ERIA Discussion Paper Series

No. 393

Technical Barriers to Trade and the Performance of Indian Exporters*

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August 2020

Abstract: *We study the effects of technical barriers to trade (TBTs) imposed by destination markets on prices, marginal costs, and markups of Indian manufacturing exporters. Using detailed firm-product-level data on prices and production from PROWESS, we first identify the underlying component of prices (i.e. marginal costs and markups), and use those as our outcomes of interest in the second stage. We find that (i) introduction of TBTs by importing countries increases marginal costs by 5% and prices by 4%, (ii) there is considerable heterogeneity based on exporters' initial productivity, (iii) productive exporters (those belonging to the lower deciles) experienced an increase in marginal costs and decrease in markups compared to low productivity exporters, and (iv) overall effects are driven by private firms (both domestic and foreign) belonging to intermediate input industries.*

Keywords: technical barriers to trade, prices, marginal costs, markups, exporters

JEL classifications: F1, F14, F16

* We would like to thank Kunal Dasgupta and other workshop participants at the Economic Research Institute for ASEAN and East Asia (ERIA) for their helpful suggestions and comments. We acknowledge financial support from ERIA. All errors are our own.

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1. Introduction

A progressive decline in tariffs has brought non-tariff measures (NTMs) under greater scrutiny as one of the major barriers to trade flows between countries.[1] The increase in NTMs has been primarily driven by a surge in regulatory measures like technical barriers to trade (TBTs) and sanitary and phytosanitary (SPS) measures. While much of the literature on NTMs focuses on how NTMs affect both aggregate and firm-level exports (WTO, 2012; Fontagne et al., 2015; Fontagne and Orefice, 2018), there is a dearth of studies focusing on how NTMs affect the performance of exporting firms.

We complement this literature by focusing on the impact of the restrictive TBT measures imposed by destination countries or markets on the performance of exporting firms utilising firm-product-level data from India. In particular, we examine how the TBTs introduced by export destinations (markets) affect prices, marginal costs, markups, and the productivity of Indian manufacturing exporters. We find that the introduction of TBTs by export markets significantly increases marginal costs and prices and reduces markups of firms. In other words, exporters absorb part of the cost increase by reducing markups, leading to a moderate increase in prices. The increase in costs and drop in markups are primarily driven by exporters with initially low marginal costs (or the most productive firms), with the opposite effect seen for firms below the top decile of the productivity distribution.

Theoretically, the imposition of a TBT can affect a firm in various ways: first, it can directly raise production costs. In particular, TBTs can be associated with either an increase in variable costs (e.g. labelling requirements) or fixed costs (e.g. new production processes) of production or both (Fontagne and Orefice, 2018). Second, the existence of different standards in different markets could entail individual fixed compliance costs for separate markets, which could severely limit exporters' production capacity and the number of markets (Chen et al., 2008). Overall, by increasing the variable or fixed costs of production, TBTs are likely to affect aggregate exports (in this case, of Indian exporters) to the markets maintaining these measures.

[1] WTO notifications for NTMs from member countries increased from around 3,000 in 1996 to more than 27,000 in 2010.

However, the overall effect on exports may be ambiguous. On the one hand, TBTs (acting as a negative export shock) may force firms to leave the market where the shock or measure originated, whereas on the other hand, it may increase exports from firms who choose to incur additional variable and fixed costs of production. Thus, the overall effect on a firm's exports will depend on the strength of these two channels. In any case, both channels are likely to increase marginal costs for firms. Whether this increase will lead to an increase in prices or not depends on the pass-through rate. A high pass-through of costs to prices will imply a relatively low decline in markups and large increase in prices.

Given such important and direct implications of the effects of TBTs, it is worth examining the effect of TBTs on exporters' costs, prices, and markups; and documenting how these firms respond to these different dimensions. To establish such effects, we use a dataset, PROWESS, which reports product-level information of costs, prices, sales, and quantities sold by Indian manufacturing firms in addition to other important firm-level information such as exports, imports, and compensation to employees from 1996 to 2010 to investigate the effects. This is the primary contribution of this chapter.

Following the literature on the productivity effects of trade liberalisation, this chapter conducts a two-step empirical analysis (Pavcnik, 2002; Fernandes, 2007; Topalova and Khandelwal, 2011). First, we compute firm-product-level marginal costs and markups using the methodology of De Loecker et al. (2016). Our dataset, PROWESS, rolls out detailed production data on sales and quantity produced at the product level. This enables us to recover the underlying components of prices (i.e. marginal costs and markups), and firm-level measures of physical efficiency. Next, we use these measures to estimate the effect of introduction of restrictive TBT measures on firms' performance.

Our results are clear and robust. In evaluating the impact of such TBTs on the performance of exporting firms, we address some of the key challenges with a focus on establishing the causal effect. First, with respect to the endogeneity of the measure itself, there is significant concern that the industries on which the regulations have been imposed were chosen based on the past export performance of Indian firms in the destination markets introducing the TBT measures. We

address this concern using a falsification test. Specifically, we show that past changes in industry-level markups are not a predictor of the current incidence of TBTs in the corresponding industry.

