

**THE IMPACT OF TRADE
LIBERALIZATION ON THE
PRODUCTION STRUCTURE OF FIRMS:
EVIDENCE FROM INDIA**

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Abstract

Recent empirical works have looked at the effect of changes in trade policies on the pattern of production of firms in the developed world. In the context of an emerging economy, this paper looks at India's manufacturing firms' data for the period 1989 to 2003 focusing on reallocation of resources across products within a firm. This is done by evaluating the relationship between tariffs and diversification at product level. The model is further estimated to cater for possible differences in the responses to trade liberalization between exporting and non-exporting firms. This study finds that there is no association between low tariffs and specialization by firms in India. However, this analysis shows that exporting firms appear to diversify more than non-exporting firms following a reduction of tariffs.

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1. INTRODUCTION

This paper examines the impact of trade liberalization on a firm's structure of production. Its main focus is the reallocation of resources across products within a firm following reduced tariffs. The idea is to see if firm activities are evenly spread across all its products or focused on a few with foreign competition. The null hypothesis to be tested is that when an economy opens up to trade, firms rationalize by cutting back on production of their high cost products and focusing on their low cost products.

A framework set up by Bernard, Redding and Schoot (henceforth, BRS (2006)) that explores how multiproduct firms behave with trade liberalization by developing a general equilibrium model is used in this study. They declare that firm productivity is a function of the firm's ability and the firm's product expertise, and that productivity improvements within and across firms occur as an economy opens up to trade. Considering the within firm effects of trade liberalization, BRS (2006) argue that firms tend to rationalize production by dropping products they have no expertise in, and focusing on their high expertise products following a decline in trade costs. Following this framework, but focusing on the intensive margins, this paper looks at the share of each product in the firm's output with trade liberalized.

In the 1980s most emerging countries abandoned their restricted trade policies and adopted trade liberalization as a development strategy. This is because trade liberalization is associated with gains in output through the expansion of some highly productive firms, whereby in a multiproduct setting this leads to dropping of products or altering the product composition of the firm's total output. In this analysis we study specialization, for it affects the volatility of output as it make firms prone to external shocks. Specialization further results in redistribution of resources which in turn impacts firms' productivity as they center their activities on their competent products.

In this analysis, the idea is to find out if firms specialize or diversify in response to trade liberalization by assessing how much output is devoted to each of the manufactured products, and to further evaluate whether the product range of firms expands or contracts in response to trade openness. There is extensive literature that stipulates that trade liberalization should result

in specialization at firm level and supporting empirical evidence exists but only for developed countries. However, no empirical work has been done for developing countries.

Therefore, this paper contributes to existing literature by looking into whether trade liberalization leads to specialization at firm level for developing countries as exemplified by India. In other words, assessing whether India will respond differently to trade when compared to developed economies. India provides an appropriate setting for this analysis because economic reforms that dealt with macroeconomic issues such as fiscal and current account imbalances, exchange rate regime and making amendments to the industrial and trade policies took place in the 1990s (Topalova, 2010). The implementation of the reforms, specifically amending the trade policy started in 1991. It was a gradual and calibrated process that created over a decade of large scale trade from 1989 to 2003. Another factor that makes India a good case study is the fact that the adoption of trade liberalization was exogenous i.e. it was externally imposed by the International Monetary Fund (IMF) as India was in a balance of payments crisis. The implementation of the trade reform was not expected and it lacked any institutional and political influences (Topalova, 2010).

Even though existing literature evaluating the impact of trade openness on aggregate output assumes each firm produces a single product (for example, Melitz (2003), Jovanovic (1982), Hopenhayn (1992) and Ericson and Pakes (1995)), this study deviates from this assumption made by such models. Instead this study assumes a firm produces numerous products and looks at multiproduct firms in India since the goal is to analyze reallocation of resources across products.

Khandelwal et al (2008) looked at India's multiproduct firms seeking to find an association between trade openness and changes in firm product mix. Their aim was to study adding and dropping of products by firms as the trade policy got altered, hence focusing on extensive margins and not intensive margins. They find no relation between trade liberalization and any product dropping. They further attributed this to the institutional environment in India, particularly industrial regulation that prevents resources from being efficiently allocated. As with Khandelwal et al (2008), this paper uses firm-product level data on multiproduct firms, however

unlike Khandalwal et al (2008) the focal point of this analysis is the reallocation of resources across products by firms as the economy opens up to foreign competition and not the number of products.

This paper estimates the relationship between trade openness captured by a decline in tariffs and reduced product diversification measured by the entropy index. The entropy index is a measure of diversification where by a value of zero for the index indicates non-diversified firm activity and large values of the entropy imply that firm activities are highly diversified. Therefore, this study explores how trade affects how much output is allocated to each product, and then followed by the effect of trade on the firm's product scope.

