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Let's Try Next Door: Technical Barriers to Trade and Multi-destination Firms

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Abstract

Stringent Technical Barriers to Trade (TBT) are expected to drive exporters out of the markets imposing these hurdles. In addition, more able multi-destination exporters can refocus on TBT-free markets and reorient their exports. By matching a database of TBT measures raised as concerns at the WTO (Specific Trade Concerns – STCs), with a firm-level panel of French exporters, we show the complex effects of restrictive TBT measures on the different margins of trade. We show that the negative effect of TBT on export participation is magnified for multi-destination firms, which can divert their exports towards TBT-free destinations. Moreover, we conduct aggregate level estimations to show that the effect of stringent TBTs in reducing export flows is magnified in more homogeneous sectors. Observing the shape of the firm distribution at sectoral level and the aggregate response of export to trade cost, we shed light on the fixed component of the additional cost imposed by TBTs on exporters.

Key Words: Non-tariff measures, TBT, Multi-destination Firms, Trade Margins.

JEL Codes: F13, F14.

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1 Introduction

Technical Barriers to Trade (TBTs) in the areas of quality, labeling and technical standards increase the cost of exporting into the country adopting such measures. The imposition of TBTs can raise the variable costs of producing the exported goods: technical standards require upgrading or at least adaptation of products or packaging, and varying standards across destinations reduce opportunities for economies of scale. However, this additional cost may also become a fixed cost (new product design, adaptation of the production chain) thereby discouraging exporters from serving markets with TBTs.

In a model with heterogeneous firms, the productivity cut-off for exporting differs with accessibility of the destination (for a given exporting country) and less productive firms will exit from more difficult destinations (Chaney 2008). However, a re-orientation of exporters to other markets can arise as a general equilibrium effect.¹ In the present paper we address this issue and test the heterogeneous reaction of firms to TBT concerns by multi-destination status, controlling for the potential heterogeneous effect by size.

Multi-destination exporters, by having low diversion cost, have the option of diverting trade to other destinations that do *not* impose TBT measures more easily than other firms. Exporters will compare the (fixed and/or variable) costs of satisfying the new standard to the cost of diverting shipments: diversion to a new destination (at the extensive margin) will impose a fixed entry cost, while diversion towards an existing destination (at the intensive margin) will impose an incremental cost for reaching marginal consumers (Arkolakis 2010). The higher the cost of complying with the TBT, the higher the probability that exporters will focus on other destinations. Given that diversion of exports comes at a cost, incumbent exporters close to the exporting cut-off will neither be able to comply with the standard nor to divert their exports (given their insufficient productivity). Thus, not all firms will divert their exports when the trade restrictiveness of a TBT is high. Multi-destination firms, by having low diversion costs, are able to switch destination countries more easily than other firms.

The main research question addressed in this paper concerns the effect of trade-hampering TBTs on the export margins of heterogeneous firms, with a focus on the reorientation of exports of multi-destination exporters.²

While the peculiarity of multi-destination firms as more “able” or productive has already been highlighted in

¹While these models provide a nice theoretical framework for understanding the firm specific effect of the imposition of NTMs, they only provide comparative statics evaluation of changes in the trade costs.

²Héricourt & Nedoncelle (2016) show that destination-diversified firms are more able to handle exchange rate risks (i.e. volatility in the real exchange rate).

the literature,³ we explore here a different characteristic of multi-destination firms: by benefiting from a wide portfolio of alternatives, multi-destination firms are expected to be more able than other firms in diverting trade towards TBT-free destinations for which fixed-costs of market access have already been paid (controlling for their size/productivity).

Accordingly, our paper builds on the literature addressing the impact of TBTs on trade, the impact of their harmonization or mutual recognition,⁴ and the market failures potentially corrected by these measures.⁵ A related contribution is Bao & Qiu (2012), who study the effects of TBT on trade margins, based on TBT notifications in the period of 1995 - 2008, and find that TBTs reduce the extensive margin of exports but increase the intensive margin. However, this result is based on aggregate data (disregarding how individual exporters with different levels of productivity adjust to stringent TBTs) and considers all notified TBTs notwithstanding their restrictiveness. Data availability is the main obstacle to uncover these complex mechanisms. One exception is Fontagné, Orefice, Piermartini & Rocha (2015) who analyze the effect of restrictive SPS measures on the export behavior of French firms finding that such measures reduce the export participation of firms but less so for big players. Another exception is Chen, Otsuki & Wilson (2006) who use the World Bank Technical Barrier to Trade Survey (2004) covering 619 firms in 17 developing countries, and find that testing procedures imposed by potential destination markets reduce export shares substantially.

To investigate the research question described above, we need to focus on *restrictive* TBTs. The Specific Trade Concerns (STCs) raised by affected exporting countries in the World Trade Organization (WTO) TBT committee are a good reflection of these. This strategy of focusing on the most restrictive regulations as revealed by the ones examined in the dedicated committees in Geneva is similar to Fontagné et al. (2015). The latter paper however focuses on a different type of regulation (SPS) and asks different questions.⁶ Independently on whether the measure is a SPS or TBT, exporting countries will concentrate their claims on the most restrictive

³Bernard, Redding & Schott (2011) and Wagner (2012) respectively on US and German data observe that exporters serving a larger number of destinations are more productive. In section 2.2 we use French data and show that multi-destination firms: (i) charge lower export price, (ii) export more and (iii) are more reluctant to exit a market. These peculiar characteristics will be controlled when addressing their adjustment to stringent TBTs.

⁴See Baller (2007); Chen & Mattoo (2008); Disdier, Fontagné & Cadot (2015); Essaji (2008); WTO (2011) for a detailed analysis of the different consequences of harmonizing versus mutually recognizing standard.

⁵See Disdier, Fontagné & Mimouni (2008) for an illustration of Sanitary and Phytosanitary (SPS) measures and TBTs. Li & Beghin (2012) perform a meta-analysis of 27 published articles on the trade impact of SPS and TBT measures.

⁶STCs data are used in Fontagné et al. (2015) to test the differentiated effect of restrictive SPS on firms of different size. Here, we are instead specifically interested in the peculiar effect of TBTs and ask whether multi-destination firms facing a TBT more easily divert destination. We also test whether these firms adjust at the extensive margin and bear the cost of entering in new markets. Importantly, we finally provide a structural decomposition of the effect of stringent TBTs shedding light on the nature of the associated costs (i.e. variable vs fixed export cost).

measures because there is a cost of complaining: trade representatives have a certain amount of time and energy to allocate among a potentially very large number of idiosyncratic regulations. Thus, our focus on the TBT-market pairs highlighted by the trade representatives in the TBT committee should capture the most restrictive trade measures.

We combine this information with firm level custom data for the universe of French exporters in order to uncover the usual adjustments to exports at the extensive and intensive margins. In line with our theoretical motivation, we define an “exporter” as a legal unit (identified by her administrative identifier) exporting within a four digit product category of the harmonized system (HS4). In other words, a legal unit exporting in two different HS4 categories is assumed to have paid twice the fixed cost of launching a new variety (once for each HS4 category). The HS4 level of product aggregation was chosen for its coherence with TBT data, which are also recorded at the HS4 level.

Our first hypothesis is that firms unable to cope with the additional fixed/variable cost of a restrictive TBT will simply exit the market. Accordingly, we expect a positive effect of stringent TBTs on firms’ exit probability. This effect is expected to be magnified for multi-destination players able to redirect their shipments towards other destination countries with less stringent TBTs. Since we do not have a continuous measure of stringency (a TBT imposed by an importer is challenged or not in the WTO committee), we compare destination with TBT concerns to destination with no TBT concern, within the (firm specific) range of destinations contemplated by the individual exporter in a given HS4.

Our second hypothesis is that multi-destination firms will look for new destinations and expand their geographical scope as a result of stringent TBTs, and will bear the cost of entering new markets with less stringent TBTs. Again, we simply compare destinations with and without TBT concerns and run a robustness check testing whether the new TBT-free destination is selected within the macro region of the country imposing the TBT.

By observing the shape of the firm distribution at the sectoral level, and the aggregate response of exports to TBT-related trade concerns, we can also assess how the two trade margins react to a change in trade costs – in our case, imposition of a stringent TBT. This helps in clarifying the nature (fixed or variable) of the cost associated with a TBT. To our knowledge, this is the first study to estimate this effect and to characterize the nature of the cost imposed on exporters, based on structural estimation of the components of the observed

adjustment.

Our findings support our reasoning. We show that the mean effect of the presence of a stringent TBT within an HS4 product category for a given destination is to induce exit of exporters. Controlling for firm size (multi-destination firms are also bigger than other firms), this effect is stronger for exporters with a portfolio of markets that includes many destinations that are free of TBTs for the considered HS4 category. A side effect of this selection is to increase the market share of incumbents: we find that some multi-destination firms that choose to remain in the market and comply with the TBT, enjoy lower competition in that destination and increase exports. We also find support for our conjecture regarding the search for new – TBT free – destinations: the presence of a stringent TBT within an HS4 product category for a given destination incites exporters to bear the fixed cost of entering new markets. This effect is magnified for exporters with an initially larger set of destination countries without TBTs, suggesting the presence of economies of scope in market access. Overall, the imposition of a stringent TBT pushes multi-destination firms out of the market and affects the welfare of the imposing country by reducing the average productivity of incumbent firms: the anti-competitive effect of TBTs is aggravated by the exit of multi-destination firms who have (on average) high productivity levels. Finally, we provide evidence based on aggregate level estimations which support the theoretical predictions in Chaney (2008): stringent TBTs reduce export flows at the sector-destination level to a larger extent for more homogeneous sectors (i.e. sectors where smaller and less productive firms account for more export sales). The strong negative effect of TBTs on aggregate export flows combined with the null effect on the intensive margin of the average firms, suggest that stringent TBTs mostly result in increases in fixed (rather than variable) trade costs.

The rest of the paper is organized as follows. Section 2 describes the data and presents some stylized facts. Section 3 discusses the empirical strategy and results on the trade margins effect of TBT concerns. Section 4 is dedicated to the diversion effect of TBT concerns. Section 5 reports aggregate level estimation results and section 6 concludes.

2 Data and stylized facts

In order to overcome the data limitations that apply to previous studies, we exploit two important databases: a recently-constructed database on STCs and a database of French firm exports.

2.1 The STCs database and examples of TBT measures

TBTs are covered by a WTO agreement which (in a nutshell) means that technical regulations, standards, and conformity assessment procedures must be implemented in a transparent and non-discriminatory way. Member countries are encouraged but not obliged to base their measures on international standards. TBTs are subject to triennial review by the WTO. The most recent review led to the publication of a report in December 2015, and highlighted the rapid increase in the notification of TBT measures (table 1). Since the first review in 1997 the number of notifications of TBTs has risen by 254%. This is however a conservative statistic since it assumes that all member countries provide such notifications.