Second, we find that the introduction of TBTs in destination markets leads to a fall of around 4.7–5.7% in quantities sold by an average Indian exporter. Third, TBTs increase marginal costs by 5% and prices by 4%, suggesting that firms absorb part of this increase in marginal costs by reducing markups, leading to a moderate price increase. Moreover, these aggregate cost effects are driven by firms in the top decile of productivity distribution (measured by their initial marginal cost), with the opposite effect for less productive firms. Additionally, dividing firms by their productivity distribution shows that firms with initially low marginal costs experience a decrease in their markups along with an increase in prices. Finally, we find substantial heterogeneity based on firm and industry characteristics. In particular, the overall effect is concentrated among private firms (both domestic and foreign, with a higher effect for foreign firms) and industries producing intermediate inputs.

Our study makes important contributions to the literature. First, it is among the first, to the best of our knowledge, to provide estimates of the efficiency and markups for exporters resulting from the introduction of TBTs. Second, most studies in the literature only focus on the impact of the regulations imposed by destination markets on the export performance of firms, and in case of only the developed countries. We depart from the literature by focusing on the internal adjustments of an exporter and that too, for a developing country. Third, ours is one of the few studies that estimates the effect of changes in trade costs on prices and the two essential components of prices: marginal costs and markups.

The rest of the chapter is organised as follows. Section 2 discusses the relevant literature, section 3 describes the data, section 4 presents the empirical strategy and results, and section 5 concludes.

2. Literature Review

This section discusses the existing literature most closely related to our work, that is, studies on the economic effects of TBTs, and our contribution to the literature. As early as 1970, trade economists like Robert Baldwin pointed out that, 'The lowering of tariffs has, in effect, been like draining a swamp. The lower water level has revealed all the snags and stumps of non-tariff barriers that still have to be cleared away.' (Baldwin, 1970: 2). With tariff barriers becoming increasingly less important (as a result of the General Agreement on Tariffs and Trade [GATT] and/or World Trade Organization [WTO] negotiations), differences in regulatory regimes across different economies are becoming ever more visible. These regulatory regimes include policies such as government procurement rules, inward foreign investment, competition policy, labour standards, environmental norms and product standards, and technical regulations (Hoekman, English, and Mattoo, 2002).[2] Orefice (2017) combined the SPS and TBT measures using the Specific Trade Concerns (STC) dataset to provide robust evidence of STCs being raised at the WTO (by an exporting country) when there is a tariff reduction (by the importer).

Studies concerning TBTs most commonly look at its trade effects. One of the first studies to investigate the trade effects of TBTs explicitly is that by Chen, Wilson, and Otsuki (2008). Using the World Bank TBT Survey database, which covers 689 firms in more than 20 industries in 17 developing countries, the study shows that different types of standards affect the intensive and extensive margin of exports differently. For example, quality standards are positively correlated with firms' average export volume and export scope; whereas certification procedures are negatively correlated with export volume and scope. To meet these standards, firms invest in additional plants or equipment, redesign their products for each export market, employ additional labour for production, carry out more testing and

[2] Baldwin (2000) highlighted that TBTs are a primary concern of the European Union (EU) as far as trade barriers are concerned, after the abolishment of all internal tariffs in 1973. Pascal Lamy, the ex-DG of the WTO, also points out that standards and rules in areas such as safety, health, or consumer protection (rather than abolishing tariffs and quotas) are 'the real 21st century trade issues' (Chen and Mattoo, 2004). The urgency of this topic is further accentuated by the significant rise in WTO dispute settlement cases concerning standards-related issues.

certification, or lay off workers instead of making these types of investments to keep costs from increasing.

In a similar study, Shepherd (2007) finds a negative association between restrictive TBT measures (e.g. in textiles, clothing, and footwear sectors) and the number of varieties of goods imported into the EU (European Union). Kamal and Zaki (2018) examining the impact of TBTs on exports of Egyptian firms find no evidence of TBTs affecting firms' intensive margin; however, extensive margin and entry probability are negatively affected.

In a more comprehensive study, Bao and Qiu (2012) estimate the trade effects of TBTs based on all notifications from 105 WTO countries from 1995 to 2008. The paper adopts a modified two-stage gravity model to control for both sample selection and firm heterogeneity bias. They find that that a country's TBT notification(s) decrease other countries' probability of exporting (extensive margin), but increase their export volumes (intensive margin). Disdier, Fontagne, and Mimouni (2008) use a gravity equation to analyse the effect of both SPS and TBT regulations on agricultural trade, and show that regulations significantly reduce developing countries' exports to members of the OECD countries, but do not affect trade between OECD members.

Lastly, Fontagne and Orefice (2018) using a firm-product-destination-level dataset for French exporters find complex effects of TBT measures on different margins of trade. Extensive margin is found to be more salient in explaining the drop in exports to the country imposing the standard, while the intensive margin of an average firm remains unaffected. They also find evidence that high-productivity, multi-destination firms are more likely to exit country markets that maintain restrictive TBTs, thus reducing competitiveness as well as average productivity in the maintaining country.

Two points can be noted from the above discussion: (i) there is no consensus on the trade effects of TBTs, and (ii) the lion's share is focused on understanding the trade effects of TBTs. In a slightly different but related context, Li and Beghin (2017) used a meta-analysis to explain the variation in estimated trade effects of TBTs using the available estimates from the literature, and accounting for data sampling and methodology differences. They argue that not controlling for

'multilateral resistance' barriers increases the likelihood of overstating the impeding effect of technical measures.

One exception is a recent study by Navaretti et al. (2019), who look at how the introduction of TBTs can affect a firm's organisation using a matched employer-employee dataset for French exporters from 1995 to 2010. Controlling for tariffs and a given state of technology, the paper finds that exporters respond to the increased complexity associated with restrictive TBTs by increasing the share of managers relative to 'blue-collar', 'white-collar', and professional workers.