This analysis uses firm-product level data. For each firm, the dataset contains information on all products produced. Such product level data is not very common for developing countries. However, data at product level is available for India and was obtained from the Prowess database.

This study finds no association between liberalized trade and specialization by firms. This contradicts the findings of empirical papers from the US and other developed countries such as Canada. Furthermore, the same relationship is estimated for exporting firms and domestic firms separately. This study finds evidence of an interaction effect, whereby the effect of tariffs on production structure varies depending on whether the firm is exporting or not. In other words, with trade liberalization, domestic firms appear to specialize more (or diversify less) than exporting firms. Now, focusing on the product scope, this analysis finds that exporting firms produce more products than domestic firms as tariffs fall.

The next section on this paper reviews previous work in this area. Section 3 explains the conceptual framework. Section 4 describes trade reforms in India. Section 5 explains the data and provides descriptive statistics. Section 6 introduces the model being estimated. Section 7 is a detailed discussion of the estimation results. Section 8 is the conclusion.

2. PREVIOUS LITERATURE

Many economies have made a move towards trade liberalization with the aim of facilitating trade flows across countries around the world and among countries committed to free trade agreements. When countries open up to trade, there is a window for gains as the domestic consumers have access to goods from abroad and enjoy lower product prices. However, in this section we consider the firm's perspective.

Numerous studies look at the impact of trade liberalization on resource allocation across firms. Pavnick (2002) provides a good example of such work. In her paper, she investigates the impact of trade openness on plant productivity using plant-level panel data for manufacturing firms in Chile spanning 1979 to 1986. She realizes that the exit of some firms from the market allows for the remaining firms to enjoy productivity gains from liberalized trade. Pavnick (2002) holds that opening to trade lowers domestic prices and forces the inefficient high cost producers to exit the market. The probability of firms exiting is high especially in sectors in which Chile had no comparative advantage signifying specialization. She further explains that the exit of firms does lead to the reshuffling of resources and output within the economy from less to more efficient producers (Pavnick, 2002). Therefore, Pavnick (2002) demonstrates reallocation of resources across firms from low productive firms to highly productive firms.

Contrary to the above, few studies look at the reallocation of resources across products within firms. These studies mostly focus on multiproduct firms in the developed world. For example, BRS (2010) look at multiproduct firms and product switching in the US from 1987 to 1997. They study firm adjustment as firms reassign resources across products within firms through dropping and adding products. They do this by examining the set of products produced by firms in a given year, and analyze how the product combinations change from one year to the next. They find that 50 percent of the US manufacturing firms alter their product set between censuses and that half of those firms alter their product set by adding and dropping at least a single product every five years. Therefore, BRS (2010) show frequent product switching or restructuring of resources within US firms.

Liu (2006) also uses US data on production bundles of firms to investigate the altering of the product mix by multiproduct firms as they respond to import competition. In his study, he

assumes that various products produced by firms are linked to one another through different complementarities. Liu (2006) uses the core competency concept and finds that when foreign competition is directed to the core product of the firm, the firm's response is to protect the core product by redirecting its resources towards the core product and away from the peripheral ones. As a result, the probability of dropping the core product declines while the probability of dropping the peripheral products rises.

Another paper looking into the alteration of resources within firms is by Bowen and Wiersema (2005). They observe US firms over the period 1985 to 1994, to explore the influence of import competition on the diversification strategy of firms. They find that trade liberalization is a contributing factor to firms reducing business level diversity and strategically concentrating on their major business lines.

Baldwin and Gu (2009) look into the trading environment of Canadian firms from 1989. During this period, the Canada-United States Free Trade Agreement (FTA) allowed for free trade between the two countries, and then in 1994 the North American Free Trade Agreement (NAFTA) facilitated the integration of Canada, Mexico, and the United States. Their model expects plants in a smaller market (Canada) to be more diversified and have short production runs. However, in response to trade liberalization, they find that the product range of non-exporting plants declines. For exporting firms, there appears to be specialization but it is not attributed to tariff reductions. Exporting firms' reaction to low tariff seems to be ambiguous (Baldwin and Gu, 2009).

A case for reallocation of resources across products in India was presented by Khandelwal et al (2008). In their analysis, they try to see if the reallocation of resources through reshuffling the product mix arises in multiproduct firms as a result of trade reforms in the 1990s. They find no relationship between trade policy changes and the product mix. They associate this outcome to the strict regulatory environment that India's firms operate in (Khandelwal et al, 2008). In this study, they focus on extensive margins i.e. product dropping; however there are no studies for developing countries looking within firms.

Having discussed papers that look into multiproduct firms and reallocation of resources within firms and across firms, this paper now diverts to other works that show links between liberalized trade and specialization.

