

# TBTs, Firm Organization and Labour Structure\*

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## Abstract

This paper investigates the effect of foreign shocks induced by the introduction of Technical Barriers to Trade (TBTs) in importing countries on exporting firms' occupational structure. We rely on Specific Trade Concern data to identify trade-restrictive TBT measures, combined with matched employer-employee data for French exporters in the period 1995-2010, and with information on product-destinations served by each exporter. Controlling for time-invariant firm/occupation effects and for time-varying sector/occupation shocks, 2SLS estimates show that exporting firms respond to the imposition of TBTs at destination by raising the share of managers at the expense of blue collars, white collars and other professionals.

**Keywords:** skill composition, labor demand, trade barriers, non-tariff measures

**JEL codes:** F13, F14, J23, J24

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# 1 Introduction

Trade shocks in export markets may affect the relative demand for skills (Burstein and Vogel, 2017; Harrigan and Reshef, 2015; Yeaple, 2005; Biscourp and Kramarz, 2007). Trade policies that impose new technological standards in destination markets may also affect the occupational structure of exporting firms, as they require to devise and implement new production and/or organizational processes. More specifically, new technological standards raise skill-intensive fixed export costs, due to the need to adapt the production process, as well as to additional coordination requirements and marketing needs: therefore, they alter the relative demand for skills.<sup>1</sup> This paper investigates the effects of shocks induced by the introduction of a specific class of Non-Tariff Measures (NTMs) in exporting countries, namely stringent Technical Barriers to Trade (TBTs), on firms' occupational structure.

Analyzing the employment effects of NTMs is extremely relevant in the light of their increasing importance. Trade policy has recently undergone profound transformations. Multilateral agreements, Preferential Trade Agreements and unilateral episodes of trade liberalization have limited the use of tariff measures as an instrument of trade policy. Therefore, policymakers increasingly resort to NTMs to obstacle trade and protect domestic producers.<sup>2</sup> NTMs imply non-negligible increases in trade cost, and often represent an impediment to trade (see World Trade Report 2012; Fontagné et al. 2015; Crivelli and Groeschl 2016; Fontagné and Orefice 2018; Grundke and Moser 2019).

Within NTMs, we focus on the most stringent TBTs identified here as those challenged by exporting countries in the dedicated WTO committee. TBTs are measures that impose technical requirements on exporting firms as they refer to technical regulations (and the related assessment of conformity) and specific characteristics of a product; such as quality, production process methods, labeling and packaging characteristics.<sup>3</sup> While these measures are not explicitly aimed at restricting trade, and are often actually intended to protect the environment, consumer safety and national security, in many instances they do act as effective trade barriers (see WTO (2012) for a survey) and even

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<sup>1</sup>Matsuyama (2007) argues that fixed export costs are skill intensive because they involve services and tasks related to marketing, research, communication and logistic knowledge. Brambilla et al. (2012) provide empirical evidence in support of this view.

<sup>2</sup>Pascal Lamy, the former Director General of the World Trade Organization (WTO), in his farewell statement in July 24 2013 evoked the increasing role of NTMs as potential protectionist policies: " *The issue today is with the difficulties involved in trade opening. Domestic trade politics have become more difficult and trade deals have become more complex because the nature of obstacles to trade has evolved. We are no longer negotiating just the reduction of tariffs, but also of non-tariff barriers, which have gained enormous importance*".

<sup>3</sup>In particular, a technical regulation is " *a document that sets out product characteristics or related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, process or production method*" (UNCTAD (2019)). The International classification of NTMs is available at: <https://unctad.org/en/Pages/DITC/Trade-Analysis/Non-Tariff-Measures/NTMs-Classification.aspx>. A detailed definition of TBTs is provided at: <https://unctad.org/en/Pages/DITC/Trade-Analysis/Non-Tariff-Measures/MAST-Group-on-NTMs.aspx>.

respond to reductions in import tariffs (Orefice, 2017; Francois et al., 2011; Beverelli et al., 2019).

Of course, not all TBTs are trade-restrictive, as they disseminate information on products' characteristics and reduce uncertainty to the benefit of the consumer. However, a subset of TBTs are restrictive enough (i.e. imply considerable increases in export cost), and potentially unjustified on safety or other acceptable grounds, such that exporting countries challenge them and are object of Specific Trade Concerns (STCs) in the dedicated committee at the WTO.<sup>4</sup> Trade *restrictive* TBT measures represent a particularly suitable example of increases in fixed export costs.<sup>5</sup> Since TBT measures affect the technical standards of products, complying with such measures requires specific professional figures. In this paper we explicitly look at how STCs on TBT (reflecting those measures that represent actual increases in fixed export costs) affect the occupational composition of firms.<sup>6</sup> To the best of our knowledge this is the first paper that studies the labor market consequences of restrictive NTMs on the labor demand of firms.

In the present paper, we exploit the variability of restrictive TBTs over time and their different occurrence in different markets – for a given category of products – as a trade shock for exporters. Our identification strategy relies on variation in the exposure of exporters to restrictive TBT measures (i.e. TBTs on which a concern has been raised) on their different markets. We observe the year in which the concern is raised at the WTO committee, and the duration of the case at the HS4 product category and destination level. Detailed French Custom data allow us to observe the portfolio of product-destination of exporting firms, from which we build firm-level time-varying measure of exposure to trade-restrictive TBTs.

To properly identify the effects of such trade obstacles, we need to isolate the impact of TBTs from the impact that other determinants of export behavior have on the occupational composition of the firm. So, other trade obstacles, such as tariffs at destination, are explicitly controlled for in

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<sup>4</sup>Specific Trade Concerns (STCs) on TBTs are cases raised at the WTO TBT Committee by a complaining country (one or more) against a technical standard imposed by another WTO member state on a (claimed) unjustified basis. An example of STC on a TBT measure is the concern raised by European Union in 2011 at the dedicated TBT WTO committee on Australia's Tobacco Plain Packaging Bill that fixed the size of tobacco products' packaging to be sold in Australia.

<sup>5</sup>In earlier work, Fontagné and Orefice (2018) have shown that trade restrictive TBTs impact mainly the extensive margin of trade for French companies, with a small (weak) effect on the intensive margin. The same conclusion holds in sector-aggregated estimations. In the framework of trade models with heterogeneous firms (Chaney 2008), this outcome is consistent with an increase in fixed rather than variable export costs, and justifies interpreting the imposition of new TBTs as an increase in fixed export costs.

<sup>6</sup>While TBTs arguably raise *fixed* export cost, other NTMs, such as Sanitary and Phyto-Sanitary or the Pre-Shipment Inspection measures represent a mix of fixed and variable export cost (see Fontagné et al. 2015 and 2020), and therefore are less likely to affect firms' skill intensity. TBTs differ from Sanitary and Phyto-Sanitary measures (SPS) as the former relate to technical standard of mainly manufacturing products, while the latter concern mainly food and agri-food product and their ingredient composition (contents of pesticides, ingredient mix, etc). Therefore, from a purely economic perspective, while the imposition of a TBT implies almost exclusively a rise in the fixed export cost (see Fontagné and Orefice 2018), the imposition of an SPS implies an increase in both variable and fixed export costs (see Fontagné et al. 2015).

the empirical exercise.<sup>7</sup> Beyond trade, we also need to control for technological shocks potentially affecting the within-firm job composition. Our empirical approach relies on the assumption that such technological shifts are sector $\times$ occupation $\times$ year-specific and fully captured by a set of time-varying sector-occupation effects. Finally, other unobserved firm-specific (time-invariant) characteristics, such as average productivity, management structure and the quality of managers are captured by firm $\times$ occupation-specific fixed effects.

Despite this rich set of controls, an endogeneity concern may arise if the lobbying activity of firms determines which TBT measure is challenged at the WTO committee. This concern is strongly reduced in our study for two reasons. First, EU-raised STCs are unlikely to be affected by a specific French firm. Second, firm fixed effects fully control for the average (time-invariant) lobbying power of each firm. An additional concern originates from the fact that the number of TBTs that each firm faces may depend on the choice of the markets served by each firm. Insofar as self-selection into high- or low-TBT intensive destinations depends on time-invariant factors, such as managerial ability, this is captured by firm fixed effects. To further address any remaining reverse causality concern and the possibility of endogenous selection of firms into destination markets induced by time-varying firm-specific shocks, we propose an Instrumental Variable approach in which the presence of a EU-raised TBT Specific Trade Concern is instrumented by the presence of a Non EU-raised STC. Such an instrument is unlikely to be correlated either with firm-level shocks triggering entry in destination markets or with the lobbying power of French firms.<sup>8</sup> This reassures on the validity of the instrumental variable. However, any causality claims must be taken with a grain of salt, as they rely on the (untestable) assumption that the exclusion restriction holds.<sup>9</sup>

We gather firm-specific information from several individual- and firm-level data sources from France. We measure the composition of the workforce in French firms in terms of professional categories exploiting the DADS (*Déclarations Annuelles des Données Sociales*), a matched employer-employee large-scale administrative database.<sup>10</sup> The professional categories include managers (further split in several subcategories), professionals, white collars, qualified blue collars and non qualified blue col-

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<sup>7</sup>Of course, the overall demand for labor may shift in reaction to changes in exports. Our analysis is not concerned with the impact of TBTs on the *level* of employment in exporting firms, but rather on the within-firm composition of the workforce.

<sup>8</sup>Of course, the fact that TBTs are raised by countries other than the EU, does not make the decision to enter the market exogenous. However, for our IV-based identification strategy to work, all we need is that the instrument is uncorrelated with the (endogenous) entry decision (i.e. that the exclusion restriction holds).

<sup>9</sup>We try and provide further confidence that our results are not picking up the endogenous selection of firms into specific destination markets, by showing results from two additional stratification sample checks, based on different subsets of firms with arguably homogeneous productivity levels or serving a stable set of destinations over time.

<sup>10</sup>We use the “DADS-postes”, which covers the universe of French firms. The drawback is that some individual characteristics of employees, such as education, are not observable.

lars.<sup>11</sup> We also exploit information on the list of product-destinations served by each French exporter over the period 1995-2010 (customs data provided by the *Direction Générale des Douanes et Droits Indirects*, DGDDI). Finally, as mentioned above, we rely on *restrictive* TBTs as revealed by Specific Trade Concern, at HS 4-digit and by destination, so that for each firm we are able to compute the number of exported varieties (i.e. product-destination combinations) under technical standards (TBT) that really imply an increase in the cost of exporting due to additional complexity of the firm's process (i.e. cost of complying to the technical standard).

