The Sound of Silence

Non transparent technical regulations as obstacles to trade

IRENE IODICE[1,2]

[1]Scuola Superiore Sant'Anna (Pisa)
[2]Université Paris 1 Panthéon-Sorbonne*

This version - June 11, 2020†

Abstract

This work investigates the protective nature of newly introduced technical regulations that are not properly disclosed at the international level. We begin by building a novel database which identifies the process of adoption of those Technical Barriers to Trade (TBTs) that have been contested to the WTO through a Specific Trade Concern (STC). We then cross-reference this database with a firm-level panel of French exporters and we carry out an event study. We find that in more than 1/3 of the studied cases, countries have adopted the underlying regulations without previously announcing the change to other members. In these cases, the new regulation hampers exporters by causing a temporary halt of their activity. This stop lasts from one to two semesters, and it is shorter in the case the content of the new TBT is eventually disclosed by governments. While large firms are able to wait until more information is available, small firms exit the market. We interpret this evidence as suggesting that countries can effectively hinder foreign competitors by raising the uncertainty about the profitability of the market. This in turn raises firms real option to delay their investment decision on whether to export there.

Keywords: Non Tariff Measures · TBTs · Trade margins

Understanding how to comply with foreign technical regulations is not an easy task for exporters. The procedure of collecting information on the details of a technical requirement, on the goods it targets, and on how to prove conformity with it can be very costly. If the access to this information is made particularly complicated for foreign firms, domestic regulations can affect the export behavior of firms. While there is consent in the literature that countries can misuse technical regulations to protect domestic industries (Beverelli et al., 2014; Orefice, 2017), little is known about the role of transparency in the protective nature of these policies. This is surprising given that, over the last decades, technical regulations have gained relevance, becoming among the most reported trade barriers by exporters (OECD, 2005).[1]

*Email me at Irene.Iodice@etu.univ-paris1.fr.

†I thank Lionel Fontagné, Lisandra Flach, Mathieu Parenti, Ariell Reshef, Angelo Secchi, Anne-Celia Disdier, Maria Bas and seminar participants to the Paris Trade seminars for insightful comments.

[1]In his farewell statement to the General Council in 2013 Pascal Lamy, former Director-General of the World Trade Organization (WTO), stressed the key role of non-tariff barriers in new trade policies. In particular, surveys of exporting firms across OECD countries document that "technical measures and customs rules and procedures ... are [consistently] among the five most reported categories of non tariff [trade] barriers" (OECD 2005, p. 24).

But this is all the more surprising given that exporters complain even more about procedural obstacles related to foreign regulations than about the regulations themselves (International Trade Center, 2016).

This chapter aims to fill this gap by providing a framework to investigate the nature of these trade barriers. We first document the relevance of procedural obstacles among technical regulations. We then estimate the impact of newly introduced regulations that have not been properly disclosed internationally on the exporting behavior of firms. To interpret our results and guide additional understanding of the phenomenon we make use of a theoretical baseline model of investment under uncertainty using the intuitions of the real options literature developed in Dixit et al. (1994).

The object of this study are technical regulations that are trade restrictive. We consider those regulations, namely Technical Barriers to Trade (TBTs), that have been contested by exporting countries at the WTO through a soft law mechanism called Specific Trade Concern (STC).[2] Raising a STC against another WTO member is costly: trade representatives must allocate their resources in preparing the case among a potentially large arena of misbehaviors. Therefore, this set of TBTs should identify the most trade restrictive regulations. We use the timeline recommended by the WTO to characterize transparency in the introduction of a new TBT. Essentially, countries should announce the draft measure through a document called "Notification" at least eight months before the enforcement. We define as non transparent the case in which governments fully elude this timeline and enforce the TBT without previously announcing it to the other WTO members. We refer to these TBTs as *Surprise Measures*. The database on Specific Trade Concern, as coded by the WTO, does not, at least directly, report when and how contested TBTs have been introduced. To fill this gap, we construct a novel database by using information from the content of the STCs and from Notifications, which have been parsed while detecting the dates of implementation of TBTs.[3] This procedure allows us to identify when a measure has been introduced and whether it has been previously announced. We then match this data with a panel of French exporters covering the period 1995-2007 to estimate the differential effects of Surprise Measures on firms' trade margins. Our identification relies on the common trend assumption across products that are exported to a certain destination within a certain sector. We compare goods that are similar except for the fact that some have been object of the new regulation and others have not. In addition, the fact that our sample includes TBTs that are not Surprise, which we call *Announced Measures*, provide us with a benchmark to evaluate the effect of the lack of transparency itself.

In the first part of this work, we document the pervasiveness of transparency-related obstacles using the content of STCs. To do so we use the motivation provided by countries to rise a case at the TBT Committee.[4] Consistently, we find that almost 40% of the TBTs rised as STCs are Surprise Measures, they have been enforced without being previously announced.[5] The importance of transparency emerges also by looking at the dynamics of French product level exports around the adoption of a restrictive TBT.

[2]STCs may be brought by any WTO member considering to be negatively affected by an SPS/TBT measure imposed by a WTO trading partner. They represent 'soft law' mechanisms to deal with NTMs, as they are based on diplomatic relations, rather than adjudication.

[3]This procedure is able to identify the history for more than 70% of the measures touched by a STC.

[4]This result is coherent with the evidence from International Trade Center's 2016 survey on EU exporters. Indeed, "information and transparency issues" are among the most reported procedural obstacles by European firms. These includes inaccuracy or information on the licensing and certification process.

[5]These issues are prevalent also recently. For example, in 2017, 56% of STCs raised for the first time concerned unnotified measures. See Note by the Secretariat, 'Twenty-Third Annual Review of the Implementation and Operation of the Agreement', G/TBT/40, at 24.

While measures that have been announced do not have a significant impact, Surprise Measures cause a substantial fall, of around 20%, in the export value of those products covered by the new regulation. We test further the distinction between Announced and Surprise measures while accounting for firm heterogeneity.

We identify two regimes for the effects of TBTs on firms' behavior, depending on how the regulation has been implemented. Announced TBTs cause exit of firms in the period before the TBT is introduced and an increase in the export value for those who stay. Surprise TBTs are instead associated to a substantial decrease, ranging between 20 and 30%, of the average export value in the semester in which the measure is enforced. On the other hand, they do not determine substantial exit. We interpret these differences in terms of the different timing in which firms evaluate whether to adopt the new technical requirement as well as the information at disposal when taking this decision. Timing is crucial whenever the choice to comply with the new regulation implies an investment that is at least partly irreversible. In case of Announced measures, the announcement of the change in regulation affects firms' expected payoff before entering the market, when the per period sunk cost of exporting there has not yet been paid. This allows the firm to take into consideration the additional cost of adapting the new regulation in the decision to serve the market in that period. On the other hand, Surprise measures affect the instantaneous payoff once the firm has entered and already paid the per period sunk cost to serve the market. The different timing in which firms consider whether to implement the new requirement explains why exit of firms is significant only when the change in regulation is announced. Information are also crucial to decide when to invest, if firms are uncertain about their future payoffs and they have an option to wait. In the case of Surprise TBTs, the lack of Notification about the new regulation rises the uncertainty on the costs of serving the market. This in turn rise the value of the real option of waiting to collect more information before adapting the new standard.

In support of this interpretation, we observe that the average exporter reduces its export activity with the market covered by a Surprise TBTs, by cutting on the frequency -the extensive margin- rather than on the average value per shipment. This reinforces the idea that firms undergo a temporary halt of their activity, which is observed as a reduction in the number of months in which exporters serve the market. The adverse effect of these TBTs is short-lasting, firms recover their export activity in a couple of semesters. However, not all firms are equally able to survive this period. Small and medium size firms tend to exit definitely the market, while only large firms can afford to wait. We investigate further whether the temporary halt can be interpreted as due to an increase in the real option of waiting to invest. We exploit the presence of delayed Notifications to investigate their role in reducing the uncertainty of the trading environment. We find that delayed Notifications, which provide late formal information on how to adopt the new requirement, reduce the persistence of the export halt. This finding further strengthens the idea that by eluding transparency, countries effectively hinder the investment decisions of firms.

Previous empirical literature has found transparency in trade policy to boost trade and investment flows (Francois, 2001; Helble et al., 2009; Lejárraga and Shepherd, 2013). Metrics used in these type of works are very broad in scope – they are built on perception-based indices or on general transparency provisions within regional trade agreements. An exception, is a recent work by Ing et al. (2018) which proposes an index based on what governments actually do in the area of Non Tariff Measures (NTMs). Their index includes the number of NTMs that are notified by a country. We share with this work the focus

on Non Tariff Measures, since NTMS, and TBTs in particular, are complex legal instruments which can impose substantial procedural obstacles. In our work we use the procedure of implementation of these regulations, to capture not only whether, as in the case of Ing et al. (2018), but also *how* countries announce and disclose these type of regulations. In doing so we provide transparency with a definition along one fundamental attribute: predictability.[6]

Our work thus refers to the literature that studies the role of trade policy uncertainty on investment decisions of international firms. Recent theoretical contributions (Handley and Limao, 2015; Coelli, 2018) have combined intuitions from trade models with firm heterogeneity (Melitz, 2003) with those from the real options literature (Dixit et al., 1994). In presence of an irreversible investment and the possibility to wait, uncertainty on the trade environment incentives firms to delay the investment decision on whether to enter a market (Handley and Limao, 2015) or to undergo technology upgrading (Handley and Limão, 2017; Coelli, 2018). These studies test their predictions by exploiting the enforcement of trade Agreements as episodes of changes in policy uncertainty and using variation in the gap between applied and bounds tariffs (similarly also (Carballo et al., 2018)). Instead, little is known on the sources of uncertainty about NTMs. In this chapter we propose to look at the presence of formal Notification about the implementation of a TBT. We then use episodes of changes in TBTs, with and without formal Notification, to estimate the effect of reduced uncertainty on the export investment decision of foreign firms.

We also contribute to the literature that has studied NTMs to restrict trade. Previous literature has found that NTMs have been used to compensate reductions in applied tariffs.[7] However, while 'There is little question that governments sometimes do deploy regulations to favor domestic producers over foreign ones', how they succeed is still mostly un-answered (Rodrik, 2018). The complex and heterogeneous nature of NTMs makes it indeed very challenging to distinguish whether a measure pursues a legitimate policy objective rather than a disguised protectionist motive.[8] In addition, database on NTMs are usually silent with respect to the time series of the underlying regulations.[9] Recent literature have therefore used NTMs contested at the WTO through STCs to identify those regulations that restrict trade, and the time of the concern to proxy the one of the underlying regulation.[10] To investigate the nature of the obstacles behind these NTMs, some works use firm level data to distinguish the effects on the intensive (average export value) and extensive (number of exporters) margins of trade (Fontagné et al., 2015).

[6] Helble et al. (2009) identify two dimensions of transparency: predictability (reducing the cost of uncertainty) and simplification (reducing information costs). As acknowledged by the authors, their indexes are not able to disentangle the two but instead try to account for both sources together.

[7] A non exhaustive sample of the literature that has studied the trade policy substitution between tariff and Non Tariff Measures includes Moore and Zanardi (2011) Beverelli et al. (2014) and Orefice (2017). The last two works have dealt specifically with TBTs. In particular, Beverelli et al. (2014) show that policy substitution between tariffs and TBTs prevails in developed countries. Orefice (2017) that TBTs (and also SPSs) become effective barriers to trade as a consequence of reductions in tariffs.

[8] An example is the different thresholds set by the US and EU regulation on the speed below which all hybrids and electric vehicles have to emit artificial warning sounds for pedestrians. The US National Highway Traffic Safety Administration issued in December 2010 this to be below the 30kph. The European Union issued in 2014 set, instead, a lower threshold, of 20 kph, motivating this as to be due to differential risk for noise pollution. However, engineer studies are far from unanimous on which is the best threshold that trades off noise pollution with efficacy of the sound in preventing injuries. [Regulation (EU) No 540/2014 of the European Parliament]

[9] For an exhaustive overview of this issues refer to Ederington and Ruta (2016).

[10] For an exhaustive overview of this literature refer to Ederington and Ruta (2016). For example, Herghelegiu (2018) use a sample of developing countries and finds that only TBTs and SPSs that have been object to a concern are used to substitute tariffs.

This distinction is then used to infer whether these barriers impose mostly a variable rather than a fixed costs.[11] Our contribution to this literature is twofold. First, we investigate the nature of these trade barriers. We do this by looking at a recently added information on the database about STC, i.e. the reasons why WTO members complain about other members' use of TBTs. Second, we propose an algorithm which cross-references data on STC with external documents, to collect information on the history of these regulations. This allows to identify whether the effect manifests as a consequence of the policy change.

