Protection or Protectionism: The Effect of Technical Regulations on Input Sourcing*

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Abstract

We study how technical regulations affect firms' input sourcing and supply chain structure. We link French firm-level customs data (2000–2017) to a newly coded database that spans the universe of WTO Technical Barriers to Trade (TBTs) notifications, EU single-market regulatory harmonisation, and trade-agreement depth. From this combined dataset, we build a text-based index of regulatory distance that captures origin specific adaptation costs. Guided by a model of input search and renegotiation, we exploit within firm–product–origin variation to estimate the effect of new regulations. We find that TBTs lead French firms to shift sourcing toward harmonised origins, reduce imports from high-distance countries, and raise prices across all suppliers. This effect is weaker for products with high relationship-specific investments but more pronounced for larger firms. Our findings highlight the role of regulatory alignment in shaping global value chains and the importance of bargaining power in determining cost pass-through.

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1 Introduction

The expansion of global value chains (GVCs) has fundamentally changed how firms and countries organise their production. As of 2022, intermediate goods accounted for over 22 percent of global trade (WITS, World Bank). Advances in transportation, information technology, and logistics have enabled firms to source inputs across borders and to spread stages of production across multiple countries. Nonetheless, international sourcing remains a costly and complex process, requiring firms to invest substantial search efforts in finding compatible partners and maintaining quality standards across distant locations. Technical standards play a critical role in addressing these challenges and are thus central to the efficient functioning of modern GVCs (Gereffi et al., 2005; Nadvi, 2008).

Although standards can reduce information asymmetries and mitigate contractual frictions in sourcing decisions, they could also create barriers to GVC participation. Lamy (2015; 2016) highlights an international externality arising from regulatory heterogeneity: firms producing for multiple markets must comply with divergent standards, often sacrificing economies of scale. This raises adaptation costs for foreign producers and encourages governments to use regulatory measures as a form of protectionism, inducing foreign firms to relocate (Grossman et al., 2021).

Despite the growing prominence of technical standards, referred to, in the World Trade Organization (WTO) terminology, as "Technical Barriers to Trade" (TBTs), empirical evidence on their impact on supply chains and firm performance remains scarce.[1] This is particularly striking in light of the documented shift in trade protection from final goods to intermediate inputs (Bown, 2018). In the past fifteen years, TBTs notified to

[1]TBTs encompass standards, and technical regulations, typically aimed at health, safety, product quality, and environmental concerns.

the WTO affecting intermediate goods have increased at twice the rate of those targeting other product categories (WTO, 2020). Yet we know little about how firms respond to these regulations or how they reshape global sourcing networks.

This paper investigates how technical regulations shape the input sourcing strategies of manufacturing firms. A key empirical challenge lies in accurately mapping technical regulations to trade flows and tracking their evolution over time. We address this by constructing a comprehensive TBT database for 1995–2020, covering 1,242 products and 142 countries, using a machine-learning algorithm to extract Harmonised System (HS) product codes from textual descriptions. We combine this data with French firm-level customs data from 2000 to 2017, data on EU product-market harmonisation measures, and data on the depth of EU trade agreements. From these sources, we develop a novel index of regulatory distance, capturing the adaptation cost each origin country faces when new technical standards are introduced in the French market. The index is derived through text analysis of the technical content in TBT notifications, comparing the regulatory requirements of new EU measures to pre-existing technical standards in the source countries, converting these textual differences into measurable compliance shocks. This allows us to examine whether upstream producers absorb the adaptation burden or whether firms shift sourcing toward suppliers better positioned to meet EU regulatory requirements.

The EU provides an ideal setting to study these dynamics. Its stringent technical regulations and integrated single market allow us to observe how French manufacturing firms adjust their sourcing patterns in response to regulatory shocks. Crucially, our dataset identifies not only the last country from which a product was shipped, but also the country of manufacture, which bears adaptation costs for the new standards.[2]

[2]An illustrative example of the type of regulation we study is the EU regulation on batteries as part

To guide our identification, we extend the search and bargaining framework of Grossman et al. (2024) to incorporate TBT adaptation costs. The key insight is that while TBTs are *de jure* non-discriminatory, applying to all suppliers regardless of origin, their *de facto* burden varies with regulatory distance. Firms weigh the cost of renegotiating with existing suppliers to meet the new standards against the cost of searching for better-aligned alternatives. This trade-off between adaptation costs and search frictions determines both the direction and intensity of sourcing adjustments.

Our empirical strategy exploits within firm–product–origin variation, allowing us to observe how the same firm reallocates sourcing across countries for the same product following the introduction of a new EU regulation depending on the regulatory distance. We control for firm-product-origin and origin–year–HS2 fixed effects to absorb unobserved heterogeneity, supply shocks and broader sectoral dynamics. To address endogeneity in the timing of EU regulations, we use an instrumental variable approach based on the timing of analogous TBTs introduced by the United States. This instrument captures global trends in product regulation that are plausibly orthogonal to French importers' sourcing behaviour.

We find that the introduction of a new TBT significantly reshapes sourcing patterns along both intensive and extensive margins. Along the intensive margin, a one standard deviation increase in our regulatory distance index reduces imports from affected origins by 2.7 percent, while simultaneously increasing imports from harmonised partners by 4.3 percent—a pattern consistent with trade diversion toward suppliers already aligned with EU rules. Along the extensive margin, firms respond by adjusting their supplier networks: they are 2.1 percentage points more likely to add an harmonised supplier and 2.7 to 3.5

of the Green Deal. It imposes strict requirements on hazardous substances, minimum recycled content, carbon footprint standards, performance criteria, labelling mandates, and recycling targets (codified under TBT symbol "G/TBT/N/EU/775").

percentage points less likely to add a non-harmonised one. Across all origins, unit values rise by 2 to 3 percent, indicating that suppliers successfully pass through adaptation costs to buyers, likely reflecting their bargaining power when switching options are limited.

Our findings are robust to several checks, including controls for TBT accumulation, origin country development levels, alternative instrumental variable specifications, and accounting for trade-facilitating regulations. Heterogeneity analyses reveal that the impact of TBTs is mediated by adjustment costs and firm capabilities. Lower switching costs enable greater reallocation toward EU suppliers. Bargaining power dynamics, proxied by buyer reliance on specific origins, determine the extent of cost pass-through: high reliance leads to larger price increases and quantity reductions. Firm scale also matters, as larger firms exhibit greater capacity to restructure supply chains aggressively, shifting toward lower-cost EU origins while dropping higher-cost non-EU suppliers.

These results reveal an important mechanism through which behind-the-border regulations affect trade. Like MFN tariffs, TBTs are *de jure* non-discriminatory and affect all trading countries simultaneously; unlike MFN tariffs, however, they do not impose a uniform, observable wedge. Instead, they generate origin-specific adaptation costs that rise with regulatory distance. These costs interact with switching frictions and bargaining dynamics. As a result, trade diverts toward harmonised suppliers and away from misaligned ones; unit values rise broadly as adaptation costs are passed through and outside options deteriorate. Adjustments are muted when relationship-specific investments bind but pronounced among larger buyers with greater reconfiguration capacity. In short, TBTs act as re-optimisation shocks: regulatory alignment and search-and-bargaining frictions determine who bears the burden and how sourcing is reconfigured. TBTs are simultaneously adaptation-cost barriers and catalysts for reorganisation, with effects that vary across firm, product, and origin.

Related literature We contribute to three strands of the literature: (i) supply-chain adjustment to trade policy shocks, (ii) firm-level responses to non-tariff measures (NTMs), and (iii) the economics of standard-setting and regulatory cooperation.

First, we build on the growing theoretical work on trade policy and global value chains (Antràs and De Gortari, 2020; Conconi et al., 2018; Ornelas et al., 2021). Grossman et al. (2024) show how unexpected input tariff changes disrupt supply chains when buyers face sunk search costs. Related models treat search frictions as sunk investments to match with GVC partners (Allen, 2014; Grossman and Helpman, 2005; Fontaine et al., 2023; Huang et al., 2024; Krolikowski and McCallum, 2021). We extend this framework by replacing the tariff border wedge with TBT-induced, origin-specific adaptation costs. These costs interact with search frictions and bargaining dynamics to generate testable implications for trade diversion and pass-through. Our empirical findings confirm that regulatory dissimilarity drives sourcing reallocation, with effects varying systematically by bargaining power and switching costs.

Second, we add to the empirical literature on NTMs and GVCs, which mostly uses product-level data (Blind et al., 2018; Chen and Mattoo, 2008; Ghodsi and Stehrer, 2019; Mei and Xu, 2024). We use French firm-level customs records to track sourcing adjustments at a more granular level. Following Bas and Strauss-Kahn (2014), we distinguish intermediate inputs from carry-along trade and focus on the country of manufacture rather than the last country of shipment. This distinction matters because manufacturers bear the adaptation burden, not re-exporters. Ideally, one would observe firm-to-firm transaction data with importer identifiers to trace supply chain links directly, but such data for France are available only for intra-EU flows (Martin et al., 2023).

While most firm-level work on TBTs examines the exporter's perspective (Disdier et al., 2023; Fontagné and Orefice, 2018; Iodice, 2020; Navaretti et al., 2018), we focus

on importing producers' sourcing decisions. Singh and Chanda (2021) study importer markups, but do not model search frictions or supplier switching. We explicitly incorporate both, allowing us to examine how firms reallocate across origins and renegotiate prices when faced with regulatory shocks.

Finally, our work contributes to the political economy of trade and standardisation (Antràs and Staiger, 2012; Blanchard et al., 2025; Bondi et al., 2025; Garcés and Vogt, 2024; Macedoni and Weinberger, 2021; Maggi and Ossa, 2021, 2023; Parenti and Vannoorenberghe, 2024). Building on the insight that adaptation costs increase with regulatory distance (Grossman et al., 2021), we go beyond broad NTM typologies (Cadot et al., 2015) or stated objectives (Ghodsi & Stehrer, 2019) by constructing a text-based, time-varying measure of regulatory distance between the French market and origin-country requirements. We compare the technical content of TBT notifications to pre-existing standards in origin countries, converting textual differences into measurable adaptation shocks.

The remainder of the paper proceeds as follows. Section 2 provides stylised facts on the growing use of TBTs by the EU and their impact on European imports, motivating our theoretical framework in Section 3. Section 4 describes our data sources, including the construction of the TBT database and our measure of adaptation costs. Section 5 lays out the empirical strategy, while Section 6 discusses the main results. Section 7 explores the underlying drivers of trade diversion and Section 8 concludes.

2 Motivational Evidence

This section outlines the EU's technical standards regime and presents some stylised facts that motivate our empirical investigation.

Institutional Framework At the multilateral level, the WTO Agreement on Technical Barriers to Trade sets disciplines for technical regulations and standards, including transparency and notification obligations. Members are expected to base regulations on relevant international standards where they exist, except where such standards would be insufficient for achieving legitimate objectives. The EU notifies its measures to the WTO, and these notifications underpin our TBT database and product mapping.