Controlling for firm $\times$ occupation-specific time-invariant unobserved heterogeneity, time-varying sector $\times$ occupation shocks, and tariffs at destination, we find that one additional Specific Trade Concern on TBT implies a 0.3 percentage point increase in the firm's share of managers (i.e. the top hierarchical layer). When instrumenting the EU-raised TBTs faced by French firms in a given destination-sector with the TBTs raised by non-EU countries in the same destination-sector to account for residual endogeneity concerns, we find that one additional TBT concern increases the share of managers by 1 percentage point, i.e. a non-negligible 5% and 7% increase in the share of managers in firms facing, respectively, at least one TBT and no TBTs at baseline. The average increase in the share of managers in the firm facing a restrictive TBT is matched with a decrease in the share of all other occupational groups (in particular qualified and non-qualified blue collar occupations).

Interestingly, when we break down managers into finer occupational categories, we find that exporters affected by TBTs at destination resort to higher shares of both salaried heads of enterprise (CEOs and firm directors) and engineers. This result indicates that firms respond to the increased complexity caused by more stringent TBTs (i.e. adaptation cost) by raising the proportion of workers in managerial and technical positions employed at the highest hierarchical layer. Our findings are in line with previous literature highlighting the skill-intensive nature of fixed export costs (Matsuyama, 2007; Brambilla et al., 2012). We add to this stream of literature by characterizing the specific occupational groups (among skilled workers) that are used by firms to overcome the TBT-driven increases in fixed export costs.

This paper bridges together two strands of literature. The first is the one on the labor market consequences of trade. While early empirical studies in this literature suggested that such effects were small, with the increasing wage inequality of the last decades of the previous century being ascribed to skill-biased technological change, recent evidence has challenged this view. There is now growing consensus that in the US manufacturing sector, over the period 1991-2011, local labor markets

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<sup>11</sup>See section 2.2 for detailed description of occupation groups.

highly exposed to import competition from China experienced larger job losses than less exposed areas (Acemoglu et al., 2016; Autor et al., 2013). More generally, the polarization of the labor market has been explained by the combination of trade and technological progress (both trade exposure and the share of hours worked in technology-related occupations grew hand in hand implying the difficulty to disentangle their respective responsibilities).<sup>12</sup>

Due to the scant availability of data on firms' employment and workforce composition, relatively little attention has been devoted to the effect of trade shocks on the *occupational composition* of firm.<sup>13</sup> One (first) notable exception is Friedrich (2021) that investigates the effects of trade shocks on within-firm wage inequality. He uses a trade shock happening in Denmark in 2006, the Cartoon Crisis, to show that the drop in exports of firms that traded with Muslim countries caused wage compression associated with a reduction in the number of hierarchical layers within the firm. A (second) notable exception is Sforza (2020) that studies how firms adjust their organizational structure in response to negative shocks. He compares a credit supply shock with a trade (China) shock. While the former is found to affect high-skilled workers more than low-skilled workers, the latter is found to reduce employment at all levels.

We complement this literature, first, by analyzing the effect on the relative demand for skills of a different type of shock, namely Non-Tariff Measures, that has the potential to raise skill-intensive fixed costs; second, by investigating the effects of the trade shock on the *export* (rather than on the import) side, a relatively underinvestigated aspect.<sup>14</sup> We show that NTMs do tilt the relative demand for skills of exporting firms, inducing them to raise the share of managers at the expense of blue collars, white collars and professionals. This is probably due to the fact that high-skill workers, such as engineers, are needed to adapt the production process to the new technical standards.

The second strand of literature we touch upon is the one that argues that firms organize production in knowledge-based hierarchies (Garicano, 2000; Caliendo and Rossi-Hansberg, 2012) and predicts that

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<sup>12</sup>Using data on 16 Western European countries, Goos et al. (2014) study the role of off-shoring and technological change on the job polarization of EU labor markets over the period 1993-2010. They show the rise in employment shares for high-paid professionals, managers and low-paid personal service workers; and the contemporaneous fall in the employment share for manufacturing routine office workers. Using matched French employer-employee data from 1994 to 2007, Harrigan et al. (2020) find a polarization pattern particularly detrimental to middle wage occupations. Using matched employer-employee Danish data over the period 1999-2009 Keller and Utar (2016) attribute one sixth of the decline in mid-skills workers employment to the Chinese import competition. Kerr et al. (2019) show that the job polarization pattern observed in Finland over the period 2000-2014 has been fueled by the dynamics of entry firms for the low-level service tasks increase, and by continuing firms for the high-level abstract tasks.

<sup>13</sup>Trade shocks may also affect the portfolio composition of exporting firms. This channel has also been analyzed in (Bernard et al., 2011; Mayer et al., 2014; Fontagné et al., 2018).

<sup>14</sup>Exceptions in this respect are Bas and Bombarda (2013) and Maurin et al. (2002) who consider the labor market consequences of trade liberalization at destination. More recently, Feenstra et al. (2019) use US data between 1991 and 2011 and show that export expansion creates new jobs that, at the industry level, largely offset the job loss due to Chinese import competition. The net effects is instead found to be negative at the community zone level. None of these papers focuses on the relative demand for skills within the firm.

firms react to shocks by managing the number of layers in the organization.<sup>15</sup> We add to this literature by looking at whether firms respond to Technical Barriers to Trade by increasing managerial complexity and find that exporting firms that face a higher number of technical standards at destination expand the share of managers in total employment, i.e. they reshape the organizational pyramid with the top layer growing at the expense of lower-tier layers.<sup>16</sup>

The paper proceeds as follows. Section 2 describes the data and presents basic descriptive statistics. Section 3 discusses the empirical strategy. Section 4 presents our results on the occupational composition of firms and on the number of hierarchical layers. Section 5 concludes.

## 2 Data description and sample selection

In this section we present the data employed in our empirical exercise. WTO Specific Trade Concerns and French Customs data are presented in section 2.1. In section 2.2 we discuss the matched employer-employee data and the workers' occupation classification adopted to define the employment shares by occupation category. In section 2.3 we present some descriptive statistics concerning the presence of TBT barriers.

### 2.1 Specific Trade Concerns on TBT

We use Specific Trade Concern (STC) data released by the WTO to identify trade *restrictive* Technical Barriers to Trade.<sup>17</sup> All the WTO member states have the possibility of raising a concern at the TBT WTO Committee against a technical standard imposed by another member (STC).<sup>18</sup> The TBT WTO Committee usually holds three formal meetings per year. Meetings are open to all WTO members, governmental observers and intergovernmental organization, and analyze each concern raised by member states (i.e. technical standard affecting complaining country's trade), and deliberate on

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<sup>15</sup>Using French data, Caliendo et al. (2015) find evidence that French manufacturing firms grow by actively managing the number of layers in their organization, while Caliendo et al. (2020) find that expanding Portuguese firms add layers of (middle) managers.

<sup>16</sup>The present paper also adds to the literature on the relationship between executive team structure, market competition and firm's product choice (Guadalupe et al., 2014; Bresnahan et al., 2002; Guadalupe and Wulf, 2010), and to the literature studying the link between management practices and propensity to export that finds that management is disproportionately more important for trade operations than for domestic ones (Bloom et al., 2021).

<sup>17</sup>We discard trade concerns raised on Sanitary and Phytosanitary measures (SPSs) because they constitute a mix of fixed and variable costs with unclear expected consequences on the occupational structure of firms. Following Matsuyama (2007) we do expect only fixed export cost related shocks affect the skill composition of firms. SPSs are mostly related to the contents of food products (ingredient mix) and do not concern technological and/or technical standard to be complied with (small fixed costs component attached to SPS). Indeed, as showed in Fontagné et al. (2015) the imposition of a new SPS measure implies a mix of variable and fixed costs for the exporting firms.

<sup>18</sup>Notice that raising a STC is a prerogative of member states. Single firms are not allowed to raise autonomously STC at the WTO committee. The possibility that a single firm might lobby its government to raise a STC is discussed in section 3 and addressed by both the inclusion of firm fixed effects and our IV strategy.

whether the challenged technical standard is legitimately imposed or not.<sup>19</sup> If not, the imposing country has to remove the technical standard.<sup>20</sup> STC are therefore raised by complaining country only if the underlying standard has a non-negligible negative effect on trade. For this reason, by focusing on TBT STC we rely only on technical standards entailing a considerable trade costs (adaptation to the technical standard) for exporting firms.

When one or several WTO members raise a concern at the TBT WTO Committee over a non-tariff measure, they specify the country imposing the measure, the product of concern and the objective of the measure concerned.<sup>21</sup> All this information is recorded and made available by WTO.<sup>22</sup>

A collection of all STCs provides a systematic set of all the TBT measures perceived as sizable trade barriers by exporters. Indeed, the measures have to be sufficiently important for exporting countries to raise a “concern” at the WTO. For this reason, we can be fairly sure that our data do identify *barriers* to trade. This is an important advantage with respect to using other TBTs sources based on exhaustive list of measures in place. Indeed other datasets (as TRAINS or Perinorm), by listing all the measures imposed by a country, mix together measures that restrict trade with those that might even increase trade.<sup>23</sup> An example of STC on a TBT measure is the concern raised by Peru in 2001 against EU. The Peruvian government complained at the WTO committee against the EEC regulation 2136/89 that prevented Peruvian exporters to use the trade description “sardines” for their products (i.e. “sardinops sagax sagax” according to the *Codex Alimentarius standards*). This measure was solved with a mutually recognition.<sup>24</sup> Another example of STC TBT measure is the concern raised by EU in October 2010 against the China’s new General Safety Technical Code for Textile Products.<sup>25</sup> This measure fixed a mandatory limit PH value for textile products and banned the use of aromatic Amines 2.4 and 2.6 Xylidine in textile products. The complaining country considered this measure more trade restrictive than necessary, and asked for scientific evidence supporting the TBT measure.