There is a slightly different but related literature on how the harmonisation of standards (TBTs and/or NTMs) affects trade (Moenius, 2004; Baller, 2007; Fontagne, von Kirchbach, and Mimouni, 2005; Disdier, Fontagne, and Cadot, 2015). The results are mixed, depending on the sample and/or period of study. Baller (2007) finds that mutual recognition of agreements has a strong and positive influence on both export probabilities and trade volumes for partner countries. On the other hand, Disdier, Fontagne, and Cadot (2015) found that this happens only in Southern countries expanding trade with Northern countries (developed economies) at the expense of their trade with non-bloc Southern partners (developing and emerging markets).

Lastly, with respect to India, although few studies focus on the debate between product-related standards and its effect on trade, but most are either qualitative in nature (Chaturvedi and Nagpal, 2002) or estimate the effect of NTBs in general (Mehta, 2005; Saqib and Taneja, 2005) or SPS requirements (Mehta, 2002). In contrast, our chapter examines the effect of TBTs introduced by destination markets on the efficiency of exporting firms. Our results will contribute to the small but growing literature on the effects of NTMs on firm performance using detailed firm-product-year-level data.

3. Data

3.1. PROWESS

Our primary source for firm-level data is the PROWESS database from the Centre for Monitoring the Indian Economy (CMIE). This database contains information on the financial performance of over 45,000 firms across the manufacturing, services, financial, and utility sectors. These firms account for a substantial portion of output in the organised manufacturing sector and taxes collected by the government. For this study, we focus on firms in the manufacturing sector from 1996 to 2010.

A unique feature of the database is that it captures detailed information on firms' product-level production, including the quantity, sales, and capacity of each product manufactured by a firm. The 1956 Companies Act requires firms to report detailed production data for all products manufactured by a firm. The internal product classification of CMIE assigns a unique 20-digit code to each product. Following De Loecker (2011), we aggregate the products to 12 digits, as the level of disaggregation is comparable across products at this level. Therefore, the products in our dataset should be seen as narrowly defined categories within industries, rather than a specific product variety like barcode scanner datasets. There are over 3,500 unique products in our sample. These product codes are then mapped to the 2004 National Industry Classification (NIC) at the -digit level. We also use data on industry-level exports from India to other countries from the World Integrated Trade Solutions (WITS).

3.2. Specific Trade Concerns (STCs) Database

The effect of the TBT measures on trade is ambiguous. While they hinder trade flows by increasing the cost of trade, they can also help in addressing market failure and result in a positive impact on trade. This analysis focusses on the subset of TBTs likely to restrict trade flows. To identify these restrictive TBTs, we use the WTO's STC Database, which systematically captures details about all concerns raised by member countries against other members maintaining the TBTs in the WTO TBT committee. Given the time and resource constraints, countries are only likely to raise concerns if the TBTs induce a considerable increase in trade costs for

exporters in these countries. For each concern, we observe (i) the countries raising the concerns, (ii) the maintaining country, (iii) the products covered by the measure, (iv) all the dates on which the concern was discussed in the committee meeting, (v) the issues with the TBT measure, and (vi) the objective of the measure concerned. We identify the incidence of the TBTs as they were first raised in the TBT committee meeting.

The STC dataset has several advantages compared to alternative datasets on TBTs for the purpose of our analysis. The WTO notifications database covers all TBT measures noted by member countries to the WTO. However, it is not possible to identify the regulations as restrictive and in addition, countries often do not notify the WTO of all TBTs that they maintain. Other datasets like the UNCTAD TRAINS database only have cross-sectional data and do not identify the restrictive ones.

Table 1.1 reports the yearly incidence of STCs for all countries and India divided into concerns and products. The numbers indicate a consistent yearly incidence of new TBTs, leading to a secular increase in these measures covering many product lines maintained by member countries during the study period.

Table 1.1: Yearly Incidence of Specific Trade Concerns

Year	All Countries		India	
	Concerns	Products	Concerns	Products
	(1)	(2)	(3)	(4)
1995–2000	52	578	0	0
2001	15	317	2	125
2002	20	436	2	171
2003	15	471	0	0
2004	14	29	1	14
2005	12	337	0	0
2006	24	459	2	7
2007	27	329	4	142
2008	32	333	0	0
2009	46	363	3	193

Source: Authors' calculation based on the STC dataset.

4. Technical Barriers to Trade and Firm Performance

4.1. First-Order Effects: Aggregate Exports

Before addressing our main research question (firm-level adjustments to TBTs), we study their effect on exports from India, aggregated at the industry level. We regress the log of exports at the country-industry level on the lagged values of the incidence of TBTs in the corresponding industries by the countries from where the TBTs are imposed using the following equation:

$$\log (exports)_{cht} = \alpha_0 + \alpha_{ch} + \alpha_{ht} + \beta_1 TBT^{IND}_{ch,t-1} + \varepsilon_{cht} \qquad (1)$$

where c is country, h is the Harmonized System (HS) four-digit industry, and t is year. $TBT^{IND}_{ch,t-1}$ is an indicator variable. It is equal to 1 if a TBT has been imposed at the HS-4 (h) product line by country c at time $t-1$. α_{ch} is country-product fixed effects and α_{ht} is product-year fixed effects, which control for country-product and product-year specific unobservable variables that can be correlated with exports as well as the incidence of TBTs.