Within the EU, technical standards operate under two regimes: *harmonisation* and *mutual recognition*. Approximately 70% of EU production falls under fully harmonised standards, ensuring uniform requirements across member states. The remaining sectors rely on mutual recognition, which in principle allows goods lawfully produced in one member state to be marketed in others.[3] In practice, however, only 13% of eligible firms effectively benefit from mutual recognition. Regulatory complexities and administrative hurdles lead most exporters to adapt to national standards instead, limiting the principle's practical effect.[4]

Beyond its internal market, the EU extends regulatory alignment through preferential trade agreements (PTAs) containing provisions on technical standards that go beyond WTO disciplines, including agreements with Euro-Mediterranean partners, Chile, Turkey, and South Africa.[5]

These institutional arrangements create systematic variation in compliance costs. Although EU technical regulations are non-discriminatory by law, the adaptation cost a supplier faces depends on regulatory alignment with the EU—whether firms source from within the EU, from countries with explicit alignment provisions, or from third coun-

[3]See the EU Website for details.

[4]The European Commission (2017) concludes that "mutual recognition is not functioning well and that the principle and the Regulation had limited effects in meeting the foreseen objectives."

[5]See Table A.4 for the complete list.

tries. This origin-specific variation forms the basis of our identification strategy and is operationalised through our text-based regulatory distance index.

Trends and Preliminary Evidence Figure 1 reveals the evolving intensity of EU technical regulation across product types. Each point represents the share of HS-4 products within each category affected by newly notified TBTs in that year. Intermediate goods experienced a surge in regulatory activity: starting from around 20% coverage in 2000, new TBT introductions peaked at roughly 50% around 2010-2012, before moderating to approximately 35% by 2020. Consumption and capital goods show more stable patterns with lower annual coverage rates. This wave of regulation targeting intermediate inputs coincides with rapid GVC expansion, implying that firms sourcing regulated intermediate goods faced repeated and substantial adaptation pressures over the past two decades.

Table 1 provides preliminary evidence that TBTs introduced by the EU redirect sourcing toward EU suppliers. An EU TBT's entry into force is associated with a 1.2 percentage point increase in the intra-EU import share (Column 1). The effect is larger for final goods (1.7 percentage points) than for intermediates (0.4 percentage points; Column 2), consistent with higher adjustment frictions along supply chains. Diversion intensifies in more elastic sectors: the positive TBT $\times \sigma$ coefficient (Column 3) implies that a one-unit increase in the elasticity of substitution amplifies the TBT effect by 0.5 percentage point, indicating larger shifts where substitution is easier.

These patterns suggest reallocation toward EU suppliers, especially for final goods and in more substitutable product markets, though weaker for intermediate goods, consistent with higher switching costs. However, product-level regressions cannot reveal whether shifts reflect dropping non-EU suppliers, adding EU suppliers, or renegotiation

Figure 1: New EU TBTs coverage across HS-4 products, by type of goods



Notes: The figure shows the share of HS-4 products affected by newly notified EU TBT regulations in each given year, using the BEC classification to distinguish between capital, consumption, and intermediate goods. For each year, the measure captures the union of HS-4 products across all new TBT notifications introduced in that year. Values are displayed as three-year centred moving averages; faint dots show the raw yearly shares. Since the BEC classification is defined at the HS-6 level, 16% of HS-4 products map to multiple BEC categories; when equally split, assignment is random. Results are robust to excluding these ambiguous HS-4 codes.

with incumbents. The remainder of the paper addresses these limitations using firm-level customs data and our measure of regulatory distance.

Table 1: Effect of EU Technical Regulations on Intra-EU Import Shares

	Dependent variable:		
	Share of EU imports sourced intra-EU (log)		
	(1)	(2)	(3)
TBT enforcement	0.012**	0.017**	0.036***
	(0.005)	(0.007)	(0.007)
TBT × Intermediate		−0.013*	−0.046***
		(0.008)	(0.008)
TBT × σ			0.005***
			(0.0004)
Observations	21,768	21,606	21,129
R^2	0.867	0.877	0.880
Year FE	Yes	Yes	Yes
HS4 FE	Yes	Yes	Yes

Notes: The dependent variable is the log of the intra-EU import share by HS4 product and year. All regressions include HS4 and year fixed effects. σ denotes the elasticity parameter from Fontagné et al. (2022), estimated at the HS-6 product level, averaged to HS-4, and centred so that its cross-product mean is zero. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

3 Theoretical Framework

Motivated by the two main stylised facts highlighted in the previous section: (i) EU standards induce trade diversion and (ii) the effect is less pronounced for intermediate goods, we build on the GVC model of Grossman et al. (2024), hereafter referred to as GHR. In the GHR framework, final goods producers face a non-recoverable, upfront search cost when searching new suppliers. We extend this framework by incorporating input adaptation costs to the new standard, which vary by supplier location and influence

the optimal configuration of supply chains.

While our setup largely follows GHR, we provide a concise overview below to establish notation, with additional details in Section A.4. Our discussion concentrates on the key modifications from the original GHR model and their implications for sourcing decisions.

Setup and Notation In a monopolistically competitive market, firms produce differentiated products ω using labour and a composite intermediate good.[6] This intermediate good is made from a range of inputs indexed by j, combined in fixed ratios using Leontief technology. Firms have two options for each input: produce it internally using a standard technology or find an external supplier, located either domestically or abroad. A firm looking for a potential supplier can take a draw from a cumulative distribution $G(.)$. At a cost of F, the match-specific inverse productivity, a, is revealed. The supplier's productivity and the wage rates in their country determine the unit cost of production. With all suitable suppliers, the firm negotiates short-term, renewable contracts through Nash-in-Nash bargaining, with exogenous weights β for the buyer and $1-\beta$ for the seller. This negotiation sets the input price $\rho(a)$, and consequently, the perceived marginal cost of the intermediate good.

If the match is unsatisfactory, the firm resumes its search for a new supplier, at an additional cost of F. The optimal search strategy involves a reservation-stopping rule denoted by $\bar{a}$, such that a firm takes another draw for the input if and only if all of its prior draws for that input had inverse match productivities that exceed $\bar{a}$. With this setup, the negotiated price represents a weighted average of the supplier's production cost and the buyer's outside option. Specifically, the cost of producing the input with

[6]The demand side of our model follows standard model of trade under monopolistic competition with preferences characterised by quasi-linear utility, where the sub-utility of the differentiated good is iso-elastic with $\epsilon > 1$. The elasticity of substitution among brands σ is also constant.

the reservation match productivity, whose weights depend on the negotiation power of the two parties governed by β. Assuming the distribution of productivity takes the form $G(a) = a^{\theta}$, with $\theta > 1$, where θ seizes the spread, one can obtain an analytical form for the reservation rule as follows:

$$\bar{a}^{\theta+1} = \frac{f(\theta+1)}{\beta m w} \tag{1}$$

where m is the units of intermediate inputs, w is the wage and f is the expected flow cost of searching.[7] Intuitively, when search draws are more costly or when the distribution of productivities is more concentrated, the stopping rule is more tolerant, i.e., higher $\bar{a}$. On the contrary, when the foreign wage is higher, the scale of production is larger, or the buyers have more bargaining power, the search cost is greater, i.e., lower $\bar{a}$. In this situation, the producers have more incentive to find a better match.

3.1 Departing from Free Trade

To study the introduction of a TBT on input j, we assume that the enforcement of a TBT comes as a surprise to downstream producers who have already formed their supply chains in country A. Once the TBT is implemented, firms expect it to persist indefinitely.

Let η^{TBT} be the adaptation cost to the new TBT that suppliers of the input have to incur to adjust their production. We assume that the size of η^{TBT} varies across countries, and might be small enough to only induce changes in the volume of imports for some countries or large enough to induce exit and to alter the preferred location for search of suppliers. Under free trade, the price distribution of inputs sourced from country A

[7] The expected capital cost is given by $S(\bar{a}) = F + [1 - G(\bar{a})]S(\bar{a})$, where $G(\bar{a})$ is the probability that the firm retains the match and thus does not incur in further search costs. The expected cost flows is instead given by $f = rS(\bar{a})$ where r is the constant interest rate.

dominates that of any other country. However, the introduction of a TBT might raise the relative cost of sourcing from this country. This is particularly true if there exists another country (including the home country), B, from which η^{TBT} is lower such that $\eta_B^{TBT} w_B < \eta_A^{TBT} w_A$, where w_A and w_B denotes the wage in country A and B respectively, then country B becomes the new origin for all prospective searches once the TBT is enforced.[8]

A "small" relative adaptation cost of TBT satisfies $\eta_B^{TBT}/\eta_A^{TBT} > w_A/w_B$, while a "large" relative adaptation cost satisfies $\eta_B^{TBT}/\eta_A^{TBT} < w_A/w_B$.[9]

3.2 Small Relative Adaptation Costs to a TBT

We first focus on the situation in which, even after the introduction of the TBT, country A still has the lowest efficiency-adjusted wage, i.e., $\eta_B^{TBT} w_B > \eta_A^{TBT} w_A$. Albeit the supply location does not change, the imposition of a TBT imposes a cost that is borne by both buyer and supplier depending on their negotiation power. In particular, $\rho(a, \eta_A^{TBT})$ denotes the renegotiated price that final firm ω pays to its supplier for input j, including the cost of adapting to the new standard, η_A^{TBT}.

The outside option for the producer is to conduct a new search in country A, with optimal stopping rule $\bar{a}(\eta_A^{TBT})$, and to pay a price to a new supplier of $\mu_\rho[\bar{a}(\eta_A^{TBT}), \eta_A^{TBT}]$, which is the mean of $\rho(a, \eta_A^{TBT})$ conditional on $a < \bar{a}(\eta_A^{TBT})$. The producer's net benefit from remaining with its original supplier amounts to $\mu_\rho[\bar{a}(\eta_A^{TBT}), \eta_A^{TBT}] m(\eta_A^{TBT}) + f/G[\bar{a}(\eta_A^{TBT})] - \rho(a, \eta_A^{TBT}) m(\eta_A^{TBT})$, where $m(\eta_A^{TBT})$ is the quantity of the composite intermediate good that the firm assembles with the TBT enforced. For the supplier, the

[8] Inputs are symmetric, thus it is always optimal for a firm to search for all of its suppliers in a single country, although that target country might change following the imposition of a new standard.

[9] We test in the empirical section, several reasons why the cost of implementation differs across countries, such as the presence of PTA with provision on TBT, differences in regulatory distance with the EU, or different level of relationship-specific investments.

surplus is simply the difference between revenue and production cost, or, $[\rho(a, \eta_A^{TBT}) - wa\eta_A^{TBT})]m(\eta_A^{TBT})$.