Overall, the TBT-STCs database contains information respectively on 318 specific trade concerns raised over the period 1995-2010. For each concern, we have information on: (i) the country raising the concern,<sup>26</sup> (ii) the country imposing the measure, (iii) the product codes (HS 4-digit) involved

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<sup>19</sup>The discussion at the WTO Committee can be on existing (in force) or in the pipeline TBT measures.

<sup>20</sup>Information and official documents concerning each TBT STC are publicly available through the TBT Information Management System of the WTO. See <http://tbtims.wto.org/>

<sup>21</sup>The TBT committee provide to WTO members a forum where discussing issues related to technical measures imposed by other members.

<sup>22</sup>The STC dataset is available at [http://www.wto.org/english/res\\_e/publications\\_e/wtr12\\_dataset\\_e.htm](http://www.wto.org/english/res_e/publications_e/wtr12_dataset_e.htm).

<sup>23</sup>Technical standards might reveal consumer tastes at destination.

<sup>24</sup>See [https://www.wto.org/english/tratop\\_e/dispu\\_e/cases\\_e/ds231\\_e.htm](https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds231_e.htm)

<sup>25</sup>See document G/TBT/N/CHN/20/Rev.1.

<sup>26</sup>Each concern can be raised by one or more countries. In few cases, the same STC is raised by both EU and non-EU countries.

in the concern,<sup>27</sup> (iv) the year in which the concern has been raised to the WTO and (iv) whether it has been resolved and how. So we build a panel dataset tracking the presence of an ongoing STC on TBT for a specific country pair (imposing-complaining country) and product combination over time.<sup>28</sup> Then we disentangle the STCs raised by EU (which are the relevant ones for French firms exports) from those raised by non-EU countries (used to build our instrumental variable in what follows). Finally, we collapse this dataset by HS 4-digit, destination and year, keeping the information on whether a given product-destination combination has at least one ongoing STC on TBT raised by EU and/or extra-EU member (in a given year). Importantly, concerns are raised, then discussed in the committee, and withdrawn after a while, generally based on a gentleman agreement amending the regulation. Some concerns failed to be fixed, and nevertheless the case may disappear if the exporting country considers that it cannot be solved and that its exporters will adjust and comply. Notice that a concern is considered solved by the WTO if it is not raised in the dedicated TBT committee for two years or more. Then, the date of the last raising at the TBT committee is assumed to be the date of the resolution of the STCs.<sup>29</sup>

The STC TBT dataset is then used to compute the number of stringent TBTs faced by each French exporter. To this end we matched STC data with French Custom data providing information on the list of product-destination served by a given French exporter over the period 1995-2010.<sup>30</sup> For each firm we have information on the export value into a given product-destination. The dataset classifies product categories using Combined Nomenclature at 8 digits (CN8) but it has been aggregated here at HS 4-digit level to be consistent with the STCs dataset. Then we merge individual exports with STCs by HS 4-digit and destination, so that for each firm we computed the number of exported varieties (i.e. product-destination combinations) affected by a TBT-STC. Each firm has a unique identification code (“SIREN”) that allows us to match custom/STC data with DADS data discussed in the next section.

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<sup>27</sup>Given the nature of our exercise, ideally one should use a more disaggregated product classification. French custom data are provided at HS 6-digit level, and this would be the ideal product-aggregation to test whether a firm is affected by the presence of a technical standard at destination. However, in the STCs notified at the WTO the sector information is almost exclusively reported at the broad HS 4-digit level (only very few STCs give information at HS 6-digit level).

<sup>28</sup>This represents an additional advantage to the use of alternative dataset (e.g. by WITS) who provide only cross-sectional information on the presence of TBTs.

<sup>29</sup>The publicly available dataset does not include the year of resolution of STCs. On this respect we benefited from a confidential data by the WTO, in which a STCs on TBT is assumed to be solved if it is not raised in WTO committee for two years or more. The date of the last raising at the TBT committee is assumed to be the date of the resolution of the STCs. In our dataset, the great majority of STC on TBT last between 2 and 3 years.

<sup>30</sup>Provided by the DGDDI (*Direction Générale Des Douanes et Droits Indirects*), these data are subject to statistical secrecy and are quasi exhaustive of the universe of French exporters. There is only a declaration threshold of 1000 euros that applies to any extra-EU destinations (for European countries such threshold is higher and around 150000 euros).

## 2.2 Matched employer-employee data

We measure the composition of the workforce in French exporting firms using the DADS (*Déclarations Annuelles des Données Sociales*), a matched employer-employee large-scale administrative database. These data are based upon mandatory employer reports of the earnings of each employee subject to French payroll taxes which essentially apply to all employed persons in the economy (including self-employed). Each observation in DADS corresponds to a unique individual-plant combination in a given year, with detailed information about the plant-individual relationship, including the number of days during the calendar year that the individual worked in that plant, the (gross and net) wage, the type of occupation (classified according to socio-professional categories), the full time/part time status of the employee. Moreover, it provides the fiscal identifier of the firm that owns the plant, the geographical location of both the employing plant and firm, as well as the industry classification of the activity undertaken by the plant/firm. The data span the 1995-2010 period. Since we are interested in the job composition of firms, we have to disregard micro-firms. For this reason we restrict the analysis to companies having at least 5 employees after removing workers with missing and zero gross wages.

Before moving to the descriptive and econometric evidence, we need to clearly define the occupation groups considered in what follows. Based on the French occupation classification (*Catégories Socioprofessionnelles*, CS 2-digit), we follow Caliendo et al. (2015) and categorize workers on the basis of their hierarchical level in the organization, which mimics (although imperfectly) the skill content of occupations within a firm. To this purpose, as shown in Table A1, we define five occupational categories: (i) *managers* (PCS codes from 21 to 38, including CEO, sales executives, engineers and other managers), (ii); *professionals* (PCS codes from 42 to 48, including technicians and administrative and sales intermediate professionals), (iii) *white collars* (PCS codes from 53 to 56, including administrative and sales employees), (iv) *qualified blue collars* (PCS codes from 62 to 65, including qualified production workers), (v) *non-qualified blue collars* (PCS codes from 67 to 69, including non-qualified production workers).<sup>31</sup>

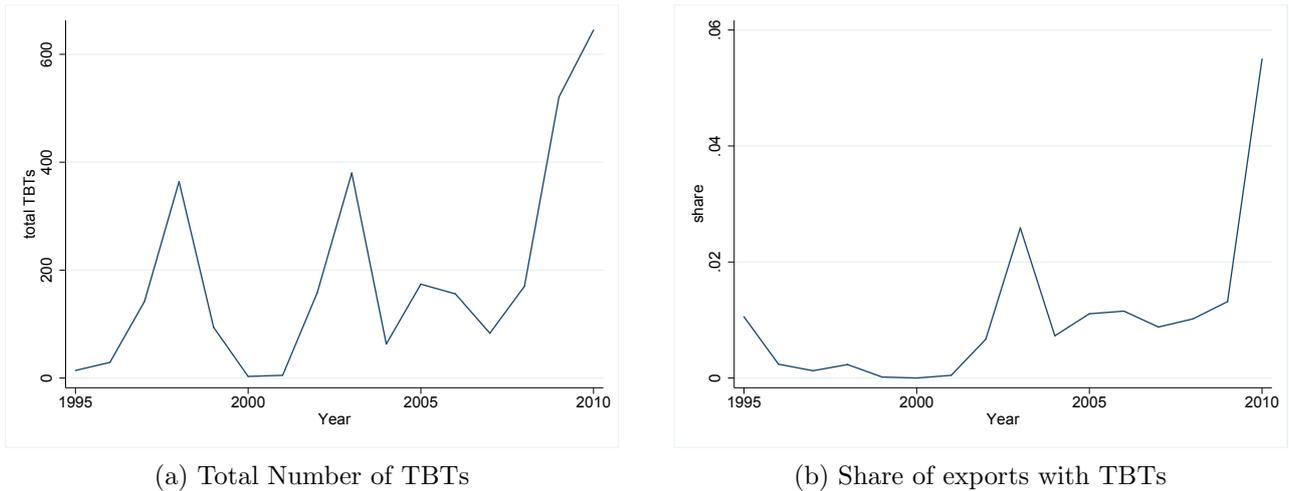
## 2.3 Descriptive statistics

This section aims at showing the relevance of restrictive TBTs for French firms, and a first descriptive evidence of the correlation between the imposition of TBTs at destination and the occupational composition of French firm.

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<sup>31</sup>A full list and description of the French occupation categories defined by the French Statistics Institute (INSEE) can be found here: <https://www.insee.fr/fr/information/2406153>.

Figure 1: TBTs: total and share of exports



Note: number of sector-destination pairs under ongoing EU-raised STCs on TBT.

Note: share of total exports towards sector-destination with ongoing STC on TBT (coverage ratio).

Figure 1 shows two graphs: the left panel reports the evolution of the total number of destination-HS4 combinations with ongoing STCs on TBTs raised by the EU between 1995 and 2010,<sup>32</sup> while the right panel shows the evolution of the share of French exports towards destination-product combinations under active STCs on TBTs (share over the total value of French exports). To closely follow our econometric exercise, both measures are computed on the sample of HS4 sectors and firms used in the econometric estimations. The number of TBT concerns varies a lot over time, increasing to almost 400 concerns before the year 2000, decreasing to almost zero between 2000 and 2001 and then peaking again in 2003 and in 2009.<sup>33</sup> The peaks in 2003 and 2009 in the number of varieties under TBT STCs (left panel in figure 1) mirror into the relatively high share of French exports under TBT STCs observed in years 2003 and 2009 (right panel of figure 1). The large variation over time (and across products) of STC TBT measures is key for our identification strategy based on the within variation of TBT-induced change in fixed export cost (see the next section).