Table 1.2: Effect of Technical Barriers to Trade on Exports

	Exports	
	(1)	(2)
$TBT^{IND}_{ch,t-1}$	–0.173***	–0.226***
	(0.063)	(0.0571)
N	29,622	29,404
R-sq.	0.766	0.821
Country-HS4 FE	Yes	Yes
Year FE	Yes	Yes
HS4 × Year FE	No	Yes

Notes: Columns 1and 2 use the logarithm of exports from India to country c at the HS-4digit level (h) as the dependent variable. $TBT^{IND}_{ch,t-1}$ is an indicator variable equal to 1 if country c imposes a TBT on an Indian HS4 industry h in time $t-1$. Numbers in parentheses are robust standard errors clustered at the -digit industry level. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

Table 1.2 reports the required results. Column 1 includes country-industry and year fixed effects, while in column 2 we include country-industry and industry-year fixed effects. Our coefficient of interest is negative and statistically significant across both columns, suggesting that the incidence of TBTs in destination markets negatively affects exports from India to those markets. In particular, the incidence of TBTs resulted in an around 22% decline in exports of the product lines on which TBTs have been imposed in the destination markets.

4.2. Baseline Results: Effect on Prices, Costs, Markups, and Productivity

This section examines the consequence of the negative export shocks resulting from the imposition or incidence of TBTs in destination markets on the performance of manufacturing exporters.

4.2.1. Endogeneity of Regulations

However, before doing so, there is another crucial issue, which needs to be addressed regarding our identification strategy to establish that the effect of the TBTs is exogenous, at least with respect to the performance of Indian manufacturing exporters. A primary issue in evaluating the causal effect of TBTs relates to the selection of industries based on their outcome variables. To provide some evidence for the absence of such an effect, we conduct a falsification test and check whether the past values of markups (of industries where TBTs are imposed) are significantly correlated with the current incidence of TBTs (imposed by destination markets on Indian exporters corresponding to those industries) , using the following specification:

$$TBT^{IND}_{j(p),t} = \alpha_0 + \alpha_{j(p)} + \alpha_t + \beta_1 \Delta\mu_{j(p),t-1} + \varepsilon_{j(p)t} \qquad (2)$$

where Δ is one period difference (lagged), and $j(p)$ is the industry (2004 NIC) associated with product p. We calculate the industry-level markups as the sales share weighted sum of firm-product-level markups. Our coefficient of interest is β_1. A statistically insignificant coefficient would suggest that past values of markups have little or no predictive power with respect to the current incidence of TBTs in that industry.

We measure the industry-level exposure to TBTs for Indian firms by

$$TBT_{j(p)t}^{IND} = \sum_{c} e_{jc} \times tbt_{jct}$$

where $TBT_{j(p),t}^{IND}$ is the exposure of industry $j(p)$ at time t to TBTs. tbt is an indicator variable that equals 1 if country c has imposed a TBT measure in year t on industry j. e_{jc} denotes the initial share of Indian exports to country c to total exports from India in industry j.

Table 1.3 reports the results from estimating equation 2. Columns 1 and 2 utilise the full sample, which is for 1996–2010; while columns 3 and 4 restrict observations to the pre-financial crisis period (1996–2007). In addition, columns 2 and 4 exclude all years after the first year when $TBT_{j(p),t}^{IND} > 0$. This is to avoid capturing the effects of these measures on industry-level markups. The coefficient on the lagged changes in markups is insignificant across all of the columns, suggesting that past changes in markups do not predict the current incidence of TBTs.

Table 1.3: Endogeneity of Technical Barriers to Trade

	$\boldsymbol{TBT_{j(p)t}^{IND}}$			
	1996–2010		1996–2007	
	(1)	(2)	(3)	(4)
$\Delta Markups$	–0.0001	–-0.00004	–0.00003	–0.00003
	(0.0001)	(0.00004)	(0.0001)	(0.00004)
N	846	434	642	371
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: Columns 1–4 use TBTs imposed on India by country c as the dependent variable. Columns 1 and 3 include all the observations; columns 2 and 4 exclude years after the first year when $TBT_{j(p)t}^{IND} > 0$. $\Delta Markups$ are industry-level markups calculated as real sales weighted average of firm-product level markups. Numbers in parentheses are robust standard errors clustered at the -digit industry level.
Source: Authors' calculations.

4.2.2. Empirical Strategy and Results

Following the literature on the productivity effects of trade liberalisation, we carry out our main empirical analysis in two steps. First, we compute firm-product-level prices, marginal costs, and markups. Second, we use these estimates as our outcome variables of interest to estimate the effect of the introduction of restrictive TBT measures in destination markets on Indian exporting firms.

We estimate the prices, marginal costs, and markups at the firm-product level using the methodology of De Loecker et al. (2016). This method is well suited for our analysis as it uses information on quantities to eliminate bias from unobserved output prices, accounts for bias arising from unobserved input prices, and allows for multi-product firms. Table 1A.1 reports average output elasticities and average returns to scale. Average returns to scale is greater than 1 for most sectors, implying increasing returns to scale. For a translog production function, the output elasticities are a function of factor inputs, and even for sectors with average returns to scale below 1 many firm-products have increasing returns to scale.