This paper refers also to the literature that has studied the effects of TBTs on trade. An example is the work by Bao and Qiu (2012), which uses all the TBTs notified at the WTO, and finds that the presence of a notified TBT decreases other countries' extensive margins, while increases their intensive margin. They explain this as to be due to a rise in the fixed cost, which pushes out of the market some firms. When considering, instead, only those TBTs that entail product standard harmonization, Schmidt and Steingress (2018) observe that these measures rise trade both trough an increase in the sales volume of existing exporters as well as through entry of new exporters. They explain this as a market size effects: harmonization works as a demand shifter, raising firms' incentives to produce those varieties. On the other hand, Fontagné and Orefice (2018) focuses on TBTs that have been risen as STC by the EU to identify stringent TBTs and finds that they induce exit of exporters. The authors do not find however a significant effect on the intensive margin of firms. Our work reconciles this peculiar result. Within TBTs raised as STCs there are two regimes: when announced, restrictive TBTs produce effects that are similar to the ones observed by Bao and Qiu (2012) for the sample of notified measures. This effect is then offset by the negative effect of the surprise measures. Our work confirms that depending on the reasons that lie behind the adoption and design of TBTs, trade effects of exporters may be very different. In another interpretation, Maggi et al. (2018) prove that Red Tape Barriers might impose different firms' behaviors depending on whether the import demand is sufficiently concave.

The remainder of the chapter proceeds as follows. Section 1 provides background on the institutional setting and explain how we measure lack of transparency. Section 2 and 3 describe the data the event-study framework we employ to evaluate the effects of non transparent TBTs. Section 4 describes the main results and section 5 discusses their interpretation. Section 6 discusses the results on the heterogeneity of the effect along firm characteristics while 7 the persistence of the effects of uncertainty. Section 8 concludes.

1 Institutional Framework

According to the TBT Agreement, WTO members can introduce in their domestic market, technical standards that differ from international ones to pursue legitimate policy objectives. Countries might aim, for example, to guarantee the quality of the imports, to protect human health or the environment, its national security, or to prevent deceptive practices. On the other hand, these measure should not create any arbitrary or unjustifiable discrimination between domestic and foreign competition. To do so, along

[11] This is because, in a model with firm heterogeneity á la Chaney (2008) the aggregate trade elasticity to fixed trade costs is predicted to be driven by the extensive margin, with a negligible role of the intensive margin. A sample of this literature includes Fontagné et al. (2015).

with providing a legitimate rationale, governments must implement a TBT in the least trade-restrictive way.[12] For example, countries must announce the new measure to international partners enough in advance and disclose all relevant information to guarantee the transition within a predictable market environment. Whenever a WTO member believes that these principles have not been respected, she can contest the TBT by raising a Specific Trade Concern to the WTO and identifying the nature of the issue.[13] When looking at the objectives proposed by governments for those TBTs that have been contested to the WTO, the majority are legitimate ones. The most frequent being related to the protection of human health and safety, or of the environment (panel (a) of Figure 1).

The Mexican ban of the chlorofluorocarbon compounds (CFCs) for the manufacture and import of household refrigerators and air conditioners is an example of a TBT which has been contested despite a seemingly legitimate rationale. Indeed, the use of CFCs might have serious environmental consequences as their long lifetimes in the atmosphere can deplete the ozone layer. Raising concerns about the effects of CFCs started back in the end of the 80s, when countries came together to the signature of the Montreal Protocol. In the 90s, this Protocol was further strengthened by calling for the complete elimination of CFCs by the year 2010. In Mexico, the ban has been adopted and enforced in the same day, under a status of emergency, on the 22th September 1998. Interestingly, the Mexican standard has been formally announced to international partners only on the 12th of October 1998, once the measure have already been implemented.[14] When the TBT Committee met in November 1998, the representative of the United States drew attention to the new Mexican standard through a STC, raising an issue on "transparency". In particular, the US delegate questioned the nature of emergency with which the measure has been implemented and claimed that exporters were uncertain on how to comply with the new regulation. For example, international partners were not provided with a list of accredited laboratory that perform conformity assessment tests.[15]

Interestingly, issues related to the procedure of how a TBT has been disclosed and implemented are the most pervasive. Indeed, the majority of the concerns are raised because of issues of transparency (panel (b) of Figure 1).[17] This is surprising in light of the fact that international disciplines codifies explicitly how countries should introduce a new TBT. This procedure is summarized in the timeline shown in Figure 2. Essentially, governments are required to announce other members about proposed measures which might have a significant effect on trade and which are not based on international standards. They do so by providing a Notification, which is a formal document which discloses, among others, information on how to implement the new regulation.[18] This formal announcement must take place at an early stage so that to allow exporters to adapt in time to the changing requirement. Then, a 60-day comment period begins, during which other members can look into the details of the draft, ask for further information

[12] The TBT Agreement states that "Members shall ensure that technical regulations are not prepared, adopted or applied with a view to or with the effect of creating unnecessary obstacles to international trade." (Art. 2.2)

[13] These are discussed within the TBT Committee that meets every four months.

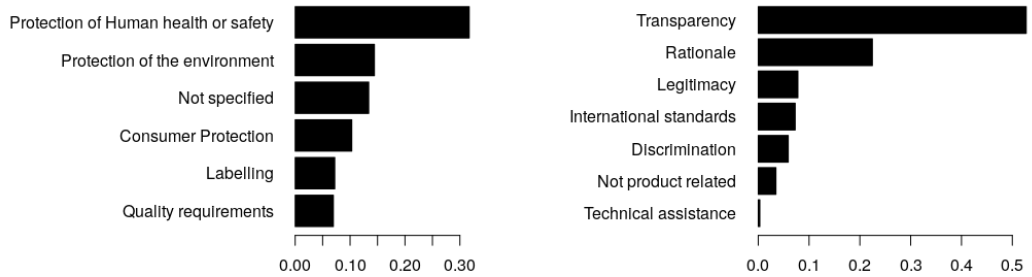
[14] One can find the full text of the formal announcement on the ITM database under the Symbol G/TBT/Notif.98.485

[15] "She questioned the nature of the emergency and indicated that, in order to comply with the Mexican regulations, products had to be tested by an accredited laboratories. Until today, however, not a single laboratory had been accredited to perform the required tests. Therefore, US exporters were uncertain about how to comply with the regulation." (G/TBT/M/14, par 35)

[17] We group, similarly to what done in the ITC survey (2016), "transparency" with "missing information" and "unreasonable time".

[18] A notification is "a transparency obligation requiring member governments to report trade measures to the relevant WTO body if the measures might have an effect on other Members" (World Trade Organization, 2017).

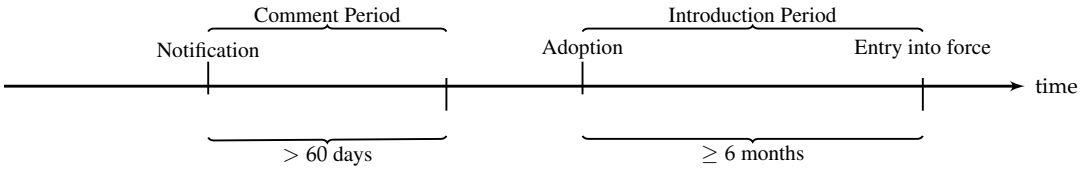
Figure 1: Most frequent Objectives and Motivations of STCs



(a) Objectives (b) Motivations

Sample of TBTs contained in the STC database. Each STC has one or more objectives (motivations). One occurrence is thus the combination STC-objective (motivations). The total number of occurrences in the dataset is 598 (478).[16]

Figure 2: Ideal timeline of introduction of a new technical regulation



Notes: Elaboration from the The WTO Agreements Series on TBTs.

and then provide written comments. Afterwards, countries can introduce the measure, leaving (at least) 6 months before it becomes compulsory. Thus, between notification and entry into force no less than 8 months should pass.

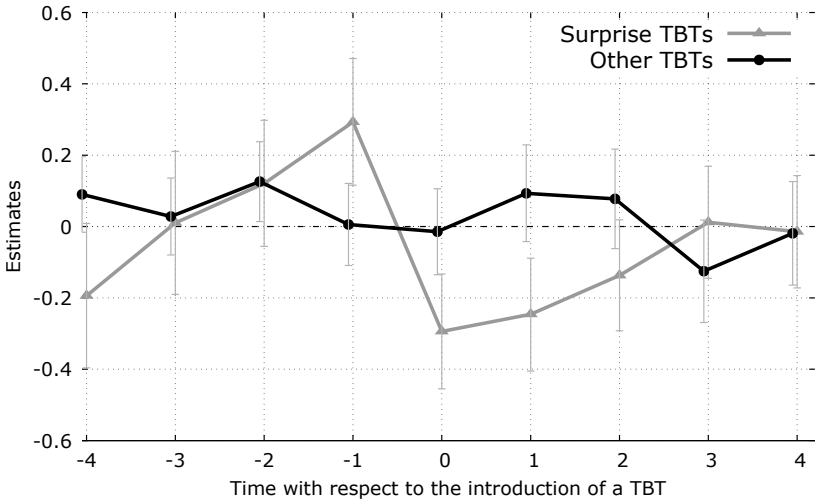
1.1 Surprise Measures

The fact that the procedure of introduction of a new TBT is codified and agreed among WTO members help us in defining the lack of transparency. In particular, we define as non-transparent the avoidance of this procedure – the case in which a country enforces a TBT without previously announcing it. In such cases, we call the underlying TBT a Surprise measure. The Mexican case above represents therefore an example of these measures.

When measures are instead notified before being enforced we call them *Announced Measures*. This distinction becomes relevant for policymakers as far as it is informative of the source of trade obstacles.[19] Essentially, this is the case if it is the lack of transparency itself, which imposes idiosyncratic costs to exporters. For example, the introduction of a Surprise measure might be associated to delays in customs clearing or might increase the probability of a shipment to be rejected at the customs. In addition, the lack of transparency might also impose to exporters a cost of searching and screening the documentation

[19] Based on interviews with trade representatives from various WTO member countries, Holzer (2019) distinguishes STCs that contest how the measure has been implemented from STCs that challenge the content of the measure.

Figure 3: French exports dynamics around the introduction of a TBT



Notes: Time is a semester. The image plot the estimated coefficients, and relative 95% confidence bar, of a model where we regress the (log) value of French export in a (product, destination country, time) market over semestral dummies around the introduction of the TBT, for two type, Surprise and Other TBTs. The model includes (product,destination country) fixed effects and therefore exploits the time variability within markets TBTs. All TBTs information come from WTO STC database. In Appendix **??** the regression table.

since they have to inform autonomously about the new requirement. With respect to Announced TBTs, Surprise Measures can rise the uncertainty on the profitability to serve the market. Surprise TBTs then can also increase the opportunity cost to invest before the uncertainty is solved, which in turn incentives firms to wait until formal information will be are provided.

Figure 3 plots the log change in French exports for those products that are subject of a trade restrictive TBT, conditional on destination and product time-invariant characteristics. French exports are substantially hit by unexpected changes in foreign technical regulation. Interestingly, these type of regulations are enforced in presence of a positive trend in French exporting activity, suggesting that countries may have used these regulations as a shelter from import penetration. On the other hand, this adverse effects seems to be temporary, lasting on average no longer than a year. Similar patterns are not observed for other TBTs, where the aggregate export activity seems not to be substantially altered.

2 Data and Stylized facts

In order to study the role of the lack of transparency for TBTs which impede trade, we face two types of empirical problem. First, given the extremely large number of regulations and their heterogeneous nature, it is difficult to classify which type of regulations are indeed trade restrictive. For example, the same HS6 product might be touched by several regulations, that cover different aspects of it. Some of them might even be aiming at boosting trade, as episodes of harmonization to international standards.[20]

[20]This kind of measures are studied in Schmidt and Steingress (2018).

Second, database on TBTs and NTMs in general, usually lacks identification codes of the underlying regulation and therefore it is hard to trace back the timeline of introduction of the measure.[21]

To identify the set of potentially trade restrictive TBTs we use the WTO database on TBT Specific Trade Concerns. This database records all the concerns raised to the WTO, but it provides only the period in which a STC is active over a proposed or adopted regulation, while does not directly report the timeline of the underlying regulation.[22] Previous literature has proxied the time of introduction of a TBT with a window around the period in which the concern is ongoing. However, recently, the WTO STC database on TBTs has been updated and now contains identification keys for the regulations. We use these keys to retrieve external documentation by web-crawling the WTO repository on TBTs (the Information Management System repository). We fill the gap in the data and create a new database with the timestamps of the regulation by parsing the aforementioned documentation. This database is meant to be merged with both firm-product level data as well as with information on products' tariff rates. This database

2.1 STC Database

The database is managed by the WTO and contains information about all the concerns raised between 1995 and 2011, for a total of 318 STCs.[23] These concerns regard 403 different TBTs, since within the same STC countries might complain about one or more measures, proposed or adopted by another WTO member. Interestingly, concerns might also be raised over TBTs that have never been formally notified by countries, a circumstance that is not envisaged under the TBT Agreement.

For each concern, the database reports the country that has introduced the measure (maintaining country), the HS product codes affected by the measure, the objective of the regulation provided by the maintaining country, the date of initiation (and further dates if prolonged), the country(-ies) that has complained about the measure (raising country) and the motivation of its complaint (the issue).[24]

2.2 New Database about Timelines of TBTs

We capture the timeline of a TBT through three dates: notification, adoption and entry into force. The latter two are used to identify the period over which the TBT is introduced in a market: after the adoption, firms may start to implement the measure, and they will have to comply to it by the date of enforcement. The notification date will be used to identify when the country informs the WTO about the new regulation. Note that there are some contested TBTs that have never been notified.