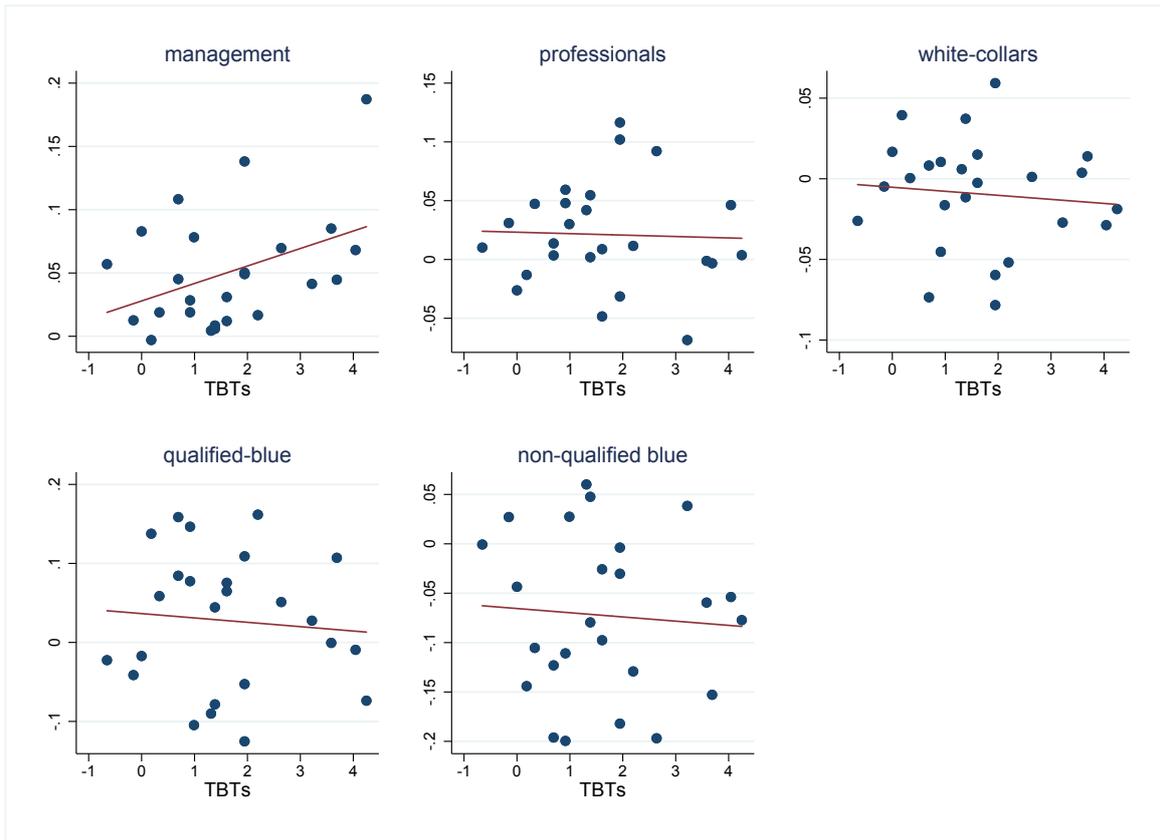
Figure 2 provides a visual representation of what we aim at testing in our econometric exercise. It plots the long-term difference between 2010 and 1995 in the average number of TBTs faced by a French firm belonging to a given HS 4-digit sector (horizontal axis),<sup>34</sup> against the same long-term change in the average share of employees by occupation group in each HS 4-digit manufacturing sector

<sup>32</sup>The left panel of figure 1 shows only active STCs on TBT. So, when TBT concerns are solved there is a decrease in the number of active TBTs.

<sup>33</sup>In 2000-2001 many concerns raised by the EU were resolved. In particular, the sudden reduction in the number of active TBT concerns in 2000-2001 is due to the resolution of two big STCs raised by the EU against measures imposed by Egypt on 219 HS4 chapters and solved in 2000-2001 (see minute G/TBT/Notif.98.206).

<sup>34</sup>For all French firms in each HS 4-digit sector and year, we calculate the number of destination-product combinations covered by TBT, and we compute the average across firms in our sample in each HS4-year combination. The horizontal axis of Figure 2 reports the 2010-1995 change of such averages.

Figure 2: TBTs and changes in the within firm employment composition



Source: Authors' calculations on DADS, WTO STCs and French Custom data. Note: in the vertical axis we report the change in the average share of employment (by type of occupation) across firms within a HS 4-digit sector. In the horizontal axis we report the change in the average number of TBTs faced by French firms over the period 1995-2010. Each point represents a 4-digit sector. Sectors without TBT or having zero change in TBT are not reported to the sake of readability (given the presence of firm fixed effects subsuming sector fixed effects, these sectors do not contribute to the identification of our econometric results).

(vertical axis). The figure shows that, in HS 4-digit sectors with more intense increases in the number of stringent TBT measures, we observe larger changes in the share of managers (panel 1), and smaller changes in the share of white-collars (panel 3), qualified and non-qualified blue collars (panel 4 and 5). Changes in the share of professionals reported in panel 2 seem to be uncorrelated with the change in the number of TBT faced by French firms. The correlations in Figure 2 (albeit weak) are consistent with the idea of firms changing their workforce composition, when hit by the imposition of technical standards at destination, towards managerial occupations.

Interestingly, Table 1 shows the absence of pre-trend in the shares of each employment category over the pre-treatment period (i.e. before the presence of TBT in at least one variety exported by the firm). The share of managers and non-qualified blue collar workers respectively increase and decrease just after the firm faces a new TBT measure among the exported varieties.

In Table 2 we report some in-sample descriptive statistics. We divide the sample into firms that

Table 1: Occupational shares before and after the TBT

	managers	professionals	white-collars	qualified blue	non-qualified blue
t-2	0.120 (0.098)	0.208 (0.112)	0.171 (0.173)	0.319 (0.170)	0.083 (0.069)
t-1	0.121 (0.097)	0.215 (0.108)	0.172 (0.168)	0.321 (0.166)	0.078 (0.066)
t0	0.131 (0.101)	0.215 (0.105)	0.163 (0.164)	0.326 (0.166)	0.075 (0.064)
t+1	0.132 (0.104)	0.216 (0.105)	0.151 (0.162)	0.329 (0.167)	0.074 (0.064)
t+2	0.134 (0.106)	0.218 (0.108)	0.147 (0.159)	0.328 (0.166)	0.076 (0.063)

Source: DADS, WTO STCs and French Custom data for 1995 to 2010. We report the average occupational share in each period before and after the introduction of the TBT (t0) and the standard error of employment share in parenthesis in each entry of the table.

serve sectors-destinations that have never been affected by Specific Trade Concern (last column of the table), and firms that have faced at least one TBT between the 1995 and 2010 (i.e. firms facing at least one TBT concern on one of its product-destination markets over the period). Firms experiencing at least one TBT concern face one average 1.76 TBT concerns. The second and third row of Table 2 show the number of firms and the percentage of firms in each column. As expected, firms facing STCs on TBT are the minority (12% of the sample). The rest of the table, for the sample of affected and non-affected firms, shows: (i) the sectoral distribution, (ii) the average employment share by macro-occupation, and (iii) the average trade friction (tariff and distance) and export margins.

We observe a total of 30,777 firms: among them, we have 3271 firms affected at least once by a restrictive TBT between 1995 and 2010.<sup>35</sup> When looking at the sectoral distribution of firms with concerns, as expected, the manufacturing of food, beverages and tobacco is over-represented in the sample with TBTs (i.e. share of firms facing at least one TBT larger than TBT-free firms). Looking at macro-occupations, the shares of managers and professionals are higher among firms with TBTs, while both the shares of qualified and non-qualified blue collars is lower. In general, firms in the TBT sample are serving relatively more distant destinations, face higher average tariffs, and export a wider portfolio of varieties than other exporting firms. This suggests that TBT-affected and TBT-free firms are substantially different in terms of observables and this, in turn, requires accurate econometric modeling to take care of potential unobserved heterogeneity. The next section discusses our empirical strategy.

<sup>35</sup>Although from French Custom data we observe more than one hundred thousands firms, the sample of firms shrinks considerably because we drop firms with less than 5 employees (as job composition does not make sense for micro-firms), and firms that do not appear in matched employer-employee DADS data (i.e. French exporters that are not obliged to declare their workforce composition).

Table 2: In-sample descriptive statistics

	At least one TBT	TBT-free
Average number of TBTs per affected firm	1.76	0
Firm/year observations	3,271	27,504
% of firms	11.9	88.10
<i>Sectoral distribution (%)</i>		
Manufacturing of food, beverages and tobacco	12.91	7.04
Manufacturing of of textiles and leather	24.97	13.30
Manufacture of wood, paper, publ./print	1.7	10.33
Chemical products, rubber, metals	21.65	36.64
Machinery and equipment	9.77	10.62
Manufacture of electrical and optical equipment	21.65	11.40
Transport equipment/furniture	7.37	10.68
<i>Occupations (%)</i>		
Share of managers	18.89	13.1
Share of professionals	23.51	20.18
Share of white collars	10.94	10.33
Share of qualified blue collars	29.15	33.94
Share of non qualified blue collars	17.31	21.95
Tariff	0.11	0.075
Market distance (km)	14,574	9,582
Number of market served	22.48	7.87
Number of varieties	75.32	17.10
<i>Observations</i>	5,118	161,260

Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

### 3 Empirical strategy

Our basic empirical specification borrows from Fontagné et al. (2015) with the caveat that the impossibility to attribute workers to the production of a specific good for a specific export destination forces us to work at the firm-year level (i.e. total number of firm’s product-market combinations under TBT concern). Our preferred specification addresses endogeneity issues adopting an IV approach. We now present the set up and the instrumental variable strategy sequentially.

#### 3.1 Basic set up

We estimate the following equation:

$$y_{i,t,k} = \alpha_{i,k} + \gamma_{s,t,k} + \beta_{1,k}TBT_{i,t-1} + \beta_{2,k}Tariffs_{i,t-1} + \varepsilon_{i,t,k} \quad (1)$$

where  $y_{i,t,k}$  is the share of the occupational category  $k$  in the employment (total number of workers) of firm  $i$  at time  $t$ .<sup>36</sup> The term  $\alpha_{i,k}$  is a firm×occupation fixed effect, and  $\gamma_{s,t,k}$  is a set of (1-digit) sector×year dummies specific to occupation  $k$ .  $Tariffs_{i,t-1}$  measures the average tariff level faced by each French firm across its exported products and destinations, and aims at isolating the effect of technical barriers to trade from traditional tariffs.<sup>37</sup> Specifically, we attach the tariff level faced by firm  $i$  in each of its product-destination combinations, and then take the simple firm specific average tariff across products and destinations served by the firm.<sup>38</sup>

The variable  $TBT_{i,t-1}$  measures the number of Specific Trade Concerns on TBTs faced by the firm  $i$  at time  $t - 1$ ,<sup>39</sup> measured as the sum of the EU-raised TBT Specific Trade Concerns faced in all the products-markets combinations in which the firm exports,  $TBT_{i,t-1} = \sum_{sj} I_{sj,t-1}^{TBT} \times I_{isj,t-1}^{EXP}$  where  $I_{sj,t-1}^{TBT}$  is a dummy variable equal to one if a EU-raised TBT STC is active in a product-market combination  $sj$  and  $I_{isj,t-1}^{EXP}$  is equal to one if the firm  $i$  exports into such a product-market combination.<sup>40</sup> Therefore our coefficient of interest,  $\beta_{1,k}$ , measures the impact of the number of TBTs faced by the specific firm on the share of workers employed in occupation  $k$ . Notice that

<sup>36</sup>Occupation groups are defined in section 2.2.