Next, we show how sales share and quantity produced vary with markups and marginal costs. Figures 2B.1 and 2B.2 plot the demeaned values of markups against sales share, and marginal costs against physical quantity. We find that firm-products with high markups and low marginal costs have a higher share of overall firm sales (Figure 2B.1), and are produced in larger quantities (Figure 2B.2).

With these estimates of firm-product-level prices, marginal costs, and markups in hand, we exploit the following specification to study the effect of incidence of TBTs on the corresponding firm-product-level prices, marginal costs, and markups:

$$X_{ipt} = \alpha_0 + \alpha_{ip} + \alpha_{j(p),t} + \beta_1 TBT^{IND}_{j(p),t-1} + Z_{j(p),t} + \varepsilon_{ipt} \qquad (3)$$

where X is either log of sales, quantities sold, price, marginal cost, or markup at the firm-product level. i denotes the firm, p denotes the product, and $j(p)$ denotes the industry (-digit 2004 NIC) associated with product p. Z_{jt} denotes the vector of control variables, including industry-level output and input tariffs. We use firm-product fixed effects (α_{ip}) to control for unobserved heterogeneity in the

determinants of outcome variables that are firm-product specific. The 3-digit industry-year ($\alpha_{j(p),t}$) fixed effects control for industry-year specific shocks that affect outcome variables and are correlated with the incidence of TBTs in an industry.

Table 1.4 reports our results from sales and quantities sold. Columns 1 and 2 use data for 1996–2010, and columns 3 and 4 use data for 1996–2007. We find a significant effect on quantities sold, where the imposition of TBTs led to a 4.7%–5.7% drop. However, we find no effect on sales. This effect may be concentrated for only a small set of firms (see section 4.2.3).

Table 1.4: Effect of Technical Barriers to Trade on Firm Performance: Sales and Quantities

	1996–2010		**1996–2007**	
	Sales	Quantity	Sales	Quantity
	(1)	(2)	(3)	(4)
$TBT^{IND}_{j(p)t-1}$	-0.069	-0.384**	-0.062	-0.451**
	(0.256)	(0.190)	(0.266)	(0.201)
N	39,989	39,989	39,989	39,989
R-sq.	0.897	0.959	0.904	0.961
Firm-Product FE	Yes	Yes	Yes	Yes
3-digit Industry × Year FE	Yes	Yes	Yes	Yes

Notes: Columns 1 and 3 use sales, and columns 2 and 4 quantity sold of a firm our outcome variable of interest. $TBT^{IND}_{j(p)t-1}$ denotes exposure to TBTs for industry $j(p)$ in time $t-1$. All the specifications control for output and input import tariffs (at $t-1$ period) for India. Numbers in parentheses are robust standard errors clustered at the -digit industry level. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

We present our benchmark results from estimating equation 3 in Table 1.5. Columns 1–3 report results for the full sample (1996–2010), while columns 4–6 cover the years before the 2008 financial crisis (1996–2007). Overall, the results suggest that any incidence of a TBT measure in any destination market leads to a significant increase in both prices and marginal costs for firms. A 10-percentage point increase in TBT^{IND} leads to an increase in prices by 3%–4% and in marginal costs by 5%. The coefficient is negative but insignificant for markups.

Table 1.5: Effect of Technical Barriers to Trade on Firm Performance: Prices, Costs, and Markups

	1996 – 2010				1996 – 2007			
	Prices	Marginal Costs	Markups		Prices	Marginal Costs	Markups	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$TBT^{IND}_{j(p)t-1}$	0.315***	0.497**	-0.182	0.213*	0.389***	0.520**	-0.130	0.282**
	(0.117)	(0.231)	(0.232)	(0.114)	(0.133)	(0.241)	(0.241)	(0.126)
N	39,989	39,989	39,989	39,989	30,378	30,378	30,378	30,378
R-sq.	0.981	0.950	0.818	0.939	0.982	0.953	0.832	0.944
Controlling for marginal cost	No	No	No	Yes	No	No	No	Yes
Firm-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3-digit Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1 and 5 use prices, columns 2 and 6 use marginal costs, and columns 3–4 and 7–8 use markups as our outcome variable of interest. Columns 1–4 report results for the 1996–2010, whereas columns 5–8 use 1996–2007 as the reference period. $TBT^{IND}_{j(p)t-1}$ denotes exposure to TBTs for industry $j(p)$ in time $t-1$. All the specifications control for output and input import tariffs (at $t-1$ period) for India. Numbers in parentheses are robust standard errors clustered at the -digit industry level. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

This effect on markups and in turn prices represents a combination of two distinct channels. The first manifests through an imperfect pass-through of costs to prices. Faced with an increase in marginal costs, firms reduce markups and only pass along part of this increase to prices. The second is the direct effect of these TBTs on markups and prices. This channel depends on whether the exporter chooses to stay in the destination market or exits. For instance, exporters that choose to incur the fixed and/or variable costs for the restrictive TBTs may expand in these destination markets and experience an increase in markups as a result of reduced competition from the exit of other exporters, quality improvements, and/or increased demand.

To understand whether this direct effect is at work, we control for marginal costs in columns 4 and 8. The coefficient on TBT^{IND} is positive and significant, implying that firms increase their markups conditional on marginal costs. This would only be the case if most firms in our sample complied with the regulations and increased their markups because of reduced competitiveness in the destination market.[1] Next, we focus on the channels and type of firms that drive these results.