TBT measures cover technical regulations, standards and procedures not included in the scope of Sanitary and Phytosanitary measures (which relate to human/animal and plant protection). According to the WTO a technical regulation falling under the TBT agreement is “*a document that lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory*”; a standard is “*a document approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory*”; a conformity assessment procedure is “*any procedure used, directly or indirectly, to determine that relevant requirements in technical regulations or standards are fulfilled*” (see WTO (2014) p.13).⁷ TBTs apply to technical requirements introduced: (i) for health or safety purposes, (ii) to standardize products, (iii) to ensure quality standard, or (iv) to avoid consumer deception.

The WTO database on STCs records concerns raised in the dedicated WTO committee, which provides WTO members with a forum to discuss issues related to TBT measures imposed by other members.⁸ When a country complains about a TBT measure imposed by another WTO member country (the *imposing* or *maintaining*

⁷Examples of technical regulation are: “maximum permitted levels of lead in paint used on toys” or “emission requirements for diesel engine” or “cosmetic labeling” (requirement of describing the chemical composition in the label of personal hygiene products).

⁸The dataset is available at http://www.wto.org/english/res_e/publications_e/wtr12_dataset_e.htm. The publicly available dataset does not include the year of resolution of STCs. On this respect we benefited from a confidential data by the WTO, in which a STCs on TBT is assumed to be solved if it is not raised in WTO committee for two years or more. The date of the last raising at the TBT committee is assumed to be the date of the resolution of the STCs.

country), it must specify the product concerned, the type of concern regarding the measure, and the objective of the measure. This information provides a systematic set of all TBT measures perceived by exporters to be sizable trade barriers (i.e. measures sufficiently important for countries whose exports are affected to raise a “concern” in the WTO TBT committee). Thus, we rely on *barriers* to trade. This is the main advantage of using the STC dataset rather than other sources (e.g. TRAINS or Perinorm).⁹

Overall, we have 318 STCs raised in the WTO TBT committee during the period 1995-2011. Each STC corresponds to a concern raised by one or more countries in relation to a TBT measure imposed by one or more of their trading partners. This figure is conservative compared to the cumulated number (more than 13,000) of notifications during the period 1995-2009 reported in table 1. For each concern, we have information on: (i) the country or countries raising the concern and the country imposing the measure, (ii) the product codes (HS 4-digit) involved, (iii) the year in which the concern was presented to the WTO, and (iv) whether it has been resolved and how. Since we have detailed data on French firm exports in the period 1995-2007, in our econometric exercise we focus on a sub-sample of 159 concerns raised by the EU during 1995-2007. While concerns are raised by the EU, not by member states, TBT measures at destination are non-discriminatory, and quality standards across EU countries are homogeneous (as defined at the EU level). So we can plausibly assume that when a STC is raised by the EU it might represent a barrier for French firms. Notice that product-destination combinations not served by French exporters are not present in our merged database. Finally, given the lag structure of our econometric exercise (see section 3), in order to be consistent over the entire paper, we rely on the 1997-2007 period.

Based on the full sample of STCs, table 2 presents descriptive evidence for the sample of STCs on TBTs used in our empirical exercise. Table 2 column 2 shows that the number of countries targeted by (at least one) STC is increasing over time. Column 3 shows that the number of HS-4 chapters with at least one TBT concern has been increasing exponentially over the period analyzed.

Our dataset also provides information on the primary object of the STC on TBTs. This allows us to characterize the nature of the underlying TBT measure. Table 3 presents five most frequent objectives reported in the list of STCs on TBTs. Table 4 presents the number of HS-4 chapters under STCs by imposing country. The same table but for EU-raised TBT concerns is presented in online appendix table 1. We observe that EU

⁹Some TBT measures indeed can favor trade by addressing problems of asymmetric information or network externalities (Moenius 2004, Fontagné, von Kirchbach & Mimouni 2005).

and China are often targeted by STCs when they impose restrictive TBT measures.

An interesting example of labeling measure (TBT) preventing trade was the Specific Trade Concern raised by Peru in 2001 against the EU. According to the Peruvian government, EEC regulation 2136/89 prevented Peruvian exporters from continuing to use the trade description “sardines” for their products. Peru submitted that according to the relevant *Codex Alimentarius standards* (STAN 94-181 rev. 1995), the species “sardinops sagax sagax” is listed as among those species which can be traded as “sardines”. Thus, Peru considered that the regulation constituted an unjustified barrier to trade (Articles 2 and 12 of the TBT Agreement and Article XI:1 of GATT 1994). This measure was solved by mutual recognition.¹⁰ Another example is the STC on TBT raised by fourteen WTO member countries against the Australia’s technical standard on the packaging of tobacco products (olive-colored plain packaging with no logos and no brand images) - see minute G/TBT/N/AUS/67. This measure constitutes a fixed cost for exporters that want to serve the Australia market (adaptation of the production process).

In the empirics we use only STCs raised by the EU. The first example is the concern raised by the EU representative in October 2010 in the WTO TBT committee against China’s new General Safety Technical Code for Textile Products (see document G/TBT/N/CHN/20/Rev.1). This measure sets a mandatory limit PH value for textile products, prohibited the presence of the aromatic Amines 2.4 and 2.6 Xylidine in textiles, and set a maximum level of 20 mg/kg for acrylamine dyes. According to the EU this measure had no impact on consumer’s health or safety and therefore was more trade restrictive than necessary. In this case the complaining country asked for scientific evidence on the basis of China’s imposition of this measure. This case remains unsolved over our period of observation. Another example of STC raised by the EU against China involved the beverage sector, specifically wine. Notified in May 2006, this measure specifies the terminologies, definitions, technical requirement and labeling of imported wines. In particular, this measure fixed a level of sulphur dioxide consistently below the level imposed by international standards. The EU delegation considered such measure being unnecessarily restrictive for their wine exporters (see document TBT/N/CHN/197).

Such concerns in the WTO TBT committee are common, suggesting that TBTs represent impediments to trade without necessarily protecting consumers in the imposing countries. For this reason, in the present paper we do not discuss the welfare effects of TBTs related with consumer protection in the imposing country; we

¹⁰See https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds231_e.htm

simply observe a potential negative welfare effect in the imposing country due to the reduction in the number of firms and in the average productivity of firms complying with the standard (anti-competitive effect of TBTs).

2.2 French firm-export data

Individual export data on French firms are provided by French Customs for the 1995-2007 period.¹¹ We focus on the 1997-2007 period since we lose the two starting years after calculating the firm's exit probability (for details see section 3). The French firm dataset includes export records at firm, product, and market levels for all French exporters (legal units). Although the dataset classifies product categories using the Combined Nomenclature at 8 digits (e.g. CN8 is an 8-digit European extension of HS6 comprising some 10,000 product categories) we aggregate export data at HS-4 level for coherence with the STC TBT dataset.

Since the EU is considered a single country in WTO committees, we restrict our firm-level sample to extra EU-27 export flows throughout the whole period. Given the huge number of observations and the need to square the dataset to compute a firm exit dummy, we select a subsample of relevant destination countries. We calculate total export flows by destination market, retaining markets with above-10 percentile exports. Destinations in the bottom 10 percentile of total French exports can be considered less relevant for French exporters. Finally, in order to reduce the bias from occasional exporters (churning), we retained firm-HS4-destination units with positive exports at least four times during the period 1995-2007 (alternatively at least two times excluding firms that stop exporting after the raising of a STC on TBT and re-export again with the same TBT in force - see online appendix table 6).

Figure 1 depicts the number of exporters (firm-HS4 combinations) by extra-EU destination country in 2005. As expected, the main destinations are the US and Switzerland which are respectively among the most attractive and close markets for French firms. Figure 2 shows the positive correlation between the number of exporters and market attractiveness (as GDP and the GDP/distance ratio); the US, Switzerland, and Japan are the most attractive markets for French exporters if we consider GDP/distance ratio as a measure of attractiveness.

The main advantage of individual exporter data is their high quality and the possibility to see clearly whether TBTs affect the intensive/extensive margins of trade, the dynamics of exit from foreign markets, and firms' export price setting. We would also like to control for firm characteristics when determining the effect of TBTs.

¹¹These data are subject to statistical confidentiality and have been acceded at CEPII.

However, since data on French firm characteristics are available only for firms with more than 20 employees, we rely on export-based measures of firm characteristics to keep the universe of exporting French firms.

Using transaction level data for the universe of French exporters, we can provide some descriptive evidence on the specificity of multi-destination firms. We classify each firm based on quartiles of the number of destinations without STCs raised by EU on TBT (i.e. *TBT-free* for simplicity) served by the firm in 1995 (to reduce endogeneity) - $k_{i,s,1995}$. Table 5 shows that firms with number of destinations, $k_{i,s,1995}$, above the 90th percentile of the $k_{i,s,1995}$ distribution (which corresponds to 17 TBT-free destinations)¹² account for the highest share of French exports: they represent 32% and 33% of total French exports in 2000 and 2005 respectively. To stress the peculiarity of multi-destination firms, table 6 presents illustrative regressions to compare the export performances of multi-destination firms (having $k_{i,s,1995} > 17$) to the rest of French firms over the period 1997-2007 (note that we will use alternative thresholds in our main empirical exercise). The variables listed on the left are the dependent variables in these regressions; the coefficients refer to a dummy variable that is equal to 1 for multi-destination firms. The unit of observation is firm-product(HS4)-destination-year. It emerges that multi-destination firms export more, and more intensively (export value per item exported within the HS4 category); they also are more reluctant to exit from a market, and (on average) they charge a lower export price than the rest of exporting French firms.

As a control variable our empirical strategy includes the tariffs faced by French firms into a given destination-sector (HS 4-digit). In this way we can disentangle the effect of non-tariff (TBT) measures from standard tariffs. We used TRAINS data at HS 4-digit level for the complete set of destination countries covered here for the period 1997-2007.

3 Empirical strategy for firm level estimations

The main objective of the paper is to study the asymmetric effect of stringent TBTs (as reflected by STCs on TBT measures) on the export margins of heterogeneous firms, with a focus on the multi-destination status of firms. The first conjecture tested in this section concerns the fact that stringent TBTs, by increasing trade costs, will push firms out of the market imposing the TBT. Multi-destination firms will consider reorienting their exports towards TBT free markets for which they have already paid the fixed cost of entry. Our second

¹²See figure 1 in the online appendix for the empirical distribution of $k_{i,s,1995}$.

conjecture - tested subsequently in section 4 - is that multi-destination exporters will also look for *new* markets as a result of stringent TBTs. They will expand their geographical scope towards TBT free markets and bear the fixed costs of entry into new destinations. Finally, in section 5, we compute aggregate trade response to the presence of a restrictive TBT at destination and structurally decompose it into the two components identified by Chaney (2008), i.e. extensive vs intensive margin channel. This decomposition helps in clarifying the nature of the trade cost imposed on firms in relation to TBT concerns.