<sup>37</sup>We use effectively applied bilateral tariffs from MAcMap (CEPII) database ([http://www.cepii.fr/CEPII/fr/bdd\\_modele/presentation.asp?id=12](http://www.cepii.fr/CEPII/fr/bdd_modele/presentation.asp?id=12))

<sup>38</sup>We prefer to compute the simple rather than the weighted average across product-destination tariffs to avoid the endogeneity concern of any export-based weight used to compute the weighted average.

<sup>39</sup>We keep the number of TBTs at  $t - 1$  as we assume that any adjustment in the workforce composition of firms takes time. Taking the lagged number of concerns faced by the firm also reduces reverse causality concerns.

<sup>40</sup>We address the concern that the  $TBT_{i,t-1}$  variable may simply reflect the *total* number of destinations served by a given firm in Section 4.1, where we check the robustness of our results on different sub-samples of firms with stable portfolios of destinations over time.

the variable  $TBT_{i,t-1}$  varies both when a concern is raised (or solved)<sup>41</sup> on a market in which the firm is already present, and when the firm enters or exits a market in which a concern exists. This raises an endogeneity concerns which is addressed (and discussed) in the Section 3.2. We run the above specification, separately for each occupation  $k$ , on the full sample of manufacturing *exporting* firms with more than 5 employees resulting from the merge between Custom and matched employer-employee data (see section 2 for more details on the estimation sample). We do not consider firms with less than 5 employees as micro firms do not have a complete spectrum of occupations and this would inflate the dataset with zeros for many occupational categories. Also, we do not consider domestic firms in order to have a proper counterfactual, i.e.  $TBT_{i,t-1} = 0$  if the firm exports uniquely towards TBT-free destinations. Results from estimates on these samples are presented in Section 4.

Any time-invariant firm-specific factor – including average productivity, average firm size and managerial structure (and quality) – affecting the share of workers employed in occupation  $k$  is controlled for by the occupation-specific firm fixed effect  $\alpha_{i,k}$ . Namely, firm fixed effects also control for the average size of the firm. This is particularly relevant in our empirical strategy because large firms may export (on average) towards a wider set of destinations and thus face more TBT measures. Moreover, firms with good managerial structure and capabilities may opt for a larger set of destination markets, and therefore face a larger number of TBTs among destinations. Firm fixed effects, by controlling for the average managerial capability of the firm, purge our results from any managerial-related time-invariant confounding factor. The use of a within estimator also reduces reverse causality concerns, as any reverse causality argument must be valid in deviations from the occupation-specific firm average (rather than in levels), as further discussed in section 3.2.

In all specifications we always include (1-digit) sector-year dummies specific to occupation  $k$  to control for any sector-time-occupation specific factor affecting the workforce composition of French firms. This controls for any time-varying technological shocks to occupation  $k$  common to all firms in a given sector. Indeed, unobserved sector-specific demand shocks may require an adjustment in the composition of the workforce of firms operating in the sector and will be controlled for by the fixed effect  $\gamma_{s,t,k}$ . Finally, any time-varying firm-specific shock that affects *homogeneously* all the workers' categories of the firm – i.e. that affects the employment level – is mechanically controlled for by having the *share* of a given worker category over total employment as dependent variable.

Even though our specification includes a rich set of fixed effects  $\alpha_{i,k}$  and  $\gamma_{s,t,k}$  that allow us to address many potential sources of omitted variable bias, there may be additional sources that we

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<sup>41</sup>Since the  $TBT_{i,t-1}$  variable captures both the imposition and the resolution of a TBT restrictive measure, its effect on the occupational composition has to be interpreted as symmetric.

discuss in the next sub-section.

### 3.2 Additional sources of bias and instrumental variable strategy

First, one may worry about reverse causality. Due to political economy of trade barriers, one may argue that EU-raised Specific Trade Concerns may result from the lobbying activity of large skill-intensive French firms at the EU commission. As discussed above, the rich set of fixed effects  $\alpha_{i,k}$  and  $\gamma_{s,t,k}$  included in equation (1) considerably reduces this concern, as any reverse causality argument must be valid in *deviation* from the firm time-invariant average (i.e. deviations from the average firm's occupational composition affecting the change in the set of product-destination combinations under restrictive TBT). Yet, one may not exclude that firms whose skill-intensity grows with respect to the time-invariant average are better able to lobby the EU Commission to raise a STC on TBT.

A second concern is that we risk not disentangling the effect that comes from an *exogenous* change in the number of TBTs faced by a given firm, and the *endogenous* firm's entry decision. Following a positive firm-level productivity shock (or change in the managerial structure), firms might at the same time become more skill-intensive and enter product-destination markets with TBTs, thus facing endogenously additional TBT measures. This might lead to the fallacious conclusion that firms coping with stringent TBTs upgrade the skill composition of their workforce. Insofar as the source of unobserved firm-level heterogeneity is time-invariant, this concern is fully addressed by the use of firm $\times$ occupation fixed-effects. However, it is still possible that time-varying firm-specific shocks induce firms to endogenously self-select into specific destination markets.<sup>42</sup>

For these reasons, we complement the specification laid out in equation (1) with an IV strategy aimed at addressing the remaining concerns. In building the IV for TBTs we benefit from the rich information contained in the STC data. As a source of exogenous variation in the number of STCs on TBT faced by French firms, we use the STCs raised by *non-EU* countries, which are plausibly orthogonal to any time-varying non observable shocks hitting French firms. More specifically, we instrument our main dependent variable, i.e. the number of product-market combinations under EU-raised Specific Trade Concerns on TBT to which the specific firm  $i$  exports at time  $t - 1$ , with the number of STCs raised by the rest of the world (extra-EU) on the sample of product-destination combinations served by firm  $i$  at time  $t - 1$ .

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<sup>42</sup>Finally, one may worry about the residual endogeneity of TBTs if unobserved HS 4-digit specific shocks (as opposed to shocks at the 1-digit sector level controlled for by  $\gamma_{s,t,k}$ ) affect both the workforce composition of firms and the probability of observing a TBT at destination.

$$TBT_{i,t-1}^{IV} = TBT_{i,t-1}^{non-EU} \quad (2)$$

Our IV, therefore, varies at the firm level, very much as the endogenous explanatory variable  $TBT_{i,t-1}$ . The rationale for this IV is that STC raised by non-EU countries are unlikely to be affected by any (time-varying) characteristics of French firms. More formally, the identification assumption is that STC raised by non-EU countries are orthogonal to any firm-level shocks, and in particular to the workforce composition of a specific French firm (conditioning on firms and sector-by-year effects specific to occupation  $k$ ). Under this assumption, we capture the exogenous variation of the EU-TBTs that is not correlated to the time-varying firm-level shocks that may induce firms to self-select into specific destinations. Notice that we are not claiming that using an IV based on TBTs raised by countries other than the EU makes the decision to enter the market exogenous. Rather, our IV estimates rely on the untestable assumption that the instrument is uncorrelated with the (endogenous) entry decision (i.e. that the exclusion restriction holds). Summing up, as customary, the validity of our IV strategy relies on the untestable assumptions that the conditional variation of the instrument is as good as random and that the exclusion restriction holds. In order to provide corroborating evidence supporting the plausibility of these identifying assumptions and showing, therefore, the robustness of our results, we propose two sample stratification checks.

First, we check whether our results are confirmed on a sub-sample of firms with arguably homogeneous productivity levels. To this end, we focus on a sub-sample of firms that serve more than 6 markets (the 95<sup>th</sup> percentile of the distribution of markets served by firms on average over the period); as only high-productivity firms serve a large number of markets (Bernard et al., 2011, 2007), this allows us to zoom in on a subset of relatively homogeneous and high-productivity firms. Endogenous selection into specific destinations is arguably less problematic for this sub-sample of high-productivity firms. Since these firms always have the ability to potentially serve any destination, they are less likely to selectively enter into TBT-affected markets.

Second, we rely on a sub-sample of firms with a stable portfolio of destinations over time.<sup>43</sup> We propose two definitions of “stable” portfolios: (i) firms having at least 3 or 4 or 5 years of presence into the average destination,<sup>44</sup> and (ii) firms whose shortest export-spell is on average of 3, 4 or 5 years.<sup>45</sup> The latter strategy captures firms whose average shortest spell (i.e. number of years of

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<sup>43</sup>One obvious option would be to select firms with a constant set of destinations over the entire period. However, this dramatically reduces the size of the sample.

<sup>44</sup>For each firm we count the total number of years of presence in a destination country and then compute the average across all destinations.

<sup>45</sup>We count number of consecutive years in which each firm exports into a specific destination (export-spell) and take

continuous presence in a destination market) is not too short. The idea is that firms having a stable portfolio of destinations do not base their entry/exit decision on the presence of TBT at destination, and, therefore, the within-firm TBT variation can be plausibly considered as exogenous.

The combination of the IV strategy with firms fixed effects and the sample-stratification exercises discussed above helps reducing the concerns about the different potential sources of bias (reverse causality and endogenous selection of firms into markets), but of course, given the impossibility to properly test the exclusion restriction assumption, the cannot fully eliminate them. With this *caveat* in mind, we interpret the evidence below as suggestive of the presence of a causal relationship between TBTs and the composition of the workforce of French firms.