[21] For example, Trains and Perinorm provide information which are snapshot of the existing regulations at the time the data were collected.

[22] A STC is active from the moment in which is rised ad the TBT commitee until when the case is no longer discussed. Within the WTO an STC is considered to be no longer active 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.

[23] The dataset is freely available at https://www.wto.org/english/res_e/publications_e/wtr12_dataset_e.htm

[24] While there is no official information on the specific HS product concerned by each STC on TBT, the WTO computes an HS mapping through text documentation.

To collect these dates we use two sources of information: i) the documents provided by the country introducing the TBT, including possibly the Notification and ii) the content of the STC from the records of the Meetings of the TBT Commitee also called Minutes. We access the first type of information through an identification code provided in the STC database.[25] For each code, we download the documentation available by web scraping the WTO online repository on TBTs.[26] There are two main types of document: the Notification and the Revision.[27]. We process these as follows:

1. from the Notification we retain i) the date of notification, ii) the proposed date of adoption and iii) the proposed date of entry into force. The format of this document is standard and therefore we could automatize its reading.[28]

2. From the Revisions we collect information on whether a TBD date has been added afterwards, or whether the initial proposed dates have been modified.[29] Unfortunately, these documents are not standardized and we had to collect information manually.

We then text parse the information of the Minutes, which are the documents recorded by the Secretariat during the meetings, to see whether further dates are provided by the concerned country.[30] The Minutes are particularly useful to collect information for those cases in which the country has not notified the measure or has later updated them.[31]

Figure 4 shows how the final sample is obtained. Note that revised dates are those that have been modified with respect to the proposed ones, because, for example, they have been updated in a Revision. Added dates are those that have been found, either in Minutes or in later Revisions, in case the notification misses these information.[32] On overall, we identify the timeline for 301 out of the 403 measures, almost the 75%.

A concern with this methodology might be the selection bias introduced in our sample due to the fact that the timeline of less transparent measures, by their nature, are more difficult to identify.[33] However, this possibility is mitigated by the fact that the sources of documentation from which we retrieve the dates are heterogeneous. In particular, the fact that we can collect information from the Minutes, which

[25] This is called "Document Symbol". In most of the cases, it has a standard format, which includes "G/TBT/N/" followed by the country isocode at 3 digit plus the number of the notification. For example, on December 11^{th} 2018 Turkey has reported a notification, whose "Document Symbol" is "G/TBT/N/TUR/142" .

[26] This is accessed through the TBT Trade-Information Management System at "http://tbtims.wto.org/en/Notifications/Search" through the "requests" package from Python libraries. Note that the same program might also be used to download documentation for other NTMs, e.g. the SPSs, by providing a list of identification keys. We will soon make it available on my website at https://ioire.github.io

[27] Potentially, there is also the Addendum and the Corrigendum, but these two sources of information are less relevant to us, since they provide information such as the availability of translated documents or the correction of typos.

[28] An example of this document is provided in the Appendix Figure 9, Soon I will upload on my web page all the program written in Python 3.6 to replicate the database. The same code can be used for different type of notifications, as well as SPS documents. Note also that, while the date of notification is always present, the other two may be left "To be decided".

[29] In two cases, this document informs about the withdrawal of the measure.

[30] Appendix provides details on how information from the Minutes are treated.

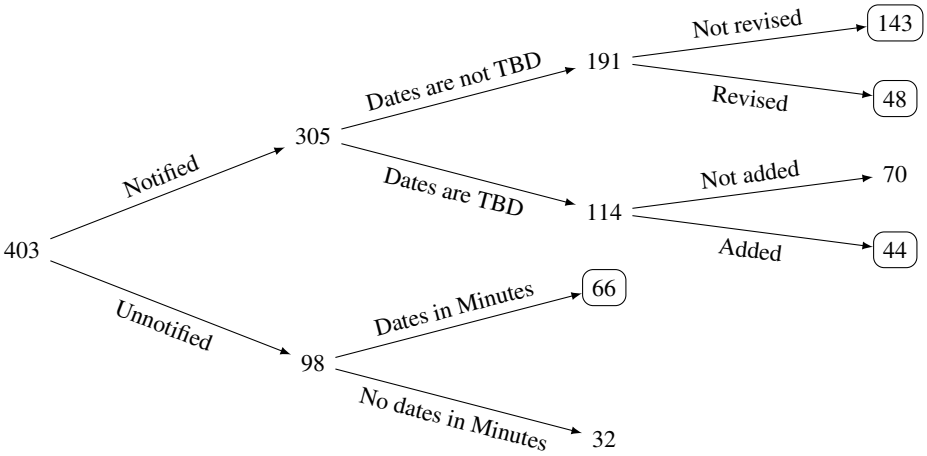
[31] In case divergent dates are found from the various sources, we apply the following ranking: we first pick the dates in the minute, then the ones in the revision and lastly the proposed dates in the notification. The information of the minute is the preferred one because countries might modify the proposed date of adoption or enforcement without providing documentation that formalize this.

[32] For further details please refers to A

[33] A sampling bias could be due to the varying probability of being included in the sample due to the transparency with which the measure has been introduced.

are produced by a third country, reduces issues of this selection. Moreover, the share of notified measure for which we can identify the timeline is 77%, while is 67% for unnotified ones. Therefore our ability to retrieve dates between notified and unnotified TBTs is not substantially different.

Figure 4: Data sources for the database on TBT timelines



Notes: Frequency of TBTs by the source from which their timeline information is retrieved. The edges of the tree represent attributes that identify whether a certain source of information can be used. Final nodes with rectangular frames highlight those cases in which we could identify the timeline.

2.3 Stylized Facts about Timelines of TBTs

Using these new database we are able to identify those technical regulations that have been introduced as Surprise Measures. These are almost 40% of the sample for which we have identified the underlying timeline of introduction. Table 1 shows the frequency of Surprise TBTs by country and number of HS4 products within HS2 categories. Surprise measures are common in developed countries and they are also relatively very frequent in the two giant developing economies, China and India. China has introduced unattended regulations very frequently, given the fact that she is a more recent member of the WTO. In the case of India, Surprise TBTs are even more frequent than Announced ones. Surprise TBTs are mostly common among food products, with wine and spirits being by large the most touched category.

Among Surprise Measures we distinguish two cases, illustrated in Figure 5, (a) Never Notified and (b) Notified in delay. The former are measures for which the Notification will never be provided. This means

Figure 5: Types of Surprise measures

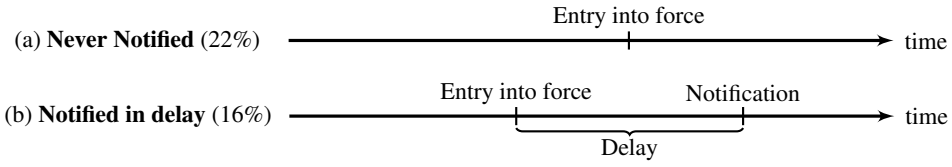


Table 1: Top 5 countries and products by surprise TBTs

Country	#(Surprise TBTs)	Share (%)	Sector (HS2)	#(Surprise TBTs)	Share (%)
EU	17	26	Beverages & Spirits (22)	29	40
Korea	10	48	Meat (02)	18	50
China	10	27	Edible Preparations (21)	17	35
India	7	70	Fish (03)	15	47
USA	7	50	Electrical Machinery (85)	13	33

Notes: The share of Surprise is the ratio between the number of contested TBTs introduced by a country (within an HS2 catgory) as Surprise measures over the total number of contested TBTs introduced by the same country. Results are shown for the first ten countries in terms of Surprise share and only for those countries with at least 3 contested TBTs.

that WTO members will not receive any formal documents with the details of the new requirement. For example, this is the case of a measure introduced by Mexico in 1997, regarding the the labelling of spirits. The requirement has not be formally disclosed to the WTO through a Notification even after the enforcement. The European Union has therefore re-raised a STC on this measure in a following meeting of the TBT Commission in an attempt to receive clarifications on it.[34] In other cases, the regulation is enforced and notified thereafter - this is the case instead, of the Mexican ban on CFCs, where the notification occurred with a delay of one month from the enforcement. On average, the Notification occurs within three months, and in almost all the cases the measure is eventually notified within a year.

2.4 French Firm Level Data

The firm-level data comes from two different sources: (i) the French customs, which reports exports for each firm by destination, product and month for the period between 1995 and 2007 and (ii) BRN (*Régime du bénéfice réel normal*), the French firm level administrative database which provides information on firms' balance-sheets, over the same period.[35] We aggregate the monthly trade data at the semestral level so that our panel includes 26 periods. The choice of using a semestral panel comes from a trade off between the possibility to exploit at most our data on timelines and the fact that there is a lot of seasonality and lumpiness in the monthly data, that is that most companies do not sell the same product to a given market in every month. Instead, the median exporter ship a certain HS4 product in a destination twice a semester.

The link to BRN, while it reduces the sample to relatively larger firms, allows us to identify the principal activity of enterprises. In this way, we can select the manufacturing industries, which are the ones directly interested by changes in technical requirements of production. Note that this dataset has been used in several trade related papers dealing with French data (Eaton et al., 2011; Mayer et al., 2014). In addition it allows us to have access to information on the domestic sales of the firm, which is used identify class sizes independently from the exporting activity.

[34] Details on this example can be found in the WTO Database on STCs, item 20.

[35] Firms are obliged to comply with BRN status if they earn annual revenues larger than 763K €. The dataset is accessed through facilities provided by the INSEE (the French Statistical Institute) and were made available for analysis after careful screening to avoid disclosure of individual information.

Table 2: Summary statistics for STC database

	Mean	Median	Min	Max
#(TBT) by Country	4	5.2	1	27
#(HS4 categories) by TBT	32	3	1	314
#(months) in the Introduction Period by TBT	1.3	1	1	6

Notes: Each STC can cover more TBTs when the rising country refers to more Notified measures.

2.5 Construction of the Estimating Sample

Since we have detailed data on French firm exports in the period 1995-2007, we use a sample of 123 TBTs that have been object of a STC by the European Union and that have been introduced in the same period.[36] These 123 contested TBTs have been raised against a total of 31 different countries, with China being the largest target. Table 2 shows that there is a large variability in terms of HS4 categories covered by each TBT. The one that covers the largest number of HS4 products the Mexican "Mandatory standard on Labelling of Industrial Products", which interests several products across a large number of different HS2 sections from textile to food. The length of the introduction period is instead rather homogeneous across regulations, with the majority having been introduced within just one semester. The longest introduction period regards the Korean "Mandatory Emission standard for Automobiles", which was adopted in April 2000 and enforced 3 semester thereafter, in June 2002.[37]

We restrict the firm-level sample to export flows towards extra EU-27 destinations since concerns might be rise by the EU against extra-EU countries. Concerning the products, the WTO STC database records them at the 4-digit Harmonized System, therefore we aggregate at this level the export data, which is originally at the Combined Nomenclature at 8 digits.[38] 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. [39] Then, this data has been joined with tariff data from TRAINS, which contains information on the effectively applied tariffs (defined as the lowest available tariff between preferential and MFN) at the HS 4-digit.[40]

Table 3 reports the average number of exporters, of HS4-country pairs and of the value of exports for the full sample as well as for those markets touched at least once by one TBT in our sample. Interestingly,

[36] Ideally, one would want to identify those TBTs that are trade restrictive specifically to French exporters, however, European countries participate as a single entity within the TBT Commitee. On the other hand, technical regulation are homogeneous across EU countries and TBT measures are applied in a non-discriminatory way to all trading partners. Therefore, we can plausibly assume that a TBT contested by the EU proxies an obstacle for French firms.

[37] G/TBT/N/KOR/4

[38] Actually, the STC database contains 6% of HS2s products, 62% HS4s and the remaining 32% are HS6 goods. We keep the level of the analysis at 4-digit HS and we therefore drop the concerns that refers to HS2 goods, to avoid imputing to all HS4 subcategories, while we aggregate the HS6 at the HS4 level.

[39] A similar cleaning procedure is applied in Fontagné and Orefice (2018). This makes our work comparable with theirs. Note that the number of countries in the sample is reduced from 168 Non-EU countries to 151.

[40] HS 4-digit tariff data is a simple average tariff within HS-4 headings of the HS-6 tariff level data, this aggregation is directly provided by TRAINS. Unfortunately, the database has many empty entries, in the literature there are various algorithm that have been used proposed to increase the number of observations. In this chapter, we apply the interpolation procedure suggested in Beverelli et al. (2014). In addition, 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.

Table 3: Summary statistics of the estimation sample

	SEMESTRAL AVERAGE	
	Full sample	Touched by TBT
#(HS4, country)	35964	1122
#(exporters)	17131	2580
Total Export	3.26e+10	2.44e+09

these markets are the 3% of all the possible (destination-HS4) pairs, still, their value represent around the 7.5% of the total export value.

3 Research Design

This Section describes how we estimate the effects of the introduction of a new regulation on the exporting activity of firms. We first present the variables of interest, we then illustrate the empirical strategy and finally we discuss how we tackle potential issues to our identification.