3.1 Trade diversion within the initial geographical scope of incumbent exporters

In this section we present our strategy for testing our first conjecture by estimating the effect of stringent TBTs on both the exit probability and firm’s participation in the export market. Beyond firm size, the heterogeneous reaction of exporters to a common shock in trade costs is expected to be shaped by their multi-destination status. Indeed, multi-destination firms, having lower diversion cost can switch destination countries more easily than other firms by reorienting their exports within their initial geographical scope: the sunk cost of entering alternative destinations has already been paid. In particular they can simply drop the destination country having a STC on TBT (*drop* strategy) and reorient their exports towards destinations without STCs on TBT (for simplicity here indicated as *TBT-free* destinations).¹³ We also examine the extent to which TBTs affect the intensive margin and the export prices of incumbent firms.

In our empirical strategy the average effect of a stringent TBT is captured by a dummy, $TBT_{s,j,t}$, reflecting the existence, at time t , of an ongoing (unresolved) TBT concern in product category s raised by the EU against an importer country j . While there is not official information on the specific HS product concerned by each STC on TBT, we use the HS mapping computed by the WTO and adopted in the World Trade Report 2012. Notice that the $TBT_{s,j,t}$ dummy turns to zero when the TBT concern is solved, i.e. when the concern is not raised in WTO committee for two years or more.¹⁴ By taking the contemporaneous $TBT_{s,j,t}$ dummy we make the implicit assumption that a STC is raised the same year of the underlying TBT measure. This may not be the case, and a TBT concern can be raised at the WTO after the imposition of the underlying TBT measure. In a robustness check reported in the online appendix table 10 we address this issue by using a specification

¹³As explained in section 2.1, in the econometric exercise we use only STCs raised by EU on TBT.

¹⁴See WTO (2012) pag. 129 for further details on the date of resolution of TBT STCs. In the online appendix figure 2 we provide descriptive evidence on the average duration of TBT concerns by imposing country. It emerges that the average duration of a TBT concern (across products and destinations) is 1.6 years.

with lagged TBT concern.

To investigate how TBT concerns shape the adjustments of multi-destination exporters we interact the TBT dummy with the multi-destination status of the firm in the starting year 1995 - $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$, the 1995 chosen to reduce endogeneity concerns. Multi-destination status is a dummy equal to 1 if the number of TBT-free destination markets served by firm i , for product s in 1995 - $k_{i,s,1995}$ - is above a certain threshold \bar{k} . We use the top-10th percentile of the distribution of $k_{i,s,1995}$ as a threshold \bar{k} . This threshold, given the observed distribution of $k_{i,s,1995}$, corresponds to 17 destinations. So, our dummy $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$ is equal to 1 if the number of TBT-free destinations in 1995 is greater than 17. Indeed, the top 10th percentile of the $k_{i,s,1995}$ reflects the “exceptional” nature of multi-destination firms (or *global* firms). Alternatively, as a robustness check, in tables 2 - 5 in the online appendix we use the top 5th and 1st percentiles of the $k_{i,s,1995}$ distribution as a threshold for the dummy $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$.

The multi-destination status of the firm is identified by using the number of *TBT-free* destinations in order to capture the idea that firms reorient their exports towards destinations (already served) without STCs on TBT. However, the imposition of a TBT in a specific country might have general equilibrium consequences affecting the degree of competition (price index) in third countries. This might affect the preference of the multi-destination firms for diverting trade towards *TBT-free* destinations. So, as a robustness check, we use the *total* number of destinations served by the firm to compute the multi-destination dummy $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$. Results for this robustness check are reported in the last column of all the baseline regressions.

So, the estimated equation is:

$$\begin{aligned}
y_{i,s,j,t} = & \alpha + \beta_1 TBT_{s,j,t} + \beta_2 (TBT_{s,j,t}) * I_{i,s,1995}(k_{i,s,1995} > \bar{k}) + \beta_3 I_{i,s,1995}(k_{i,s,1995} > \bar{k}) \\
& + \beta_4 (TBT_{s,j,t} * \ln(size)_{i,1995}) + \beta_5 (TBT_{s,j,t} * Domestic_{i,s,1995}) + \beta_6 Domestic_{i,s,1995} \\
& + \beta_7 (TBT_{s,j,t} * Visibility_{i,HS2,j,1995}) + \beta_8 Visibility_{i,HS2,j,1995} \\
& + \beta_9 \ln(tariff + 1)_{s,j,t} + \phi_{HS2,t,j} + \mu_i + \varepsilon_{i,s,j,t},
\end{aligned} \tag{1}$$

where the subscripts i, s, j , and t respectively denote firm, HS 4-digit product category (or 2-digit sector if HS2), destination country, and year.

Our dependent variables are: (i) a dummy variable for a firm exiting a certain market (a dummy for no exports by the firm in years t and $t + 1$ but exports in the previous 2 years); (ii) a dummy variable for firm-product export participation (the extensive margin of exports), meaning positive trade flows into a certain product-destination market combination; (iii) the firm’s export values (in logs) to capture the intensive margin of trade; and (iv) the price of exported goods (in logs), approximated by trade unit export values (TUV hereafter).¹⁵

Our explanatory variables are the $TBT_{s,j,t}$ dummy, and its interaction with the multi-destination status of the firm, $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$. By doing so, the coefficient on the TBT dummy is the effect of TBTs for firms with less than 17 TBT-free destinations. However, having one or ten destinations can make a difference. So as a robustness check in the online appendix table 8 we use a binned model where the effect of TBT is estimated by quartile of number of TBT-free destinations.

Notice that multi-destination exporters are also large and high-productive firms. So, in order to isolate the multi-destination status from the firm size effect, in equation (1) we control for firm size and its interaction with the TBT dummy. Since we do not have exhaustive information on French exporters’ balance sheets, we calculate the size variables in terms of exports and not total sales. Indeed, the empirical literature shows that export values are a good proxy for the firm’s overall size: big exporters are usually larger and more-efficient than non-exporters (see Mayer & Ottaviano (2008)). We define this variable as: $ln(size)_{i,1995} = \sum_{s \in S} \sum_{j \in J} exports_{i,s,j,1995}$. We take the size of the firm in 1995 in order to avoid any endogeneity concerns related to the firm size proxy.

There is an important issue related to the structure of our data that is worth mentioning. In order to compute the exit dummy and track a given firm-product-destination combination over the entire period, we squared the dataset and include zeros when the firm does not export into a given product-destination. So, when counting the number of TBT-free destinations in 1995 to compute the multi-destination status of the firm, we may have *zero* for firms exporting *only* in destinations with TBT and also for domestic firms (i.e. not exporting to any destination in 1995, but exporting afterwards). In 1995, these firms are pure domestic firms which become exporters later on, i.e. less experienced firms. Although we have no *a priori* on the effect of TBTs for these firms, we need to control their dynamics when a TBT is imposed. We do so by simply

¹⁵Despite the dichotomous nature of some of our dependent variables, we estimate equation 1 via OLS. To avoid the incidental parameter problem due to the sizable set of fixed effects we include in all regressions, we rely on simple linear probability model (LPM) rather than on non-linear probit (or logit) models. In addition, LPM provides simple direct estimates of the sample average marginal effect.

interacting the TBT variable with a dummy equal to 1 if the firm-product combination was purely domestic in 1995 - $Domestic_{i,s,1995}$, and zero otherwise. In order to isolate the effect of TBT concerns from traditional tariff protection we control also for applied tariffs at the product level ($Ln(tariff + 1)_{s,j,t}$).¹⁶

Finally we add two sets of fixed effects. First, a set of firm fixed effects (μ_i) to control for firm-specific and time-invariant unobserved characteristics which might affect the trade performance of exporters. Second, a set of three-way fixed effects (HS2-Destination-Year) - $\phi_{HS2,t,j}$, to control for country-time-HS2-level varying factors such as business cycles, import-demand shocks and multilateral trade resistance (as highlighted by Head & Mayer (2014)) which might affect trade. These three-way fixed effects control also for the geographic orientation of French exports. In addition, HS2-destination-year fixed effects control also for measures imposed by a country in response to a negative domestic shock in a given sector. As a robustness check, in the online appendix table 7 we include also destination-products (HS4) fixed effects controlling for the sensitivity of a specific product-destination to be object of a STC at the TBT committee of the WTO.

An important potential issue to address is endogeneity. The inclusion of firm and country-HS2-time fixed effects drastically reduces any endogeneity concerns due to the omitted variables bias. Reverse causality arises if the government of a certain destination market introduces a TBT measure in response to high levels of imports from a specific French firm (and then a STC is raised by the EU against this measure). This is a remote possibility, and especially if we consider that we use TBT concerns raised by the EU as a whole (and not STCs raised specifically by France). However, it might be the case that a STC is raised by the EU if a French firm (with high lobby power) complains about a specific measure imposed in a given product-destination.

We qualitatively reduce this concern by running several robustness checks. First, we use the STCs raised by any country in the world rather than by EU only. Namely, we consider also STCs raised by extra-EU countries, which are less subject to the endogeneity concern described above - see appendix table A2. Second, we drop top-exporting firms into a given product-destination (i.e. firms with export value in 1995 above the 99th) who are more likely to complain in presence of a stringent TBT - see table A3. Third, in the online appendix table 9 we show that the probability of observing a EU-raised TBT concern in a given product-destination is unrelated with the amount of French exports toward such product-destination. The total amount of French exports is

¹⁶The tariff data come from the TRAINS database. Since TRAINS provides tariffs in percentage points (i.e. 10% ad-valorem tariff listed as 10), we divide tariff by 100 and then compute the price equivalent transformation $\log(\text{tariff}+1)$.

never significantly correlated with the probability of having a STC on TBT (see online appendix table 9).¹⁷

While these robustness checks (partially) reduce the endogeneity concern, we rigorously address this issue in two steps. First, we introduce a variable controlling for the firm's visibility in a given destination j , HS2 chapter in 1995 - $Visibility_{i,HS2,j,1995}$. This is calculated as (the logarithm of 1 plus) the share of exports of a firm in a certain market and HS2 sector over total French exports in the same market and sector. This is also introduced as an interaction term with the TBT concerns variable. If a government imposes a TBT to curb the exports of a specific firm, then this exporter will suffer relatively more from TBT imposition. Our estimation results show that this is never the case: highly visible firms are not targeted by the imposition of TBT (so they do not have specific interest in pushing the EU to raise a STC at the WTO). As a further way of reducing reverse causality concern, we estimate our regressions lagging the TBT variable by one year: there is a small chance that a concern raised at $t - 1$ is driven by exports at time t . Results using lagged TBT dummy qualitatively confirm our main results (see online appendix table 10).