4.2.3. Heterogeneity

In this section, we study the heterogeneity of firm responses. We start by looking at the productivity distribution of firms based on their marginal costs.

a) Productivity

One of the most important factors affecting the firms differentially in terms of the effect of restrictive TBTs is their initial marginal costs. Recent heterogeneous trade models with destination product-specific fixed costs of exporting, as in Chaney (2008), predict that the effect of change in variable and fixed costs affect the intensive and extensive margins of trade differently. While changes in fixed costs of production induce changes in trade flows through the extensive margin, changes in variable trade costs affect both the intensive and extensive margin of trade. Further, the empirical evidence in the literature is consistent with restrictive TBTs mainly inducing changes in fixed costs of trade. Fontagne and Orefice (2018) study French exporters and find that the extensive margin is salient in explaining changes in trade flows in response to the introduction of restrictive TBTs in the

[1] The PROWESS dataset consists primarily of medium-sized and large firms.

destination markets. As a response to the incidence of TBTs, multi-destination exporters may reallocate exports to alternative destinations that they already serve.

To test heterogeneity for the effect based on initial efficiency, we classify firms into deciles based on the ranking of the marginal costs (corresponding to industry) for the first year a firm-product pair enters the sample. Thus, firm-products with the lowest marginal costs in their first year in our sample are classified into the lowest decile. In other words, the most productive firms belong to the lowest decile. We estimate the following specification to test for heterogeneity based on initial marginal costs:

$$X_{ipt} = \alpha_0 + \alpha_{ip} + \alpha_{j(p),t} + \beta_1 TBT^{IND}_{j(p)t-1} + \beta_2 (TBT^{IND}_{j(p)t-1} \times Decile_{ip}) + Z_{jt} + \varepsilon_{ipt} \quad (4)$$

where $Decile_{ip}$ denotes the decile of the firm-product ip in the initial period. Table 1.6 reports the results.

Table 1.6: Effect of Technical Barriers to Trade on Firm Performance: Heterogeneity Based on Productivity

	Prices	Marginal Costs	Markups
	(1)	(2)	(3)
$TBT^{IND}_{j(p)t-1}$	0.504**	2.449**	-1.945***
	(0.210)	(0.608)	(0.714)
$TBT^{IND}_{j(p)t-1} \times Decile_{ip}$	-0.038	-0.396***	0.359***
	(0.031)	(0.106)	(0.116)
N	39,989	39,989	39,989
R-sq.	0.981	0.952	0.822
Firm-Product FE	Yes	Yes	Yes
3-digit Industry × Year FE	Yes	Yes	Yes

Notes: Column 1 use prices, column 2 uses marginal costs, and column 3 uses markups as our outcome variable of interest. All the regressions use data for 1996–2010. $TBT^{IND}_{j(p)t-1}$ denotes exposure to TBTs for industry j in time $t-1$. $Decile_{ip}$ denotes the decile for each firm-product in an industry based on the inverse of their initial marginal cost. All the specifications control for output and input import tariffs (at $t-1$ period) for India. Numbers in parentheses are robust standard errors clustered at the -digit industry level. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

Our estimates from columns 1–3 show that the effect of TBTs on marginal costs is non-monotonic. In other words, the coefficient on $TBT^{IND}_{j(p),t-1}$ is positive and significant, while the coefficient on the interaction with $Decile_{ip}$ is negative and significant in column 2. Firm-products with high initial marginal costs experience a relative decrease in marginal costs while firm-products with initially low marginal costs experience a rise in marginal costs. In other words, the most productive or most exposed firms experience an increase in margin.

Similarly, we find that firm-products with initially high marginal costs differentially increase their markups (column 5), while firm-products with initially low marginal costs experience a decrease. We find no heterogeneity in price responses for low- and high-marginal-cost firms (column 1). These results indicate that initially low-marginal-cost firms are more likely to be exposed to restrictive regulations as they experience an increase in marginal costs and prices. This is because productive exporters are more likely to cater to multiple destinations and therefore have a higher likelihood to be exposed to the introduction of restrictive TBTs.[2]

Table 1A.2 looks at the heterogeneous response (in terms of initial productivity) of firms, using sales and quantities sold as the outcome variables of interest. The coefficient on $TBT^{IND}_{j(p),t-1}$ is negative and significant, while the coefficient on the interaction with $Decile_{ip}$ is positive and significant. This implies that low-marginal-cost firm-products contract in terms of sales as well as quantity produced, relative to high-marginal-cost firm-products that experience increased production and sales. These findings are again consistent with more productive exporters serving relatively more destination markets than do less productive exporters, and are hence more exposed to the introduction of TBTs. Overall, our results suggest that the introduction of these measures negatively affects high-productivity exporters leading to increased costs, lower markups, higher prices, and reduced sales for these exporters.

b) End Use and Ownership

We start our analysis based on whether the industry is an intermediate good or final goods industry. We use the classification by Nouroz (2001) to classify

[2] Our measure for exposure to restrictive TBTs is observed at the industry level as we do not observe destination markets served by each exporter.

industries into intermediate goods consisting of basic, intermediate, and capital goods industry and final goods consisting of consumer durable and non-durable goods. We estimate the following specification to test heterogeneity in responses, based on industry end use:

$$X_{ipt} = \alpha_0 + \alpha_{ip} + \alpha_{j(p),t} + \beta_1(TBT^{IND}_{j(p),t-1} \times IG) + \beta_2(TBT^{IND}_{j(p),t-1} \times FG) + Z_{jt} + \varepsilon_{ipt} \quad (5)$$

where IG denotes intermediate goods industries, and FG denotes final goods industries. Columns 1–3 of Table 2.7 report the results. We find that the overall effects are driven entirely by firms belonging to intermediate goods industries.

