	(1)	(2)	(3)	(4)
Intermediate Goods	4.45	18.15	4.60	4.12
Final Goods	5.34	17.54	4.26	4.15

Notes: The numbers represent average across all firms belonging to each industrial category according to National Industrial Classification (NIC) 2004 4-digit level. 'Share of Imports from China' is the percentage share of Chinese imports in total imports. 'Product Variety' is the average number of products produced by a manufacturing firm in these product categories.

Table 14: Chinese Competition and Product Variety of Indian Firms: Alternative Methods

	Ln(Product Scope + 1)							Multi-Product Firm = 1
	WTO Membership				Liu & Rosell (2013)	Mion & Zhu (2013)	Acemoglu et al. (2016)	WTO Member
	One Year Before and After	Input Tariffs	Putting Other LWC	WTO=1 if year≥2000				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$DComp_{IN}^{China}$	0.001	-0.003^{c}	-0.003^{c}	-0.002	0.447	-0.196^{b}	0.008	0.004
	(0.001)	(0.002)	(0.002)	(0.002)	(0.785)	(0.087)	(0.026)	(0.004)
$FComp_{IN}^{China}$	-0.0005	0.002	0.002	0.001	-0.001	-0.002	0.003	-0.003
	(0.0008)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
$InputTariff_{t-1}$		-0.014						
		(0.026)						
$DComp_{IN}^{Other\ LWC}$			0.856^{a}					
			(0.096)					
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.35	0.21	0.21	0.21	0.19	0.17	0.20	0.10
N	8,477	60,979	58,783	60,979	50,181	60,979	44,724	60,825
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in columns (1) - (7) is the natural logarithm of number of products manufactured by a firm in each year plus 1. Column (8) uses a probit specification where the dependent variable takes a value 1 when a firm is multi-product firm. '$DComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in the domestic market. In columns (5), (6) and (7) , it is measured according to the definition provided by Liu and Rosell (2013), Mion and Zhu (2013), and Acemoglu et al. (2016). '$FComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in an export destination (US). '$InputTariff$' is the logarithm of input tariffs faced by Indian industries at NIC 4-digit. '$DComp_{IN}^{Other\ LWC}$' is the share of imports from all other low-wage countries. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), 'TechAdop/GVA' and size (sales) of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain other terms of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.

Table 15: Chinese Competition and Product Variety of Indian Firms: Size (= Sales) Heterogeneity - Alternative Methods

	Ln(Product Scope + 1)							Multi-Product Firm = 1
	WTO Membership				Liu & Rosell (2013)	Mion & Zhu (2013)	Acemoglu et al. (2016)	WTO Membership
	One Year Before and After	Input Tariffs	Putting Other LWC	WTO=1 if year≥2000				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$DComp_{IN}^{China} \times Qr_1$	0.002	-0.016^a	-0.016^a	-0.017^b	-2.169^b	−0.195	-0.044^c	-0.028^c
	(0.004)	(0.003)	(0.003)	(0.008)	(1.029)	(0.211)	(0.027)	(0.016)
$DComp_{IN}^{China} \times Qr_2$	0.001	-0.007^b	-0.009^b	-0.023^b	−0.948	-0.580^b	0.013	-0.045^c
	(0.003)	(0.003)	(0.004)	(0.009)	(1.799)	(0.232)	(0.154)	(0.023)
$DComp_{IN}^{China} \times Qr_3$	0.002	-0.021^a	-0.021^a	-0.023^c	0.318	−0.286	0.022	−0.042
	(0.004)	(0.004)	(0.004)	(0.013)	(1.427)	(0.345)	(0.200)	(0.029)
$DComp_{IN}^{China} \times Qr_4$	0.002	-0.013^a	-0.013^a	−0.029	2.502	−0.566	0.067	−0.052
	(0.003)	(0.004)	(0.004)	(0.020)	(2.183)	(0.505)	(0.289)	(0.036)
$FComp_{IN}^{China} \times Qr_1$	0.001	0.001	0.0004	−0.001	−0.001	0.003	0.002	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.005)
$FComp_{IN}^{China} \times Qr_2$	−0.0001	0.002	0.002	0.003	−0.001	0.006^c	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.007)	(0.005)
$FComp_{IN}^{China} \times Qr_3$	−0.0003	0.007^b	0.007^b	0.004	0.001	0.005	0.001	0.004
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.004)	(0.009)	(0.006)
$FComp_{IN}^{China} \times Qr_4$	−0.001	0.004	0.004	0.006	−0.0002	0.002	−0.003	0.008
	(0.001)	(0.003)	(0.003)	(0.005)	(0.002)	(0.007)	(0.012)	(0.008)
$InputTariff_{t-1}$		−0.068						
		(0.045)						
$DComp_{IN}^{Other\ LWC}$			0.016^a					
			(0.001)					
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.11	0.12	0.12	0.12	0.26	0.11	0.12	0.10
N	16,692	119,229	114,569	119,229	56,574	119,229	76,355	119,083
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in columns (1) - (7) is the natural logarithm of number of products manufactured by a firm in each year plus 1. Column (8) uses a probit specification where the dependent variable takes a value 1 when a firm is multi-product firm. '$DComp_{IN}^{China}$, is the measure of Chinese import competition faced by Indian firms in the domestic market. In columns (5), (6) and (7) , it is measured according to the definition provided by Liu and Rosell (2013), Mion and Zhu (2013), and Acemoglu et al. (2016). '$FComp_{IN}^{China}$, - measure of Chinese import competition faced by Indian firms in an export destination (US). '$DComp_{IN}^{Other\ LWC}$, is the share of imports from other low-wage countries. Quartiles ($Qr_{i=1,2,3,4}$) are defined according to the capital intensity of a firm. A firm belongs to 1st quartile if the capital intensity of that firm is $\langle$ 25th percentile of the total capital intensity of the corresponding industry and so on. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), and 'TechAdop/GVA' of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.