Second, we use an Instrumental Variable approach (2SLS). Our instrument is a dummy $IV\ TBT_{jst}$ which is equal to 1 if two conditions hold: (i) if country j has an active TBT concern on at least one product other than s and (ii) if at least one third country (other than j) has an active TBT concern over product s at time t . The idea is that the probability of an active TBT concern from country j over product s is positively correlated with the activism of country j in imposing a measure (on other products than s), and with the sensitivity of product s to being protected by a third country. The imposition of TBT by third countries (other than j), and the imposition of TBT on a product other than s are likely to be exogenous with respect to French exports into a specific js combination. We then interact the instrument $IV\ TBT_{jst}$ with firm specific characteristics (size, domestic and multi-destination status) to instrument all the interactions described in equation 1. The relevance of our instrument is displayed at the bottom of table 11 which reports the first stage coefficients of interest. For example, the coefficient of $IV\ TBT_{jst}$ refers to a first stage estimation with the TBT dummy as a dependent variable. Similarly, the coefficient of the interaction between $IV\ TBT_{jst}$ and $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$ refers to the first stage estimation of the interaction between TBT and $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$ as a dependent variable. In the last rows of table 11 we also report the joint F-stat for the first stage which is above (or slightly below) 10,

¹⁷The only significant coefficient is for the total export of multi-destination firms, but with an opposite sign as a reverse causality argument would suggest.

implying that the instruments are not weak.¹⁸

In the online appendix table 11, as a further robustness, we run a 2SLS specification with a different instrumental variable: a dummy equal to one if at least a third country ($k \neq j$), belonging to the same geographic region as j , has an active TBT STC on product s . Our main results hold with good first stage regression statistics.¹⁹

3.2 The effects of TBT on firms' margins of trade

We now present our main findings concerning exporters' adjustment to TBT concerns. Results for the estimated equation 1 are reported in tables 7-10 for respectively the exit probability, the extensive margin, the intensive margin and the price charged (proxied here by the unit value of the firm-HS4-destination-year flow).

Table 7 presents the results for the firms' exit probability. The mean effect of the presence of an active TBT concern within an HS4 is to push firms out of the market imposing this measure (column 1): as expected, the imposition of stringent TBTs induces the exit of incumbent exporters, consistently with the idea that TBTs represent a fixed adaptation cost. This effect holds also after controlling for the interaction between TBT and firm size, and for the specific behavior of less experienced firms (column 2).

Let us now turn to the export reorientation effect we are interested in. Consistent with our reasoning, in column 3 of table 7 we observe that the positive effect of TBT concerns on the probability of exit is magnified for multi-destination exporters (i.e. firms which in 1995 exported towards 17 or more TBT-free destinations): the coefficient of the interaction term between TBT and $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$ is positive and significant in column 3. This result holds after controlling for the firm's visibility and its interaction with TBT (column 4). The fact that high visibility firms do not suffer from imposition of a TBT more than other firms, suggests the absence of any reverse causality concerns. So we can conclude that although multi-destination firms have a lower probability of exiting markets, they are more prone to do so in presence of stringent TBTs. This result is robust to a different definition of the multi-destination status of the firm, based on the number of *total* rather *TBT-free* destinations (see column 5 in table 7).

¹⁸The problem of weak instruments could be present in the estimations in columns (6) and (8) where the joint F-stat is around 7; thus, the results of these two estimations should be interpreted with caution. Notice that usually the low joint F-stat is due to the inclusion of big sets of fixed effect and conservative clustering of standard errors which might be the case here.

¹⁹Notice that in this case, in order to have a powerful first stage regression we did not cluster the standard errors at destination-HS4-year (as we do in all other specifications). This does not represent a problem since we are interested here in the interaction between TBT and the multi-destination status of the firm which is firm-destination-HS4-year specific.

Table 8 shows the effect of TBT concerns on the extensive margin of French exporters (participation). For all specifications, the presence of TBT concerns reduces the probability of exporting into the destination imposing the measure on the considered HS4 product category. Large firms, because they are sensitive to economies of scale, are less present in destinations imposing costly changes in their production lines (i.e. stringent TBTs), as suggested by column 2. In column 3, controlling for firm size and multi-destination status in 1995 by firm fixed effects, we observe that the mean negative effect of a TBT concern is exacerbated for multi-destination firms: these exporters are even less inclined than other firms to export to destinations with active TBT concerns because they can easily redirect their shipments to TBT-free destinations. This is the general equilibrium-like effect we are interested in, whereby comparing the stringency of the TBT (as revealed by active concerns) and the related cost of diverting trade, multi-destination exporters are inclined to divert their sales either to other destinations already present in their market portfolio, or to new TBT-free destinations (we discuss this in full in section 4.2).

Let us stress the presence of the interaction between the TBT dummy and the firm size in columns 2-5. The redirection effect we have observed holds controlling for the average firm size (we always include firm fixed effects) and for the interaction between size and the presence of a TBT (the sign of this interaction is negative and significant, suggesting that big firms, being more sensitive to economies of scale, are less inclined to meet stringent TBTs).²⁰

Finally, column 4 in table 8 includes the interaction between TBT and visibility of the firm. Reverse causality concerns arise if the government imposes TBT measures to face imports from high visibility firms. In this case, high visibility firms should suffer the imposition of TBTs with a larger extent, i.e. negative interaction between TBT and firm visibility. Here, the coefficients of interest hold with the expected sign, and the interaction between TBT and visibility is positive and significant. This means that high visibility firms gain from the imposition of a TBT, confirming the absence of reverse causality. So we conclude that the presence of TBT concern reduces the probability of exporting into the destination imposing the measure, with a magnified effect for multi-destination firms. The result holds when we use the alternative definition of multi-destination status

²⁰This is not the case in Fontagné et al. (2015). Indeed, SPS and TBT are different types of measures with different objectives. While SPSs do not necessarily imply the adaptation of the production line (often the simple adaptation of the mix of raw materials suffices to meet the measure), this is the case for TBT measures representing technical standard to be fulfilled: " *The TBT Agreement covers technical regulations, standards and conformity assessment procedures. Technical regulation is a document that lays down product characteristics or their related processes and production methods. Compliance is mandatory. They may also deal with terminology, symbols, packaging, marking or labeling requirements.*" WTO (2014) Technical Barriers to Trade WTO Agreement Series.

dummy (see columns 5), and when we include HS4-destination fixed effects (see online appendix table 7).

The null effect of tariffs on the extensive margin (participation) is not surprising as tariffs represent an increase in the variable export cost and so are expected to affect mainly the intensive margin of exports (as shown in table 9). Notice that here tariffs are meant as simple control variable and the associated elasticity must be taken *cum grano salis*. Indeed, an aggregation bias (HS 4-digit tariff) may cause a downward bias in tariff estimations (the effect of peak HS 8-digit specific tariffs is diluted). Also, a selection bias may affect the coefficient on tariff. Only high-productive firms are able to serve high (tariff) protected markets; so destination-product combinations having high tariff protection are observed only for high-productive firms (see Bas, Mayer & Thoenig (2017)).

Table 9 presents the results for the firm's intensive margin. The presence of a TBT concern has a *positive* and significant effect on the intensive margin of (incumbent) multi-destination firms only - see positive interaction between TBT and $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$ in columns 3 and 4. This suggests that (stringent) TBTs act as a barrier to entry reducing competition in the imposing country to the benefit of surviving exporters. Multi-destination firms (on average) exit from the market imposing the measure; but those choosing to comply with the imposed standard benefit from reduced competition. Similar results are obtained in appendix table 8 where we adopt a binned model and the effect of TBT is estimated by quartile of number of TBT-free destinations. The presence of a TBT concern reduces the export participation of multi-destination firms (i.e. firms having more than 17 TBT-free destination) and increase the exported value for incumbent multi-destination firms. Interestingly, the presence of TBT concern has a strong negative effect also on mono-destination firms.

Because stringent TBTs add a further cost of exporting, we expect a positive average effect of TBT on the export price for firms complying with the standard. Table 10 presents the estimation results for the export prices of complying firms. Coherent with the above reasoning, we obtain a positive and significant coefficient of the TBT dummy.

As for endogeneity concerns, table 11 presents the results of the 2SLS estimations and confirms the relevance of our instrumental variable (see first stage results at the bottom of table 11). The F-stat reported in the last row of the table 11 suggests a problem of weak instrument in column 6 and 8 only, where the F-stat is about 7 - below the rule of thumb value of 10. However, low joint F-stat may be due to the inclusion of big sets of fixed effect and conservative clustering of standard errors. The results for the exit probability (columns 1 and 2) show

that stringent TBTs push average firms out of the market, with this effect magnified for multi-destination firms. Multi-destination firms are less inclined to cope with TBTs (columns 3 and 4), but conditioned on deciding to adapt to the standard, they enjoy the reduced competition (columns 5 and 6). We got qualitatively similar results by using the alternative instrumental variable described in section 3 (see table 11 in the online appendix).

To wrap up, our empirical strategy points to the complex effect of the imposition of stringent TBTs: this induces the exit of exporters from the imposing country and, conditional on their size, a reorientation of exports to TBT-free markets by multi-destination firms. There is a reduction in competition at destination and prices charged by exporters increase.

4 Multi-destination firms seeking for new markets

The evidence reported in the previous section suggests peculiar behavior of multi-destination firms facing TBT concerns and reorienting their exports to alternative destinations. In this sub-section we develop this line of reasoning further: we study the adjustment of firms at the extensive margin enabled by the inclusion of new destinations in their geographic portfolios. Specifically, we investigate whether the firm enters new markets *after* exiting from the TBT imposing market. Here, the general equilibrium-like conjecture is not only that multi-destination firms increase their sales (intensive margin) on TBT-free destinations, but that they reorient their sales towards *new* markets.

4.1 Trade diversion beyond the initial geographical scope of incumbent exporters: new markets

In presence of TBT concerns in a given destination country, instead of simply exiting the market (*drop* strategy) or exit and reorient sales towards existing destinations, the firm might both exit the market and *add* a new TBT-free destination (*add* strategy). This happens as soon as the fixed costs of exporting into a new destination are below the costs of staying in the market imposing the TBT, and complying with this stringent regulation, or paying the incremental cost of reaching new customers in existing destinations. In this case we should see a positive effect on the number of *new* destinations countries at (t+1).