The first study on the effect of trade policy on specialization by Martincus and Estevadeordal (2009) looked at ten Latin American countries, members of the Latin American Integration Association (LAIA) over the period 1985–1998. During this period, unilateral trade openness programs were implemented as well as regional integration initiatives. Martincus and Estevadeordal (2009) estimated measures of overall specialization and average tariffs and tested the relationship between the two. They found that over the period, a decline in tariffs was associated with a significant increase in production specialization (Martincus & Estevadeordal, 2009).

A similar finding was obtained by Palangkaraya and Yong (2011) as they assessed the link between trade liberalization and productivity gains. Using Australian manufacturing data from 1993-94 and 1996-97, Palangkaraya and Yong (2011) tested three possible hypotheses for productivity increment. These included establishing whether the productivity improvement arises through either inefficient firms exiting, economies of scale as surviving firms increase their outputs or through inefficiency reductions by cutting employment. They found that the productivity gains following Australian trade liberalization were a result of employment shedding (Palangkaraya & Yong, 2011). This is because a reduction in tariffs causes a decline in domestic demand for domestic products. This in turn focuses domestic firms to narrow down their activities of the import competing sector, hence laying off workers and increasing specialization in products they have a comparative advantage in (Palangkaraya & Yong, 2011).

The increase in specialization following a reduction of trade barriers is also suggested by Gu, Sawchuk and Whewell (2003). They assert that the Canada-U.S. Free Trade Agreement (FTA) which required the two countries to slowly eliminate all manufacturing tariffs over a ten- year period beginning in 1989 was expected to improve Canadian productivity through increased specialization and economies of scale. Prior to implementation of the agreement, it was believed the FTA tariff reductions and the integration of the two economies would cause the firms to specialize as they are supplying to a larger market which implies an increase in the scale of

production, higher productivity, and lower costs of production (Gu, Sawchuck & Whewell, 2003). They find that in response to reductions in tariffs, firms become more efficient through product specialization.

Baldwin, Beckstead and Caves (2002) assessed changes in diversification of firms and plants in the Canadian manufacturing sector from the early 1970s. They observe an increase in specialization of firms and plants. However the increase in specialization was more dramatic from the late 1980s as Canada committed itself to the Free Trade Agreement with the US and later with the North American Free Trade Agreement (NAFTA) in the early 1990s (Baldwin, Beckstead & Caves, 2002). Furthermore, they find a close correlation between the low trade barriers and changes in specialization, in the sense that plants that exported more intensively are the ones that experienced product-level specialization the most.

In their study, Di Giovanni and Levchenko (2006) use data from the 2005 UNIDO Industrial Statistics Database to analyze the impact of trade liberalization on volatility of output produced. They laid out a number of mechanisms that link openness to trade to volatility. One of their hypotheses was that trade liberalization impacts output volatility through specialization. They argued that when the firms specialize in certain products, external shocks to the economy affect product prices and output more drastically relative to if the economy was diversified (Di Giovanni & Levchenko, 2006). They estimated a relationship between diversification measured by the Herfindahl index and the amount of trade. Their analysis resulted in a clear positive relationship between trade and specialization thereby asserting that trade increases volatility indirectly through greater specialization (Di Giovanni & Levchenko, 2006).

This thesis complements previous works by providing a developing country context of how firms respond to trade policy changes as exemplified by India. Given that the aim is to explore resource allocation within firms, this analysis will consider the heterogeneous effects of multiproduct firms as foreign competition is reduced.

3. CONCEPTUAL FRAMEWORK

BRS (2006) provide the framework for evaluating the reaction of India's firms to trade liberalization. They build up a general equilibrium model that studies the behavior of US firms following globalization. Firms in this model vary in firm-specific ability and product-specific expertise. They explain that a firm's ability and product expertise complement each other in the sense that, firms can have the same expertise in a product but high ability firms may find it profitable to produce the product than a low ability firm.

Their model predicts that as trade is liberalized, there is resource reallocation within firms as firms rationalize production, and across firms as firms enter and exit the market. The model is described as follows: Prior to producing anything, firms incur a sunk entry cost. Thereafter they observe their ability and product expertise, which helps them decide whether they will produce or not. If they decide to produce, a decision needs to be made on what the product set will be. Once production is given a go ahead, firm fixed headquarter costs are incurred followed by other product-specific costs for each product they produce. Product expertise varies across products for a given firm with a certain ability, whereas firms vary in their abilities. For a firm with high ability, the level of product expertise at which they cannot cover their cost is lower, which allows them to have a greater product set (BRS, 2006). This implies that high ability firms (typically exporting firms) will produce a greater product set than low ability firms.

At equilibrium, there is self selection across firms where the highly productive firms remain in the market and the low productive exit, and self selection within firms involves gearing most resources to high expertise products and less to low expertise products.