As widely recognized in the previous literature, also tariffs cannot be considered as purely exogenous in a firm-specific regression if a firm has sufficient power to influence the trade policy of the destination country, or if such a country reacts to a firm specific import shock by raising tariffs.<sup>46</sup> For this reason, we instrument also the average tariffs faced by the specific French firm to further reduce any remaining endogeneity concern. The IV for tariff is based on the tariff level faced by extra-EU countries in exporting toward a given destination-sector market. For each destination  $j$  and sector  $s$  we calculate the average import tariff imposed towards extra-EU exporting countries ( $\text{Tariffs}_{s,j}^{\text{non-EU}}$ ). We instrument the firm's average tariff using the average tariff imposed by firm's destinations towards non-EU exporters:

$$\text{Tariffs}_{i,t-1}^{\text{IV}} = \frac{1}{S} \frac{1}{J} \sum_{sj} \text{Tariffs}_{s,j,t-1}^{\text{non-EU}} \quad (3)$$

where  $S$  and  $J$  stand respectively for total number of sectors  $s$  and destination  $j$  served by firm  $i$  at time  $t - 1$ . The tariff level imposed by destination  $j$  on sector  $s$  toward a non-EU exporter can be plausibly considered exogenous and affecting the occupation composition of firm  $i$  only through its effect on  $\text{Tariff}_{i,t-1}$  (exclusion restriction). Notice that also for tariffs, the instrument varies at the firm level as the endogenous variable. We run the IV specification, separately for each occupation  $k$ , on the full sample of exporting manufacturing firms as described in section 2; results from IV estimates are presented in section 4. Sample stratification IV estimates are presented in section 4.1.

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its minimum. Thus, for each firm-destination, we have the shortest export-spell. Next, we average across destinations.

<sup>46</sup>The endogeneity concern is particularly remote when the effectively applied tariff corresponds to the applied MFN rate. Indeed, MFN applied tariffs are not set to face imports from a specific country.

## 4 Results: TBTs and the occupational composition of firms

We estimate equation (1) on all manufacturing companies that have exported at least once between 1995 and 2010, therefore using a sample of over 30,000 manufacturing companies. Table 3 reports results from separate regressions of equation (1) for each occupational category. In particular, we look at the effect of TBT on the share of managers, professionals, white collars, qualified and non-qualified blue collars in the firm's total workforce. The first column shows the fixed effect OLS estimation, while the second column shows the results from the fixed effects IV estimation, where both technical barriers to trade and tariffs are instrumented as explained in the previous section. The dependent variable is the share of full-time equivalent employees in occupation  $k$  over the total workforce of the exporting firm. The measure of TBTs is the (1-year lagged) total number of concerns (HS4-destination pairs) faced by each company while tariffs are measured by the average level of tariffs faced by the firm among the product-destination served (also 1-year lagged). As indicated in equation (1), all regressions include firm fixed effects and the interaction between (1-digit) sector dummies and year dummies.

Table 3 shows strong and significant results for the managerial layer, in both specifications: an additional TBT concern in one of the markets where the firm was present in the previous year, increases the share of managers by 0.3 percentage points. The fact that IV estimates are also positive and significant is reassuring as it implies that fixed effects OLS estimates are not simply capturing entry in difficult markets (i.e. markets characterized by high TBTs) accompanied by an increase the share of managers, by firms hit by a positive (unobservable) shock. The point estimate of the TBT coefficient is three times bigger (1 percentage points) when estimated via IVs. For firms almost unaffected by TBT at  $t - 1$  (i.e. facing zero or one TBT among destination markets) the imposition of a new TBT implies a 5% to 7% increase in the share of managers. The difference in point estimates between OLS and 2SLS can be interpreted in light of the political economy concern discussed above. If firms that are not able to comply with new TBT (less manager-intensive firms) are more likely to lobby for raising a STCs at the WTO (implying a negative correlation between the share of managers and the number of TBT) then the OLS coefficient would be downward biased. Consistent with this argument, when endogeneity is addressed, the point estimate becomes larger. The table also reports the main first-stage coefficients, i.e. the coefficient of the instrument for TBT of the first-stage TBT equation and the coefficient of the instrument for tariffs of the first-stage tariff equation, along with the Kleibergen-Paap Wald test. Not surprisingly, the first-stage coefficients of the instruments are highly significant and there is no evidence of instruments being weak.

The average increase in the share of managers comes with a significant decrease in the shares of professionals, qualified and non-qualified blue collars, suggesting a strong impact of stringent TBTs on the workforce composition of French exporters. In particular, an additional TBT concern in one of the product-destination combinations served by firm  $i$  at time  $t - 1$  decreases the share of professionals by 0.3 percentage points, and the share of qualified and non-qualified blue collar jobs respectively by 0.3 and 0.2 percentage points. In other words, the increase in the share of managerial occupations is compensated by the reduction in professional and blue collar occupations. All in all, and in line with the previous literature highlighting skilled workers nature of fixed export costs, an increase in the TBT-induced fixed export cost is faced by an increase in the firm's skilled intensive managerial occupations.

## 4.1 Robustness checks

### 4.1.1 Top exporters serving more than 6 markets

As discussed above, firms may endogenously self-select into destinations having large or small number of STCs on TBT. For instance, following a positive productivity shock (notice that the average productivity of the firm is captured by fixed effects), a firm may decide to enter a promising but costly (TBT-imposing) product-destination market. Our IV approach takes care of this concern under the assumption that the instrument is uncorrelated with firm-level productivity shocks. Another way to (imperfectly) address this concern, is using a sub-sample of firms with arguably homogeneous productivity levels. To this end, in Table 4 we include only firms that serve more than 6 markets (the 95<sup>th</sup> percentile of the distribution of markets served by firms on average over the period), and thus having almost homogeneously high productivity levels.<sup>47</sup> Not surprisingly, in this sub-sample of firms the share of managers is on average higher than in the full sample of firm used on our baseline (respectively 20% for firms with at least one TBT and 15% for firms without TBTs).

Results reported in Table 4 confirm our baseline findings with point estimates reassuringly similar to those obtained on the full sample, both for the fixed effects and the IV+fixed effects specification. Thus, also for the most productive firms exporting in at least 6 markets, the presence of stringent standards at destination drives companies towards a new organizational structure relying on a higher share of managers and lower share of professionals (the coefficients on qualified and non-qualified blue

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<sup>47</sup>In moving from full sample to multi-destination firms (i.e. those with more than 6 destinations) the number of observations shrinks by 66% as we lose small firms with very incomplete time span and firms exporting to a very small set of destinations.

Table 3: TBTs and the occupational composition of firms. Full sample

	TBT	
	FE	IV + FE
<i>Share of Managers:</i>		
TBTs	0.003*** (0.000)	0.010*** (0.001)
Tariffs	-0.006** (0.003)	-0.003 (0.005)
<i>Share of Professionals:</i>		
TBTs	-0.001 (0.000)	-0.003*** (0.001)
Tariffs	0.002 (0.004)	0.002 (0.007)
<i>Share of White Collars:</i>		
TBTs	0.001* (0.000)	-0.000 (0.000)
Tariffs	0.009*** (0.003)	0.010* (0.006)
<i>Share of Qualified Blue Collars:</i>		
TBTs	-0.000 (0.000)	-0.003* (0.001)
Tariffs	-0.001 (0.006)	0.000 (0.010)
<i>Share of Non Qualified Blue Collars:</i>		
TBTs	-0.002*** (0.000)	-0.002* (0.001)
Tariffs	-0.003 (0.006)	-0.009 (0.009)
IV: TBT		0.451***
IV: Tariffs		0.608***
Observations	189,981	138,854
First stage Kleibergen-Paap rk Wald F statistic		159.71
Number of firms	29,990	22,275
Firm FE& Sector×Year FE	YES	YES

Note: Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

collar jobs are similar to the baseline estimation but imprecisely estimated).<sup>48</sup>

Table 4: Effect of TBTs on the occupational composition of firms. Top exporters serving more than 6 markets.

	TBT	
	FE	IV + FE
<i>Share of Managers:</i>		
TBTs	0.002*** (0.0007)	0.008*** (0.001)
Tariffs	-0.003 (0.009)	0.004 (0.011)
<i>Share of Professionals:</i>		
TBTs	-0.001 (0.0007)	-0.003** (0.001)
Tariffs	-0.013 (0.011)	-0.001 (0.014)
<i>Share of White Collars:</i>		
TBTs	0.0007 (0.0006)	-0.0006 (0.0009)
Tariffs	0.012 (0.009)	0.004 (0.013)
<i>Share of Qualified Blue Collars:</i>		
TBTs	-0.0007 (0.001)	-0.002 (0.001)
Tariffs	-0.005 (0.014)	-0.006 (0.018)
<i>Share of Non Qualified Blue Collars:</i>		
TBTs	-0.001* (0.0008)	-0.001 (0.001)
Tariffs	0.011 (0.013)	0.001 (0.016)
IV: TBT		0.468***
IV: Tariffs		0.583***
Observations	64,045	63,250
First stage Kleibergen-Paap rk Wald F statistic		169.03
Number of firms	8,399	7,392
Firm FE& Sector×Year FE	YES	YES

Note: Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

<sup>48</sup>The table also reports the first-stage coefficients of the instruments and the Kleibergen-Paap Wald F test that shows no evidence of weak instruments problems.

### 4.1.2 Firms with stable portfolio of destinations

An alternative approach to address the issue of firms endogenously selecting into specific destination markets is to restrict the estimation sample to firms that have a stable portfolio of destinations. This considerably reduces concerns about firm self-selection as it is plausible that firms with a stable set of destinations do not base their entry/exit decision on the presence of TBT at destination. Therefore, the presence of a new TBT can be considered, even more safely, as exogenous to firm-specific unobserved shocks in this subsample.

Table 5 shows the results of a first robustness check using sub-sample of French firms having *at least and alternatively* 3 (column 1), 4 (column 2) or 5 (column 3) years of average presence *per* destination (i.e. firm's average presence across destinations). As expected, the sample of firms shrinks considerably, but our results hold. The plausibly exogenous imposition of a TBT in one of the destinations stably served by the firm, induces an increase in the share managers and a reduction in the share of qualified blue collar. The robustness of the results to this sample cut reinforces the confidence that the results obtained on the full sample identify the causal effects of TBTs.