To investigate this second type of adjustment, we collapse the dataset for firm-product-year so that for each

firm-product combination we can track the total number of *new* TBT-free destinations. For each firm-product we can compare the set of destinations at time t with those at time $t - 1$, and count the number of *new* TBT-free destinations. We use the number of new TBT-free destinations by firm-product at time t as the dependent variable in the following estimating equation:

$$y_{i,s,t} = \alpha + \beta_1 TBT_{i,s,t-1} + \beta_2 k_{i,s,t-1} + \beta_3 (TBT_{i,s,t} * k_{i,s,t-1}) + \phi_{s,t} + \mu_{i,s} + \varepsilon_{i,s,j,t}, \quad (2)$$

The main explanatory variable, $TBT_{i,s,t-1}$, is a dummy that is equal to 1 if the firm exported a given product to at least one destination having STC on TBT at $(t-1)$. We also include as a control the number of destinations served by firm i on product s at time $t - 1$, $k_{i,s,t-1}$. This approximates the multi-destination status of the firm at time $t - 1$. We interact the above two mentioned variables to test the peculiar behavior of multi-destination firms facing TBT concerns in terms of their destination portfolio. Finally, we include firm-by-product and product-by-year fixed effects to control for firms specific characteristics and any product specific unobserved shock.

However, firms plausibly reorient their shipments (from TBT-affected to TBT-free destination) within a set of destinations having similar trade cost - for more distant destinations, trade costs might be high enough to overpass the cost of complying with the stringent concern.²¹ For this reason we count the number of new TBT-free destination countries within macro-regions (namely East and South Asia, Latin America, Africa and Middle East), and estimate equation 2 for every macro-region. The idea is that for French firms the shipment cost across destinations within a macro-region is roughly the same, so that firms may divert shipments as soon as a TBT is imposed by a country in the region. Then we adopt the same logic and replicate equation 2 for two sets of countries having distance from France respectively above and below the median.

4.2 The effects of TBTs on exporting to new markets

The results for the estimation of equation 2 are reported in table 12. As expected, when a firm faces a TBT concern on product s in (at least) one of its destinations at $(t-1)$, she will ship the particular HS4 product

²¹We are grateful to an anonymous referee for suggesting to test this additional mechanism.

category to new – TBT-free – destinations in t . We show that the number of new TBT-free destinations is affected positively if the exporter is hit by a stringent TBT a time $(t-1)$ for the same HS4 product category in an existing destination (column 1-8). This effect is magnified for those firms with multiple TBT-free destinations at $(t-1)$ - see columns 2 and 3. As a robustness check we replicate the same type of estimation by macro-region: (i) East and South Asia, (ii) Latin America, (iii) Africa and Middle East. So we specifically test whether the existence of a TBT concern in a given macro-region pushes firms diverting shipments towards TBT-free destinations in the same macro-region. Our main results hold for macro-region specific estimations and for the two sets of destination countries with similar distance from France. See table 12 columns 4-8. Finally, in a further robustness check reported in online appendix 12 we estimate a similar specification but using simply the probability of adding a new TBT-free destination as dependent variable (i.e. dummy equal to one if the firm reaches a number of TBT-free destinations greater than zero). Results hold.

This result is in line with our hypothesis: in the presence TBTs, exporters will balance the cost of complying with this regulation against the fixed cost of entering a new market, and will make the decision to serve the new market if the regulation is stringent (as revealed by the existence of a STC). More productive exporters already serving several destinations, are shown to be more likely to make the decision to enter a new market. This result suggests the presence of economies of scope in terms of future prospects, distribution networks, and product branding.

5 Aggregate level implications: sector-destination estimations

So far we provided micro-level evidence supporting the fact that stringent TBTs push firms out of the imposing market, with a magnified effect for multi-destination firms which are less inclined to meet stringent technical standards because they have the option of redirecting their sales to existing or new alternative destinations. Multi-destination firms can switch destination countries more easily than other firms, and after imposition of a TBT may even move to *new* TBT-free destinations. At the same time, we found that multi-destination firms complying with the measure benefit from TBTs at the intensive margin - see table 9. In this section we take the stock of these results and examine the aggregate implications of these microeconomics adjustments. We focus on aggregate export flows and show the heterogeneous macro-level effect of TBTs on sectors with different

densities of multi-destination firms and on sectors with different distribution of exporters' size and productivity.

Firstly, following our firm-level evidence, in sectors with a high share of multi-destination firms, the aggregated effect of TBT is expected to be magnified on the extensive margin and attenuated on the intensive margin. Secondly, in a model with heterogeneous firms and a CES demand function, Chaney (2008) argues that the aggregate trade cost elasticity is exacerbated in more homogeneous sectors, where more output is concentrated among smaller and less productive firms. Thus, in testing the macro-level effect of TBTs we have to control for the heterogeneity of sectors in terms of firm size distribution - here inversely approximated by the Pareto shape parameter of firm size distribution.²²

To test these predictions, we aggregate our dataset at product-destination-year level and estimate the following regression:

$$\begin{aligned}
 y_{s,j,t} = & \alpha + \beta_1 TBT_{s,j,t} + \beta_2 (TBT_{s,j,t}) * MultiDestShare_{HS2,j,t} + \beta_3 MultiDestShare_{HS2,j,t} \\
 & + \beta_4 (TBT_{s,j,t}) * ParetoParameter_{HS2,j,t} + \beta_5 ParetoParameter_{HS2,j,t} \\
 & + \beta_6 Ln(tariff + 1)_{s,j,t} + \phi_{st} + \phi_{jt} + \varepsilon_{s,j,t},
 \end{aligned} \tag{3}$$

where the subscripts have the same meaning as before. The dependent variable $y_{s,j,t}$ is in turn: (i) the total export value in each product-destination cell (in log), (ii) the number of exporting firms in the product-destination cell (in log, the *extensive margin* channel), and (iii) the average export per firm in a product-destination cell (in log, the *intensive margin* channel). $TBT_{s,j,t}$ is a dummy variable indicating the presence of an active TBT concern in a given product s (HS4) and destination j , and $Ln(tariff + 1)_{s,j,t}$ is the tariff level faced by French firms when exporting product s to destination j .

To control for the heterogeneity in firm size distribution, we interact the TBT dummy with the estimated shape parameter of the Pareto distribution of firms size in each sector HS2-destination cell (time invariant). We use the QQ estimator as in Head, Mayer & Thoenig (2014) to recover sector-destination specific Pareto shape parameters. The QQ estimator basically minimizes the sum of the squared errors between the theoretical and the empirical quantiles and gives an indirect measure of the estimated Pareto shape parameter which is easily

²²This mimics what we have done in the firm level evidence by controlling for the size of the firm and its interaction with TBT dummy.

reversed by assuming an elasticity of substitution $\sigma=4$ (as in Head et al. (2014)).²³ As the shape parameter of the Pareto distribution is an inverse measure of the heterogeneity of the sector for a given destination, we expect a negative sign on its interaction with TBT.

The variable *MultiDestShare* is the share of multi-destination exporters over the total number of exporting firms in the sector(HS2)-destination cell. This variable provides information on the presence of multi-destination firms in the HS2 sector for a given destination country. This level of aggregation being chosen in order to keep a sufficient high number of firms in a given sector-destination-year cell. By interacting the TBT dummy with *MultiDestShare* we aim to capture whether the expected negative effects of TBT on the extensive (intensive) margin is magnified (attenuated) in sectors with high presence of multi-destination firms, as we would expect from firm level estimations in tables 7 and 9.

The results in table 13 support these predictions. The presence of a stringent TBT reduces aggregate exports by 50% (see column 1), the number of active firms by 22% (see column 4) and the average export per firm by 34% (see column 7). Interestingly, the negative effect of TBT concerns on total export is attenuated for products (HS4) belonging the sectors (HS2) with many multi-destination firms (column 2). However, this result vanishes when we control for the firm size heterogeneity of the sector (column 3), where the negative effect of TBT is magnified in more homogeneous sectors (where more output is concentrated among small firms). This is perfectly in line with the theoretical prediction in Chaney (2008).

As expected, the presence of multi-destination firms in the sector-destination matters. Coherently with our previous results, the negative effect of TBT on the extensive margin channel (number of exporting firms) is magnified in sectors with high share of multi-destination firms - see table 13 column 5. Importantly, this result holds after controlling for the sector heterogeneity in terms firm size distribution (column 6). Concerning the average export per firm (intensive margin), we find that the average negative effect of TBT is attenuated in sectors with many multi-destination firms (see columns 8-9). This is coherent with results in table 9 showing that multi-destination firms complying to TBTs export more.

This approach can finally shed light on the nature of additional trade costs imposed by TBTs. In Chaney (2008) the aggregate trade elasticity to *fixed* trade costs is predicted to be driven by the extensive margin,

²³See appendix section 1 and Head et al. (2014) for details of the theoretical and empirical quantiles of the Pareto distribution and the QQ estimator. The Pareto shape parameter is obtained as $\gamma = (\sigma - 1)\tilde{\gamma}$, where $\tilde{\gamma}$ is the empirical shape parameter.

with a negligible role of the intensive margin.²⁴ In order to disentangle the aggregate effect of TBTs between the intensive and the extensive channels, we calculate the change in aggregate exports from: (i) incumbent firms - active in the market over the entire period (*intensive margin channel*) and (ii) the entry-exit exporters to/from a specific market (*extensive margin channel*). We then repeat the decomposition exercise proposed in Berman, Martin & Mayer (2012). We run gravity-type regressions where the dependent variable is the (log of) total export by destination-product-year for respectively incumbent and entry-exit exporters firms.²⁵ We control for bilateral-sector tariffs and include country-year and product-year fixed effects. The main regressor of interest for such gravity-type estimations is the TBT dummy. The estimated coefficients for the TBT dummy are respectively $\hat{\beta}_{incumbent}$ and $\hat{\beta}_{entry}$. Then we can calculate the share of total exports due to respectively incumbent and entry-exit exporters as V_i/V , where V is the aggregate destination-product-year exports and V_i is the total exports for incumbent or entry/exit firms ($i=incumbent$ or $entry$). Finally the impact of TBT on the intensive margin can be written as $\hat{\beta}_{incumbent} * (V_{incumbent}/V)$, and similarly for the extensive margin as $\hat{\beta}_{entry} * (V_{entry}/V)$.

The results of these calculations are reported in table 14. As expected, the $\hat{\beta}s$ for both incumbent and entry-exit exporters flows are negative and highly significant, but the share of total trade due to the entry-exit of firms is predominant. This implies that at the aggregate level TBT has a predominant effect through the extensive margin channel. The intensive margin channel makes a smaller contribution at the aggregate level (as expected based on our firm level estimations). Overall, these results reinforce our argument that stringent TBTs represent mainly a fixed (rather than a variable) trade cost for exporting firms.

6 Conclusion

To uncover the adjustment channels of heterogeneous exporters faced with stringent technical barriers in certain markets, we combined information on TBT Specific Trade Concerns in the WTO committee with firm level custom data for the universe of French exporters. Theoretical models with heterogeneous firms suggest that small and less productive exporters will be unable to cope with the additional fixed/variable costs of a restrictive

²⁴The specificity of our approach, as opposed to Chaney (2008) is to rely on a dichotomous measure of trade costs, which prevents us to interpret our parameter estimates as an elasticity.