3.1 Definition of Variables

Let $A_{HS4,d}$ and $E_{HS4,d}$ be the date of adoption and entry into force of the TBT regulations, respectively; with $HS4,d$ denoting 4-digit HS product category and destination country. These dates contain the day, month and semester of the event. We call introduction period ($I_{HS4,d}$) the semester(-s) from the one in which the measure is adopted to the one in which it is eventually enforced. We use this to identify an indicator which takes value 1 when a restrictive TBT is introduced in the $(HS4,d)$ market, i.e. $\text{TBT}_{HS4,d,t} = \mathbb{1}[\text{if s} \in I_{HS4,d}]$. Note that $A_{HS4,d}$ and $E_{HS4,d}$ are not available in those markets where a restrictive TBT has never been introduced, thus the indicator TBT is zero over the full time span. We then call $N_{HS4,d}$ the notification date and use this to define Surprise measures as:

$$\text{SurpriseTBT}_{HS4,d,t} = \mathbb{1}[\text{if } (N_{HS4,d} = NA \text{ or } N_{HS4,d} > E_{HS4,d}) \text{ and } TBT_{HS4,d,t} = 1]. \quad (1)$$

$\text{SurpriseTBT}_{HS4,d,t}$ take value 1 during the period in which the measure is introduced, if by the time of enforcement there is no previous notification. This includes both the cases in which the TBT will never been notified, and therefore $N_{HS4,d}$ is Not Available , as well as those cases in which the notification occurs later than the enforcement. Similarly, we define Announced measures as

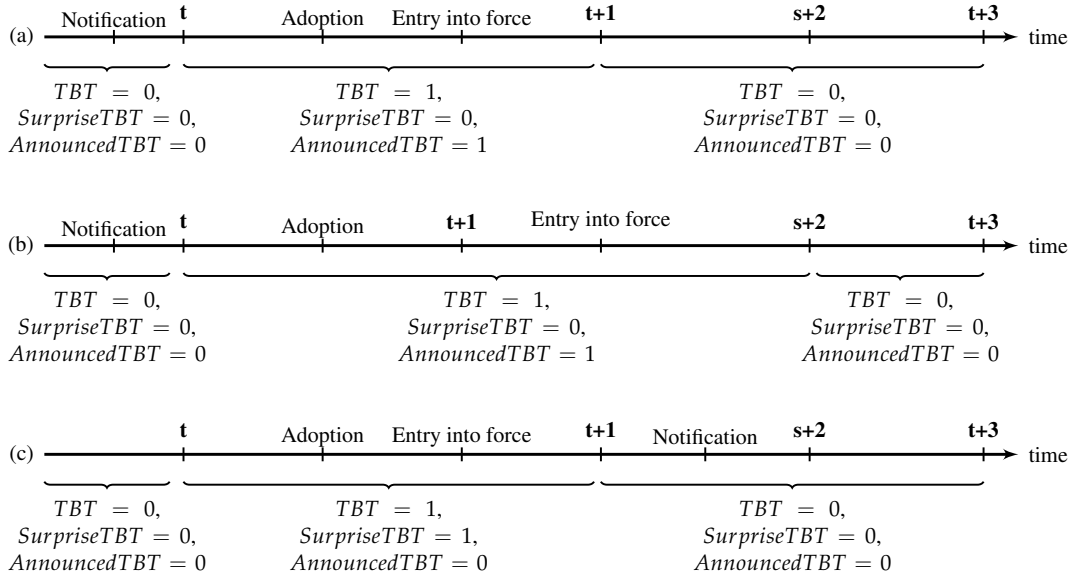
$$\text{AnnouncedTBT}_{HS4,d,t} = \mathbb{1}[\text{if } N_{HS4,d} \leq E_{HS4,d} \text{ and } TBT_{HS4,d,t} = 1]. \quad (2)$$

Figure 6 illustrates the behaviors of our indicator functions for some ideal timelines. Each timeline is (HS4-country) specific, but the index $(HS4,d)$ is dropped from the notations. Panel (a) shows a case in which adoption and entry into force occur in the same semester s. Therefore, the TBT indicator takes value one in that period while zero in the others. In the meantime, since the notification occurs before

the enforcement, Surprise is zero while Announced is one. Panel (b) shows a case in which adoption and entry into force occur in two consequent semesters. Also in this case, the notification precedes the introduction, so in the two periods $AnnouncedTBT = 1$. On the contrary, Panel (c), depicts a case in which the notification occurs after the enforcement, therefore when $TBT = 1$ also $SurpriseTBT = 1$.

In conclusion, note that there are some (HS4,d) that have been touched by more than one TBTs over time. For these markets the introduction period contains multiple windows over which the TBT switch on and off. For example, Korea has introduced three regulations on passenger cars that has been contested by EU, in 1998, 2002 and 2006 respectively. Each episode might me either Surprise or Announced, depending of whether the underlying measure has been notified before the relative enforcement.

Figure 6: Illustration of the indicator functions for three ideal timelines



Notes: Illustration of three ideal timelines. Each timeline is (HS4-country) specific, but we drop the index $HS4, d$. Timeline (a): $TBT = 1$ in one period since and the measure is adopted and enforced in the same semester; $Surprise = 0$ because the notification is before the enforcement. Timeline (b): $TBT = 1$ in two periods since the TBT is enforced the semester after the one of the adoption; $Surprise = 0$ since notification is before the enforcement. Timeline (c): $TBT = 1$ in one period since and the measure is adopted and enforced in the same semester; $Surprise = 1$ because the notification is after the enforcement.

3.2 Empirical Strategy for Firm Level Estimation

To quantify the average effect of a trade restrictive TBT on firms' trade margins one can estimate the following linear regression model:

$$y_{i,HS4,d,t} = \alpha + \beta_0 \text{TBT}_{HS4,d,t} + \epsilon_{i,HS4,d,t}, \tag{3}$$

where α is the intercept and $y_{i,HS4,d,t}$ denotes the trade margins of firms, with i being the firm identifier.

A concern with this identification strategy is the possible endogeneity of the imposition of a regulation. Endogeneity might stem from an omitted variable. This is the case if an external shock induces correlation between the probability of imposing a new technical regulation on certain goods and variations in

firms' margin of trade over the same goods. For example, if countries couple TBTs with other policies that target the same goods. Existing literature has found evidence of the use of TBTs as a policy substitute of tariffs cut (Orefice, 2017). Then, in our preferred specification we add the applied tariff rate at the HS4 product level, in order to avoid confounding the effects of changes in regulation with those of changes in tariffs.[41] In addition to changes in tariff, there might other policies that are however unobserved. To circumvent this instance, we add a set of three-way fixed effects HS2-destination country -semester ($\mu_{HS2,d,t}$). These fixed effects controls for varying factors such as business cycles, import-demand shocks and multilateral trade resistance (Head and Mayer, 2014). We also add firm dummies (μ_i) to control for firm unobserved, time invariant characteristics that are likely to shape idiosyncratic exporters' behavior. Our preferred specification is therefore as follows

$$y_{i,HS4,d,t} = \beta_0 \text{TBT}_{HS4,d,t} + \delta asinh(\text{tariff}_{HS4,d,t}) + \mu_{HS2,d,t} + \mu_i + \epsilon_{i,HS4,d,t}. \quad (4)$$

The identification strategy consists of comparing changes in trade margins across HS4 products sold by similar firms, operating in initially similar market conditions except for the introduction of a restrictive TBT.[42]

The standard errors of the coefficients for all estimations are clustered at the $(HS4, d, s)$, i.e. at the level of assignment of the treatment in our research design.[43] Our standard errors, therefore, account for the possibility that firms' trade margins may be correlated between units that are shocked by the same regulation.

A similar specification and identification strategy is used to investigate the differential impacts of Announced and Surprise TBTs. In this case, we distinguish the two treatments, as defined in equations 1 and 2, and include them both in our specification:

$$y_{i,HS4,d,t} = \alpha_0 \text{AnnouncedTBT}_{HS4,d,t} + \beta_0 \text{SurpriseTBT}_{HS4,d,t} + \\ + \delta asinh(\text{tariff}_{HS4,d,t}) + \mu_{HS2,d,t} + \mu_i + \epsilon_{i,HS4,d,t}. \quad (5)$$

To capture firms' trade margins we use as dependent variables (i) the firm's export value (in logs) to capture the intensive margin of trade and (ii) a dummy variable for a firm exiting a certain market to proxy the extensive margin, which we define as follows:

$$\text{exit}_{i,HS4,d,t} = \begin{cases} = \mathbb{1} \text{ if i exports HS4 in d in s and s-1 but never in s+1 and s+2} \\ = 0 \text{ if i exports HS4 in d in s and s-1, and at least once in s+1 and s+2.} \end{cases} \quad (6)$$

An exiting firm has therefore sold product $HS4$ in destination d in this period as well as in the last one but will not export it in the following two.[44] We use two lags because of semestral data, to avoid confounding

[41] The tariff level is transformed through the hyperbolic arcsine (asinh). This is because the asinh function is close to the logarithm while still allowing to include observations with zero tariff in the analysis.

[42] A similar identification strategy has been used in Fontagné and Orefice (2018), where, however, the time of the effect of a TBT is proxied by the period in which a concern is risen.

[43] In Abadie et al. (2017), the authors discuss this experimental design reason for clustering, which is when clusters of units, rather than individual units, are assigned to a treatment.

[44] In the Appendix we discuss alternative definitions of exit.

the effect of exit with the absence of the market due to seasonality.[45] Note that the probability of exit a market is a lagged proxy of the extensive margin there. This means that, if *ceteris paribus* a firm exits a market today, one records a reduction in the number of firms in the market tomorrow.

3.3 Validation of the research design

We here discuss two potential issues with our identification strategy, namely underidentification and the validity of the parallel trend assumption, and how we handle them.

3.3.1 Underidentification

A potential issue associated with 4 and 5 regards the underidentification associated to the structure of the fixed effects as well as the potential non convexity of the weights in computing α_0, β_0 as weighted averages of different TBTs events (Borusyak and Jaravel, 2017; de Chaisemartin and D'Haultfœuille, 2018; Goodman-Bacon, 2018; Abraham and Sun, 2018). In our estimation, underidentification arise if a restrictive TBT touches all HS4 products within an HS2 category. Then, within a treatment unit one can not disentangle the market characteristics from the effects of the treatment event.[46] Table 2 shows that the average TBTs touches indeed several HS4 products, making underidentification plausible. We test this scenario in the robustness checks. Other concerns about the underidentification are mitigated because our sample has a very large group of untreated observations, which means a rich set of potential good comparison. We show for example, that our results are robust to the use of alternative set of fixed effects aimed to detect a idyosincratic behavior in markets touched by TBTs. In addition, we show that our results are stable to reductions in the variance of the length of the introduction window of TBTs. Large variability in the treatment length might cause the estimators to be weighting the event by event estimates in an implausible way.[47]

3.3.2 Parallel trend assumption

Another source of endogeneity, in addition to omitted variables as discussed above, might stem from reverse causality. For instance, if the government of a certain destination market introduces a TBT in response to import penetration from French firms, or if a STC is raised by the EU against a regulation in a market because French firms are loosing market shares there. Regarding the latter case, this issue should be mitigated by the fact that we use concerns raised by the EU as a whole and not raised specifically by France. In addition, Figure 3 suggests this not to be our case. Instead, given the positive trend before the introduction of a Surprise measure, the former is a more plausible threat to our identification. The inclusion of the set of fixed effects plays here again a crucial role: our research design treats the variability

[45] We also control that the firm still exports something or somewhere else to rule out the possibility to confound a firms' exit with the complete termination of her export activity, for example in case of her death.

[46] Underidientification is an issue discussed in the literature about the staggered treatment setting, where the presence of unit and time fixed effects arise a problem of multicollinearity (Borusyak and Jaravel, 2017)

[47] In settings with treatment effect heterogeneity and variation in treatment timing, these weights can be negative, see e.g. de Chaisemartin and D'Haultfœuille (2018) for a discussion on how the negative weights arise.

in the introduction of restrictive TBTs as good as random conditional on market and firm characteristics. In other words, the parallel trend assumption of the difference in difference design is here imposed conditional on being an HS4 products sold by a similar firm in the same period, to the same country of destination within the same HS2 sector. In order to inspect the validity of this assumption, we run a specification analogous to 4 but introducing additional dummies to select a larger window:

$$y_{i,HS4,d,t} = \sum_{l=-B}^{-1} \left(\alpha_l \mathbb{1}[L^{AnnouncedTBT}_{HS4,d,t} = l] + \beta_l \mathbb{1}[L^{SurpriseTBT}_{HS4,d,t} = l]\right) + \sum_{k=0}^{A+1} \left(\alpha_k \mathbb{1}[K^{AnnouncedTBT}_{HS4,d,t} = k] + \beta_k \mathbb{1}[K^{SurpriseTBT}_{HS4,d,t} = k]\right) + \delta asinh(\text{tariff}_{HS4,d,t}) + \mu_{HS2,t,d} + \mu_i + \epsilon_{i,HS4,d,t}, \quad (7)$$

where $L_{HS4,d,t}$ represents the number of periods before the introduction of the TBT while $K_{HS4,d,t}$ the one after, while the superscripts $AnnouncedTBT$ and $SurpriseTBT$ are used to distinguish windows around Announced versus Surprise TBTs. Therefore these two variables represent the relative time around the introduction of a TBT. More specifically $L_{HS4,d,t} = s - min\{I_{HS4,d}\}$ is the number of periods before the first semester of introduction of the TBT, while $K_{HS4,d,t} = s - max\{I_{HS4,d}\}$ is the number of periods after the last semester of introduction. For example, $L_{HS4,d} = -1$ identifies the period before the introduction of the TBT. Then, $B \geq 0$ are the number of time lags from the treatment included in the model, while $A \geq 0$ are the specific short run effects. If the introduction of a TBT is randomly assigned and unpredictable conditionally on the tariff level and on the market and firm fixed effects, there are no pre-trends, $\beta_l = 0$ for $l < 0$. This assumption will be tested graphically and statistically. In addition, an event study design, by focusing on trade margins around the event window, allows us also to investigate the dynamics and persistence of the effect.