The renewed Nash bargaining yields:

$$\rho(a, \eta_A^{TBT}) = \arg\max_q \left[\mu_\rho[\bar{a}(\eta_A^{TBT}), \eta_A^{TBT}] + \frac{f}{m(\eta_A^{TBT})G[\bar{a}(\eta_A^{TBT})]} - q\right]^\beta (q - wa\eta_A^{TBT})^{1-\beta}$$

whose solution gives that:

$$\rho(a, \eta_A^{TBT}) = \beta wa\eta_A^{TBT} + (1-\beta)w\eta_A^{TBT}\mu_a[\bar{a}(\eta_A^{TBT})] + \frac{1-\beta}{\beta}\frac{f}{m(\eta_A^{TBT})G[\bar{a}(\eta_A^{TBT})]}, \quad (2)$$

where $\mu_a[\bar{a}(\eta_A^{TBT})]$ is the is the conditional mean of a for $a \leq \bar{a}(\eta_A^{TBT})$ and

$$\mu_\rho[\bar{a}(\eta_A^{TBT}), \eta_A^{TBT}) = w\eta_A^{TBT}\mu_a[\bar{a}(\eta_A^{TBT})] + \frac{1-\beta}{\beta}\frac{f}{m(\eta_A^{TBT})G[\bar{a}(\eta_A^{TBT})]}. \quad (3)$$

A firm that conducts new searches once the "small-adaptation cost" TBT has been introduced chooses $\bar{a}(\eta_A^{TBT})$ to minimise $\mu_\rho[\bar{a}(\eta_A^{TBT}), \eta_A^{TBT}) + f/G[\bar{a}(\eta_A^{TBT})]$, the sum of procurement costs and the debt burden imposed by search costs. The new first-order condition becomes:

$$m(\eta_A^{TBT})w\eta_A^{TBT}\mu_a'[\bar{a}(\eta_A^{TBT})] = \frac{fg[\bar{a}(\eta_A^{TBT})]}{\beta G[\bar{a}(\eta_A^{TBT})]^2} \quad (4)$$

which, after rearranging terms, can be written as:

$$w\eta_A^{TBT}\{\bar{a}(\eta_A^{TBT}) - \mu_a[\bar{a}(\eta_A^{TBT})]\}G[\bar{a}] = \frac{f}{\beta m(\eta_A^{TBT})} \quad (5)$$

We can substitute (2) into (5) to derive the new expression for the negotiated price:

$$\rho(a, \eta_A^{TBT}) = \beta\eta_A^{TBT} wa + (1-\beta)\eta_A^{TBT} w\bar{a}(\eta_A^{TBT}) \tag{6}$$

Note that all input prices increase in preserved supply links for $\eta_A^{TBT} > 1$ and $\bar{a}(\eta_A^{TBT}) > \bar{a}$. The latter condition requires the stopping rule to become less stringent after the introduction of a TBT with "small" adaptation costs. Importantly, the benefit of continued search is proportional to the cost of the input bundle m: the smaller m, the larger $\bar{a}$. When the demand for final goods is elastic and the production function has constant returns to scale, the derived demand for inputs is elastic as well. Consequently, an increase in adaptation costs will lead to a reduction in m, thereby raising the marginal cost threshold.

3.3 Large Relative Adaptation Costs to a TBT

For a larger adaptation cost, the optimal location for searching might be altered. If $w_A < \eta_B^{TBT} w_B < \eta_A^{TBT} w_A$, country B becomes the new optimal origin from which to search for a new supply link. We denote b the realisation of a draw from the (inverse) productivity distribution in country B and $\bar{b}^{TBT}$, the optimal rule in the equilibrium once the TBT is enforced. We assume that the distribution of the inverse supplier's productivity $G(.)$ is the same in B, and the cost of drawing a match is still F.

We denote with a_B, the inverse productivity of the marginal supplier that is retained after the TBT is enforced, so that firms renegotiate with suppliers in country A that have $a \in (0, a_B]$ and replace their original suppliers that have match productivities $a \in (a_B, \bar{a}]$ with new partners in B.[10] The negotiated prices for inputs imported from countries A

[10] If $a_B = \bar{a}$, no new searches are occurring.

and B can be re-written as follows:

$$\rho_A(a, \eta_A^{TBT}) = \beta \eta_A^{TBT} w_A a + (1-\beta)\eta_B^{TBT} w_B \bar{b}^{TBT} \tag{7}$$

and

$$\rho_B(b, \eta_B^{TBT}) = \beta \eta_B^{TBT} w_B b + (1-\beta)\eta_B^{TBT} w_B \bar{b}^{TBT}. \tag{8}$$

These TBT-inclusive prices, $\rho_A(a, \eta_A^{TBT})$ and $\rho_B(b, \eta_B^{TBT})$, are weighted averages of the unit cost of production and the unit cost of an input produced by a supplier in country B at the reservation level of productivity ($\bar{b}^{TBT}$).

The new stopping rule $\bar{b}^{TBT}$ identifies the worst match that a buyer would accept conditional on searching in the new country B. This worst match yields an opportunity to purchase an input at price $\eta_B^{TBT} w_B \bar{b}^{TBT}$. If $\eta_A^{TBT} w_A a < \eta_B^{TBT} w_B \bar{b}^{TBT}$, the original supplier offers a better deal than the reservation match. Conversely, if $\eta_A^{TBT} w_A > \eta_B^{TBT} w_B \bar{b}^{TBT}$, search in B yields a better negotiated price even at the worst possible match among the acceptable ones. Thus, $a_B = \min\{\eta_B^{TBT} w_B \bar{b}^{TBT} / \eta_A^{TBT} w_A, \bar{a}\}$ and producers retain suppliers with reservation level $a \leq \dfrac{\eta_B^{TBT}}{\eta_A^{TBT}} \dfrac{w_B}{w_A} \bar{b}^{TBT}$ and replace those with $a > \dfrac{\eta_B^{TBT}}{\eta_A^{TBT}} \dfrac{w_B}{w_A} \bar{b}^{TBT}$.

3.4 Testable Implications

3.4.1 Small relative adaptation costs (no supply location change)

If $w_A < w_B$ and $\eta_A^{\text{TBT}} w_A \leq \eta_B^{\text{TBT}} w_B$, the optimal *origin* for search does not change. A higher adaptation wedge raises unit costs, which reduces spending on intermediates m;

by the stopping rule,

$$\bar{a}^{\theta+1} = \frac{(\theta+1)\,f}{\beta\, w_A\, \eta_A^{\mathrm{TBT}}\, m} \quad \Rightarrow \quad m \downarrow \Longrightarrow\ \bar{a} \uparrow,$$

so firms become more tolerant of mediocre matches and undertake less additional search. Renegotiation with continuing suppliers then yields higher input prices even without supplier switching:

$$\rho_A\Big(a, \eta_A^{\mathrm{TBT}}\Big) = \beta\, \eta_A^{\mathrm{TBT}}\, w_A\, a + (1-\beta)\, \eta_A^{\mathrm{TBT}}\, w_A\, \bar{a}\Big(\eta_A^{\mathrm{TBT}}\Big),$$

given an increase in η_A^{TBT} and in $\bar{a}\Big(\eta_A^{\mathrm{TBT}}\Big)$.

Empirically: Small adaptation wedges do not trigger reallocation but raise prices within incumbent-origin links and dampen further search (higher $\bar{a}$); quantities within continuing relationships decline (lower m), with no reallocation across origins and no increase in entry into new origins.

3.4.2 Large relative adaptation costs (switch to an aligned origin).

If $w_A < \eta_B^{\mathrm{TBT}} w_B < \eta_A^{\mathrm{TBT}} w_A$, search is redirected to B. Let $\bar{b}$ be the reservation cutoff in B and

$$a_B = \min\left\{ \frac{\eta_B^{\mathrm{TBT}} w_B\, \bar{b}}{\eta_A^{\mathrm{TBT}} w_A},\ \bar{a} \right\}.$$

Incumbents with $a \le a_B$ are retained; those with $a > a_B$ are replaced by B-suppliers. The renegotiated prices are

$$\rho_A(a) = \beta\, \eta_A^{\mathrm{TBT}}\, w_A\, a + (1-\beta)\, \eta_B^{\mathrm{TBT}}\, w_B\, \bar{b}, \qquad \rho_B(b) = \beta\, \eta_B^{\mathrm{TBT}}\, w_B\, b + (1-\beta)\, \eta_B^{\mathrm{TBT}}\, w_B\, \bar{b}.$$

Reallocation intensity: The replacement share $P(a > a_B)$ increases with the effective cost gap and falls with search frictions:

$$\frac{\partial P(a > a_B)}{\partial\Big((\eta_A^{\mathrm{TBT}} w_A)/(\eta_B^{\mathrm{TBT}} w_B)\Big)} > 0, \qquad \frac{\partial P(a > a_B)}{\partial f} < 0, \qquad \frac{\partial P(a > a_B)}{\partial \beta} > 0,$$

since

$$\bar{b}^{\theta+1} = \frac{(\theta+1)\, f}{\beta\, w_B\, \eta_B^{\mathrm{TBT}}\, m},$$

so higher f (equivalently, higher capitalised search cost) or lower β raises $\bar{b}$ and increases retention.

Price anchoring and dispersion: For any operating link, current costs are below the outside option ($\eta_A^{\mathrm{TBT}} w_A a \le \eta_B^{\mathrm{TBT}} w_B \bar{b}$, $\eta_B^{\mathrm{TBT}} w_B b \le \eta_B^{\mathrm{TBT}} w_B \bar{b}$), so both ρ_A and ρ_B are bounded above by $\eta_B^{\mathrm{TBT}} w_B \bar{b}$ (anchoring at B's reservation cost). Cross-origin price differences satisfy

$$\rho_A(a) - \rho_B(b) = \beta\Big(\eta_A^{\mathrm{TBT}} w_A a - \eta_B^{\mathrm{TBT}} w_B b\Big),$$

so prices converge as $\beta \downarrow 0$ (greater supplier bargaining power with more weight on the common outside option) and diverge as $\beta \uparrow 1$ (greater buyer bargaining power).

Empirically: large adaptation costs wedges trigger reallocation, with more exit from high-cost origins, more entry into aligned/low-distance origins, and prices in both origins anchored by the aligned-origin reservation cost. Stronger buyer power (β) amplifies replacement and cross-origin price dispersion, while higher search costs (higher f) suppress replacement.

4 Data Set and Key Variables

This section describes the data used to analyse how TBT-related adaptation costs influence firms' sourcing decisions. We begin by explaining how we address three core challenges: (i) identifying TBTs that could affect trade, (ii) determining their product coverage and timing, and (iii) measuring adaptation costs. We then present the firm-level data employed in our empirical analysis and conclude with descriptive statistics on French firms' sourcing behaviour.