²⁵Here incumbent firms are continuous exporters, i.e. firms exporting over the entire period. Entry/exit firms are those with non-exporting spell in the period.

TBT and will exit. In addition, reorientation of exports to other markets may be interpreted as a general equilibrium effect: multi-destination firms reorient their exports towards TBT free markets where they are present for the same HS4 category of products. A similar theoretical argument would also suggest that a sub-sample of firms will be sufficiently productive to envisage new destinations, expand their geographical scope, and bear the associated fixed costs, provided that these markets have less stringent TBTs. These conjectures are confirmed by our results. Stringent TBTs drive the average firm out of the market (reducing competition for the survivors). Multi-destination players are encouraged to redirect their exports to other destinations (free of TBT concerns), and are more likely to exit as a response to a stringent TBT - because they have the option of redirecting their exports towards TBT-free destinations. Thus, the imposition of a stringent TBT, by pushing multi-destination (high-productive) firms out of the market, reduces the average productivity of incumbent firms (i.e. the welfare of the imposing country).

In a second set of estimations we showed that when firms face stringent TBT in a given destination, they opt for serving new TBT-free markets. This adjustment is magnified for geographically diversified firms (multi-destination firms), suggesting the presence of economies of scope in foreign market access.

Finally, using aggregate estimations at sector-destination level, we find that stringent TBTs represent mainly increases in fixed (more than variable) trade costs, with aggregate extensive margin adjustment magnified for sectors with many multi-destination firms (more prone to divert trade towards TBT-free destinations).

To our knowledge, this is the first empirical study of the nature of the costs imposed by stringent TBTs, and the heterogeneous reactions of multi-destination exporters shaping the aggregate trade elasticity. We are aware that also the multi-product status of a firm might affect the firm's response to TBT imposition. We leave this for future research.

7 Acknowledgments

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8 Tables and Figures

Table 1: Total notifications of TBTs per triennial review period.

1995-97	1998-00	2001-03	2004-06	2007-09	2010-12	2013-15
1737	2012	2096	2658	4673	5845	6150

Source: WTO, Seventh triennial review of the operation and implementation of the agreement on technical barriers to trade under article 15.4. 3 December 2015, p.12.

Table 2: TBT concerns by year.

year	Number of Countries with at least one STC on TBT	Number of HS4 items under TBT STC in at least one country	Average number of TBT concerns per country
1997	7	342	16.19
1998	5	355	21.84
1999	3	402	13.35
2000	6	247	10.03
2001	11	280	25.58
2002	11	335	23.61
2003	12	556	38.10
2004	12	454	21.06
2005	13	467	17.61
2006	11	454	18.00
2007	20	408	16.16

Source: Authors' calculations on the STC database, WTO

Table 3: The top-5 motives for TBT concerns.

Objective	nb occurrences across STCs	Frequency over the total specified objectives*
Protection of Human Health or safety	135	22.60%
Protection of the Environment	67	11.20%
Consumer Information or Protection	48	8.00%
Labelling	28	4.70%
Quality	26	4.30%

Source: Authors' calculations on the STC database, WTO

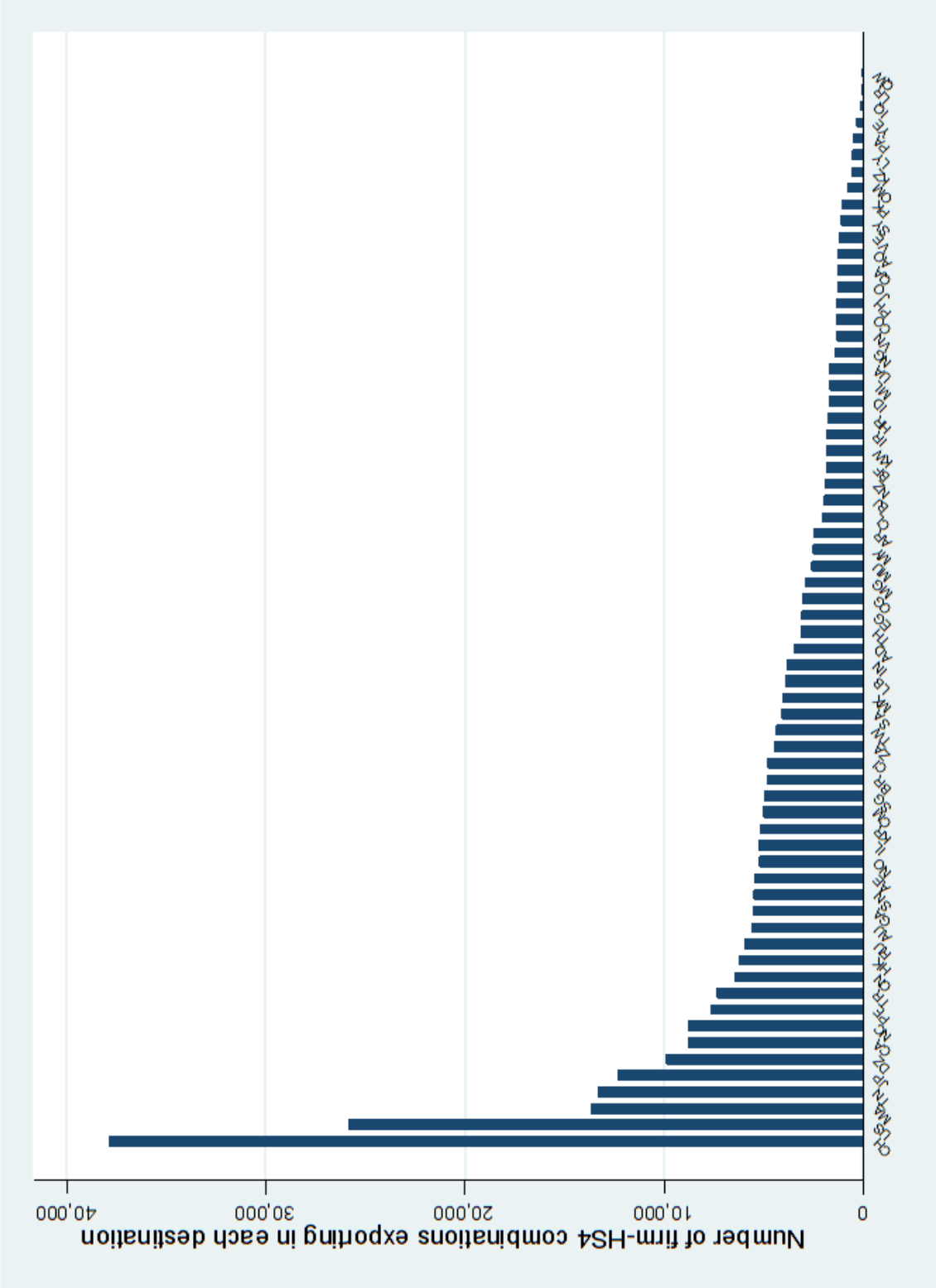
Note: Each STC has one or more objectives. One occurrence is thus the combination STC-objective. The total number of occurrences in the dataset is 598. * The frequency reported in the column is thus the ratio between the number of occurrences of a objective over the total number of occurrences in the dataset.

Table 4: Number of HS4 items object of a STC in TBT by imposing country and year.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Argentina	0	0	0	0	0	0	0	161	161	0	0	7	7
Brazil	0	0	158	0	0	167	3	5	2	2	0	10	15
Canada	1	1	0	0	0	0	0	0	0	0	0	1	2
Chile	0	0	0	0	0	167	0	0	0	0	0	0	0
China	0	0	0	0	0	1	210	214	3	31	225	30	197
Colombia	0	0	0	0	0	0	0	0	0	5	0	0	1
Ecuador	0	0	0	0	0	0	0	4	4	0	0	0	0
Egypt	0	2	166	166	3	0	0	0	0	0	0	0	0
European Union	4	179	16	81	82	277	251	426	429	258	261	273	274
Hong Kong	0	0	0	0	0	1	0	0	0	0	0	4	0
India	0	0	0	0	0	2	171	10	14	0	7	18	14
Indonesia	0	0	0	0	0	4	0	0	0	2	0	0	6
Israel	0	3	0	0	0	0	0	0	0	0	0	1	1
Japan	0	0	0	0	167	167	5	2	0	0	14	0	2
Korea	0	0	9	0	49	0	14	10	3	16	5	5	8
Kuwait	0	0	0	0	0	0	0	131	0	0	0	0	0
Malaysia	0	0	0	0	0	0	0	0	0	18	0	0	0
Mexico	0	315	328	0	0	0	0	0	2	2	0	0	0
Moldova	0	0	0	0	0	0	0	0	0	0	0	2	8
New Zealand	0	0	0	167	4	4	4	4	4	4	4	4	0
Peru	0	1	0	0	0	0	0	0	5	11	5	5	5
Philippines	0	0	0	0	0	0	0	0	0	0	2	2	0
Qatar	0	0	0	0	0	0	0	0	0	0	0	8	0
South Africa	0	0	0	0	0	0	3	0	0	170	0	0	161
Switzerland	0	0	0	0	0	0	0	0	5	5	5	5	0
Taipei	0	0	0	0	0	0	0	0	0	0	0	52	1
Thailand	0	1	0	0	0	2	2	0	0	0	0	4	4
Turkey	0	0	0	0	0	0	0	0	0	0	0	2	0
United States	28	0	0	0	6	1	25	170	21	22	29	67	75
Uruguay	0	0	0	0	0	0	0	0	0	0	1	1	0
Venezuela	0	0	0	0	0	0	44	44	0	0	0	0	0

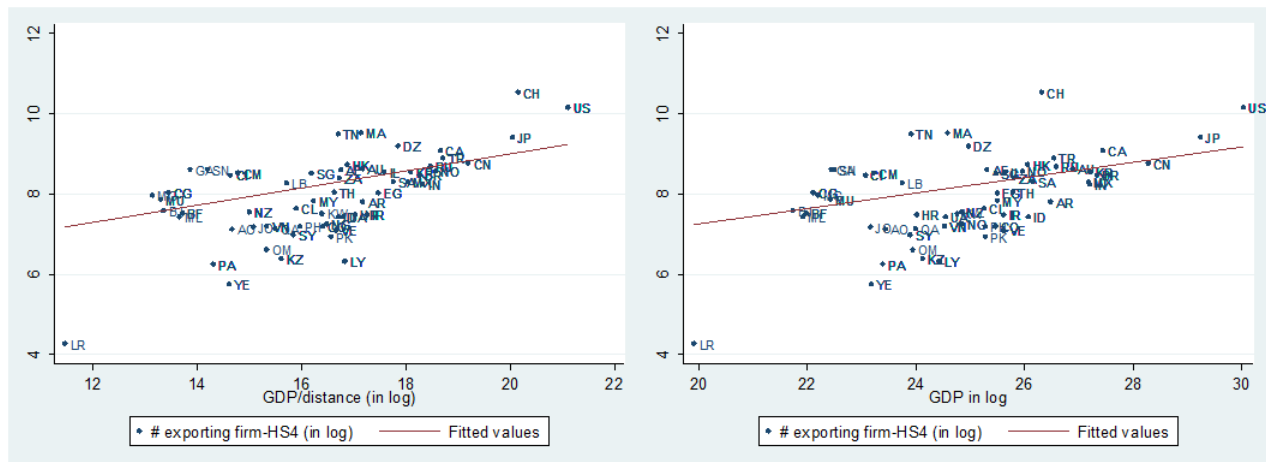
Source: Authors' calculations on the STC database, WTO

Figure 1: Number of exporters (i.e. firm-HS4 combinations) exporting in 2005 by destination country.