With trade liberalization, high ability firms will expand in their high ability products, and export them. These exported products also have to be sold domestically. This expansion causes wages to rise due to labor market competition, as more labor is demanded for production of these high ability products. Hence, high ability/exporting firms have to drop some of their low-expertise products, and also reduce output on products they sell only locally (BRS, 2006). The concept of core competencies also applies to low ability, domestic firms who have to drop some of their low

expertise products and reduce output on goods they sell locally. Hence, both exporting and domestic firms drop products with trade liberalization. However, exporters unlike domestic firms can still produce a greater range of products since they have high ability, and find it profitable to produce some of their low expertise products.

It then follows that this analysis uses the above-mentioned concept and framework set by BRS (2006), where firms' ability variations determine whether they can survive in any product market and whether they can trade. Like BRS (2006), this paper looks at the extensive margins, but also explores how much of the total output is attributed to each product.

4. EMPIRICAL SPECIFICATION

Evaluating the effect of trade openness on the firm's product structure calls for evaluating whether firms diversify or specialize. It follows that a measure for product diversification called the entropy index which captures the concentration of the firms' sales at product level is constructed (Baldwin, Caves & Gu, 2005). The entropy index is given by:

$$E = \sum_{i=1}^N S_i \text{Log} \left(\frac{1}{S_i} \right)$$

where E is total diversification. Assume that K is total sales of the firm and K_i is the contribution of product i to the total sales of the firm. It then follows that S_i is the share of the i^{th} product in the firm's sales given by $S_i = K_i / K$ and N is the number of products produced by the firm per year. A value of zero for the entropy diversification index i.e. $E=0$ implies the sales are concentrated in a single product line. The other extreme shows that the firm's sales are spread evenly across all its products i.e. well diversified ($E=1$), whereby the maximum value for the entropy index is the logarithm of the number of products (N) (Baldwin, Caves & Gu, 2005).

The entropy index varies with the product composition of the firm. The contribution of each product to the total sales (the share of each product) impacts the entropy index. Let's consider the following two examples: Firstly, if a firm goes from producing 2 products which equally

contribute to the total sales to 2 products whose shares of the total sales are 1/3 and 2/3, the entropy index decreases from 0.69315 to 0.63418. Secondly, consider a firm that produces three products, whose shares of the total sales are even. If this firm changes the shares of the products to 1/5, 2/5 and 2/5, the entropy index changes from 1.09758 to 1.05493. This is because in the latter settings of both examples one product is more dominant, hence not equally spread. Furthermore, if the number of products increases, the entropy index will increase. For example, if a firm initially produces 2 products whose shares of the total sales are 1/2 and 1/2 and then adds a third product and the contribution of each of the three products becomes 1/3 of the sales. In this scenario, even though the proportion of each product is even, the entropy index increases from 0.69315 to 1.09758 as the number of products has increased, therefore more diversity. Another scenario would be of a firm switching from producing 3 products each contributing 1/3 to the total sales to producing 2 products whose shares are 1/3 and 2/3 respectively. In this case the entropy index will decline from 1.09758 to 0.63418 as the number of products has declined and the new product combination has a product with a bigger share of the total shares.

Therefore the share of each product, the number of products produced or both can affect the entropy index. The theoretical literature emphasizes that with trade liberalization, firms rationalize their products by dropping their low expertise products and specializing in their core competencies. Hence the theory associates trade liberalization (fall in tariff) with a decline of the entropy index.

This paper uses tariff data to capture trade openness where a decline in the tariff levied on various commodities signifies a more liberalized economy. It follows that we regress the entropy index of firm i in sector j at time t on tariffs of sector/industry j at time t

$$\text{Entropy}_{ijt} = \alpha_0 \text{ijt} + \alpha_1 \text{Tariff}_{jt} + \varepsilon_{ijt} \quad (1)$$

This model expects the coefficient of tariff α_1 to be positive, which implies low tariff, less diversification. This model is estimated separately for exporting and domestic firms. It is expected from the theory (BRS, 2006) that domestic firms and exporting firms react differently to reduced tariffs because exporting firms are typically more productive and larger, while domestic firms are less productive.

The model in equation (1) is generalized as

$$Y_{ijt} = \alpha_{0ijt} + \alpha_1 \text{Tariff}_{jt} + \varepsilon_{ijt} \quad (2)$$

where the outcome variable Y can either be entropy or number of produced products. We try to capture any interaction effects by adding a tariff*domestic variable.

$$Y_{ijt} = \alpha_{0ijt} + \alpha_1 \text{Tariff}_{jt} + \alpha_2 \text{Domestic}_{ijt} + \alpha_3 \text{Tariff}_{jt} * \text{Domestic}_{ijt} \\ + \alpha_4 \text{Tariff}_{jt} * \text{Pre-multiproduct}_{ijt} + \varepsilon_{ijt} \quad (3)$$

All regressions are Ordinary Least Square (OLS) with fixed effects where both firm and time (year) fixed effects are considered. The idea is to eliminate the effect of the unobserved time invariant firm specific attributes on the estimated relationship. This is important because not accounting for fixed effects provides incorrect estimates, as these constant firm specific factors may be affecting the estimated relationship which should only be influenced by the variables included in the model.