4 Estimating Firms' Reaction to Surprise TBTs

In this Section we discuss our estimates of the effects of changes of regulations on firms' trade margins. The second part of this Section is devoted to test their quality. We then look at the estimates of the dynamics of the effects. These estimates are used to both verify the validity of the parallel trend assumption and to investigate the persistence of the effects due to a change in regulation.

4.1 Baseline Results

Table 6 reports the estimates of the two baseline specifications described in model 3 and 4. The table has 6 columns: in columns 1-2, the dependent variable is the export value in log, followed by the probability of exit in columns 3-4, and the lagged probability of exit in 5-6.

Estimates of model 3 in columns 1,3,5 show that the introduction of a restrictive TBT increases the probability of exiting the market in the period before the introduction (around 4.5%), while does not affect significantly the intensive margin. These results are similar to the ones found in Fontagné and

Orefice (2018).[48] The null effect on the intensive margin of the average firms, coupled with the evidence of a strong negative effect of TBTs on aggregate export, has motivated the authors to argue that restrictive TBTs mostly increases the fixed (rather than variable) trade costs which push some firms out of the market.[49]

However, when we estimate model (4) and disentangle Announced from Surprise measures, a very different picture emerges. Announced measures are associated to a rise in the average export value of firms (around 23%) and a positive effect (almost 6%) on the probability of exit in the period before the introduction. Surprise measures cause instead a substantial fall, of around 30%, in the average export value of exporters, while they do not significantly impact the probability of exit. This set of results unveils two different regimes within restrictive TBTs. When Announced, a TBT produces a positive effect on the intensive margin, which is then offset on the average restrictive TBT by the negative effect of Surprise measures.

What we find for Announced measures is in line with Bao and Qiu (2012). The authors have indeed estimated the effects of TBTs by using a sample of notified measures. The authors interpret these results in terms of the evolution of competition as well as of exporters' demand in the market. In particular, they suggest that, in addition to the reallocation of market shares due to selection, the rise in the aggregate export is coherent with the idea that, when TBTs pursue legitimate objectives, they work as an information revelation or quality assurance feature. This raises consumers confidence over foreign goods and hence boosts demand for imports. In our case, instead, we do not observe an aggregate increase in French exports following the introduction of a TBT (Figure 3). Thus the average increase in firms' intensive margin is here more coherent with a story of reallocation of market shares across French exporters, following a rise in the cost to serve the market, rather than an information-revealing aspect of these TBT.

On the other hand, results on Surprise measures are new to the literature. In this case we observe a fall in the intensive margin, while not a significant exit of firms.

4.2 Underidentification

Often TBTs touch a large set of products within or even across HS2 sectors. When this happens, there are fewer candidates to be included in the counterfactual group of untreated units. To check that our results do not suffer of this underidentification we test whether our estimates are robust to drop those TBTs that cover a large share of HS4 products within the same HS2 sector. Point estimates of α_0 and β_0 do not almost change when we exclude those TBTs which cover more than 90%, 80%, 70% and 60% of units within an $HS2, d, t$ group (see Tables 14 and 15 in the Appendix).

We test weather our results are stable to the exclusion of those TBTs where the introduction period extends over several semesters. This is because, in case of heterogeneous treatment length, the Difference in Difference estimator is a variance weighted average of treatment effects, where the weights depends on both sample size and the variance of the treatment status (Goodman-Bacon, 2018). Implausible

[48] Note that the estimate of β_0 on exit is higher both because we use higher frequency data, as well as because we use a more precise definition of a TBT which considers the actual dates of the TBT rather than the ones of the STC.

[49] In Chaney (2008) the aggregate trade elasticity to fixed trade costs is predicted to be driven by the extensive margin, with a negligible role of the intensive margin.

Table 4: Announced vs Surprise measures - Baseline Model

DEPENDENT VARIABLE	Export_t		Exit_t		Exit_{t-1}	
	(1)	(2)	(3)	(4)	(5)	(6)
TBT	0.11		0.01		0.045^c	
	(0.09)		(0.017)		(0.01)	
SurpriseTBT		-0.27^b		0.04		0.00
		(0.13)		(0.03)		(0.02)
AnnouncedTBT		0.23^b		0.00		0.055^a
		(0.11)		(0.01)		(0.02)
asinh(tariff)	-0.05^a	-0.05^a	0.00^a	0.00^a	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	4,214,856	4,214,856	2,522,245	2,522,245	2,418,685	2,418,685
Adj. R2	0.26	0.26	0.11	0.11	0.11	0.11
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
HS2-Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Export is in log, so the marginal effect of a dummy reads $100(e^{\beta}-1)\%$, with β being the coefficient on the dummy. Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 since who exits does not export in the period. Significance levels: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$.

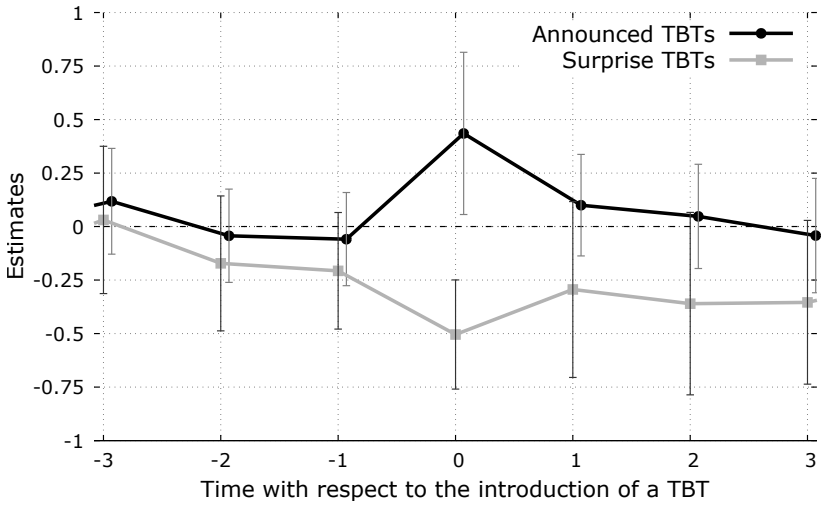
negative weights may arise if there is a large variance in the duration of the treatment. Long introduction period might occur only for Announced TBTs, since Surprise ones by construction, are introduced in one semester, the one in which they are enforced. Then, apart from the the quality of the estimation, the fact that Announced TBTs have introduction periods which might last longer than those of Surprise TBTs can generate differences in the interpretation of the effects. Interestingly, when we sub-sample those TBTs whose introduction period last no more than 3 (cols 1 and 2 of Table 17), 2 (cols 3 and 4), and 1 (cols 5 and 6) semesters, the average effect does not change dramatically and, if anything, decrease on both the intensive and (coherently) the extensive margin. In other words, the shorter the period of introduction of the measure, the lower the exit of firms from the market, the lower the gain in market shares from surviving firms. This can be explained by the fact that longer introduction are usually granted in case of more complicated requirements, for which longer adaptation is needed and plausibly a larger investment.

4.3 Dynamic Effects

We are interested in the dynamic effects of Surprise and Announced TBTs for two reasons. First, it permits us to test the parallel trend assumption, and therefore the quality of our identification. Second, it allows to investigate the persistence of the effects and to validate and enrich the interpretation of the phenomenon. Figures 7 and 8 plot the regression estimates of Equation 7 for a time window around the introduction period of a TBT, for the export and the exit probability.[50] Each Figure display 2 panels, representing the coefficients for the sample of Surprise and Announced measures, respectively.

[50] We choose three lags, i.e. one year and an half, since at the earliest a Notification occurred 21 months before the introduction, while at the latest, a late Notification is provided 19 months later.

Figure 7: Dynamic model for Export, regression coefficients and 95% CI



Notes: The image plot the estimated coefficients of equation 5 with lags and leads around the treatment, for two type of treatments, Surprise and Announced TBTs. The dependent variable is here the (log) value of export.

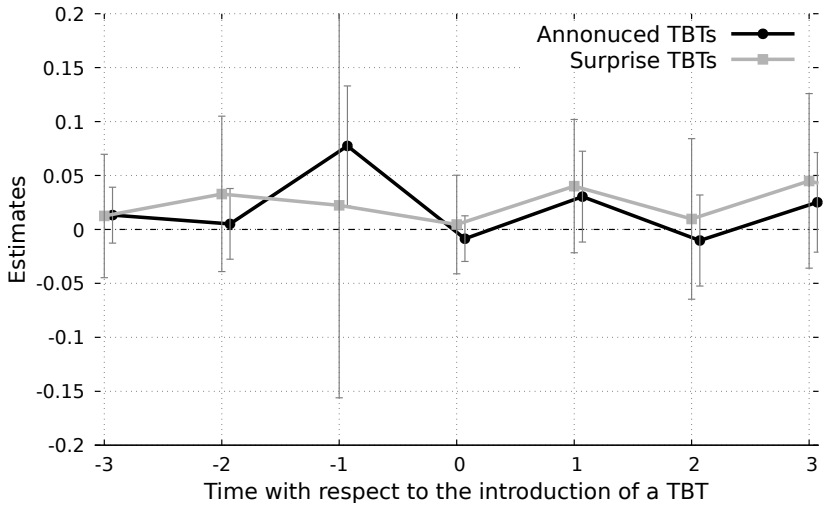
Figure 7 shows that, for both Surprise and Announced measures the effect on the value of export is significant only during the period of introduction of the TBT. In both cases, no substantial pre-trend is detected. This means that before the introduction of a TBT, the HS4 product lines touched by the new regulation are not statistically different from the others within the same HS2 produce category, that we use as counterfactual group. This is mostly important for the Surprise measures, for which we have observed a positive trend that precedes the introduction of the TBT relative to the average performance of French exports. In contrast, during the introduction of a new requirement we detect an idiosyncratic behavior in the export of targeted products. However, this appears to vanish quickly, even if the estimates are quite imprecise, mostly in the case of Surprise measures.

Figure 8 shows that the effect of Announced measures on the probability of exit is significant just in the period before the regulation is enforced. This is coherent with the timing of the announcement: almost the entirety of the Announced measures are notified between 3 and 6 months before the introduction period. This suggest that in case of Announced measures firms know there will be negative shock in the next period and will there exit before incurring the per period cost. On the other hand, there is no significant exit on the average firm following a Surprise TBT. Yet in this case too estimates of Surprise TBTs are more imprecise.

4.4 Robustness Checks

Alternative counterfactual groups The choice of including $(HS2, d, t)$ set of fixed effects allows us to compare products that are, except for being subject to the new regulation, otherwise similar in their characteristics. We have indeed shown that these groups of products are on a parallel trend before the advent of the TBT. Then, if the country target through a Surprise TBT those imports that are performing relatively well in the country, we expect their effect to be particularly negative with respect to otherwise similar goods than relative to the average product sold in the destination. Indeed, Table 12 shows

Figure 8: Dynamic model for Exit, regression coefficients and 95% CI



Notes: The image plot the estimated coefficients of equation 5 with lags and leads around the treatment, for two type of treatments, Surprise and Announced TBTs. The dependent variable is here the probability of exit.

that the estimates of a model where we include just (destination,time) pair fixed effect is lower, around 17%. Interestingly, when we instead exclude the firm fixed effect, estimates do not change dramatically. This suggests that firms are hit by Surprise TBTs despite their destination, product, time invariant characteristics, such as the time invariant component of differences in firms overall ability and exporting performance.

Full sample of French exporters As discussed in Section 2.4, the estimating sample includes those firms that are under the BRN regimes, which is those that earn annual revenues larger than 763€. Matching trade data with administrative data allows us to resort information on both domestic and export activity which will be used to identify size classes in a way less dependent from the exporting activity of a firm. This database is the standard for works that French data but might however potentially introduces a severe selection bias towards larger firms. We show this not to be the case in Appendix 11. While observations almost double in size the results remains qualitatively similar. Differences are in the direction that one would expect. In case of Announced measure, the estimated coefficient on exit is slightly larger in the full sample, while the estimate on the the intensive margin became non significant. The coefficients associated to Surprise Measure do not change substantially, it decreases but in a not significant way. An explanation of this can be found in the next section.

5 Interpreting the effects of Surprise measures

By distinguishing the effects on firms' trade activity, our estimates uncover differences between Announced and Surprise TBTs. While Announced measures cause exit of firms before the introduction of the new measure, Surprise measures affect adversely firms' trade activity by causing a simultaneous drop in their export value.