Source: Authors' calculation on French Custom Data.

Figure 2: Number of exporters (i.e. firm-HS4 combinations) exporting in 2005, GDP and GDP/distance in destination countries.



Source: Authors' calculation on French Custom Data and WB Development Indicators.

Table 5: Number of exporters (i.e. firm-HS4 combinations) by bin and their export share over total French exports.

Bins	Number of exporting firm-HS4		Export Share (in %)	
	2000	2005	2000	2005
$I_{i,s,1995}(k_{i,s,1995} = 0)$	65529	73956	23	32
$I_{i,s,1995}(0 < k_{i,s,1995} \leq 1)$	32092	19822	7	6
$I_{i,s,1995}(1 < k_{i,s,1995} \leq 6)$	19251	14513	16	12
$I_{i,s,1995}(6 < k_{i,s,1995} \leq 17)$	4403	3765	22	17
$I_{i,s,1995}(k_{i,s,1995} > 17)$	1417	1294	32	33

Table 6: Multi-destination premia in French firms, 1997-2007.

	Multi-destination premia	
Exit Dummy	-0.004*** (0.001)	-0.011*** (0.001)
Participation Dummy	0.195*** (0.007)	0.199*** (0.006)
Log export	1.199*** (0.056)	1.323*** (0.046)
Log export per product	0.992*** (0.059)	1.076*** (0.042)
TUV	-0.188*** (0.032)	-0.131*** (0.022)
Destination-Product-Year FE	yes	yes
Firm FE	no	yes

Note: all results are from OLS regressions of the firms outcomes listed on the left on a dummy variable being equal to one if the firm has a number of TBT-free destinations in 1995 above the 90th percentile, i.e. 17 destinations.

Table 7: Exit probability estimation.

Dep. Var.	Exit Dummy				
	(1)	(2)	(3)	(4)	(5)
TBT	0.025*** (0.008)	0.016** (0.008)	0.015* (0.008)	0.015* (0.008)	0.016* (0.008)
TBT* $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			0.011* (0.006)	0.011* (0.006)	0.014* (0.008)
$I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			-0.011*** (0.000)	-0.011*** (0.000)	-0.012*** (0.001)
TBT*Visibility 1995				-0.011 (0.012)	-0.011 (0.012)
TBT*Firm size 1995		0.002 (0.001)	0.002 (0.002)	0.003 (0.002)	0.003 (0.002)
TBT*Domestic Dummy 1995		0.014*** (0.005)	0.015*** (0.005)	0.015*** (0.005)	0.015*** (0.005)
Log(tariff+1)	0.007** (0.003)	0.007** (0.003)	0.007** (0.003)	0.007** (0.003)	0.007** (0.003)
Firm Fixed Effects	yes	yes	yes	yes	yes
HS2-Destination-Year Fixed Effects	yes	yes	yes	yes	yes
$k_{i,s,1995}$	# TBT-free destinations in 1995				# destinations
Observations	5,879,232	5,879,232	5,879,232	5,878,870	5,878,870
R-squared	0.059	0.059	0.059	0.059	0.059

Visibility and Domestic Dummy in 1995 are included but not reported when interacted with TBT. Clustered standard errors by destination-HS4-year in parentheses.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.

Table 8: Extensive margin estimation.

Dep. Var.	Participation Dummy				
	(1)	(2)	(3)	(4)	(5)
TBT	-0.046*** (0.017)	-0.065*** (0.019)	-0.064*** (0.019)	-0.065*** (0.019)	-0.065*** (0.019)
TBT* $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			-0.046*** (0.013)	-0.044*** (0.013)	-0.056*** (0.015)
$I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			0.186*** (0.001)	0.186*** (0.001)	0.200*** (0.001)
TBT*Visibility 1995				0.117*** (0.026)	0.115*** (0.026)
TBT*Firm size 1995		-0.010*** (0.003)	-0.008** (0.003)	-0.021*** (0.004)	-0.020*** (0.004)
TBT*Domestic Dummy 1995		0.081*** (0.017)	0.082*** (0.017)	0.083*** (0.017)	0.083*** (0.017)
Log(tariff+1)	0.006 (0.007)	0.005 (0.007)	-0.000 (0.007)	-0.000 (0.007)	0.001 (0.007)
Firm Fixed Effects	yes	yes	yes	yes	yes
HS2-Destination-Year Fixed Effects	yes	yes	yes	yes	yes
$k_{i,s,1995}$	# TBT-free destinations in 1995				# destinations
Observations	5,879,232	5,879,232	5,879,232	5,878,870	5,878,870
R-squared	0.108	0.111	0.117	0.117	0.116

Visibility and Domestic Dummy in 1995 are included but not reported when interacted with TBT.

Clustered standard errors by destination-HS4-year in parentheses.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.

Table 9: Intensive margin estimation.

Dep. Var.	Log of export value				
	(1)	(2)	(3)	(4)	(5)
TBT	0.081 (0.076)	0.083 (0.079)	0.063 (0.076)	0.062 (0.076)	0.075 (0.076)
TBT* $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			0.145** (0.070)	0.146** (0.070)	0.142* (0.079)
$I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			1.244*** (0.006)	1.244*** (0.006)	1.352*** (0.007)
TBT*Visibility 1995				0.062 (0.168)	0.043 (0.169)
TBT*Firm size 1995		0.016 (0.021)	-0.011 (0.019)	-0.017 (0.028)	-0.013 (0.029)
TBT*Domestic Dummy 1995		-0.057 (0.046)	-0.015 (0.045)	-0.015 (0.045)	-0.027 (0.046)
Log(tariff+1)	-0.126*** (0.038)	-0.128*** (0.037)	-0.161*** (0.037)	-0.161*** (0.037)	-0.155*** (0.037)
Firm Fixed Effects	yes	yes	yes	yes	yes
HS2-Destination-Year Fixed Effects	yes	yes	yes	yes	yes
$k_{i,s,1995}$	# TBT-free destinations in 1995				# destinations
Observations	3,007,840	3,007,840	3,007,840	3,007,660	3,007,660
R-squared	0.324	0.336	0.354	0.354	0.353

Visibility and Domestic Dummy in 1995 are included but not reported when interacted with TBT.

Clustered standard errors by destination-HS4-year in parentheses.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.

Table 10: Export price estimation.

Dep. Var.	Log of Trade Unit Value				
	(1)	(2)	(3)	(4)	(5)
TBT	0.127*** (0.048)	0.097** (0.047)	0.101** (0.047)	0.101** (0.047)	0.099** (0.047)
TBT* $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			-0.057 (0.035)	-0.056 (0.035)	-0.062 (0.040)
$I_{i,s,1995}(k_{i,s,1995} > \bar{k})$			-0.099*** (0.003)	-0.099*** (0.003)	-0.122*** (0.004)
TBT*Visibility 1995				0.022 (0.069)	0.022 (0.070)
TBT*Firm size 1995		-0.000 (0.010)	0.006 (0.011)	0.004 (0.013)	0.004 (0.013)
TBT*Domestic Dummy 1995		0.073*** (0.027)	0.065*** (0.025)	0.065*** (0.025)	0.068*** (0.026)
Log(tariff+1)	-0.271*** (0.022)	-0.271*** (0.022)	-0.268*** (0.022)	-0.268*** (0.022)	-0.268*** (0.022)
Firm Fixed Effects	yes	yes	yes	yes	yes
HS2-Destination-Year Fixed Effects	yes	yes	yes	yes	yes
$k_{i,s,1995}$	# TBT-free destinations in 1995				# destinations
Observations	3,007,840	3,007,840	3,007,840	3,007,660	3,007,660
R-squared	0.771	0.771	0.771	0.771	0.771

Visibility and Domestic Dummy in 1995 are included but not reported when interacted with TBT.

Clustered standard errors by destination-HS4-year in parentheses.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.

Table 11: Instrumental Variable Estimations.

	Exit		Extensive		Intensive		Export Price	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TBT	0.098*** (0.030)	0.073** (0.034)	0.115 (0.114)	-0.391*** (0.135)	0.654 (0.401)	1.005** (0.401)	-0.333 (0.334)	-0.471 (0.316)
TBT* $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$	0.052* (0.026)	0.064** (0.025)	-0.266*** (0.060)	-0.021 (0.065)	2.290*** (0.396)	2.149*** (0.372)	-0.094 (0.136)	-0.035 (0.130)
$I_{i,s,1995}(k_{i,s,1995} > \bar{k})$	-0.011*** (0.000)	-0.011*** (0.000)	0.186*** (0.001)	0.186*** (0.001)	1.237*** (0.006)	1.237*** (0.006)	-0.099*** (0.003)	-0.099*** (0.003)
TBT*Firm size 1995	-0.017*** (0.006)	-0.014* (0.007)	-0.113*** (0.015)	-0.046*** (0.017)	-0.347*** (0.092)	-0.395*** (0.094)	0.086* (0.046)	0.105** (0.049)
TBT*Domestic Dummy 1995	0.048* (0.029)	0.048* (0.029)	0.972*** (0.203)	0.972*** (0.203)	-0.636** (0.252)	-0.636** (0.252)	0.249** (0.116)	0.249** (0.116)
Log(tariff+1)	0.007** (0.003)	0.007** (0.003)	-0.000 (0.007)	-0.000 (0.007)	-0.161*** (0.037)	-0.161*** (0.037)	-0.268*** (0.021)	-0.268*** (0.021)
First Stage Coefficients								
IV TBT	0.122***	0.124***	0.122***	0.124***	0.088***	0.090***	0.088***	0.090***
IV TBT* $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$	0.190***	0.190***	0.190***	0.190***	0.183***	0.184***	0.183***	0.184***
IV TBT*Firm size 1995	0.144***	0.145***	0.144***	0.145***	0.123***	0.123***	0.123***	0.123***
IV TBT*Domestic Dummy 1995	0.158***	0.158***	0.158***	0.158***	0.115***	0.115***	0.115***	0.115***
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
HS2-Destination-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5879232	5879232	5879232	5879232	3007840	3007840	3007840	3007840
Joint F-stat	15.48	11.70	15.48	11.70	9.26	6.92	9.26	6.92

Domestic Dummy in 1995 is included but not reported when interacted with TBT.