4.1 Construction of a New Database on TBTs

While several NTM databases have recently emerged to capture rising non-tariff protection, their coverage is often limited to short periods or specific countries (UNCTAD, 2017). The WTO TBT Notification portal is the most comprehensive source, recording all TBTs notified by WTO members since 1995. However, product details are frequently incomplete, prompting us to create a more complete database of HS-4 product codes through a six-phase procedure.

In the first phase, we retain all notifications that explicitly include HS codes. We then rely on the WTO I-TIP website to match HS codes when available. Next, we consult *addendum* documents, notification texts, and official national documents to extract missing codes. We then assign missing product codes from fully matched notifications with the same textual product description. In a further step, we link ICS codes to HS codes using official WTO correspondences and the Han et al. (2019) mapping. Finally, we apply a Support Vector Machine (SVM) classifier to infer HS codes for any remaining incomplete entries. This classifier compares TBT descriptions with known HS labels and achieves 95.7% accuracy on a held-out test set, as detailed in Section A.1.

By combining these steps, our new database covers 28,301 notifications, 142 countries, and 1,242 products over 1995–2020 (Table A.2). The steps beyond those previously used by Ghodsi et al. (2017) allow us to match an additional 10,788 notifications to HS codes over 1995–2019. We work at the HS-4 level because most regulations are specified at this broad category (73% of total notifications), compared with only 1.6% at HS-6. Although HS-4 aggregation may underestimate TBT coverage, it yields a cleaner control group of unaffected products as a counterfactual.

Table A.1 reports the annual average share of new TBTs affecting products across sectors. Traditional industries such as animal and vegetable products, and foodstuffs have the highest TBT coverage; however, even sectors with more complex supply chains (e.g. machinery and electrical) have about 20% of products covered by new TBTs each year.

4.2 Data Sources on Trade Agreements

Within the EU and the European Free Trade Association (EFTA), free movement of goods in harmonised sectors relies on uniform standards and conformity assessment procedures, whereas non-harmonised sectors follow the principle of mutual recognition.[11] In practice, mutual recognition can sometimes be challenging to implement, leading many exporting firms to adapt directly national standards. To identify these differences, we consult the European Commission's list of non-harmonised (or partly harmonised) NACE 2 sectors. To create the list of non-harmonised products, we follow Bolatto et al. (2023), and first adopt RAMON concordance from 6-digit HS 2002 to 6-digit CPA 2002 classification, and subsequently from CPA 2.1 to NACE Rev.2 at the 4-digit level. We rely on the UN correspondence tables between HS, ISIC and NACE classifications for the missing

[11] See Tables A.6 and A.7 or the EU Website for a the list of non-harmonised sectors.

sectors.

Beyond the internal EU/EFTA framework, many countries deepen market integration with the EU through preferential trade agreements (PTAs). The World Bank PTA database, developed by Mattoo et al. (2020), covers 269 PTAs that entered into force between 1960 and 2017, indicating whether standards, and technical regulations are harmonised or mutually recognised.[12] Merging this information with our TBT database identifies scenarios where a TBT introduced by one country extends to another via harmonised standards or mutual recognition.

4.3 Proxies for Adaptation Costs to TBTs

We use two proxies for the adaptation costs induced by technical regulations, both grounded in the notion of "regulatory distance" between what governs the French market and what prevails in the source country.

We first rely on a binary alignment proxy, distinguishing EU from non-EU origins. Across sectors, we indicate whether product requirements are fully harmonised under EU law or fall under mutual recognition. We also capture if the source country is part of a PTA with the EU that includes an harmonisation or mutual recognition of TBT clause. These indicators capture institutional alignment that should attenuate adaptation costs.

Secondly, we use a continuous, time-varying index of regulatory distance that quantifies textual dissimilarity between regulations applied in France and in the origin country. For each product p and year t, we take as reference the most recent TBT on the French market—either an EU (if p is in an harmonised sector) or a French national regulation. We then compile the set $\mathcal{S}_{pot}$ of all measures governing p in origin country o at time t. For EU origins in harmonised sectors, the same regulations apply across countries, so the

[12] Table A.3 details the variables used.

two countries are perfectly aligned. For EU origins in mutual recognition sectors and all non-EU origins, $\mathcal{S}_{pot}$ comprises national regulations.

We represent each regulation, i.e., the description of the measure from the TBT Notification, as a TF–IDF vector (weighting words by their frequency within versus across documents) and compute the average cosine similarity between the new EU/France TBT reference and each regulation in the origin's stock.

Regulatory distance is defined as the complement of this average similarity:

$$\eta_{pot}^{TBT} \equiv 1 - \frac{1}{|\mathcal{S}_{pot}|} \sum_{s \in \mathcal{S}_{pot}} \cos\Big(\text{Text}_{pt}^{\text{EU/France}}, \text{Text}_s\Big),$$

where $|\mathcal{S}_{pot}|$ is the number of regulations in the origin's stock, s indexes individual texts, and $\cos(\cdot,\cdot)$ measures cosine similarity between TF–IDF vectors. Since cosine similarity lies in $[0,1]$, so does η_{pot}^{TBT}.

η_{pot}^{TBT} is equal to zero when regulations are textually identical (EU origins in harmonised sectors). Higher values reflect substantive differences in technical specifications or labelling requirements, implying larger adaptation costs for exporters. The continuous nature of the index captures variation in regulatory stringency and content both across countries and over time.

Consistent with expectations, Figure A.1 underscores how regulatory dissimilarity declines with both geographic proximity and smaller income differences, implying that countries closer in space or per-capita GDP are more likely to share comparable regulations. Appendix A.2 details the data sources and the text-processing steps used to build this measure.

4.4 French Firm Level Data

We rely on two primary sources for French firm-level data. We first use *Sirene*, an administrative database that tracks all active and discontinued firms in France, to identify manufacturing firms based on their primary NAF codes, ensuring consistency over time.[13]

The second data source comprises French Customs records covering 2000–2018, with firm-level details on imports and exports disaggregated by product (NC8 tariff lines) and partner country.[14] For each imported shipment, the database specifies both the country of shipment ($PAYP$) and the country of origin ($PYOD$), where the latter denotes the location of production or substantial transformation. We focus on $PYOD$ under the assumption that technical regulations affect the principal manufacturing site.[15]

To identify intermediate inputs, we build on Feenstra and Hanson (1996) and Bas and Strauss-Kahn (2014). Specifically, we compare each firm's imported HS4 codes with its main exported HS4 code (defined by total annual exports). Any imported HS4 code that differs from the main export code is treated as an intermediate.

4.5 Descriptive Statistics

We present two sets of descriptive statistics to illustrate firms' sourcing patterns and the relevance of TBTs.

Table 2 reports the sourcing behaviour of the average (mean) and median importer. On average, a firm retains about half of its intermediate inputs from one year to the

[13]We accessed Sirene in January 2020. To handle revisions in the NAF classification for 2003 and 2008, we rely on INSEE's official conversion tables.

[14]To ensure product codes remain comparable despite periodic HS classification changes, we adopt CEPII's correspondence tables.

[15]Before 2010, imports with extra-EU origins were recorded only if they exceeded €1,000. Following Bergounhon et al. (2018), we apply this threshold uniformly throughout our sample to maintain consistent coverage across years and countries. Fortunately, this adjustment does not significantly affect the number of importing firms, the mix of HS codes, or the share of intra-EU trade in the data (Figure A.2).

next, whereas the median importer carries over approximately two-thirds, suggesting stable input mixes. The typical firm sources the same product from nearly two different countries, and this figure remains largely unchanged across the sample period, indicating limited variation in geographic diversification. Additionally, the average importer sources a given HS4 product from the EU about half the time, whereas the median importer relies on EU origins nearly two-thirds of the time. This difference points to a "size premium", whereby larger firms are more likely to import from outside the EU.

Table 3 provides a broader overview of key statistics, broken down into four time periods. Over these intervals, the total number of importing firms is around 35,000. Meanwhile, the share of imported goods covered by at least one TBT nearly doubles, rising from 0.53 to 0.99, indicating that regulatory measures increasingly encompass most traded products. Conversely, the average measure of regulatory dissimilarity declines from 0.71 to 0.66, suggesting gradual convergence or alignment of standards across markets. Overall, these figures highlight growing regulatory exposure and trade volumes, alongside a modest improvement in the harmonisation of technical requirements with the EU.

Table 2: Summary statistics on firms' sourcing

	Mean Importer							**Median Importer**						
	Intermediate Import Products			Sourcing Origins per Product				Intermediate Import Products			Sourcing Origins per Product			
Year	Count	%New	%Cont.	Count	%New	%Cont.	%EU	Count	%New	%Cont.	Count	%New	%Cont.	%EU
2001-2004	14.8	57.6	38.0	1.9	63.0	33.1	48.4	7.0	51.3	43.0	1.5	57.6	37.2	59.3
2005-2008	16.3	36.4	50.2	2.0	44.7	43.9	49.4	8.0	25.0	56.7	1.5	36.4	49.4	61.8
2009-2012	18.1	28.7	53.6	2.0	37.5	47.0	49.8	8.8	16.2	62.2	1.6	28.0	52.1	62.8
2013-2017	20.7	26.8	54.5	2.0	35.4	48.0	48.3	9.8	13.2	64.0	1.5	24.9	54.3	59.9

Notes: Products are classified at the HS4 level. Intermediate import products refer to goods imported by firms that do not constitute part of their core export activity. The 'Count' variable represents either the number of distinct HS4 products or the number of unique sourcing countries per HS4 product. %New reflects the average share of newly imported products (origins per product) within a firm's basket of intermediate imports. %Cont denotes the share of products that have been imported over consecutive years; the remainder is the share of imports that have been discontinued. %EU denotes the share of sourcing links originating from the European Union.

Table 3: Summary Statistics on the Estimation Sample

Statistic	2000–2002	2003–2005	2006–2009	2010+
# Importers	33,169	34,046	35,499	39,829
# HS4 Imported Intermediate Inputs	1,242	1,242	1,242	1,242
Total Imports	485.9	521.6	804.1	1,631.6
TBT (Binary Treatment)				
Mean	0.53	0.66	0.82	1.00
By Origin				
TBT in EU origins	0.35	0.45	0.55	0.68
TBT in Non-EU origins	0.18	0.21	0.26	0.32
By Regulatory Integration				
TBT with Harmonisation	0.17	0.21	0.26	0.33
TBT with Mutual Recognition	0.19	0.26	0.32	0.37
TBT without Har. & Mut. Rec.	0.17	0.19	0.23	0.29
Avg. Regulatory Dissimilarity (Cosine Measure)				
Mean	0.68	0.67	0.66	0.65
Std. Dev.	0.47	0.46	0.46	0.45

Notes: Total Imports are in billions of Euro. # Importers and # HS4 Codes represent the number of distinct importers and HS4 product codes in our estimation sample. The TBT binary treatment is a dummy variable equal to one if a TBT is enforced at time t (or earlier, unless withdrawn). The TBT treatment by origin and by regulatory integration represents the average value of the treatment variable interacted with indicators for whether the origin is EU or non-EU, and the type of regulatory integration (Harmonisation, Mutual Recognition, or neither). Regulatory Dissimilarity is measured as the average cosine dissimilarity between EU TBT regulations and those active in the origin market.