We interpret this evidence within a framework of investment under uncertainty using the intuitions of the real options literature developed in Dixit et al. (1994). This framework builds on two main elements: (i) the irreversibility of investments and (ii) the possibility to wait to invest. Most of the investment are partly irreversible, they generate assets that can not be fully appropriated to an alternative use of a firm. In other words, these investments, once complete, become sunk costs. The choice of exporting in a market is modelled as an irreversible investment in Limão and Maggi (2015) and Hanson et al. (2016). Also the choice of staying in a market can include the evaluation of some irreversible costs. These are associated for example to updating the distributional networks, tailoring production to changing regulation and filling in periodic declarations and other forms. The role of future conditions is particularly important when firms must decide on costly irreversible investments such as adopting a new product requirement, producing a new good or selling in a market. The reason is that a firm with an opportunity to invest is holding an option similar to a financial call option, which gives the right but not the obligation to buy an asset at some future time. When a firm makes an irreversible investment expenditure, it looses this option to invest. For example, it gives up the possibility of waiting for new information to arrive that might impact on the profitability or timing of the investment. This lost option value is an opportunity cost that must be considered as part of the cost of the investment.

We can think of a change in technical regulation as a change in the sunk cost to serve that market. In case of Announced measures, this change affects firms' expected payoff before entering the market, when the per period sunk cost of exporting there has not yet been incurred. This allows the firm to take into consideration the additional cost of adapting to the new regulation in the decision to serve the market in that period. On the other hand, Surprise measures affect the instantaneous payoff once the firm has entered and already paid the per period sunk cost. The different timing in which firms consider whether to implement the new requirement explain why we observe a significant exit of firms in the case the change in regulation is anticipated by firms, while we do not in the case the measure is unexpected.

In case of surprise TBTs, we can explain the fall in the export value, along with no significant exit, as to be due to a temporary halt in the exporting activity of firms within the semester. We interpret this halt to be caused by a rise in the uncertainty of serving the market. We think of this as to be due to the fact that when countries avoid to codify the regulation through a notification they rise the uncertainty on the profitability of the market. This interpretation finds support in the words of the US representative bringing the case of the Mexican ban to the TBT Committee. The lack of information on the list of licence providers, he argued, raised the uncertainty on the cost of proving conformity of its own products. The increase in uncertainty rise in turn the value of the real option of waiting to collect new information before implementing the investment to adapt to the new standard. In other words, by rising the uncertainty, Surprise measure incentives firms to delay their investment decision about remaining in the market. We therefore think of this temporary halt as the output of firms decision to wait for new information to come.

5.1 A temporary halt of export

While we interpret the drop in the export value as due to a temporary halt of the activity of exporters, another possibility is that firms continue to export but at a reduced intensity. If firms halt their exporting

Table 5: Announced vs Surprise measures - Shipment margin

DEPENDENT VARIABLE	#(Shipments)	Export per Shipment
	(1)	(2)
SurpriseTBT	-0.201^{b}	-0.195
	(0.083)	(0.145)
AnnouncedTBT	-0.044	0.253^{b}
	(0.035)	(0.113)
asinh(tariff)	-0.007^{a}	-0.051^{a}
	(0.001)	(0.002)
Obs.	4,214,856	4,214,856
Adj. R2	0.26	0.26
Firm FE	Yes	Yes
HS2-Country-Time FE	Yes	Yes

Notes: The number of shipments is the number of months in which a firm is active. The export per shipment is the average export value per active month. Export is in log, so the marginal effect of a dummy reads $100(e^{\beta}-1)\%$, with β being the coefficient on the dummy. Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 since who exits does not export in the period. Significance levels: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.

activity, we should observe a reduction in the frequency with which a firm operate in a market. On the other hand, if firms keep the same shipment rate but reduce their size we expect to see a fall in the average export value per shipment. As shipment unit we use data on monthly export activity. We decompose the semestral export value into (i) the number of months in which a firm exports and (ii) the average export value per active month. We then use these two margins as the new dependent variables in our baseline model in equation (5). The estimates in table 5 shows that the average number of months in which a firm serve a market with a product falls substantially when an unexpected TBT is introduced on it. The average shipment instead does not. This evidence support our interpretation that when firms are caught by Surprise TBTs they stop, at least for a while, to serve the market. The fact that simultaneously we do not record a significant exit suggests this to be only a temporary halt.

6 Firm heterogeneity and the ability to wait

With firm heterogeneity not all firms are equally likely to survive the same negative shock. Those firms that were close to the surviving cutoff before the shock will be forced to exit. This is the case for both Announced and Surprise measures, if the new regulation impose additional costs to serve the market whatever the source of the cost is. In both cases, we expect the least productive firms to struggle the most in surviving the change in the regulation. In this section we look at the differential effects of Announced and Surprise measures for different classes of firms' size.[51]

[51] In the standard framework a' la Melitz, differences in terms of productivity maps into the differences in performances of firms, such as their size.

6.1 Estimating the role of size

We proxy the size of a firm with its total sales in the domestic market. This choice is made to reduce potential concerns of simultaneity in case we were to use the export value. We classify the size of the firms in three groups. We do this by using the 40th and 80th percentile of the size distribution in each period s. We define three dummy variables for each group $Size_{c,i,t}$ with c indexing $\{S, M, L\}$, which takes value one when the total sales of a firm is respectively below or equal the 40th, above the 40th but below the 80th, above or equal the 80th percentile. We augment our specification in 5 with size classes and their interaction with Announced and Surprise TBTs:

$$y_{i,HS4,d,t} = \sum_{c\in\{L,M\}} \gamma_{0,c}\ \text{Size}_{c,i,s} + \sum_{c\in\{L,M,S\}} \alpha_{0,c}\text{Size}_{c,i,t} \times \text{AnnouncedTBT}_{HS4,d,t} \\ \sum_{c\in\{L,M,S\}} \beta_{0,c}\ \text{Size}_{c,i,t} \times \text{SurpriseTBT}_{HS4,d,t} + \\ + \delta_1 asinh(\text{tariff}_{HS4,d,t}) + \mu_{HS2,d,t} + \mu_i + \epsilon_{i,HS4,d,t} \quad (8)$$

We drop $\text{Size}_{S,i,s}$ in order to have our estimates as deviation from small firms in markets where the regulation does not change. We are interested in decomposing the effect of a regulation into the marginal contribution of each size class. We will therefore be looking at the estimates of $\beta_{0,c} + \gamma_{0,c}$ for Surprise TBTs and $\alpha_{0,c} + \gamma_{0,c}$ for Announced TBTs. For the marginal effect of being treated by a regulation, given a certain size, we will be looking at $\beta_{0,c}$ and $\alpha_{0,c}$ across size classes c.

6.2 Results and discussion

Table 6 reports the estimates of the specifications described in model 5 and 8. The table has 6 columns: in columns 1-2, the dependent variable is the export value in log, followed by the probability of exit in columns 3-4, and the lagged probability of exit in 5-6.

In markets with no change of regulation, the medium (large) size firm exports on average 22% (46%) more of a small firm counterpart and she is around 7% (12%) less likely to exit the market.

Conversely, in markets touched by a Surprise TBT, the medium size firm exports even less than the small firm counterpart in a market with no regulation, on average 21% less, and is around 6% more likely to exit the market. Large firms touched by a Surprise TBT export instead only 21% more than a small firm counterpart in a market with no regulation and are always 12% less likely to exit the market. Small firms export instead 34% less then their counterpart in markets with no TBT and their probability to exit the market is 13% larger. By comparing each class size with its own counterpart in a market not touched by a regulation, we see that the expected export value is substantially lower for all the three size classes. The drop in export value is more substantial for small and medium size firms, who loose 29% and 34%, respectively, against the 17% loss for large firms. On the other hand, the probability of exit increase significantly only for small and medium firms, by 12% and 13% respectively. On the contrary, in the period before the introduction of a Surprise TBT we do not record any significant change in the probability of exit for any size class.

In markets touched by an Announced measures, the medium size firm exports again on average 22% more of the small firm counterpart in a market with no TBT. Large firms export around 91% more, while small firms get larger - they export 27% more than the small firm counterpart in a market with no TBT. In the period before the introduction of the Announced TBT small firms exit with a probability that is 10% bigger, medium firms with no substantial difference, while large firms are only 4% less likely, then the small counterpart in a market with no TBT. Then, by comparing each class size with its own counterpart in a market not touched by a regulation, we see that the expected export value is substantially larger for small and large firms. In the period before the introduction of a announced TBT, the probability of exit increase for all class sizes, but in particular for small firms.

This set of results reinforces our interpretation of the estimates of the baseline model. In case of Announced measures, mostly small firms exit before the TBT is implemented to avoid to pay the sunk cost to serve the market and adopt the new regulation. In case of Surprise TBTs, firms did not expect the change and exit within the same period in which the measure is enforced. Only large firms do not exit substantially, while the record a significant reduction in the export value pointing to the fact that this firms undergo a temporary stop. We interpret this evidence as suggesting that large firms wait and delay their investment decision on serving the market. One possible reason of why large firms are more prone to wait is that they find it easier to divert their sales somewhere else. This channel has been investigated in Fontagné et al. (2015), who finds that multi-destination firms, are able to switch destination countries more easily than other firm when they are hit by a new TBT. They explain this by benefiting from a wide portfolio of alternatives, multi-destination firms are more able than other firms in diverting trade towards TBT-free destinations for which fixed-costs of market access have already been paid.

7 Persistence of Uncertainty and the role of formal Information

Our argument builds on the assumption that Surprise measure rise the uncertainty on the cost to serve the market. Our theoretical framework predicts that when uncertainty rises firms will postpone their investment decision on whether to stay. This is because the uncertainty over the profitability of the investment creates a value to waiting for new information. In this section we investigate weather the arrival of new information, through late notification, erodes the value of the wait option. To do so we distinguish the dynamic effects between those Surprise measures for which a notification is provided with delay and those that are left unnotified. For this purpose, we modify our baseline specification to include the distinction between late notified and never notified ones.

7.1 Estimating the role of late notifications

We define a k-periods far from a Surprise measure to be Late Notified in semester t, if in s it is k-period apart from the introduction and a notification has been provided by the start of the semester:

$$SurpriseTBT^{UN}_{HS4,d,t,k} = \mathbb{1}[\text{if } K^{SurpriseTBT}_{HS4,d,t} = k] \times \mathbb{1}[\text{if semester}(N_{HS4,d}) < s].$$

Table 6: Effects of Announced vs Surprise measures for different size classes

DEPENDENT VARIABLE	Export_t		Exit_t		Exit_{t-1}	
	(1)	(2)	(3)	(4)	(5)	(6)
$Size_{MED,t}$	0.195^a	0.196^a	-0.072^a	-0.072^a	-0.077^a	-0.077^a
	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)
$Size_{BIG,t}$	0.378^a	0.378^a	-0.122^a	-0.122^a	-0.130^a	-0.130^a
	(0.008)	(0.008)	(0.003)	(0.003)	(0.003)	(0.003)
SurpriseTBT$\times Size_{SMALL}$		-0.339^a		0.125^b		-0.019
		(0.151)		(0.072)		(0.121)
SurpriseTBT$\times Size_{MED}$		-0.429^a		0.132^a		-0.006
		(0.094)		(0.036)		(0.092)
SurpriseTBT$\times Size_{BIG}$		-0.192^b		0.004		0.020
		(0.106)		(0.021)		(0.084)
AnnouncedTBT$\times Size_{SMALL}$		0.246^b		-0.0003		0.103^a
		(0.140)		(0.037)		(0.046)
AnnouncedTBT$\times Size_{MED}$		0.078		0.003		0.073^a
		(0.117)		(0.023)		(0.035)
AnnouncedTBT$\times Size_{BIG}$		0.273^a		-0.013		0.095^a
		(0.137)		(0.013)		(0.036)
asinh(tariff)	-0.05^a	-0.053^a	0.001^a	0.001^a	0.001^a	0.001^a
	(0.002)	(0.002)	(0.0005)	(0.001)	(0.0005)	(0.001)
Obs.	4,214,856	4,214,856	2,522,245	2,522,245	2,418,685	2,418,685
Adj. R2	0.26	0.26	0.11	0.11	0.11	0.11
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
HS2-Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Export is in log, so the marginal effect of a dummy reads $100(e^{\beta}-1)\%$, with β being the coefficient on the dummy. Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 since who exits does not export in the period. Significance levels: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$.

We then distinguish unnotified measures as those that after k-periods from the introduction have no notification. This might occur either because it will be provided afterwards or because it will never been notified:

$$SurpriseTBT^{LN}_{HS4,d,t,k} = \mathbb{1}[\text{if } K^{SurpriseTBT}_{HS4,d,t} = k] \times \mathbb{1}[\text{if semester}(N_{HS4,d}) \geq s \text{ or } N_{HS4,d} = NA].$$

We estimate a semi-dynamic model with short run effects after the introduction of the Surprise TBTs, which distinguishes the two groups:

$$\begin{aligned} y_{i,HS4,d,t} = \beta_0 SurpriseTBT_{HS4,d,t} + \sum_{k=1}^{A-1} \beta^{LN}_k SurpriseTBT^{LN}_{HS4,d,t,k} + \\ \sum_{k=1}^{A-1} \beta^{UN}_k SurpriseTBT^{UN}_{HS4,d,t,k} + \sum_{k=0}^{A-1} \alpha_k \mathbb{1}[\text{if } K^{AnnouncedTBT}_{HS4,d,t} = k] + \\ + \delta asinh(\text{tariff}_{HS4,d,t}) + \mu_{HS2,t,d} + \mu_i + \epsilon_{i,HS4,d,t} \end{aligned} \quad (9)$$

We are here interested in comparing β^{UN}_k and β^{LN}_k, to see whether the average effect of Unnoitifed TBT is more persistent – significant for a longer k – than the case of Late Notified TBTs.