Table 16: Chinese Competition and Product Variety of Indian Firms: Size (=Capital Intensity) Heterogeneity

	Ln(Product Scope + 1)							Product Scope	Product Exit = 1
	Lagged	WTO Membership						WTO Membership	WTO Membership
		Industry FE	Firm FE	Industry × Year FE	Balanced Panel	Long Difference	Imported Inputs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$DComp_{IN}^{China} \times Qr_1$	-0.007^c	-0.009^c	-0.007^c	-0.008^c	-0.021^c	-0.021	-0.329^a	0.001	-0.018^c
	(0.004)	(0.005)	(0.004)	(0.005)	(0.013)	(0.032)	(0.112)	(0.004)	(0.010)
$DComp_{IN}^{China} \times Qr_2$	-0.008	-0.019^a	-0.017^a	-0.018^a	-0.032^b	-0.093^a	-0.420^b	-0.020^a	-0.006
	(0.006)	(0.004)	(0.004)	(0.005)	(0.016)	(0.034)	(0.165)	(0.004)	(0.009)
$DComp_{IN}^{China} \times Qr_3$	-0.004	-0.009^b	-0.007^c	-0.009^b	-0.024	0.013	-0.351^b	-0.006^c	-0.019^c
	(0.005)	(0.004)	(0.004)	(0.004)	(0.017)	(0.022)	(0.147)	(0.004)	(0.010)
$DComp_{IN}^{China} \times Qr_4$	-0.004	-0.008^c	-0.006	-0.007	-0.016	0.030	-0.213	-0.002	-0.014
	(0.004)	(0.004)	(0.004)	(0.005)	(0.020)	(0.021)	(0.140)	(0.003)	(0.009)
$FComp_{IN}^{China} \times Qr_1$	0.005	0.001	0.002	-0.0005	-0.003	0.010	0.004	-0.009^a	-0.002
	(0.004)	(0.002)	(0.002)	(0.002)	(0.009)	(0.008)	(0.003)	(0.003)	(0.007)
$FComp_{IN}^{China} \times Qr_2$	0.004	0.003	0.003	0.002	-0.003	0.019^b	0.007	-0.0002	-0.005
	(0.005)	(0.004)	(0.003)	(0.004)	(0.009)	(0.007)	(0.005)	(0.003)	(0.008)
$FComp_{IN}^{China} \times Qr_3$	0.003	0.001	0.002	0.0002	-0.006	0.013	0.004	-0.005^c	0.002
	(0.005)	(0.003)	(0.003)	(0.003)	(0.010)	(0.009)	(0.004)	(0.003)	(0.006)
$FComp_{IN}^{China} \times Qr_4$	0.003	0.002	0.003	0.001	-0.004	0.013	0.004	-0.004	-0.005
	(0.004)	(0.003)	(0.002)	(0.003)	(0.009)	(0.008)	(0.004)	(0.003)	(0.008)
$ShInputs_{IN}^{China} \times Qr_1$							0.322^a		
							(0.111)		
$ShInputs_{IN}^{China} \times Qr_2$							0.402^b		
							(0.161)		
$ShInputs_{IN}^{China} \times Qr_3$							0.343^b		
							(0.145)		
$ShInputs_{IN}^{China} \times Qr_4$							0.208		
							(0.130)		
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.09	0.10	0.61	0.09	0.20	0.20	0.10	n/a	0.02
N	112,858	119,229	112,858	112,858	12,872	14,623	112,858	111,951	327,305
Industry FE	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Firm FE	No	No	Yes	No	No	No	No	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Industry FE(2-digit)*Year FE	No	No	No	Yes	No	No	No	No	No