5 Empirical Strategy

This section details our empirical approach to estimate how new technical regulations affect firms' import activities.

5.1 Identification Strategy

Our goal is to isolate the causal effect of adaptation costs to TBT on firm-level import patterns. For this purpose, we estimate:

$$y_{fpot} \;=\; \alpha_0\, TBT_{pt} \;+\; \alpha_1 \left(TBT_{pt} \times \eta_{pot}^{TBT} \right) \;+\; \delta_{fpo} \;+\; \delta_{ot,HS2} \;+\; \epsilon_{fpot}, \tag{9}$$

where y_{fpot} is a measure of import margins by firm f of product p from origin o at time t (e.g., import value). The dummy variable TBT_{pt} equals 1 if a TBT has been enforced on

product p in or before year t, while η_{pot}^{TBT} captures origin-specific adaptation costs.[16] We include sector–origin–year fixed effects, $\delta_{ot,HS2}$, to account for common macroeconomic or sectoral shocks, as well as firm–product–origin fixed effects, δ_{fpo}, to absorb any time-invariant features of individual firm–origin–product combinations.

This approach exploits within firm, product, origin variation over time, netting out broader demand shifts, unobserved heterogeneity at the firm–product level, and general changes common to all firms operating in a sector HS2 from the same origin country. By doing so, we minimise concerns about omitted variables that could bias our estimation.

We also control for potential substitution between non-tariff measures and tariffs by incorporating time-varying, product-level tariff rates (Beverelli et al., 2019; Orefice, 2017), cleaned and interpolated as in Teti (2024).

Finally, because a single TBT can simultaneously affect multiple firms importing the same product from the same origin, we cluster standard errors at the treatment-assignment level (p, o, t) (Abadie et al., 2023). This accounts for correlated outcomes among firms subject to the same regulatory shock.

5.2 Baseline Specifications

We estimate two main specifications, differing in how adaptation costs are measured. The first relies on categorical indicators:

$$y_{fpot} = \sum_{\kappa=0}^{1} \alpha_\kappa \Big(\text{TBT}_{pt} \times \mathbf{1}\{\text{EU}_{ot} = \kappa\} \Big) + \delta_{fpo} + \delta_{ot,HS2} + \epsilon_{fpot}, \tag{10}$$

where EU_{ot} indicates whether the origin country o belongs to the EU at time t ($\kappa = 1$) or not ($\kappa = 0$). The key coefficients, α_0 and α_1, capture the average effect of a TBT on

[16] When only the date of adoption is available, we follow the WTO's recommendation by adding six months to approximate the actual enforcement date.

a firm's import margins—α_1 for imports from EU sources and α_0 for non-EU sources.

When the import price is the dependent variable, we expect both α_1 and α_0 to be positive. This indicates that higher adaptation costs translate into increased input prices, whether due to renegotiating supplier contracts, which has to incur the adaptation price, or by switching to less efficient suppliers who can more easily comply with new regulatory standards. Moreover, we expect α_0 to be even larger, since non-EU producers generally face higher adaptation costs because of stricter compliance requirements.

In contrast, when input quantity is the dependent variable, two effects are anticipated. First, higher marginal production costs will reduce overall input demand. Second, there may be a shift from non-EU to EU suppliers, resulting in a negative α_0. Simultaneously, α_1 could be positive if the increased demand for inputs from new EU suppliers offsets the decline in demand for inputs from existing suppliers due to higher production costs.

For supply-chain reallocation (exit and entry), we expect that new links (entry) might appear with lower-cost (often EU) suppliers, implying a positive α_1 and negative α_0. For exit, the reverse patterns would hold.

We refine this analysis by introducing deeper integration indicators HAR_{pot} and MR_{pot} for harmonisation and mutual recognition, respectively. HAR_{pot} captures full regulatory alignment (e.g., with the EU in the harmonised sectors), which we expect to facilitate compliance and spur reallocation toward those suppliers. By contrast, MR_{pot} may entail less robust or incomplete regulatory equivalence.

The second specification uses a continuous variable to proxy adaptation costs, as follows:

$$y_{fpot} = \gamma_0 TBT_{pt} + \gamma_1 TBT_{pt} \times \text{Dissimilarity}_{pot}^{TBT} + \delta_{fpo} + \delta_{ot,HS2} + \epsilon_{fpot}. \tag{11}$$

Here, η_{pot}^{TBT} is replaced by our text-based regulatory distance measure, which captures the difference between the EU TBT on product p and the existing TBTs on p in the origin country at the time of enforcement. The coefficient γ_0 represents the average effect of a TBT on import margins for origins with zero Dissimilarity$_{pot}^{TBT}$, such as EU origins in fully harmonised sectors. In contrast, γ_1 captures the marginal effect of increasing adaptation costs, with interpretations consistent with those discussed for Equation 10.

6 Results and Discussion

6.1 Baseline Results

Import Expenditures and Input Prices Table 4 reports how TBTs influence import expenditures and input prices. Equation 10 first distinguishes between EU and non-EU origins (Columns 1 and 4), then further refines product-origin pairs based on whether they are subject to harmonisation, mutual recognition of standards, or neither (Columns 2 and 5). Equation 11 replaces categorical measures with the regulatory dissimilarity, our text-based proxy of adaptation costs (Columns 3 and 6).

Focusing on import expenditures (in logs), Column (1) indicates that TBTs increase imports from EU origins by approximately 1.8%, while the effect on non-EU origins is statistically insignificant. Column (2) further disaggregates these results: imports from fully harmonised sectors (either within the EU or through deep integration agreements) increase significantly by 4.4%, whereas those from origins relying on mutual recognition drop by 1.8%, and those lacking harmonisation or MR drop by 2%. Consistently, Column (3) shows that origins with zero regulatory dissimilarity—i.e., fully harmonised sectors—increase import expenditures by 4.3%. By contrast, a one-standard-deviation

rise in regulatory dissimilarity decreases expenditures by about 2.7% ($(e^{-0.060\times0.45})-1 \approx (e^{-0.027})-1 \approx -0.0266$), suggesting that TBTs reallocate spending toward suppliers with lower adaptation costs.[17]

Columns (4)–(6) turn to input prices (in logs). In Column (4), import prices rise significantly by 2% for EU imports and 2.6% for non-EU imports. Column (5) shows price increases across all non-harmonised categories, with the largest increase (2.6%) for origins with neither harmonisation nor MR. Column (6) confirms a positive baseline price effect of 2.2% for origins with zero dissimilarity, but shows no significant additional price effect from higher adaptation costs (the coefficient on $\text{TBT}_{pt} \times \text{Dissimilarity}_{pot}^{TBT}$ is small and insignificant). This suggests that while TBTs generally lead to higher prices, the extent of regulatory dissimilarity does not significantly exacerbate this effect, perhaps indicating that suppliers, including EU producers, possess bargaining power to raise prices irrespective of their own adaptation costs once a TBT is introduced.

Supply Chain Reallocation Table 5 examines how TBTs reshape supply chains by analysing import quantities, supplier exits, and the probability of forming new sourcing links.

Column (1) indicates that EU TBTs reduce import volumes from extra-EU sources significantly by roughly 4.3%; while the corresponding coefficient for EU origins is negligible and statistically insignificant (-0.002). Column (2) further disaggregates these effects: imports from origins with harmonised standards increase by 2.1%, while those from origins subject to mutual recognition or lacking any formal integration decline significantly by 3.3% and 4.5%, respectively. In Column (3), using regulatory dissimilarity, an origin with zero dissimilarity experiences a 2% increase in import volume, whereas

[17] One sd of dissimilarity in our sample is 0.45 (Table 3).

Table 4: Estimation of the effect of TBT on import expenditures and prices

Dependent Variable	Import Value (ln)			Import price (ln)		
	(1)	(2)	(3)	(4)	(5)	(6)
$TBT_{pt} \times \mathbb{1}\{EU_{ot} = 1\}$	0.018**			0.020***		
	(0.008)			(0.005)		
$TBT_{pt} \times \mathbb{1}\{EU_{ot} = 0\}$	-0.018			0.026***		
	(0.012)			(0.006)		
$TBT_{pt} \times \mathbb{1}\{HAR_{pot} = 1\}$		0.043***			0.022***	
		(0.009)			(0.007)	
$TBT_{pt} \times \mathbb{1}\{MR_{pot} = 1\}$		-0.018*			0.016***	
		(0.010)			(0.006)	
$TBT_{pt} \times \mathbb{1}\{HAR_{pot} = 0, MR_{pot} = 0\}$		-0.020*			0.026***	
		(0.012)			(0.006)	
TBT_{pt}			0.042***			0.022***
			(0.009)			(0.007)
$TBT_{pt} \times \text{Dissimilarity}_{pot}^{TBT}$			-0.060***			-0.002
			(0.010)			(0.007)
Observations	7,892,397	7,892,397	7,892,397	7,892,397	7,892,397	7,892,397
Firm-Origin-Product FE	Yes	Yes	Yes	Yes	Yes	Yes
Origin-Time-HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1), (2), and (3) report results for the logarithm of firm-product-origin-year *import value*, while columns (4), (5), and (6) refer to the logarithm of firm-product-origin-year *import price* as proxied by the unit value. TBT_{pt} denotes a technical regulation enforced in the French market on product p at or before time t. EU_{pt} identifies EU origins, while HAR_{pot} and MR_{pot} are used to denote cases where standards are harmonised or subject to mutual recognition. $\text{Dissimilarity}_{pot}^{TBT}$ measures the regulatory distance between new EU TBTs and existing regulations in the origin. All regressions include firm–origin–product and origin–time–HS2 fixed effects, as well as tariff controls. Standard errors are clustered at the product–origin–time level. Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

a one standard deviation increase in regulatory dissimilarity (0.45) is associated with a significant decline of about 2.6%. These results suggest that TBTs shift import volumes toward suppliers facing lower adaptation costs.

Column (4) indicates that TBTs raise the probability of terminating sourcing links with non-EU origins by 1.3 percentage points, while the effect on EU links is statistically significant but smaller. Column (5) reveals that, when disaggregated by regulatory alignment, harmonised origins exhibit an insignificant effect on exit probability (0.004), whereas those under mutual recognition see exit probabilities rise by 0.8 percentage points and those with no formal arrangements see a significant increase of 1.4 percentage points. Column (6) shows that regulatory dissimilarity has a small and statistically insignificant effect on the exit probability (a one SD increase predicts a 0.3 percentage point increase).