When estimating equation 3, firm specific controls such as Employee-Compensation and Tariff*Employee-Compensation are included where * means interaction. The idea is to control for firm size because large firms are diverse, hence the use of employee compensation as a proxy. The interaction Tariff*Pre-multiproduct is also a control variable. Pre-multiproduct is an indicator that takes the value one if a multiproduct firm existed in 1989 or 1990. Its interaction controls for the differences in the behavior of old and new multiproduct firms.

5. INDIA'S TRADE REFORM

Economic reforms in India officially started in the 1990s, when the government allowed for a more open economy that relied on market forces, reformulating the government's role and making foreign direct investment permissible by expanding the private sector in the economy (Ahluwalia, 2002). The reforms that took place focused on making changes to several economic policies inclusive of trade policies (Ahluwalia, 2002; Topalova, 2010). The step towards reforming the economy was triggered by a balance of payments crisis that hit the economy in the

late 1980s and made India's economy susceptible to external shocks. As a result, India was required to seek assistance from the World Bank and the International Monetary Fund (IMF) (Topalova, 2010). The IMF agreed to assist India under the condition that structural reforms ought to take place (Topalova, 2010). Provided that this study explores trade liberalization in India, the forthcoming discussion will be restricted to changes in the trade policy.

During the post world war II period, India was among developing economies with the most severe trade and non-trade barriers. The idea at the time was to grow the economy through protecting local industries from imports and through government intervention (Topalova, 2010). Extreme tariffs were set for commodities whose importation was permitted in addition to invasive quantitative import restrictions. Consumer goods produced locally were strictly not to be imported. The importation of consumer goods required an import licenses whose acquisition involved a lot of bureaucracy. Similarly, if a substitute to the imported product was being locally manufactured, its importation was prohibited (Ahluwalia, 2002). This restriction applied to all manufactured consumer goods; however some leniency was allowed for some capital goods, raw materials and intermediates whose importation was entirely free. (Ahluwalia, 2002).

Even though the easing of the trade regime began effectively in the 1990s, it is necessary to note that attempts to open the economy to trade were visible during the leadership of Rajiv Gandhi towards 1989-1990 where the idea was to promote exports. Despite these efforts, the tariff rate was above 90 percent and only a small proportion of manufactured goods could be imported (Cerra & Saxena, 2000).

It was not until 1991 that the government's goal became to open up the economy, but the results of this move did not show up rapidly. Capital and intermediate goods were first to be entirely liberalized in 1993, with the removal of the quantity restrictions being implemented effortlessly (Topalova, 2010). The ease with which the quotas on capital and intermediate goods were removed was due to the presence of a few local manufacturers of capital and intermediate goods at the time, hence only a few parties would have been affected by the new policy (Topalova, 2010). For the case of consumer goods, the number of local manufacturers that would be affected by the policy change was large, which made it extremely hard to abolish such import barriers. It was not until 2001 when the quantitative barriers to the importation of consumer goods were

totally eliminated (Ahluwalia, 2002). The fact that it took a decade 1991 to 2001 to eliminate import quota for final goods, holds as evidence that India's implementation of trade reforms was extremely gradual.

In his study, Ahluwalia (2002) shows that the import duty rate on all commodities was as high as 72.5 percent in 1991-1992. This rate saw a decline in the following five years to 24.6 percent in 1996-1997. Thereafter this import duty rate rose to an average of 35 percent in the period 2000 to 2002. In the following economic year, the government made further policy changes resulting in a 6 percentage point reduction in the duty rate to 29 percent in 2002-2003 (Ahluwalia, 2002). This tariff rate of 29 percent was relatively higher than the rate of other developing economies, however, it was definitely lower than the tariff rate that prevailed in 1991 and better than the invasive restriction that were in place in the pre-reform era (Ahluwalia, 2002).

India's economic reforms in the 1990s provide grounds for studying impacts such policy changes have on various aspects. In this case, we assess the effects of trade openness on the production structure of India's manufacturing firms. Topalova (2010) asserts that India qualifies as a good case study for trade liberalization because its move towards reforming the economy was completely exogenous, in the sense that the adaptation of the policy changes was sudden and unanticipated. As a result, there was no room for political influence or consideration of impact of such trade reforms on other economic aspects such as employment, consumption and production decisions (Topalova, 2010). Trade liberalization in India was not a properly planned strategy for development but rather a sudden remedy adopted by the economy. This further aids in eliminating the endogeneity problem when conducting various estimations.