4ptNotes: The dependent variable in columns (1) - (8) is the logarithm of number of products manufactured by a firm in each year plus 1. Columns (9) and (10) uses a poisson and probit specification, respectively. '$DComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in the domestic market. '$FComp_{IN}^{China}$' controls for Chinese import competition measure faced by Indian firms in an export destination (US). '$ShInputs_{IN}^{China}$' is the index of share of imported intermediate inputs from China. Quartiles ($Qr_{i=1,2,3,4}$) are defined according to the capital intensity of a firm. A firm belongs to 1st quartile if the capital intensity of that firm is $\langle$ 25th percentile of the total capital intensity of the corresponding industry and so on. Firm Controls include age of a firm, age squared, ownership dummy (domestic or foreign owned), and 'TechAdop/GVA' of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.

Table 17: Chinese Competition and Product Variety of Indian Firms: IV Results using 2001 as the Structural Break

	Ln(Product Scope + 1)			
	Aggregate		Size Heterogeneity	
	(1)	(2)	(3)	(4)
$DComp_{IN}^{China}$	-0.005^{b}	-0.009^{b}		
	(0.003)	(0.004)		
$DComp_{IN}^{China} \times Qr_1$			-0.200^{a}	-0.198^{a}
			(0.073)	(0.074)
$DComp_{IN}^{China} \times Qr_2$			-0.200^{a}	-0.190^{a}
			(0.071)	(0.071)
$DComp_{IN}^{China} \times Qr_3$			-0.194^{a}	-0.162^{c}
			(0.070)	(0.090)
$DComp_{IN}^{China} \times Qr_4$			-0.203^{a}	-0.103
			(0.070)	(0.083)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes
R-Square	0.04	0.05	0.03	0.04
N	58,783	58,783	116,340	116,340
F-Stat	14.55	13.62	13.64	14.23
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No
Industry FE(4-digit)*Year Trend	Yes	Yes	Yes	Yes
IndustryFE(2-digit)*YearFE	No	Yes	No	Yes
1st Stage				
	$DComp_{IN}^{China}$			
$DComp_{EU}^{China}$	0.905^{a}	0.777^{a}		
	(0.010)	(0.010)		
$DComp_{EU}^{China} \times Qr_1$			1.047^{a}	1.034^{a}
			(0.027)	(0.027)
$DComp_{EU}^{China} \times Qr_2$			0.949^{a}	0.914^{a}
			(0.026)	(0.026)
$DComp_{EU}^{China} \times Qr_3$			1.006^{a}	0.992^{a}
			(0.026)	(0.026)
$DComp_{EU}^{China} \times Qr_4$			1.158^{a}	1.140^{a}
			(0.028)	(0.029)

6ptNotes: The dependent variable in columns (1) - (4) is the natural logarithm of number of products plus 1. '$DComp_{IN}^{China}$' is the measure of Chinese import competition faced by Indian firms in the domestic market. '$DComp_{EU}^{China}$' is the measure of Chinese import competition faced by European Union (EU). We use '$DComp_{EU}^{China}$' as an instrument for '$DComp_{IN}^{China}$'. Quartiles ($Qr_{i=1,2,3,4}$) are defined according to the total sales of a firm. A firm belongs to 1st quartile if the total sales of that firm is $\langle$ 25th percentile of the total sales of the corresponding industry and so on. All the regressions controls for Chinese import competition measure faced by Indian firms in an export destination (US), '$FComp_{IN}^{China}$'. We do not report the coefficients for the effects of Chinese competition in the export market due to space constraints. 'Firm Controls' include age of a firm, age squared, ownership dummy (domestic or foreign owned), 'TechAdop/GVA' and size (sales; only for columns (1) and (2)) of a firm. 'TechAdop' (Technology Adoption) = R&D expenditure + Royalty payments for technical knowhow. Numbers in the parenthesis are clustered standard errors at the industry-level. Intercepts are not reported. All the regressions contain all other terms (double and individual) of the interaction. ^{c},^{b},^{a} denotes 10%, 5% and 1% level of significance.