Crucially, results also show a significant reallocation pattern operating through the entry margin. Column (7) implies TBTs lead to a 2.6 percentage point reduction in the probability of forming new sourcing links with non-EU sectors, while the effect for EU origins is negligible (-0.003). Column (8) starkly illustrates diversion through entry: TBTs significantly increase the probability of forming new links with suppliers in harmonised origins by 2.1 percentage points. Conversely, they significantly decrease the likelihood of establishing new relationships with suppliers in mutual recognition origins (by 3.5 percentage points) and those with no arrangements (by 2.7 percentage points). Similarly, Column (9) confirms this pattern using the continuous measure: TBTs significantly increase the probability of entry from origins with zero regulatory dissimilarity (baseline effect of +2.2 percentage points), but higher regulatory dissimilarity strongly deters entry. A one standard deviation increase in dissimilarity is associated with a significant 2.4 percentage point decrease in the probability of new link formation.

Overall, these findings demonstrate that TBTs drive supply chain reallocation through both intensive and extensive margins. Firms adjust quantities from existing suppliers, but also significantly alter their sourcing patterns by selectively forming new relationships. Specifically, TBTs promote entry from suppliers with lower adaptation costs (harmonised/low dissimilarity) while simultaneously discouraging entry from and increasing exit among suppliers facing higher adaptation costs (non-EU/MR/high dissimilarity). This highlights that diversion occurs not just through quantity adjustments but substantially through the creation and destruction of supply links based on regulatory alignment.

Patterns of Diversion under Varying Adaptation Costs Our theoretical framework distinguishes between scenarios based on the magnitude of relative adaptation costs between sourcing partners: (i) *small relative costs*, where firms renegotiate with current

Table 5: Estimation of the effect of TBT on supply chains reallocation

Dependent Variable	Import Quantity (ln)			Exit from old sourcing link			Entry in new sourcing link		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 1\}$	-0.002			0.006*			-0.003		
	(0.009)			(0.003)			(0.006)		
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0\}$	-0.044***			0.013***			-0.026***		
	(0.013)			(0.005)			(0.008)		
$\text{TBT}_{pt} \times \mathbb{1}\{\text{HAR}_{pot} = 1\}$		0.021*			0.004			0.021***	
		(0.011)			(0.004)			(0.005)	
$\text{TBT}_{pt} \times \mathbb{1}\{\text{MR}_{pot} = 1\}$		-0.034***			0.008*			-0.035***	
		(0.011)			(0.004)			(0.011)	
$\text{TBT}_{pt} \times \mathbb{1}\{\text{HAR}_{pot} = 0, \text{MR}_{pot} = 0\}$		-0.046***			0.014***			-0.027***	
		(0.013)			(0.005)			(0.009)	
TBT_{pt}			0.020*			0.004			0.022***
			(0.011)			(0.004)			(0.005)
$TBT_{pt} \times \text{Dissimilarity}_{pot}^{TBT}$			-0.058***			0.006			-0.055***
			(0.012)			(0.004)			(0.009)
Observations	7,892,397	7,892,397	7,892,397	4,587,521	4,587,521	4,587,521	4,702,059	4,702,059	4,702,059
Firm-Origin-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin-Time-HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are as follows: (1)–(3) correspond to the logarithm of firm-product-origin-year import quantity, (4)–(6) capture the probability of exiting an existing sourcing link for a given product from a specific origin, and (7)–(9) measure the probability of establishing a new sourcing link (i.e., a new product-origin pair). TBT_{pt} refers to technical regulations enforced in the French market on product p at or before time t. EU_{ot} identifies origins that are part of the EU in year t. HAR_{pot} denotes product-origin pairs subject to the harmonisation of standards within the EU or with the EU through a trade agreement at time t, while MR_{pot} represents those covered by mutual recognition. Standard errors are clustered at the origin-product-time level. Statistical significance is denoted as follows: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

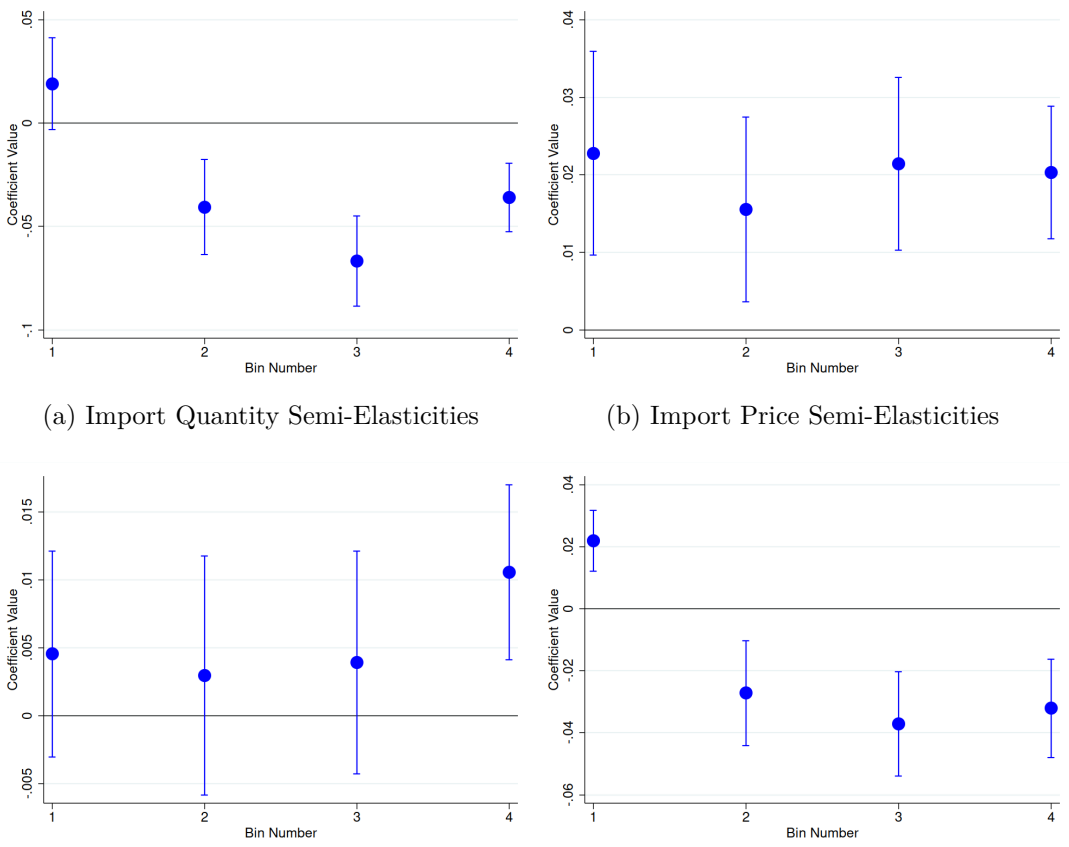
suppliers to share compliance expenses, and (ii) *large relative costs*, where firms abandon high-cost suppliers for more cost-effective alternatives. To empirically test this distinction, we partition our text-based regulatory dissimilarity index into discrete bins, with higher bins indicating greater adaptation costs relative to EU TBTs.

Figure 2 illustrates how the impacts of TBTs vary across these adaptation cost bins for key trade margins. Panel (a) shows that import volumes tend to decrease in higher-cost bins (except the lowest), suggesting that substantial compliance burdens reduce quantities demanded from these suppliers. Crucially, in the highest-cost bin, adaptation costs become sufficiently large to induce significant supplier exit (Panel (c)), aligning with the scenario where firms sever high-cost relationships. Conversely, Panel (d) reveals that new import relationships (entry) increase notably only in the lowest-cost bin, consistent with firms seeking new, easily compliant suppliers when adaptation costs are minimal,

while entry drops significantly in higher-cost bins. Interestingly, import prices rise across all cost bins (Panel b), indicating that suppliers generally pass on at least some compliance costs, regardless of their relative ease of adaptation.

These findings empirically validate our theoretical distinction: small adaptation costs primarily influence prices and quantity adjustments, whereas large costs trigger significant supply chain disruption and reallocation away from high-cost suppliers.

Figure 2: Heterogeneous Effects and Supply Chain Adjustments



(a) Import Quantity Semi-Elasticities

(b) Import Price Semi-Elasticities

(c) Probability of supplier exit

(d) Probability of supplier entry

Notes. Regulatory dissimilarity is divided into four ascending bins. Panel (a) reports TBT semi-elasticities for import quantities, panel (b) for import prices, and panels (c) and (d) display the estimated coefficients for supplier exit and new supplier entry probabilities, respectively. Coefficients are estimated from regressions interacting TBT treatment with bin dummies.

6.2 Robustness of Baseline Results

6.2.1 Number of TBTs

Our baseline specifications treat a product as covered by a TBT once the first regulation is in force. However, in reality, multiple TBTs often accumulate over time. Each additional TBT likely can raise adaptation costs, thereby reinforcing the reallocation patterns we observe.

To capture this, we construct a measure of "TBT intensity" defined as the logarithm of one plus the cumulative number of active EU TBTs for product p in year t: $\log(1 + \#\text{TBT}_{pt})$. Tables A.8 and A.9 report the corresponding results.

We find that higher TBT intensity amplifies the baseline effects. The shift in import value and quantity towards EU/harmonised/low-dissimilarity suppliers becomes more pronounced. Price increases also intensify, especially with greater regulatory dissimilarity, consistent with cumulative adaptation costs being passed on. Extensive margin adjustments are similarly reinforced: TBT accumulation further encourages entry from HAR/low-dissimilarity origins while deterring entry from non-EU/MR/high-dissimilarity sources, and increases exits primarily from non-EU and non-integrated suppliers.

Overall, this analysis confirms that our baseline findings are robust, indicating that the observed reallocation and cost effects become stronger as the cumulative TBT burden increases.

6.2.2 Regulatory Dissimilarity Index Validation - Origin Characteristics

We further validate our regulatory distance index by using the development level of the origin country as an alternative proxy. Technical regulations tend to be more stringent in high-income countries—either de jure or de facto through stronger enforcement (Disdier

et al., 2015)—making it relatively harder for developing countries to comply with EU standards.[18]

Table A.13 presents results for non-EU origins, split by development level.[19] Following the enforcement of an EU TBT, import quantities fall more sharply for developing countries. On the extensive margin, supplier exit increases significantly only for developing countries, suggesting higher compliance costs. Similarly, the probability of forming new sourcing links declines more for developing (–2.8pp) than for developed (–2.5pp) non-EU countries.

These patterns support the idea that development level is a relevant proxy for regulatory adaptation costs, providing external validation for our text-based dissimilarity measure.

6.2.3 Instrumental Variable Strategy

A potential concern with our baseline estimates is endogeneity: the adoption of an EU TBT for a specific product might be influenced by import trends from French firms. Although EU trade policy is set collectively, influential members like France could conceivably shape TBT decisions. To address this potential bias, we employ an instrumental variable (IV) approach using TBTs adopted by the United States, a jurisdiction with relativity high regulatory similarity to the EU according to our index.