Table 2.7: Effect of Technical Barriers to Trade on Firm Performance—Heterogeneity

	End Use			Ownership		
	Prices	Marginal Costs	Markups	Prices	Marginal Costs	Markups
	(1)	(2)	(3)	(4)	(5)	(6)
$TBT^{IND}_{j(p)t-1} \times IG$	0.820***	1.663***	-0.843***			
	(0.179)	(0.359)	(0.270)			
$TBT^{IND}_{j(p)t-1} \times FG$	0.049	0.296	-0.248			
	(0.177)	(0.196)	(0.307)			
$TBT^{IND}_{j(p)t-1} \times Pvt$				0.421**	0.728***	-0.306
				(0.177)	(0.211)	(0.223)
$TBT^{IND}_{j(p)t-1} \times Foreign$				0.654***	1.029***	-0.374
				(0.171)	(0.383)	(0.341)
$TBT^{IND}_{j(p)t-1} \times Govt$				0.547	1.125*	-0.578
				(0.373)	(0.582)	(0.588)
N	39,198	39,198	39,198	39,958	39,958	39,958
R-sq.	0.980	0.949	0.816	0.980	0.957	0.816
Firm-Product FE	Yes	Yes	Yes	Yes	Yes	Yes
3-digit Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1 and 4 use prices, columns 2 and 5 use marginal costs, and columns 3 and 6 use markups as our outcome variable of interest, respectively. All regressions are for the period 1996–2010. $TBT^{IND}_{j(p)t-1}$ denotes exposure to TBTs for industry $j(p)$ in time $t-1$. IG is an indicator variable which takes a value 1 if a firm produces intermediate goods; FG is an indicator variable which takes a value 1 if a firm produces final goods. Pvt is a dummy variable, which takes value 1 if a firm is domestic private firm. $Foreign$ indicates foreign firms; $Govt$ indicates govt.-owned firms. All specifications control for output and input import tariffs for India. Numbers in parentheses are robust standard errors clustered at the -digit industry level. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

Next, we study heterogeneity in exporter performance based on ownership status. We classify firms as private, government-, or foreign-owned; and estimate the following specification:

$$X_{ipt} = \alpha_0 + \alpha_{ip} + \alpha_{j(p),t} + \beta_1(TBT^{IND}_{j(p)t-1} \times Private) + \beta_2(TBT^{IND}_{j(p)t-1} \times Foreign) + \beta_3(TBT^{IND}_{j(p)t-1} \times Govt) + Z_{jt} + \varepsilon_{ipt} \quad (6)$$

Columns 4–6 report the results regarding the ownership status of firms. Our estimates suggest that the overall effects are primarily driven by private firms, both Indian- and foreign-owned. Government-owned firms show relatively weaker effects, with an insignificant effect on marginal costs and prices. The coefficient is larger for foreign-owned firms compared to private Indian-owned firms, suggesting that TBTs in destination markets affect foreign firms more severely.

5. Conclusion

While the effects of restrictive regulatory NTMs on trade flows are well documented, their effects on the performance of exporters in developing economies has been relatively less explored. This chapter looked at the effect of restrictive TBT measures in destination markets on prices, marginal costs, and markups of Indian manufacturing exporters. Using detailed firm-product-level data from PROWESS combined with data on TBT measures from the STC dataset, we find that the introduction of TBTs in destination markets increases marginal costs and prices. Faced with increased marginal costs, exporters reduce markups and increase prices moderately as a result of incomplete pass-through of prices. These measures negatively affect the most productive exporters, leading to increased costs and prices, and reduced markups and sales for these exporters.

There is considerable debate about whether measures such as NTMs and/or TBTs help or hurt firms' competitiveness. This chapter is an empirical contribution to this continuously growing debate. Although the chapter does not directly test the hypothesis of Porter and Van der Linde, it explores similar issues. Our results lend potential support for the trade-off between the compliance and competitiveness of

firms, and prove that firms most exposed to trade shocks (global standards in this case) may have to undermine their competitiveness. This suggests that the imposition of TBTs can lead to a significant reallocation of resources within industries, from high- to low-productivity firms. One problem that could hinder firm performance is its limited administrative and technical capacity, which could threaten the adoption of new norms and standards. Overall, our results suggest that technical regulations, while serving legitimate public policy objectives, should not be more restrictive than necessary to serve the objective.

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Appendix 1A

Table 1A.1: Output Elasticities

Sector	Observations	Labour	Material	Capital	Returns to Scale
	(1)	(2)	(3)	(4)	(5)
Food and beverages	1,197	0.13	0.81	0.40	0.99
Textile	2,468	0.10	0.82	0.09	1.02
Apparel and leather products	522	0.10	0.80	0.09	1
Paper and paper products	1,323	0.10	0.84	0.16	1.11
Coke and petroleum products	189	0.23	0.79	0.11	1.14
Chemical and chemical products	2,881	0.25	0.75	0.04	1.04
Rubber and plastic products	1,480	0.14	0.77	0.15	1.06
Non-metallic products	551	0.11	0.66	0.21	0.99
Basic metals	301	0.11	0.99	0.06	1.15
Fabricated metal products	295	0.34	0.8	–0.02	1.13
Machinery and equipment	1,045	0.28	0.65	0.12	1.05
Electrical machinery and electronics	752	0.27	0.77	0.01	1.05
Optical and medical instruments	156	0.05	0.60	0.40	1.05
Motor vehicles and transport equipment	656	0.24	0.62	0.30	1.16
Furniture and manufacturing n.e.c.	300	0.40	0.55	–0.13	0.83

Source: Authors' calculations.