7.2 Results and discussion

Columns 1 to 3 of Table 7 reports the estimates of the coefficients of model 9 when we increase at each stage by one the number of forward periods (A). For those measures that are notified, the drop in the export value lasts just one semester, the one in which the Surprise TBT occurs. On the other hand, the effects of unnotified measures last longer, also during the subsequent period. This suggests that indeed notifications play a role in reducing the value of the wait option. An alternative explanation could be that the group of Unnotified and Late Notified measures have different effects already at the moment of their enforcement. Table 17 in Appendix shows this not to be the case: the estimate of the lagged variables is almost the same (-0.28 versus -0.26) and indeed the p-vuale of the equality of coefficients is around 90%. In other words, while Surprise measures hit firms in an equivalent way, independently of whethter they will be or not notified in the following months, the fact of being disclosed within the semester makes the effects to not persist to the successive one.

8 Conclusion

The findings of this paper support the view that, depending on how changes in technical regulations are promoted internationally, trade effects on exporters may be very different. When TBTs are introduced in a less transparent way, they cause a temporary stop of the exporting activity of firms. Only large firms are able to wait. Small and medium firms tend instead to exit permanently the export market. In accordance with the temporary nature of this lack of information, the adverse effects are only short-lasting, encompassing at most two semesters. The provision of formal documentation from the introducing country, solves the uncertainty and allow firms to restore their exporting activity. We interpret this temporary halt

Table 7: Export, semi-dynamic for Unnotified and Late Notified

	(1) Export	(2) Export	(3) Export
$SurpriseTBT_{HS4,d,t,k=0}$	-0.269^{c}	-0.268^{c}	-0.267^{c}
	(0.14)	(0.14)	(0.14)
$SurpriseTBT^{UN}_{HS4,d,t,k=1}$	-0.310^{a}	-0.320^{a}	-0.321^{a}
	(0.119)	(0.135)	(0.135)
$SurpriseTBT^{LN}_{HS4,d,t,k=1}$	0.0936	0.0951	0.0924
	(0.193)	(0.194)	(0.194)
$SurpriseTBT^{UN}_{HS4,d,t,k=2}$		-0.186	-0.294
		(0.173)	(0.255)
$SurpriseTBT^{LN}_{HS4,d,t,k=2}$		0.0192	0.0152
		(0.177)	(0.177)
asinh(tariff)	-0.0520^{a}	-0.0514^{a}	-0.0508^{a}
	(0.00204)	(0.00206)	(0.00210)
N	3965137	3819196	3666606
adj. R^2	0.261	0.262	0.262
Firm FE	Yes	Yes	Yes
HS2-Country-Time FE	Yes	Yes	Yes

Notes: K are the number of semesters after the introduction of a TBT. The superscript UN and LN are used to distinguish the two types of Surprise TBT, Unnotified and Late Notified ones. Estimates for AnnouncedTBT and the relative forward window are not shown. The definition of the sample is described in Appendix. Export is in log. Standard errors in parenthesis are clustered at (HS4,country,Time). Significance levels: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.

as due to the fact that, in face of a rise in uncertainty, firms postpone their export decision to the time in which they have access to more information.

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A Construction of the Database

A.1 Procedure to search timestamps in the content of the concern.

The content of the Minutes that we use is a text variable provided in the STC database.[52] The algorithm that parse them look at all possible timestamps contained in the text. We then had to go over them manually to decide whether those dates where indeed the one of interests. In case no relevant dates are provided we label the measures based on the content of the Minutes in 3 ways: (i) 'Y' if the measure is already in force (ii) 'NY' not yet in force and (iii) 'NA' not available. The first case labels those measure that are declared to be in force in the text of the Minutes, even if no specific dates are provided. The second case, labels those measure that are declared to still be under a process of drafting. The third case labels those measure that do not provide sufficient information to distinguish between the above cases. For those measures that are declared in force yet, we assume that the enforcement has occurred in the semester in which the concern has been raised for the first time, since it is plausible that, as no draft is provided, the country is complaining about the entry into force of a new measure.

A.2 Estimation sample for the (semi)dynamic models

Due to the leads of lags of the treatment indicator in an event study framework, information on the treatment needs to be observed for a longer observation window than for the dependent variable. To identify the window of estimation we follow the guidelines on Data Requirement in Schmidheiny and Siegloch (2019) "For a given balanced panel of the dependent variable from $[\underline{s}, \bar{s}]$ and an effect window $[\underline{l}, \bar{l}]$, we need to observe events from $\underline{s} - \bar{l} + 1$ to $\bar{s} + |l| - 1$. If events are derived from changes in policy variables, i.e. treatment status, we need to observe treatment status from $\underline{s} - \bar{l}$ to $\bar{s} + |l| - 1$". The intuition behind this requirement is the following. Imagine that a technical regulation is introduced in October 1994. When we estimate a (semi)-dynamic model with, for example, three leads after the event ($l = 3$), we are assuming that there are short term effects up to three semesters from the introduction. This means that we follow those market up to the first semester of 1996, including them in the treated group. If we do not have information on regulation before 1995, then, we can not distinguish, at the beginning of our sample, those market that are still experiencing short term effects from those that are not. To avoid this, we will estimate our model on the window starting from $s = 3$, after all unobservable post effects have faded away."

B Baseline Tables

C Motivation Table

Data is aggregated at the $HS4, d, t$ level, which is summing exports value across firms. We then run the following specification:

[52] In Figure 9 you can find an example of the extracted text associated to a concern.

Table 8: Dynamic and semi-dynamic model estimates

	(1) Export	(2) Export	(3) Export	(4) Exit	(5) Exit	(6) Exit
$L^{AnnouncedTBT}_{HS4,d,t} = 3$	0.104		0.118	0.0156		0.0132
	(0.126)		(0.126)	(0.0159)		(0.0158)
$L^{AnnouncedTBT}_{HS4,d,t} = 2$	-0.0463		-0.0430	0.00950		0.00950
	(0.112)		(0.111)	(0.0210)		(0.0209)
$L^{AnnouncedTBT}_{HS4,d,t} = 1$	-0.0616		-0.0589	0.0876^{a}		0.0883^{a}
	(0.111)		(0.111)	(0.0310)		(0.0308)
$L^{AnnouncedTBT}_{HS4,d,t} = 0$	0.431^{b}	0.232^{b}	0.435^{b}	-0.0163	-0.00933	-0.0158
	(0.193)	(0.111)	(0.193)	(0.0145)	(0.0123)	(0.0145)
$L^{SurpriseTBT}_{HS4,d,t} = 3$	0.0300		0.0308	0.000337		0.0131
	(0.161)		(0.176)	(0.0271)		(0.0296)
$L^{SurpriseTBT}_{HS4,d,t} = 2$	-0.173		-0.172	0.0493		0.0756
	(0.146)		(0.161)	(0.0423)		(0.0490)
$L^{SurpriseTBT}_{HS4,d,t} = 1$	-0.204		-0.207	0.0201		0.0171
	(0.133)		(0.139)	(0.0986)		(0.106)
$L^{SurpriseTBT}_{HS4,d,t} = 0$	-0.366^{b}	-0.271^{c}	-0.504^{a}	0.00388	0.0393	-0.00491
	(0.150)	(0.147)	(0.130)	(0.0323)	(0.0315)	(0.0334)
$K^{AnnouncedTBT}_{HS4,d,t} = 3$		-0.0374	-0.0421		0.0386	0.0530
		(0.124)	(0.136)		(0.0291)	(0.0303)
$K^{AnnouncedTBT}_{HS4,d,t} = 2$		-0.0222	0.0475		-0.0112	-0.0176
		(0.115)	(0.124)		(0.0178)	(0.0283)
$K^{AnnouncedTBT}_{HS4,d,t} = 1$		0.111	0.100		0.0227	0.0402
		(0.127)	(0.121)		(0.0153)	(0.0267)
$K^{SurpriseTBT}_{HS4,d,t} = 3$		-0.218	-0.354		0.0399^{b}	0.0634
		(0.117)	(0.195)		(0.0190)	(0.0525)
$K^{SurpriseTBT}_{HS4,d,t} = 2$		-0.0576	-0.360		-0.0793^{b}	0.00273
		(0.151)	(0.217)		(0.0333)	(0.0568)
$K^{SurpriseTBT}_{HS4,d,t} = 1$		-0.175	-0.294		0.0181	0.0260
		(0.120)	(0.210)		(0.0167)	(0.0288)
asinh(tariff)	-0.0554^{a}	-0.0502^{a}	-0.0528^{a}	0.00148^{a}	0.000767	0.00120^{b}
	(0.00220)	(0.00214)	(0.00237)	(0.000508)	(0.000493)	(0.000542)
Obs.	3617360	3666606	3069085	2231765	2262662	1972190
adj. R^2	0.260	0.262	0.261	0.116	0.116	0.116
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
HS2-Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: L represents the lags, while K the leads, before and after the introduction of a TBT, respectively. The superscript $Antic$ and $Surp$ are used to distinguish the two types of TBT. Model (1) and (4) are semi dynamic backward models, (2) and (5) are semi dynamic forward model while (3) and (6) are dynamic models. Cols (3) and (6) are the estimates of Fig. 7 and 8. Export is in log. Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 since exit is defined for firms that have exported at least two subsequent periods. levels: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.

$$y_{HS4,d,t} = \sum_{l=-B}^{-1} \left(\alpha_l \mathbb{1}[L^{AnnouncedTBT}_{HS4,d,t} = l] + \beta_l \mathbb{1}[L^{SurpriseTBT}_{HS4,d,t} = l]\right) + \sum_{k=0}^{A+1} \left(\alpha_k \mathbb{1}[K^{AnnouncedTBT}_{HS4,d,t} = k] + \beta_k \mathbb{1}[K^{SurpriseTBT}_{HS4,d,t} = k]\right) + \delta asinh(\text{tariff}_{HS4,d,t}) + \mu_{HS4,t} + \epsilon_{HS4,d,t}, \tag{10}$$

where the variables are as defined for the full dynamic specification of 4. Note that here the model includes $(HS4, d)$ fixed effects and therefore exploits time variability within markets.

Table 9: Coefficients plotted in 7 Dynamic specification

$L^{AnnouncedTBT}_{HS4,d,t} = -4$	0.0877	$L^{SurpriseTBT}_{HS4,d,t} = -4$	-0.205*
	(0.0545)		(0.104)
$L^{AnnouncedTBT}_{HS4,d,t} = -3$	0.0247	$L^{SurpriseTBT}_{HS4,d,t} = -3$	-0.000434
	(0.0554)		(0.103)
$L^{AnnouncedTBT}_{HS4,d,t} = -2$	0.125*	$L^{SurpriseTBT}_{HS4,d,t} = -2$	0.0859
	(0.0575)		(0.0917)
$L^{AnnouncedTBT}_{HS4,d,t} = -1$	0.00353	$L^{SurpriseTBT}_{HS4,d,t} = 1$	0.275**
	(0.0591)		(0.0920)
$L^{AnnouncedTBT}_{HS4,d,t} = 0$	-0.0149	$L^{SurpriseTBT}_{HS4,d,t} = 0$	-0.295***
	(0.0618)		(0.0841)
$L^{AnnouncedTBT}_{HS4,d,t} = 1$	0.0918	$L^{SurpriseTBT}_{HS4,d,t} = 1$	-0.250**
	(0.0695)		(0.0819)
$L^{AnnouncedTBT}_{HS4,d,t} = 2$	0.0776	$L^{SurpriseTBT}_{HS4,d,t} = 2$	-0.112
	(0.0716)		(0.0807)
$L^{AnnouncedTBT}_{HS4,d,t} = 3$	-0.127	$L^{SurpriseTBT}_{HS4,d,t} = 3$	0.0127
	(0.0738)		(0.0820)
$L^{AnnouncedTBT}_{HS4,d,t} = 4$	-0.0232	$L^{SurpriseTBT}_{HS4,d,t} = 4$	-0.0185
	(0.0745)		(0.0818)
N			593490
adj. R^2		0.771	

Notes: Estimates are shown in two columns but all coefficients are estimated within the same specification as in eq 10. HS4-Country FE and Tariff level are included. L represents the lags, while K the leads, before and after the introduction of a TBT, respectively. The superscript $Antic$ and $Surp$ are used to distinguish the two types of TBT. Significance levels: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.