6. DATA

This analysis uses data on Indian manufacturing firms from the Center for Monitoring Indian Economy (CMIE) Prowess database. This database contains data for numerous firms both listed and non listed companies tracked overtime, obtained from balance sheets and income statements of the respective companies. This study uses a product-firm level panel dataset extending from the periods 1988 to 2008, where a unit of observation consists of data on a particular firm for a given year.

Testing the impact of trade liberalization on diversification by firms across products requires data on product sales by firms, which is used to construct an indicator of product diversification. It is important to note that acquiring data on products manufactured by firms in developing countries overtime is not easy; as such product-firm level datasets are quite rare for such countries. However, for the case of India, the Prowess database provides information on the units and value of sales, the latter being the data required in this analysis. The obtained sales data accounts for the fact that a firm may produce numerous products in a respective year. To measure trade liberalization, this analysis uses tariffs data at product level spanning 1988 to 2003, obtained from the Asian Development Bank to grasp the transition from periods of high tariffs to those of low tariffs.

Observations with zero or missing vales for sales and no tariff data were deleted from the dataset. The sample used consists of 6856 manufacturing firms, where 4353 are multiproduct firms. Provided that this study examines product reallocation within firms, only multiproduct firms are considered. It is an unbalanced panel because not all firms are producing all products in each year; some companies are producing more varieties in some years and less in others.

Table 1a reports the mean values calculated by years for the variables of interest in our dataset. The tariff column shows that prior to the trade reforms (1989 to 1991), the mean tariff was roughly 161%. After the adoption of trade liberalization policies, the mean tariff began to decline becoming smaller in every consecutive year and finally dropping to approximately 25% in 2003. The mean entropy index in 1989 is 0.3055; it increases to 0.3311 in 1990 and falls to 0.3143 in the next five years. This shows less diversification as trade was liberalized. From 1996, the mean entropy index in each year increases until it reaches 0.3478 in 2003 which implies the mean level of diversity within firms increased in every consecutive year.

Table 1b contains the minimum, maximum and average number of products produced by firms in a given year. It shows that in each year, two products are produced on average. The mean products appear the same for each year, possibly because this value is spread over a large number of firms whose product count ranges from 1 up to 41 products for some years.

Table 1a: Mean values for Tariff and Entropy

Year	Average Tariff	Average Entropy
1989	161.22	0.3055
1990	161.84	0.3311
1991	161.72	0.3294
1992	107.15	0.3213
1993	84.69	0.3187
1994	63.45	0.3187
1995	48.46	0.3143
1996	43.20	0.3230
1997	37.57	0.3270
1998	44.16	0.3225
1999	41.53	0.3248
2000	39.02	0.3313
2001	36.26	0.3308
2002	30.27	0.3358
2003	24.53	0.3478

Table 1b: Average, Minimum and Maximum Number of Products Produced

Year	Average Product Count	Min Product Count	Max Product Count
1989	2.28	1	33
1990	2.36	1	34
1991	2.36	1	34
1992	2.31	1	17
1993	2.30	1	31
1994	2.30	1	34
1995	2.24	1	35
1996	2.30	1	38
1997	2.35	1	40
1998	2.33	1	40
1999	2.35	1	40
2000	2.40	1	41
2001	2.42	1	41
2002	2.44	1	41
2003	2.51	1	40

7. ESTIMATION RESULTS

The tables below contain the estimated results of the relationship between low tariffs and specialization. Two interpretations of these results are provided: the direct percentage point change and the percentage change from the average i.e. elasticity. The average number of products produced, entropy index and tariffs for the whole sample are 2.93, 0.46 and 57.56 respectively.

Tables 2a, 2b and 2c present the regression estimates whereby columns 1 and 4 are OLS regressions, columns 2 and 5 consider the firm and time fixed effects and finally columns 3 and 6 report fixed effects estimates plus a control variable i.e. employee compensation. The regressions are run separately with entropy and number of products as the dependant variables.

Table 2a, column 1 shows a significant negative relationship between the entropy index and tariffs such that a 10 percentage point decrease in tariffs results in a significant 0.008 increase in the entropy index. This implies that a 1% decline in the tariffs from the average leads to an increase in the entropy index of 0.1%. This shows more diversification as tariff falls. After accounting for the unobserved firm-specific factors driving specialization (columns 2 and 3), tariffs have no significant effect on specialization. When considering the number of products, column 4 illustrates that the number of products produced by a firm significantly increases by 0.0375, as tariffs decline by 10 percentage points. This means the number of products produced increases by 0.07% following a 1% fall in tariffs. Columns 5 and 6's estimates on tariffs which account for firm specific invariant attributes are insignificant. Thus, when considering all multiproduct firms, a fall in tariff has no effect on extensive margins

This paper suspects different responses to tariffs for exporting and domestic firms, because BRS (2006) predict that exporting firms will not specialize as much as domestic firms. Therefore, tables 2b and 2c focus on domestic and exporting firms respectively.