In Table 6 we adopt an even more conservative definition of stability in destination portfolio, and use firms whose *shortest* export-spell is on average of 3 (column 1), 4 (column 2) or 5 (column 3). We calculate the shortest number of years of consecutive presence in each destinations, and then take the average across destination. Such a sample stratification reduces even further the number of firms in the sample. Nevertheless, our results are robust also to this sample definition. Again, the fact that the point estimates are similar to those obtained in the full sample is reassuring that the results are not driven by firms self-selecting into markets.

### 4.1.3 Differential effects by firm size

A last potential concern relates to the heterogeneous legal status of firms based on their size (total employment). In France, firms up to 50 employees benefit from various *ad – hoc* administrative advantages on the hiring/firing of workers. To account for the potential heterogeneous workforce composition effect of TBTs on firms with size above/below such a threshold, we interact the TBT variable with a dummy on whether the initial employment of the firm is above the threshold of 50 employees. As a robustness check we use the 75<sup>th</sup> percentile in firm size distribution as a threshold. Results are reported in Table 7.

Interestingly, the effect of the imposition of TBT on the share of managers and qualified blue collar

Table 5: Effect of TBTs on the occupational composition of firms. Firms with stable portfolio of destinations: at least 3, 4 and 5 years of presence in a given destination.

	TBT		
	IV + FE	IV + FE	IV + FE
<i>Share of Managers:</i>			
TBTs	0.010*** (0.001)	0.010*** (0.001)	0.011*** (0.002)
Tariffs	-0.003 (0.007)	-0.015 (0.009)	-0.028** (0.013)
<i>Share of Professionals:</i>			
TBTs	-0.004*** (0.001)	-0.004*** (0.001)	-0.004** (0.002)
Tariffs	0.004 (0.009)	0.010 (0.012)	0.009 (0.017)
<i>Share of White Collars:</i>			
TBTs	-0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)
Tariffs	0.011 (0.008)	0.024** (0.011)	0.028** (0.014)
<i>Share of Qualified Blue Collars:</i>			
TBTs	-0.003* (0.002)	-0.002 (0.002)	-0.004* (0.002)
Tariffs	-0.001 (0.013)	-0.006 (0.017)	0.007 (0.025)
<i>Share of Non Qualified Blue Collars:</i>			
TBTs	-0.003 (0.002)	-0.003* (0.002)	-0.002 (0.002)
Tariffs	-0.009 (0.012)	-0.011 (0.018)	-0.012 (0.025)
IV: TBT	0.451***	0.450***	0.454***
IV: Tariffs	0.586***	0.585***	0.607***
Years of presence at destination (average)	3	4	5
Observations	108,882	77,702	47,719
First stage Kleibergen-Paap rk Wald F statistic	150	144	123
Number of firms	14272	9128	5213
Firm FE& Sector×Year FE	YES	YES	YES

Note: This table includes French firms with an average export presence into a given destination of at least and alternatively 3 (column 1), 4 (column 2) or 5 (column 3), i.e. average export presence across destinations. Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

is entirely due to large firms (i.e. firms with total employment above 50 or the median size). It means that, notwithstanding the administrative advantages granted to small firms, only large firms are able to adapt their workforce to the imposition of a new TBT at destination.

Table 6: Effect of TBTs on the occupational composition of firms. Firms with stable portfolio of destinations: at least 3, 4 and 5 years export-spell in a given destination.

	TBT		
	IV + FE	IV + FE	IV + FE
<i>Share of Managers:</i>			
TBTs	0.011*** (0.002)	0.008*** (0.002)	0.012*** (0.003)
Tariffs	-0.001 (0.012)	-0.014 (0.020)	-0.024 (0.038)
<i>Share of Professionals:</i>			
TBTs	-0.003* (0.002)	-0.001 (0.002)	-0.002 (0.003)
Tariffs	-0.016 (0.015)	-0.011 (0.026)	0.072 (0.050)
<i>Share of White Collars:</i>			
TBTs	-0.001 (0.001)	0.001 (0.001)	-0.000 (0.002)
Tariffs	0.025** (0.011)	0.004 (0.022)	0.033 (0.033)
<i>Share of Qualified Blue Collars:</i>			
TBTs	-0.002 (0.002)	-0.006** (0.003)	-0.014*** (0.003)
Tariffs	-0.014 (0.023)	0.026 (0.050)	0.139 (0.087)
<i>Share of Non Qualified Blue Collars:</i>			
TBTs	-0.005** (0.002)	-0.002 (0.002)	0.003 (0.003)
Tariffs	0.011 (0.023)	0.001 (0.049)	-0.082 (0.083)
IV: TBT	0.444***	0.479***	0.478***
IV: Tariffs	0.586***	0.564***	0.612***
Minimum export-spell at destination (average)	3	4	5
Observations	51,446	23,028	9,207
First stage Kleibergen-Paap rk Wald F statistic	113	88	47
Number of firms	6458	2792	1143
Firm FE& Sector×Year FE	YES	YES	YES

Note: This table includes French firms with an average export-spell into a given destination of at least and alternatively 3 (column 1), 4 (column 2) or 5 (column 3), i.e. average (minimum) export-spell across destinations. Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

## 4.2 Managerial sub-layers

The key result so far is the positive effect of TBTs on the share of managers within the firm. However, this macro-occupational group covers a wide range of occupations (from 21 to 38 PCS French occupational code), such as directors, sales managers, engineers etc. So, testing the effect of TBTs on

Table 7: Effect of TBTs on the occupational composition of firms. Results by firm size.

	TBT	
	IV + FE	IV + FE
<i>Share of Managers:</i>		
TBTs	0.003 (0.003)	0.003 (0.003)
TBTs $\times$ Size > 50	0.008** (0.004)	
TBTs $\times$ Size > Mdn		0.010*** (0.003)
<i>Share of Professionals:</i>		
TBTs	-0.005 (0.004)	-0.003 (0.004)
TBTs $\times$ Size > 50	0.001 (0.004)	
TBTs $\times$ Size > Mdn		-0.001 (0.004)
<i>Share of White Collars:</i>		
TBTs	0.002 (0.003)	0.002 (0.002)
TBTs $\times$ Size > 50	-0.003 (0.003)	
TBTs $\times$ Size > Mdn		-0.003 (0.003)
<i>Share of Qualified Blue Collars:</i>		
TBTs	0.003 (0.004)	0.003 (0.003)
TBTs $\times$ Size > 50	-0.008* (0.004)	
TBTs $\times$ Size > Mdn		-0.008* (0.004)
<i>Share of Non Qualified Blue Collars:</i>		
TBTs	-0.004 (0.004)	-0.004 (0.003)
TBTs $\times$ Size > 50	0.001 (0.004)	
TBTs $\times$ Size > Mdn		0.001 (0.004)
IV: TBT	0.445***	0.445***
IV: TBTs $\times$ Size > 50	0.446***	
IV: TBTs $\times$ Size > Mdn		0.445***
Observations	138,854	138,854
First stage Kleibergen-Paap rk Wald F statistic	87	84
Firm FE & Sector $\times$ Year FE	YES	YES

Note: Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. TBTs  $\times$  Size > 50 (Mdn) is the coefficient of the instrument for TBT on large firms of the first-stage TBT coefficient on large firms. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

each sub-layer belonging to the managerial layer may help uncovering the specific channel driving the baseline results discussed above. We, therefore, split the managerial layer into 4 finer sub-layers: (i) CEOs;<sup>49</sup> (ii) sale executives; (iii) engineers and (iv) other top managers (lawyers, doctors, professors, etc.).<sup>50</sup>

The share of CEOs represents on average (as full time equivalent) the 3.4% of the total employment of the firm, the sale executives the 6.8%, the engineers the 4.7% and finally other top managers account for the 1.2% of total employment. In Table 8 we report the shares of these categories for firms facing TBTs and other TBT-free firms. It clearly emerges that, on average, firms facing at least one TBT have higher shares of engineers. This is probably due to the fact that engineers are needed to adapt the production process to a new technical standard and overcome the fixed export cost implied by the presence of a TBT.

Table 8: Share of managers in managerial sub-layers

	At least one TBT	TBT-free
Occupations (%)		
Share of CEOs	1.7	2.3
Share of sales executives	6.4	4.3
Share of engineers	10.3	5.8
Share of other managers	0.3	0.6

Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

Table 9 shows results from the baseline specification on each of the occupation categories composing the managerial group. From Table 9 it emerges that the positive effect we observe in Table 3 on managers is mainly driven by a positive effect on both the share of engineers and the share of sales executives. Facing one additional TBT would increase the share of engineers by 0.6 percentage points and the share of sales executives by 0.3 percentage points (see IV specification in column 2). Firms facing an additional TBT have to adapt their products to meet the technical standard; and engineers are the most needed occupations to this end. The result on the CEOs is significant when estimated via IV, with TBT increasing the share of heads by 0.1 percentage point. The share of other top-managers is only marginally (negatively) affected by the imposition of TBT at destination.

We next move to the sample of top exporters serving more than 6 markets. In this sub-sample of firms the share of engineers is on average higher than for full sample of firm used on our baseline

<sup>49</sup>In the French occupation classification the CS=2 refers to "Chef d'entreprise salarié" which is loosely translated here as CEO. For simplicity we keep this definition of CEO in what follows with the disclaimer of imperfect translation.

<sup>50</sup>We divide the category management into the following categories: CEOs: CS=2; Sales Executives: CS=37; Engineers: CS=38 and Other professionals: CS=31-33-34-35.

(respectively 11% for firms with at least one TBT and 7% for firms without TBTs). Regression results reported in Table 10 confirm the findings in the full sample, with stringent TBTs implying an increase in the share of engineers and CEOs needed to comply with the new technical standard at destination. Results on the sample of firms with stable portfolios of destinations, reported in Tables A2 and A3, are in line with results in the full sample.