Specifically, we treat the baseline interaction terms representing the TBT effect for EU origins ($TBT_{pt} \times \mathbf{1}\{EU_{ot} = 1\}$) and for non-EU origins ($TBT_{pt} \times \mathbf{1}\{EU_{ot} = 0\}$) as potentially endogenous. We instrument these using two variables derived from US

[18]For example, Otsuki et al. (2001) show that EU harmonised aflatoxin standards severely restricted food exports from Africa.

[19]We rely on the World Bank's income-level classification to categorise countries as developed, developing, or least developed.

TBT adoption (TBT_{pt}^{US}) and firm-specific exposure to the US market (Exp_f^{US}, a dummy for firms ever exporting to the US): $IV_{US_EU} = TBT_{pt}^{US} \times \mathbf{1}\{EU_{ot} = 1\} \times Exp_f^{US}$ and $IV_{US_NonEU} = TBT_{pt}^{US} \times \mathbf{1}\{EU_{ot} = 0\} \times Exp_f^{US}$.

The exclusion restriction assumes that US TBT decisions are exogenous to French firm-level import dynamics. The relevance relies on the correlation between US and EU standards (due to global trends or regulatory dialogue) and the idea that these tailored instruments, conditioned on origin type (EU/Non-EU) and the firm's US exposure, capture relevant exogenous variation predicting the respective endogenous TBT effects.

First-stage results are reported in Tables A.10 (Columns 1-2) and A.11 (Columns 1-4) and confirm the instruments' relevance. Both IV_{US_EU} and IV_{US_NonEU} significantly predict both endogenous variables (TBT_{pt}^{EU} and TBT_{pt}^{Non-EU}). As expected, the predictive power is strongest for the "matching" instrument (e.g., IV_{US_NonEU} has a larger coefficient when predicting TBT_{pt}^{Non-EU}). Furthermore, the Kleibergen-Paap Wald F-statistics for each endogenous variable (reported at the bottom of the tables) are well above conventional thresholds, mitigating concerns about weak instruments.

The second-stage least squares (2SLS) results (Tables A.10, Cols 3-5 and A.11, Cols 5-6) largely confirm that our baseline findings are robust to potential endogeneity. The IV estimates uphold the intensive margin diversion pattern: TBTs significantly increase import value and quantity from EU origins while decreasing them from non-EU origins. However, the positive price effects found in OLS become statistically insignificant. On the extensive margin, the IV estimates show reinforced ties with EU suppliers (significantly lower exit, higher entry). In particular, the effects on non-EU exit and entry become insignificant. Overall, the core finding of TBT-induced reorganisation favouring EU sources appears robust to an endogeneity bias.

6.2.4 Control for Trade Enhancing TBTs

Not all TBTs act as barriers to trade; some are explicitly designed to facilitate imports by reducing regulatory fragmentation. To account for such trade-enhancing measures, we leverage the stated objective(s) provided in TBT Notifications.[20] In particular, we flag two key objectives: harmonisation and trade facilitation. These categories capture regulatory measures aimed at aligning EU standards with international norms or streamlining trade procedures.[21]

Empirical evidence suggests that trade-facilitating TBTs have expansionary effects. As shown by Ghodsi (2024) and corroborated in Table A.12, such measures tend to increase trade volumes, reduce import prices, lower supplier exit rates, and increase entry—consistent with the market-size effects documented by Schmidt and Steingress (2022). Importantly, our key estimates remain stable after controlling for these alternative types of TBTs, confirming that the effects documented in our baseline results stem from adaptation costs rather than regulatory harmonisation efforts.

7 Drivers of Supply Chain Diversion

This section investigates the heterogeneous responses of firms' supply chains to TBTs by examining three key drivers: product-specific search costs, buyer-side market power (proxied by reliance on specific suppliers), and importer scale.

[20] Countries often report multiple objectives for a single regulation.
[21] For a full list of objectives and their relative frequencies, see Table A.5.

7.1 Search Costs and Trade Diversion

Search frictions shape the margin of adjustment to new technical regulations. When supplier matches embed relationship-specific investments, switching is costly; after an EU TBT raises adaptation costs, buyers are more likely to renegotiate with incumbents and scale back quantities rather than replace suppliers. By contrast, when switching costs are low, firms can reassign sourcing toward better-aligned origins (e.g., within the EU or harmonised partners), with greater link turnover and differential price adjustments across origins.

The estimates in Table 6 distinguish between products facing high stickiness (Columns 1–4) and those facing low stickiness (Columns 5–8), where stickiness captures the difficulty or cost of switching suppliers, as in Martin et al. (2023).[22] In the high-stickiness subsample (Columns 1–4), an EU TBT reduces import quantities from both EU and non-EU origins, suggesting limited scope for re-optimisation when relationship-specific investments are large. The propensity to exit or form new links does not change significantly, implying that high search costs offset potential gains from switching. By contrast, in the low-stickiness subsample (Columns 5–8), imports from EU sources rise significantly after the imposition of an EU TBT, while imports from non-EU suppliers decline. These patterns indicate that diversion toward relatively lower-adaptation-cost origins occurs only when search costs are small enough to permit supplier reassignment. Import prices also increase for EU origins in low-stickiness sectors, suggesting that incumbent EU suppliers can command higher prices once the regulation is introduced. At the same time, the higher probability of exiting non-EU supply links reinforces the view that switching frictions ultimately govern the extent of firms' ability to reconfigure their sourcing strategies.

[22] High-stickiness products have a stickiness value larger than the median.

Table 6: Estimation of the effect of TBT by product stickiness

	High Stickiness				Low Stickiness			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Import Price (ln)	*Quantity (ln)*	*Exit*	*Entry*	*Import Price (ln)*	*Quantity (ln)*	*Exit*	*Entry*
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 1\}$	0.015**	-0.044***	0.006	0.005	0.025***	0.032**	0.013**	0.000
	(0.007)	(0.012)	(0.004)	(0.006)	(0.009)	(0.015)	(0.005)	(0.006)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0\}$	-0.003	-0.056***	0.002	-0.011*	0.047***	-0.047**	0.032***	-0.024***
	(0.008)	(0.017)	(0.007)	(0.007)	(0.009)	(0.019)	(0.007)	(0.008)
Observations	4,130,277	4,130,277	2,360,260	2,430,381	3,725,778	3,725,778	2,146,096	2,180,990
Firm–Origin–Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin–Time–HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1)–(4) report estimates for high stickiness products, while columns (5)–(8) report estimates for low stickiness products. The dependent variables are defined as follows: *Import Price (ln)* is the logarithm of the import price; *Quantity (ln)* is the logarithm of firm–origin–product–year import quantity; *Exit* is the exit probability; and *Entry* is the entry probability of a product-origin sourcing link. TBT_{pt} denotes a technical regulation imposed on product p at time t. The indicator $\mathbb{1}\{\text{EU}_{ot} = 1\}$ equals one if the product originates from an EU country, and zero otherwise. Product stickiness is measured following Martin et al., 2023 and is defined as high if the product's stickiness measure is above the median (computed separately by year) and low otherwise. Standard errors are clustered at the origin-product-time level. Statistical significance is denoted as follows: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

7.2 Import Reliance on Specific Suppliers

Buyers' bargaining power shapes how adaptation costs are distributed between suppliers and importers. We proxy this bargaining power by France's initial reliance on specific suppliers, measured by its initial market share. Higher reliance indicates fewer available alternatives and thus weaker bargaining power (i.e., a lower β). We measure France's initial import market share using aggregated product-level import data from BACI for the year 2000. When a narrowly defined French sector sources most of its products from a single origin, the scope for substitution is limited; in contrast, lower reliance implies greater flexibility in switching suppliers when adaptation costs increase.

Table 7 categorises product–origin pairs into tertiles (T1, T2, T3) based on France's initial import market share, and interacts these with the TBT indicator and an EU dummy. For non-EU origins in the highest reliance tertile (T3), TBTs are associated with an 8.2% decline in import quantities and a 3.5% increase in import prices. These results suggest that suppliers facing buyers with high reliance can pass on a larger share of adaptation costs, leading to sharper quantity reductions. In moderately relied-upon non-EU origins (T2), price increases are smaller (1.9%), but exit rates are higher, implying that buyers can more easily substitute suppliers when alternatives are available.

In the EU subsample, import volumes remain statistically unchanged across all tertiles, while unit values rise by around 2% across tertiles, consistent with the idea that even lower adaptation costs are partially passed on when buyer power is limited. Finally, new sourcing (Column 4) is most constrained in low-reliance tertiles (T1), where entry probabilities decline by 3.6% for EU origins and 4.7% for non-EU origins, suggesting that even when alternatives theoretically exist, TBTs raise barriers to establishing new supplier relationships.

Overall, these results underscore the importance of bargaining power (proxied by reliance) in determining how adaptation costs are borne by suppliers, paid by buyers through higher unit prices, or lead to more frequent exit and sourcing reconfiguration.

Table 7: Effect of TBTs on import margins by French import reliance tertiles

Dependent Variable	(1) *Import Price (ln)*	(2) *Quantity (ln)*	(3) *Exit*	(4) *Entry*
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 1\} \times T1$	0.022***	0.020	0.016***	-0.036***
	(0.007)	(0.012)	(0.004)	(0.011)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 1\} \times T2$	0.019***	-0.016	0.007*	-0.003
	(0.006)	(0.011)	(0.004)	(0.006)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 1\} \times T3$	0.019***	-0.002	0.002	0.009
	(0.007)	(0.012)	(0.004)	(0.008)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0\} \times T1$	0.026***	-0.042***	0.020***	-0.047***
	(0.007)	(0.014)	(0.005)	(0.011)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0\} \times T2$	0.019**	-0.016	0.012**	-0.010
	(0.007)	(0.017)	(0.006)	(0.008)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0\} \times T3$	0.035***	-0.082***	0.002	-0.006
	(0.010)	(0.020)	(0.009)	(0.013)
Observations	7,892,397	7,892,397	4,587,521	4,702,059
Firm–Origin–Product FE	Yes	Yes	Yes	Yes
Origin–Time–HS2 FE	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes

Notes: The dependent variables are defined as follows: *Import Price (ln)* is the logarithm of the import price; *Quantity (ln)* is the logarithm of import quantity; *Exit* is the exit probability; and *Entry* is the entry probability of an importing firm. TBT_{pt} denotes a technical regulation imposed on product p at time t, and $\mathbb{1}\{\text{EU}_{ot} = 1\}$ equals one if the origin country o is an EU member. The tertiles (T1, T2, and T3) are defined using import values in 2000 by product origin, measured in terms of French import market share in that year. Standard errors are clustered at the origin-product-time level for robustness. Statistical significance is denoted as follows: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

7.3 Scale of Final Good Producers and Incentives for Diversion

Our theoretical framework predicts that reduced spending on intermediate inputs lowers the marginal benefit from search, making producers more tolerant of sub-optimal matches. Consequently, smaller firms should be more inclined to retain existing suppliers to avoid search costs, while larger producers have stronger incentives to restructure supply chains and search for improved matches. To mitigate endogeneity concerns, we measure firm size at the initial period based on import levels.[23]

Table 8 displays heterogeneous effects by firm size, comparing firms below and above the median. For smaller firms, the lower marginal benefit of search strengthens the bargaining position of incumbent suppliers, leading to price increases from both EU and non-EU origins (Columns (1) and (5)). Import quantities remain unaffected (Column (2)). Exit probabilities rise by 1.4 percentage points for non-EU sources while remaining unchanged for EU sources (Column (3)). Entry probabilities from non-EU origins decline by 1.8 percentage points (Column (4)).