Table 2a: The Effect of Tariffs for all multiproduct firms

	OLS		Fixed effects		OLS		Fixed effects	
			Entropy				Number of Products	
	(1)	(2)	(3)	(4)	(5)	(6)		
Tariff	-0.0833*** (0.006)	-0.0123 (0.018)	-0.0042 (0.018)	-0.3753*** (0.028)	-0.0579 (0.097)	0.0180 (0.085)		
Employee Compensation			0.0061 (0.014)			0.3968** (0.172)		
Constant	0.5122*** (0.004)	0.2637*** (0.029)	0.2659*** (0.030)	3.1508*** (0.021)	1.7608*** (0.149)	1.7523*** (0.138)		
Observations	32,069	32,069	28,737	32,069	32,069	28,737		
R-squared	0.006	0.139	0.146	0.005	0.228	0.256		
Number of Companies		4,353	3,989		4,353	3,989		

Note: All regressions are restricted to multiproduct firms. Standard errors are in parentheses and are corrected for heteroscedasticity. *** and ** indicate significance at a 1% and 5% level, respectively.

Table 2b: Estimations for Multiproduct Domestic Firms

	OLS		Fixed effects		OLS		Fixed effects	
			Entropy				Number of Products	
	(1)	(2)	(3)	(4)	(5)	(6)		
Tariff	-0.0721*** (0.007)	-0.0037 (0.021)	-0.0006 (0.022)	-0.2209*** (0.032)	0.0109 (0.088)	0.0213 (0.094)		
Employee Compensation			-0.0382 (0.045)			0.0652 (0.328)		
Constant	0.4589*** (0.005)	0.2364*** (0.035)	0.2492*** (0.037)	2.7864*** (0.022)	1.6200*** (0.152)	1.7082*** (0.161)		
Observations	18,028	18,028	14,737	18,028	18,028	14,737		
R-squared	0.006	0.095	0.103	0.003	0.166	0.180		
Number of Companies		3,437	2,809		3,437	2,809		

Note: All regressions are restricted to multiproduct firms. Standard errors are in parentheses and are corrected for heteroscedasticity. *** and ** indicate significance at a 1% and 5% level, respectively.

In both tables (2b and 2c), the OLS regressions (column 1s) show that as tariffs fall by 10 percentage points, the entropy index is 0.0011 greater for exporters than domestic firms. After accounting for firm fixed effects, columns 2 and 3 in both tables report insignificant estimates. Evaluating extensive margins instead of diversification, the OLS regressions (columns 4s)

demonstrate that the number of products produced increases by 0.03 more for exporting firms relative to non-exporters as tariff decrease by 10 percentage points. After factoring in firm-specific time invariant characteristics (columns 5 and 6), the obtained coefficients are insignificant. Therefore, even after examining the two types of firms separately, there is no link between low tariffs and specialization or number of products produced

However, it is important to note that the coefficients on the tariff variable on the fixed effect regressions (columns 2,3, 5 and 6) in all three tables (2a, 2b and 2c) are not significant, where the OLS regressions estimates (columns 1 and 4) are highly significant. This is because the OLS estimates are influenced by firm specific unobserved characteristics that are constant overtime and have not been controlled for.

Table 2c: Estimations for Multiproduct Exporting Firms

	OLS		Fixed effects		OLS		Fixed effects	
			Entropy				Number of Products	
	(1)	(2)	(3)	(4)	(5)	(6)		
Tariff	-0.0833*** (0.010)	-0.0100 (0.030)	-0.0109 (0.030)	-0.5214*** (0.052)	0.0131 (0.135)	0.0410 (0.131)		
Employee Compensation			0.0063 (0.015)				0.3725** (0.174)	
Constant	0.5721*** (0.007)	0.3098*** (0.050)	0.3132*** (0.050)	3.5804*** (0.037)	1.8191*** (0.225)	1.8331*** (0.223)		
Observations	14,041	14,041	14,000	14,041	14,041	14,000		
R-squared	0.005	0.165	0.164	0.006	0.277	0.300		
Number of Companies		2,006	2,001		2,006	2,001		

Note: All regressions are restricted to multiproduct firms. Standard errors are in parentheses and are corrected for heteroscedasticity. *** and ** indicate significance at a 1% and 5% level, respectively.