Table 9: Effect of TBTs on managerial sub-layers. Full sample

	A.TBT	
	FE	IV + FE
<i>Share of CEOs:</i>		
TBTs	-0.0001 (0.0002)	0.001*** (0.0004)
Tariffs	0.001 (0.001)	0.004 (0.003)
<i>Share of Sales Executives:</i>		
TBTs	0.0009* (0.0005)	0.003*** (0.001)
Tariffs	-0.004* (0.002)	-0.005* (0.003)
<i>Share of Engineers:</i>		
TBTs	0.002*** (0.0005)	0.006*** (0.001)
Tariffs	-0.003* (0.002)	-0.003 (0.003)
<i>Share of Other Top Managers:</i>		
TBTs	-0.0002** (0.0001)	-0.0005*** (0.0002)
Tariffs	-0.0003 (0.0009)	0.0013 (0.001)
IV: TBT		0.451***
IV: Tariff		0.608***
Observations	189,981	138,854
First stage Kleibergen-Paap rk Wald F statistic		159.71
Number of firms	29,990	22,275
Firm FE& Sector×Year FE	YES	YES

Note: Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

### 4.3 Probability to add layers

The increase in the occupational composition of French firms may come along with a change in the hierarchies within the firm. Indeed, in line with the literature exploring how firms (re)organize

Table 10: Effect of TBTs on managerial sub-layers. Top exporters serving more than 6 markets.

	TBT	
	FE	IV + FE
<i>Share of CEOs:</i>		
TBTs	-0.0001 (0.0002)	0.0005* (0.0003)
Tariffs	0.007 (0.005)	0.009 (0.006)
<i>Share of Sales Executives:</i>		
TBTs	0.0003 (0.0005)	0.0014 (0.001)
Tariffs	-0.005 (0.006)	-0.0001 (0.007)
<i>Share of Engineers:</i>		
TBTs	0.002*** (0.0006)	0.007*** (0.001)
Tariffs	-0.004 (0.005)	-0.005 (0.005)
<i>Share of Other Top Managers:</i>		
TBTs	-0.0002* (0.0001)	-0.0005*** (0.0002)
Tariffs	-0.001 (0.002)	-0.0001 (0.003)
IV: TBT		0.468***
IV: Tariff		0.583***
Observations	64,045	63,250
First stage Kleibergen-Paap rk Wald F statistic		169.03
Number of firms	8,399	7,392
Firm FE& Sector×Year FE	YES	YES

Note: Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

production in hierarchies to economize on their use of knowledge (Garicano, 2000; Caliendo and Rossi-Hansberg, 2012; Caliendo et al., 2020; Guadalupe and Wulf, 2010), it may be the case that the increase in the skill-intensive fixed export cost implied by a new standard at destination is faced by the *ad-hoc* introduction of a hierarchical layer in the firm. Therefore, in this section we also test if the increasing complexity faced by firms in export markets has an impact on the number of hierarchical layers in the organization of the firm, i.e. the extensive vertical margin of the organizational structure, as defined in Table A1 following Caliendo et al. (2015).

Table 11 shows regression results both from OLS and 2SLS fixed effects models (along the lines of the model in equation (1)) but using, in turn, three different dependent variables: (i) the total number

of hierarchical layers in the firm, *(ii)* the probability of adding a sub-layer among the top management positions (sales executives, engineers and other top managers), and *(iii)* the probability of adding a sub-layer among heads of enterprise (including CEOs or firm directors).<sup>51</sup> Unfortunately, we could not replicate exactly the same dependent variable as in Guadalupe and Wulf (2010) because we do not have information on who is reporting directly to the CEO and on who covers division manager positions in the firm.

Results reported in Table (11) show that TBTs have a positive but imprecisely estimated effect on the total number of layers (t-stat 1.7, see column 2 in Table 11). Consistently, TBTs have a positive and significant effect (2SLS specification) on the probability of adding a new sub-layer at the top of the firm's hierarchy (CEOs). Results suggest that the imposition of a new TBT does affect the number of layers in the firm – even though the point estimate is somewhat imprecise – and it also positively (and significantly) affects the probability of adding a new sub-layer at CEO level. In particular, TBTs make firms more likely to add a layer at the CEO level by 1.1 percentage points.

The estimation results on the total number of layers in the firm and on the probability of adding a new sub-layer at CEO level, taken together, suggest that the imposition of a new TBT induces the firm to increase the number of sub-layers at the top of the hierarchy, thus raising the overall number of layers in the firm.

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<sup>51</sup>We grouped sales executives, engineers and other top-managers in a single category for the sake of table readability. The effect of TBT on each specific managerial job is not statistically significant (results available upon request).

Table 11: Effect of TBTs on the firm organization.

	TBT	
	FE	IV + FE
<i>Total layers:</i>		
TBTs	0.000 (0.003)	0.012 (0.007)
Tariffs	0.024 (0.025)	-0.018 (0.04)
<i>Probability of adding a top manager:</i>		
TBTs	-0.000 (0.001)	-0.004 (0.002)
Tariffs	-0.022 (0.014)	-0.028 (0.023)
<i>Probability of adding a CEO:</i>		
TBTs	-0.000 (0.003)	0.011* (0.006)
Tariffs	0.041** (0.019)	0.022 (0.03)
IV: TBT		0.451***
IV: Tariff		0.608***
Observations	189,996	138,861
First stage Kleibergen-Paap rk Wald F statistic		159.71
Number of firms	29,990	22,275
Firm FE& Sector×Year FE	YES	YES

Note: Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

## 5 Concluding remarks

This paper provides an empirical assessment of the effect of stringent technical standards at destination on the occupational composition of exporting firms. Making use of detailed firm level matched employer-employee data for the universe of French exporters, with information on exports by destination country and Specific Trade Concern (STC) data released by the WTO on restrictive TBTs, we identify the effect of such NTMs exploiting (unexpected) changes in trade restrictive TBTs imposed on EU exports by importing countries. The use of an IV strategy implies that identification relies on the (untestable) assumption that the exclusion restriction holds. With this *caveat* in mind, our IV results – supported by an extensive set of robustness checks – suggest that TBTs, by raising the fixed costs required to serve a given destination (adaptation cost), change the skill composition of firms' workforce towards skill intensive occupations. In particular, one additional restrictive TBT among the destination-product combinations served by the firm increases the share of managers by one percentage point, and reduces the share of professional, qualified and non-qualified blue collar jobs respectively by 0.3, 0.3 and 0.2 percentage points. Among the managerial occupations, the share of engineers in production is the most affected by the imposition of restrictive TBT at destination. This supports the idea that new stringent technical standard at destination forces the firm to adapt workforce composition by hiring workers (engineers) able to adapt the product to the new standard.

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## A Data details and additional results

### A.1 Occupations

Table A1 reports the definition of the occupation breakdown.

Table A1: Occupations

Occupation	Definition	Description
Management	CS=2	CEO
	CS=38	Engineers
	CS=37	Sales Executives
	other CS=3	Other managers
Professionals	CS=4	Interm. profess. (sales, administration) and technicians.
White Collar	CS=52-56	Administration and sales employees.
Qualified Blue Collar	CS=62-65	Qualified production workers.
Non-qualified Blue Collar	CS=67-69	Non-qualified production workers.

Table A2: Effect of TBTs on managerial sub-layers. Firms with stable portfolio of destinations: at least 3, 4 and 5 years of presence in a given destination.

	TBT		
	IV + FE	IV + FE	IV + FE
<i>Share of CEOs:</i>			
TBTs	0.001** (0.000)	0.000 (0.000)	0.001*** (0.000)
Tariffs	0.008** (0.004)	0.004 (0.005)	-0.003 (0.007)
<i>Share of Sales Executives:</i>			
TBTs	0.003*** (0.001)	0.003*** (0.001)	0.003** (0.001)
Tariffs	-0.010** (0.005)	-0.018*** (0.006)	-0.019** (0.009)
<i>Share of Engineers:</i>			
TBTs	0.007*** (0.001)	0.006*** (0.001)	0.008*** (0.001)
Tariffs	-0.003 (0.004)	-0.003 (0.005)	-0.004 (0.009)
<i>Share of Other Top Managers:</i>			
TBTs	-0.0005*** (0.000)	-0.0005*** (0.000)	-0.0006*** (0.000)
Tariffs	0.001 (0.002)	0.001 (0.003)	-0.001 (0.004)
IV: TBT	0.451***	0.450***	0.454***
IV: Tariffs	0.586***	0.585***	0.607***
Years of presence at destination (average)	3	4	5
Observations	108,882	77,702	47,719
First stage Kleibergen-Paap rk Wald F statistic	150	144	123
Number of firms	14272	9128	5213
Firm FE& Sector×Year FE	YES	YES	YES

Note: This table includes French firms with an average export presence into a given destination of at least and alternatively 3 (column 1), 4 (column 2) or 5 (column 3), i.e. average export presence across destinations. Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.

Table A3: Effect of TBTs on managerial sub-layers. Firms with stable portfolio of destinations: at least 3, 4 and 5 years export-spell in a given destination.

	TBT		
	IV + FE	IV + FE	IV + FE
<i>Share of CEOs:</i>			
TBTs	0.001 (0.000)	0.001 (0.000)	0.001** (0.000)
Tariffs	0.011 (0.007)	-0.001 (0.010)	-0.013 (0.023)
<i>Share of Sales Executives:</i>			
TBTs	0.004*** (0.001)	0.002 (0.001)	0.001 (0.001)
Tariffs	-0.019*** (0.007)	-0.018 (0.014)	-0.013 (0.032)
<i>Share of Engineers:</i>			
TBTs	0.006*** (0.001)	0.006*** (0.001)	0.010*** (0.002)
Tariffs	0.006 (0.007)	-0.000 (0.013)	-0.007 (0.025)
<i>Share of Other Top Managers:</i>			
TBTs	-0.0007*** (0.000)	-0.0005** (0.000)	-0.0006 (0.000)
Tariffs	-0.000 (0.003)	0.005 (0.007)	0.008 (0.008)
IV: TBT	0.444***	0.479***	0.478***
IV: Tariffs	0.586***	0.564***	0.612***
Minimum export-spell at destination (average)	3	4	5
Observations	51,446	23,028	9,207
First stage Kleibergen-Paap rk Wald F statistic	113	88	47
Number of firms	6458	2792	1143
Firm FE& Sector×Year FE	YES	YES	YES

Note: This table includes French firms with an average export-spell into a given destination of at least and alternatively 3 (column 1), 4 (column 2) or 5 (column 3), i.e. average (minimum) export-spell across destinations. Standard errors in parentheses clustered by firm. The middle panel reports the main first-stage coefficients. IV: TBT is the coefficient on the instrument for TBT of the first-stage TBT equation. IV: Tariff is the coefficient of the instrument for tariffs of the first-stage Tariff equation. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Source: DADS, WTO STCs and French Custom data for 1995 to 2010.