Clustered standard errors by destination-HS4-year in parentheses.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.

Table 12: The dynamic effect of TBT.

Dep. Var.	Number of New TBT-free destinations							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy if TBT destination (t-1)	0.291*** (0.008)	0.368*** (0.014)	0.354*** (0.013)	0.147*** (0.016)	0.036** (0.017)	0.083*** (0.026)	0.035 (0.025)	0.158*** (0.013)
$k_{i,s,t-1}$		-0.287*** (0.002)	-0.289*** (0.002)	-0.394*** (0.004)	-0.405*** (0.004)	-0.340*** (0.002)	-0.298*** (0.002)	-0.302*** (0.002)
Dummy if TBT destination (t-1)* $k_{i,s,t-1}$		0.015** (0.007)	-0.010 (0.006)	0.215*** (0.014)	0.484*** (0.020)	0.328*** (0.023)	0.557*** (0.013)	0.134*** (0.007)
Firm-Sector FE	yes	yes	yes	yes	yes	yes	yes	yes
Sector-Year FE	yes	yes	yes	yes	yes	yes	yes	yes
$k_{i,s,t-1}$	# destinations	# destinations	# TBT-free destinations	# destinations	# destinations	# destinations	# destinations	# destinations
Region	World							
Observations	2,054,050	2,054,050	2,054,050	188,040	157,920	882,570	1,468,940	1,094,330
R-squared	0.475	0.484	0.484	0.322	0.308	0.395	0.415	0.427
Clustered standard errors by firm-HS4 in parentheses.								
*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.								

Table 13: Product-Destination specific estimations.

	Total Export (ln)			Number Exporting Firms (ln)			Avg Export per Firm (ln)		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)	(5)	(6)
TBT	-0.691*** (0.055)	-0.762*** (0.081)	-0.592*** (0.081)	-0.256*** (0.018)	-0.213*** (0.024)	-0.197*** (0.027)	-0.416*** (0.045)	-0.521*** (0.065)	-0.387*** (0.064)
TBT*Multi-destination firms share		0.439** (0.197)	0.271 (0.194)		-0.092* (0.051)	-0.093* (0.053)		0.438*** (0.156)	0.300** (0.152)
Multi-destination firms share		-0.877*** (0.097)	-0.890*** (0.114)		-0.231*** (0.021)	-0.215*** (0.022)		-0.283*** (0.036)	-0.271*** (0.040)
TBT*Pareto shape parameter			-0.412*** (0.091)			-0.077*** (0.026)			-0.288*** (0.074)
Pareto shape parameter			-0.197*** (0.013)			-0.031*** (0.002)			-0.159*** (0.011)
Log(tariff+1)	-1.080*** (0.041)	-0.990*** (0.042)	-0.907*** (0.043)	-0.587*** (0.015)	-0.562*** (0.015)	-0.561*** (0.016)	-0.430*** (0.032)	-0.401*** (0.032)	-0.328*** (0.032)
Sector-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Destination-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	399,523	399,523	384,492	496,257	496,257	475,351	399,523	399,523	384,492
R-squared	0.539	0.544	0.550	0.684	0.689	0.695	0.431	0.432	0.440

Robust standard errors in parentheses.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.

Table 14: Contributions to export response to a TBT concern.

	$\hat{\beta}$	V_i/V	Aggregate response	Aggregate response (% of total)
Intensive	-0.663***	0.307	-0.203	32%
Extensive	-0.621***	0.692	-0.429	68%
Total			-0.632	

– $\hat{\beta}$ is the estimated coefficient for TBT on a gravity type regression having the (log of) total destination-product-year specific export for respectively incumbent and new-entry exporters

– V_i/V is the share of total aggregate exports by respectively incumbent and new-entry exporters

– Aggregate response= $\hat{\beta} \cdot V_i/V$

Appendix A.

A1. QQ estimators for the Pareto shape parameter.

The Pareto distribution is characterized by a location parameter μ and a shape parameter γ . While the location parameter does not matter for trade cost elasticity, the shape parameter is crucial for the identification of aggregate trade elasticity to trade costs (see Chaney (2008); Head et al. (2014)). In particular, in Chaney (2008), the aggregate trade elasticity to variable trade cost is exactly equal to the Pareto shape parameter γ ; while the trade elasticity to fixed trade cost is directly related to γ . The Pareto shape parameter is an inverse measure of the heterogeneity of exports across firms in a given sector and can be estimated using the QQ estimator as in (Head et al. 2014).

While Head et al. (2014) calculate the Pareto shape parameter using French firms exporting in Belgium in 2000, here we are interested in Pareto shape parameters for each sector-destination combination, so we apply the QQ estimator for each sector(HS2)-destination combination (we cannot use the HS4 aggregation since this gives an insufficient number of firms in a given sector-destination cell).

The QQ estimator basically consists of minimizing the sum of the squared errors between the theoretical and the empirical distribution quantiles. The empirical quantiles are the log of (sorted) export values for a given firm i into a given sector-destination $HS2, j$. The associated CDF function is equal to $\widehat{F}_{i,HS2,j} = (i - 0.3)/(n + 0.4)$, where $i = 1$ for the firm with minimum export value and $i = n$ for the top exporting firm. The theoretical quantiles are given by $Q_{i,HS2,j} = \ln(x_{min}) - (1/\tilde{\gamma})\ln(1 - \widehat{F}_{i,HS2,j})$ where x_{min} is the minimum exported value. The OLS coefficient of the term $-\ln(1 - \widehat{F}_{i,HS2,j})$ gives an inverse measure of the empirical $\tilde{\gamma}$, with the primitive distribution value of gamma easily reversed since $\gamma = (\sigma - 1)\tilde{\gamma}$ (we follow Head et al. (2014) and use $\sigma = 4$).

Thus, by regressing the empirical on the theoretical distribution quantiles for each sector (HS2)-destination combination we obtain estimates of $1/\tilde{\gamma}$, and recover the primitive distribution shape parameters γ for each sector(HS2)-destination. Table A1 presents a synthetic view of the QQ estimator results. We show the average (across sectors within destination) of $1/\tilde{\gamma}$ and γ for a selection of four countries.

Table A1: QQ regressions. Averages of shape parameters across sectors by destinations.

	Mean across countries	USA	Japan	China	Canada
$1/\tilde{\gamma}$	1.156	1.198	1.883	1.619	1.657
γ	2.132	1.574	1.658	2.046	1.920

The coefficient $1/\tilde{\gamma}$ comes directly from a QQ regression (i.e. empirical on theoretical quantiles of the log of total exports). Then the primitive parameter can be retrieved as $\gamma = (\sigma - 1)\tilde{\gamma}$, with $\sigma = 4$.

A2. Additional tables.

Table A2: Robustness check using STCs raised by any country (not only EU raised STCs)

	Exit (1)	Extensive (2)	Intensive (3)	Export Price (4)
<i>TBT</i>	0.012* (0.007)	-0.076*** (0.019)	0.045 (0.071)	0.097** (0.044)
<i>TBT</i> * $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$	0.008 (0.006)	-0.040*** (0.012)	0.133** (0.067)	-0.058* (0.033)
$I_{i,s,1995}(k_{i,s,1995} > \bar{k})$	-0.011*** (0.000)	0.186*** (0.001)	1.244*** (0.006)	-0.099*** (0.003)
<i>TBT</i> *Visibility 1995	-0.010 (0.011)	0.096*** (0.025)	0.079 (0.155)	0.000 (0.064)
<i>TBT</i> *Firm size 1995	0.003 (0.002)	-0.016*** (0.004)	-0.015 (0.027)	0.007 (0.012)
<i>TBT</i> *Domestic Dummy 1995	0.014*** (0.004)	0.088*** (0.015)	-0.016 (0.043)	0.063*** (0.023)
Log(tariff+1)	0.007** (0.003)	-0.000 (0.007)	-0.161*** (0.037)	-0.268*** (0.022)
Firm Fixed Effects	yes	yes	yes	yes
HS2-Destination-Year Fixed Effects	yes	yes	yes	yes
$k_{i,s,1995}$	# TBT-free destinations in 1995			
Observations	5,878,870	5,878,870	3,007,660	3,007,660
R-squared	0.059	0.117	0.354	0.771

Visibility and Domestic Dummy in 1995 are included but not reported.

Clustered standard errors by destination-HS4-year.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.

Table A3: Robustness check dropping top-exporters.

	Exit		Extensive		Intensive		Export Price	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TBT	0.016** (0.008)	0.015* (0.008)	-0.067*** (0.019)	-0.066*** (0.019)	0.063 (0.079)	0.045 (0.077)	0.097** (0.047)	0.102** (0.046)
TBT* $I_{i,s,1995}(k_{i,s,1995} > \bar{k})$		0.013** (0.006)		-0.047*** (0.013)		0.125* (0.070)		-0.068** (0.033)
$I_{i,s,1995}(k_{i,s,1995} > \bar{k})$		-0.011*** (0.000)		0.184*** (0.001)		1.232*** (0.006)		-0.085*** (0.003)
TBT*Firm size 1995	0.001 (0.001)	0.000 (0.001)	-0.008** (0.004)	-0.007* (0.004)	0.009 (0.020)	-0.016 (0.019)	0.015 (0.010)	0.022* (0.012)
TBT*Domestic Dummy 1995	0.013*** (0.005)	0.014*** (0.005)	0.082*** (0.017)	0.083*** (0.017)	-0.057 (0.046)	-0.017 (0.045)	0.081*** (0.027)	0.073*** (0.026)
Log(tariff+1)	0.006* (0.003)	0.006* (0.003)	0.005 (0.007)	0.000 (0.007)	-0.148*** (0.037)	-0.181*** (0.037)	-0.255*** (0.022)	-0.253*** (0.022)
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
HS2-Destination-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
$k_{i,s,1995}$	# TBT-free destinations in 1995							
Observations	5,813,410	5,813,410	5,813,410	5,813,410	2,967,494	2,967,494	2,967,494	2,967,494
R-squared	0.059	0.059	0.112	0.117	0.340	0.357	0.774	0.774

Domestic Dummy in 1995 is included but not reported. Clustered standard errors by destination-HS4-year.

*** $p < 0, 01$; ** $p < 0, 05$; * $p < 0, 1$.