D Robustness checks Tables

Alternative definition of exit In our exercise, the time dimension is crucial, since we aim at capturing short term effects. Our definition of exit, instead, collapse past, present and future choices of firms into a single value. An exiting firm is one who chooses to exit today, as well as chooses to stay out of the $HS4, d$ market in the next 2 semesters. We here test alternatives definition of exit. To investigate the possibility of a short halt we define a "short exit" by looking only one period ahead: firms exit a market if they are present today but not in the next semester. We then investigate a "long exit": firms exit a market if they are not present for the next 3 semesters. Moreover, according to our definition of exit, an active exporter is one that has exported in the market consecutively in the last two semesters. In very seasonal markets, such as the air conditioning in Mexico discussed above, we have less active firms. We then define a "Seasonal Exit" if the firm had exported at least once between today and the last semester (once in the full year) while not in the full next one (short seasonal exit) or two (long seasonal exit). Across the board of Table 18 we observe that the only variable which is highly significant for all four alternative definitions of exit is the dummy that identifies one period before the introduction of an Announced TBT. The estimates become even larger when defining longer exit, up to around 9%, suggesting that once a firm decide not to comply with a certain regulation it will stay out from that market for long.

Table 10: Effects of Announced vs Surprise measures - Population of French exporters

DEPENDENT VARIABLE	Export_t		Exit_t		Exit_{s-1}	
	(1)	(2)	(3)	(4)	(5)	(6)
TBT	0.08		0.02		0.05^b	
	(0.09)		(0.02)		(0.02)	
SurpriseTBT		-0.24^a		0.02		-0.01
		(0.09)		(0.01)		(0.02)
AnnouncedTBT		0.13		-0.00		0.06^b
		(0.08)		(0.01)		(0.03)
asinh(tariff)	-0.05^a	-0.05^a	0.00^a	0.00^a	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	8,167,539	8,167,539	4,560,835	4,560,835	4,378,804	4,378,804
Adj. R2	0.32	0.32	0.28	0.28	0.28	0.28
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
HS2-Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Export is in log, so the marginal effect of a dummy reads $100(e^{\beta}-1)\%$, with β being the coefficient on the dummy. Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 since who exits does not export in the period. Significance levels: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$.

Table 11: Effects of Announced vs Surprise measures - Excluding Regulations on HS6

DEPENDENT VARIABLE	Export_t	Exit_t	Exit_{s-1}
	(1)	(2)	(3)
SurpriseTBT	-0.25^a	0.49^a	-0.01
	(0.10)	(0.02)	(0.02)
AnnouncedTBT	0.20	-0.00	0.10^a
	(0.14)	(0.01)	(0.04)
asinh(tariff)	-0.05^a	0.00	0.00
	(0.00)	(0.00)	(0.00)
Obs.	4,017,721	8,167,539	4,560,835
Adj. R2	0.29	0.30	0.18
Firm FE	Yes	Yes	Yes
HS2-Country-Time FE	Yes	Yes	Yes

Notes: Export is in log, so the marginal effect of a dummy reads $100(e^{\beta}-1)\%$, with β being the coefficient on the dummy. Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 since who exits does not export in the period. Significance levels: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$.

Table 12: Export, alternative set of fixed effects

	(1) Export	(2) Export	(3) Export
SurpriseTBT	-0.267^{b}	-0.299^{a}	-0.178^{a}
	(0.137)	(0.142)	(0.0687)
AnnouncedTBT	0.230^{b}	0.216	0.188^{a}
	(0.111)	(0.131)	(0.0713)
asinh(tariff)	-0.0527^{a}	-0.108^{a}	-0.0179^{a}
	(0.00201)	(0.00232)	(0.00176)
N	4214856	4215092	4249924
adj. R^2	0.261	0.094	0.221
Firm FE	Yes	No	Yes
HS2-Country-Time	Yes	Yes	No
Country-Time FE	No	No	Yes

Notes: Export is in log. Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 since exit is defined for firms that have exported at least two subsequent periods. levels: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.

D.1 Negative weighing

Table 13: Exit, alternative set of fixed effects

	(1) Exit_{s-1}	(2) Exit_{s-1}	(3) Exit_{s-1}
SurpriseTBT	0.00356	0.00674	-0.0121
	(0.0615)	(0.0639)	(0.0221)
AnnouncedTBT	0.0542^{a}	0.0550^{a}	0.0396^{a}
	(0.0198)	(0.0191)	(0.0114)
asinh(tariff)	0.00143^{a}	0.00143^{a}	-0.000388
	(0.000484)	(0.000459)	(0.000333)
N	2424981	2429888	2456379
adj. R^2	0.114	0.034	0.097
Firm FE	Yes	No	Yes
HS2-Country-Time	Yes	Yes	No
Country-Time FE	No	No	Yes

Notes: Standard errors in parenthesis are clustered at (HS4,country,time). The observations in cols 3 and 4 are larger than in 1 and 2 because of automatic drop of singletons. levels: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.

Table 14: Export, exclusion of TBTs by the coverage share of the fixed effect

	(1) Export	(2) Export	(3) Export	(4) Export
SurpriseTBT	-0.273^{b}	-0.256^{c}	-0.268^{c}	-0.256^{c}
	(0.137)	(0.139)	(0.140)	(0.147)
AnnouncedTBT	0.241^{b}	0.246^{b}	0.267^{b}	0.290^{b}
	(0.113)	(0.114)	(0.116)	(0.123)
asinh(tariff)	-0.053^{a}	-0.053^{a}	-0.053^{a}	-0.053^{a}
	(0.002)	(0.002)	(0.002)	(0.002)
N	4212139	4211987	4211893	4211524
adj. R^2	0.261	0.261	0.261	0.261

Notes: Cols represents estimation of the static specification over a sample of TBTs that cover no more than 90% (1), 80% (2), 70% (3) and 60% (4) observations within the $HS2, d, t$ category. Export is in log. Standard errors in parenthesis are clustered at (HS4,country,time). Significance level: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.

Figure 9: Example of the format of the Notification

WORLD TRADE ORGANIZATION

G/TBT/N/ARG/101
23 May 2003
(03-2765)

Committee on Technical Barriers to Trade Original: Spanish

NOTIFICATION

The following notification is being circulated in accordance with Article 10.6.

1.	**Member to Agreement notifying:** ARGENTINA **If applicable, name of local government involved (Articles 3.2 and 7.2):**
2.	**Agency responsible:** National Institute of Vitiviniculture **Name and address (including telephone and fax numbers and E-mail and Web site addresses, if available) of agency or authority designated to handle comments regarding the notification shall be indicated if different from above:** *Idem* National Enquiry Point
3.	**Notified under Article 2.9.2 [** X **], 2.10.1 [ ], 5.6.2 [ ], 5.7.1 [ ], other:**
4.	**Products covered (HS or CCCN where applicable, otherwise national tariff heading. ICS numbers may be provided in addition, where applicable):** Wine
5.	**Title, number of pages and language(s) of the notified document:** Wine – Sulphate Content (2 pages, in Spanish)
6.	**Description of content:** Establishes the maximum limits for sulphate content, expressed as potassium sulphate, both in wine that is in circulation and in wineries.
7.	**Objective and rationale, including the nature of urgent problems where applicable:** The need to establish, as an exporting country, the appropriate limits for these products through essential production and conservation techniques, as laid down by the International Organization of Vine and Wine (OIV).
8.	**Relevant documents:** INV Resolution No. 14/2003
9.	**Proposed date of adoption:** 30 April 2003 (Official Journal) **Proposed date of entry into force:** 8 May 2003
10.	**Final date for comments:** -
11.	**Texts available from: National enquiry point [**X**], or address, telephone and fax numbers and E-mail and Web site addresses, if available, of other body:** Punto Focal de la República Argentina Dirección Nacional de Comercio Interior (DNCI) Avda. J. A. Roca 651, Piso 4°, Sector 22 (1322) Buenos Aires Fax: 54 11 4349 4072 Tel.: 54 11 4349 4067 E-mail: focalotc@mecon.gov.ar Web site: http://www.puntofocal.gov.ar

Table 15: Exit, exclusion of TBTs by the coverage share of the fixed effect

	(1) $Exit_{s-1}$	(2) $Exit_{s-1}$	(3) $Exit_{s-1}$	(4) $Exit_{s-1}$
SurpriseTBT	0.003	0.002	0.005	0.003
	(0.061)	(0.062)	(0.063)	(0.065)
AnnouncedTBT	0.055^a	0.056^a	0.055^a	0.058^a
	(0.0200)	(0.0202)	(0.0204)	(0.0213)
asinh(tariff)	0.00141^a	0.00141^a	0.00141^a	0.00141^a
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
N	2,423,222	2,423,120	2,423,059	2,422,839
adj. R^2	0.114	0.114	0.114	0.114

Notes: Cols represents estimation of the static specification over a sample of TBTs that cover no more than 90% (1), 80% (2), 70% (3) and 60% (4) observations within the $HS2,d,t$ category. Export is in log. Standard errors in parenthesis are clustered at (HS4,country,time). Significance level: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$.

Table 17: Testing equality of coefficient between unnotified and late notified at the enforcement time

	Export
$SurpriseTBT^{LN}_{HS4,d,t-1,k=1}$	-0.279^a
	(0.0617)
$SurpriseTBT^{UN}_{HS4,d,t-1,k=1}$	-0.263^c
	(0.127)
asinh(tariff)	-0.0527^a
	(0.00225)
Obs.	4,214,856
adj. R^2	0.261
Firm FE	Yes
HS2-Country-Time FE	Yes

Notes: P-value under the equality of the coefficients for $SurpriseTBT^{LN}_{s-1,k=1}$ and $SurpriseTBT^{UN}_{s-1,k=1}$ is 0.8983. K represents the leads, with $k = 1$ being one period ahead. Since the variables of interest are lagged $(s-1)$, they estimates the effect of a SurpriseTBT in the period of enforcement, distinguishing between those TBTs that will be notified by the next semester, denoted with subscript LN and those that will not, denoted with subscript UN . Significance levels: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$.

Table 18: Alternative definitions of exit

	(1) Short	(2) Long	(3) Short Seasonal	(4) Long Seasonal
$L^{AnnouncedTBT}_{HS4,d,t} = 3$	0.0185	0.0172	0.0219	0.0218
	(0.0171)	(0.0171)	(0.0158)	(0.0165)
$L^{AnnouncedTBT}_{HS4,d,t} = 2$	-0.0249	0.0280	0.0253	0.0331^{b}
	(0.0167)	(0.0223)	(0.0172)	(0.0168)
$L^{AnnouncedTBT}_{HS4,d,t} = 1$	0.0571^{b}	0.0886^{a}	0.0691^{a}	0.0700^{a}
	(0.0222)	(0.0328)	(0.0253)	(0.0264)
$L^{AnnouncedTBT}_{HS4,d,t} = 0$	-0.0148	-0.0234	0.0314	0.0199
	(0.0168)	(0.0149)	(0.0191)	(0.0196)
$K^{AnnouncedTBT}_{HS4,d,t} = 1$	-0.00918	-0.000682	0.0118	0.00527
	(0.0243)	(0.0281)	(0.0199)	(0.0199)
$K^{AnnouncedTBT}_{HS4,d,t} = 2$	0.0255	-0.0169	0.0280	0.0325
	(0.0269)	(0.0276)	(0.0213)	(0.0180)
$K^{AnnouncedTBT}_{HS4,d,t} = 3$	0.0401	0.00903	0.0545^{b}	0.0547^{b}
	(0.0243)	(0.0267)	(0.0227)	(0.0243)
$L^{SurpriseTBT}_{HS4,d,t} = 3$	-0.0566	0.0603^{b}	-0.0463	-0.0229
	(0.0338)	(0.0265)	(0.0370)	(0.0342)
$L^{SurpriseTBT}_{HS4,d,t} = 2$	0.0153	0.0494	0.00433	0.00398
	(0.0336)	(0.0306)	(0.0297)	(0.0336)
$L^{SurpriseTBT}_{HS4,d,t} = 1$	-0.00702	0.0284	0.0179	0.0430
	(0.0707)	(0.115)	(0.0645)	(0.0479)
$L^{SurpriseTBT}_{HS4,d,t} = 0$	0.0107	0.0296	0.0491	0.0234
	(0.0225)	(0.0309)	(0.0382)	(0.0436)
$K^{SurpriseTBT}_{HS4,d,t} = 1$	-0.0242	0.0415	-0.0207	-0.0199
	(0.0378)	(0.0423)	(0.0313)	(0.0358)
$K^{SurpriseTBT}_{HS4,d,t} = 2$	-0.0327	0.0399	0.0562	0.0231
	(0.0603)	(0.0540)	(0.0386)	(0.0324)
$K^{SurpriseTBT}_{HS4,d,t} = 3$	0.0283	0.0388	0.0310	0.0364
	(0.0389)	(0.0260)	(0.0243)	(0.0230)
asinh(tariff)	0.00289^{a}	0.00111^{a}	0.00183^{a}	0.00155^{a}
	(0.0005)	(0.0005)	(0.0004)	(0.0005)
N	3370080	1523284	4673742	4673742
adj. R^2	0.101	0.121	0.090	0.091
Firm FE	Yes	Yes	Yes	Yes
HS2-Country-Time FE	Yes	Yes	Yes	Yes

Notes: L represents the lags, while K the leads, before and after the introduction of a TBT, where the subscript $Antic$ and $Surp$ are used to distinguish the two types of TBT. Short Exit is defined Standard errors in parenthesis are clustered at (HS4,country,time). The number of observations in cols change depending on the definition of exit, since . Significance level is $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$.