Table 3 contains the last 4 sets of regressions with the entropy index (columns 1 and 2) and number of produced products (columns 3 and 4) as the dependant variables. All four regressions evaluate the interactive effect of the domestic firm indicator. All columns include Tariff*Pre-multiproduct as a control variable, however Column 2 and 4 include more controls i.e. employee compensation and its interaction term. Looking at columns 1 and 2, the coefficients on the interaction term for domestic firms on tariff (Tariff*Domestic) show that as tariffs fall by 10

percentage points the entropy indices are lower for domestic firms than exporting firms by 0.0032 and 0.0033 respectively. This means the impact of reduced tariffs on the entropy index varies with the type of firm, and that domestic firms are more specialized in fewer products than exporting firms when trade is liberalized. Furthermore, this paper evaluates the impact of tariff cuts on the firm's extensive margins. The tariff and domestic firm interaction term in columns 3 and 4 indicate that domestic

Table 3: Fixed Effects Estimations with Interaction Effects

	Entropy		Number of Products	
	(1)	(2)	(3)	(4)
Tariff	-0.0983*** (0.021)	-0.0919*** (0.022)	-0.3445*** (0.100)	-0.2649** (0.103)
Domestic	-0.0524*** (0.011)	-0.0604*** (0.013)	-0.3664*** (0.051)	-0.3325*** (0.054)
Tariff*Domestic	0.0320** (0.013)	0.0327** (0.014)	0.3190*** (0.067)	0.2595*** (0.064)
Tariff*Pre-multiproduct Firm	0.1264*** (0.015)	0.1249*** (0.016)	0.1210 (0.079)	0.1634** (0.074)
Employee Compensation		0.0124 (0.015)		0.4179** (0.162)
Tariff*Employee Compensation		0.0112 (0.021)		0.2573 (0.184)
Constant	0.2950*** (0.030)	0.3037*** (0.031)	2.0495*** (0.155)	2.0137*** (0.140)
Observations	32,069	28,737	32,069	28,737
R-squared	0.151	0.158	0.233	0.261
Number of Companies	4,353	3,989	4,353	3,989

Note: All regressions are restricted to multiproduct firms. Standard errors are in parentheses and are corrected for heteroscedasticity. *** and ** indicate significance at a 1% and 5% level, respectively.

firms produce 0.032 and 0.026 fewer products than exporting firms respectively following a 10 percentage point reduction in tariffs. Additionally, the domestic firm indicator illustrates that domestic firms are associated with less diversification (columns 1 and 2) and fewer products (columns 3 and 4) relative to exporting firms.

Table 3 also includes an interaction term between tariff and Pre-multiproduct firm indicator i.e. it identifies firms that were multiproduct firms in 1989 and/or 1990. The significant and positive

estimate for this interaction captures the fact that firms that were multiproduct firms before India's trade reform tend to specialize more and decrease their product range with low tariffs.

Table 4: Marginal Effects for Domestic and Exporting firms

	Domestic firms		Exporting firms		Differences	
	Effect	P-Value	Effect	P-Value	Effect	P-Value
Entropy index	-0.0203229	0.270	-0.0530396	0.009	0.0327167	0.017
Number of Products	0.0768402	0.403	-0.1826613	0.051	0.2595015	0.000

Table 4 reports the direct effects and the interactive effects (last column) of a reduction of tariffs on the entropy index and number of products for exporting and domestic firms. With a 10 percentage point decline in the tariffs, the entropy index for exporting firms rises by 0.0053 and the entropy index for domestic firms rises by 0.00203. Therefore, the entropy index rises by 0.0033 less for domestic firms than for exporters. This entails that a 1% fall in tariffs result to the entropy index being 0.04% higher for exporting firms versus domestic firms. On the other hand, a 10 percentage point fall in tariffs increases the number of products produced by exporters by 0.01827 and decreases the products produced by domestic firms by 0.00768. Therefore, with trade liberalization, the difference in the number of products produced between exporters and domestic firms is 0.02595. This is equivalent to saying that the number of products produced by exporting firms is 0.05% higher than domestic firms, following a 1% decline in tariffs. These direct effects in columns 1 and 2 are insignificant; however the interaction effects i.e. the differences are significant.

8. CONCLUSION

Recent empirical works on reallocation of resources across products have overlooked developing countries, and focused on developed economies. This paper contributes to the literature by evaluating multiproduct firms in India as trade becomes liberalized. The production patterns of these firms are examined for the periods 1989 to 2003, a period that spans massive trade in India.

This paper mainly looks at the contribution of each product to the firm's output, but it also examines the changes in the extensive margins as tariffs fall.

In this analysis the data shows no link between trade liberalization and specialization in India after controlling for firm specific time invariant unobservable shocks. This is inconsistent with the findings by studies looking at developed countries. However, it is consistent with earlier studies for India. Additionally, there is a significant interaction effect, in the sense that domestic firms appear to be less diversified in comparison to exporting firms. The interaction term between tariff and the indicator for multiproduct firms that existed prior to the trade reforms shows that pre 1991 multiproduct firms seem to specialize more relative to post reform firms, as tariffs declined.

Provided that this study observes that exporting and domestic firms respond differently, this implies that the reallocation of resources within firms across products with trade liberalization depends on whether the firm is an exporting firm or a domestic firm.

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