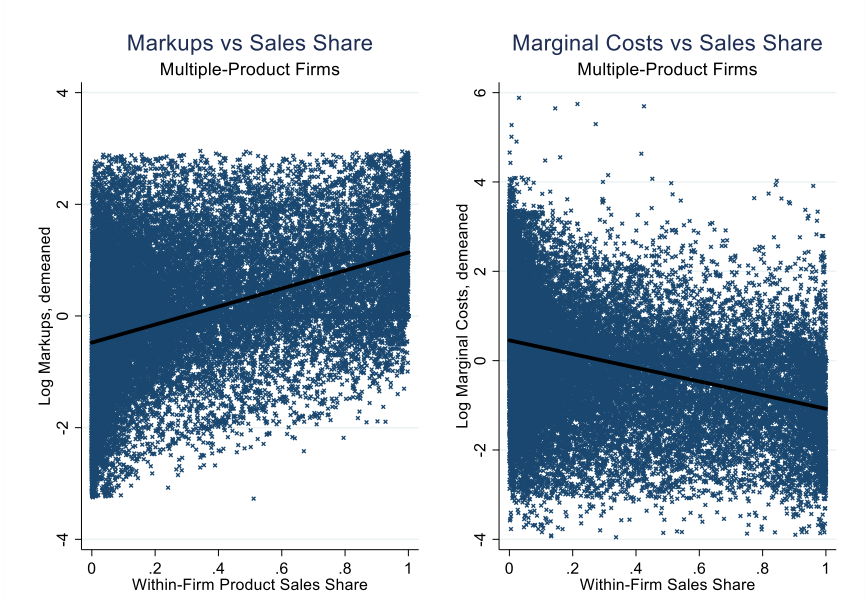
Table 1A.2: Effect of Technical Barriers to Trade on Sales and Quantity—Heterogeneity Based on Productivity

	Sales	**Quantity**
	(1)	(2)
$TBT^{IND}_{j(p)t-1}$	-1.598***	-2.102***
	(0.569)	(0.442)
$TBT^{IND}_{j(p)t-1} \times Decile_{ip}$	0.313***	0.350***
	(0.086)	(0.075)
N	39,989	39,989
R-sq.	0.898	0.960
Firm-Product FE	Yes	Yes
3-digit Industry × Year FE	Yes	Yes

Notes: Column 1 uses sales and column 2 uses quantities sold as our outcome variable of interest. All the regressions use data for 1996–2010. $TBT^{IND}_{j(p)t-1}$ denotes exposure to TBTs for industry j in time $t-1$. $Decile_{ip}$ denotes the decile for each firm-product in an industry based on the inverse of their initial marginal cost. All the specifications control for output and input import tariffs (at $t-1$ period) for India. Numbers in parentheses are robust standard errors clustered at the -digit industry level. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

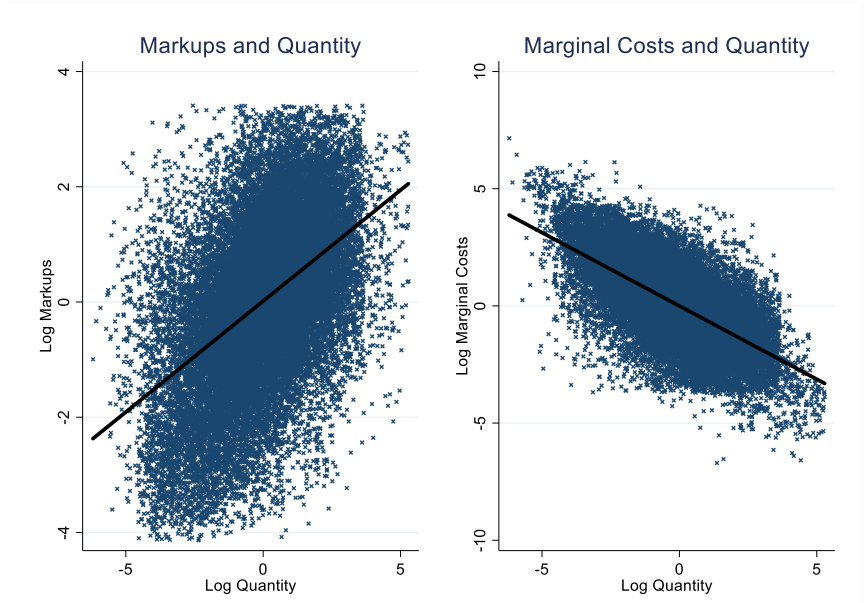
Appendix 1B

Figure 1B.1: Markups, Marginal Cost, and Sales Share



Note: Markups and marginal costs are demeaned by product-year and firm-year fixed effects and the top and bottom three percentiles observations for markups and marginal costs have been excluded.
Source: Authors' calculations.

Figure 1B.2: Markups, Marginal Cost, and Quantity



Note: Markups and marginal costs are demeaned by product-year and firm-year fixed effects and the top and bottom three percentiles observations for markup and marginal costs have been excluded.
Source: Authors' calculations.

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