For larger firms, the pattern differs markedly. Quantities from non-EU sources decline while EU imports remain stable (Column (6)). Exit probabilities increase by 0.7 percentage points for EU sources and by 1.2 percentage points for non-EU sources (Column (7)), and entry is dampened by 3.2 percentage points indicating that larger firms restructure more aggressively their supplier networks in response to TBTs.

[23] We use the first year a firm imports to measure its initial size, avoiding the exclusion of firms that do not import from the first year in our data.

Table 8: Estimation of the effect of TBT by firm's size

	Below the median size				Above the median size			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Import Price (ln)	*Quantity (ln)*	*Exit*	*Entry*	*Import Price (ln)*	*Quantity (ln)*	*Exit*	*Entry*
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 1\}$	0.014**	-0.002	0.005	0.004	0.023***	-0.001	0.007**	-0.007
	(0.006)	(0.012)	(0.004)	(0.007)	(0.006)	(0.011)	(0.003)	(0.007)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0\}$	0.019**	-0.006	0.014**	-0.018*	0.032***	-0.071***	0.012***	-0.032***
	(0.008)	(0.016)	(0.007)	(0.010)	(0.008)	(0.016)	(0.005)	(0.008)
Observations	3,725,423	3,725,423	2,019,192	2,159,379	4,148,077	4,148,077	2,553,842	2,528,777
Firm–Origin–Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin–Time–HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1)–(4) report estimates for high stickiness products, while columns (5)–(8) report estimates for low stickiness products. The dependent variables are defined as follows: *Import Price (ln)* is the logarithm of the import price; *Quantity (ln)* is the logarithm of firm–origin–product–year import quantity; *Exit* is the exit probability; and *Entry* is the entry probability of a product-origin sourcing link. TBT_{pt} denotes a technical regulation imposed on product p at time t. The indicator $\mathbb{1}\{\text{EU}_{ot} = 1\}$ equals one if the product originates from an EU country, and zero otherwise. Product stickiness is measured following Martin et al., 2023 and is defined as high if the product's stickiness measure is above the median (computed separately by year) and low otherwise. Standard errors are clustered at the origin-product-time level. Statistical significance is denoted as follows: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

8 Conclusion

This study investigates how technical standards and their associated adaptation costs, driven by regulatory diversity, shape firms' global sourcing strategies. We extend the theoretical model of Grossman et al. (2024) by incorporating heterogeneous adaptation costs, highlighting the trade-off firms face between absorbing these costs within existing supplier relationships versus seeking new, potentially lower-cost partners elsewhere.

To test the model's predictions, we develop a novel database mapping EU TBTs over 25 years and construct a text-based measure of regulatory distance between EU and exporting countries' standards, serving as a proxy for adaptation costs. Analysing detailed French firm-level import data from 2000-2017, our empirical findings reveal significant supply chain reorganisation following the introduction of EU TBTs. We find clear evidence of trade diversion towards suppliers facing lower adaptation costs: import expenditures and quantities rise for suppliers in origins with harmonised standards (value up approx. 4.4%) or low regulatory dissimilarity relative to the EU (value up approx. 4.3% at zero dissimilarity), while imports from non-EU origins decline (quantity down approx. 4.3%). Furthermore, higher regulatory dissimilarity significantly dampens import value

(a one standard deviation increase reduces value by approx. 2.7%). This reallocation occurs on the extensive margin as well: TBTs significantly deter entry from non-EU origins (probability down by 2.6pp) and increase exit probability from these sources (+1.3pp), while strongly encouraging entry from harmonised origins (+2.1pp).

Regarding prices, we find that TBTs lead to increases for imports from both EU and non-EU origins. However, these price hikes show limited correlation with our measure of regulatory dissimilarity, suggesting that market power allows suppliers, including lower-cost EU ones, to raise prices when new regulations are imposed. Our heterogeneity analysis further underscores the importance of channel characteristics: trade diversion is more pronounced for products with low switching costs, high initial reliance on specific non-EU suppliers leads to stronger price pass-through and larger quantity reductions, and larger importing firms restructure their supply chains more actively.

By systematically documenting the impact of EU technical standards on firm-level sourcing decisions and quantifying the role of adaptation costs via regulatory distance, this paper contributes to the understanding of trade policy in a world shaped by global value chains, and highlight important policy implications. As non-tariff measures like TBTs become central to trade policy, our results demonstrate that regulatory divergence acts as a significant driver of supply chain structure, potentially leading to substantial trade diversion even amidst tariff liberalisation. Understanding the adaptation costs imposed by different regulatory approaches is crucial for assessing the true impact of modern trade agreements and domestic regulations on global value chains. Future research could delve deeper into the welfare consequences of these reallocations for consumers, firms, and sourcing countries.

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A Appendix

A.1 Construction of the Machine Learning Algorithm

Many TBT notifications contain only textual product descriptions without explicit HS codes. To map these descriptions to tradeable products and merge TBT data with customs records, we implement a Support Vector Machine (SVM) classifier trained on labeled entries where HS codes are known.

The final step of the TBT database construction uses an SVM classifier to recover missing HS codes by measuring word-similarity between each TBT's product description and a reference set composed of descriptions from the HS classification and entries from Step 1. We train and test the model on labeled entries—those text descriptions that have either been associated with an HS4 code by the WTO or that are contained in the HS4 nomenclature provided by UNCTAD.

We start by transforming text descriptions of HS4 products into vector representations. We assign a fixed integer id to each word occurring in any product description of the training set. For each product text description i, we count the number of occurrences of each word w and store it in $X[i, j]$, where j represents the index of word w in a dictionary that includes all words found across HS4 product descriptions. This approach is known as a bag-of-words representation. Before vectorising, we process the texts using text pre-processing, tokenizing, and filtering of stop-words, all included in the function 'CountVectorizer' of the scikit-learn package.

Since longer HS4 descriptions will have higher average word counts than shorter ones, even though they describe products at the same level of disaggregation, we normalise the number of occurrences of each word in a description by the total number of words in that product description: these new values of $X[i, j]$ are called 'tf' for Term Frequencies.

Another refinement on top of 'tf' is to reduce weights for words that occur in many HS4 descriptions and are therefore less informative than rarer words. For example, the word 'product' is likely to appear in many HS4 headings, while we expect the word 'engine' to appear in the text description of fewer goods. This down-scaling of the weight of common words is called 'tf–idf' for "Term Frequency times Inverse Document Frequency".

The matrix that stores the 'tf–idf' values is called $\mathbf{X}$ and has size $n \times V$, where n is the number of labeled entries (i.e., product descriptions for which we know the HS4 product category) and V is the total number of words in the vocabulary. Using this feature matrix, we train a linear SVM, which is widely regarded as one of the best text classification algorithms. It consists of a minimisation of a hinge loss function with a penalty term as follows:

$$\min_{\mathbf{w}\in\mathbb{R}^V} \left\{ \frac{1}{n}\sum_{i=1}^{n} \underbrace{\max\{0, 1 - y_i \mathbf{w}^\top \mathbf{x}_i\}}_{\text{'Hinge' loss function on } (\mathbf{x}_i, y_i)} + \lambda \|\mathbf{w}\|_2^2 \right\}$$

where $\lambda \geq 0$ adjusts the margin (or 'complexity') of the solution, typically chosen using a held-out sample. Our problem is a multiclass type and we apply a one-versus-one approach, solving $\binom{K}{2}$ SVMs, where K is the number of HS4 categories. Each SVM compares a pair of HS4 categories. For example, one such one-versus-one SVM might compare the kth class, coded as $+1$, to the $(k+1)$th class, coded as -1. We classify a test observation using each of the $\binom{K}{2}$ classifiers, and we tally the number of times that the test observation is assigned to each of the K classes. The final classification is performed by assigning the test observation to the class to which it was most frequently assigned in these pairwise classifications.

For instance, a TBT describing "safety requirements for lithium-ion batteries in

portable devices" would be classified to HS 8506 (Primary cells and batteries) with high confidence based on keywords like "battery," "lithium," and "portable." We evaluate the predictive accuracy of the classifier on a test set, which represents around 30% of the labeled HS4 product descriptions that have not been used to train the classifier, and we achieve 95.7% accuracy.

A.2 Construction of an Index for Regulatory Dissimilarity

To capture the compliance burden that origin-country producers face when new TBTs are introduced in the French market, we build a continuous, time-varying index of regulatory distance, $\eta_{pot}^{\text{TBT}} \in [0, 1]$. This index compares the text of measures governing product p in the French market at time t with the stock of measures in origin o at the same time. Higher values indicate greater textual divergence in regulatory requirements and thus higher adaptation costs.

Reference text and origin stock. For each (p, t), let $\text{Text}_{pt}^{\text{EU/France}}$ denote the most recent measure governing the French market. We identify harmonised sectors using EU Single Market directives and regulations. In these sectors, the EU regulation supersedes national rules and the reference text is the latest EU measure. Otherwise, the reference text is the latest French national measure. For origin o, define $\mathcal{S}_{pot}$ as the set of all measures in force for product p at time t. In EU-harmonised sectors, the same EU measure applies in all EU countries, ensuring perfect alignment. For non-EU origins and in mutual-recognition sectors (where national regulations remain in force), $\mathcal{S}_{pot}$ comprises the origin country's national measures.

Pre-processing and TF–IDF. Before vectorisation, we apply a uniform cleaning pipeline to all texts (EU/France reference and origin measures). We first detect language and, when needed, translate descriptions into English so all comparisons occur in a single language. We then normalise the text by lowercasing, applying Unicode normalisation, trimming extra whitespace, and removing punctuation. The cleaned text is tokenised, English stop-words are removed, and tokens are lemmatised to their base forms to reduce inflectional variation. Finally, we construct TF–IDF vectors over unigrams with a capped vocabulary of $V = 10{,}000$ features. This pipeline reduces noise, aligns languages, and concentrates the vocabulary on informative terms.

Text representation and similarity. We represent each document (the TBT description) as a TF–IDF vector. For vectors $\mathbf{x}, \mathbf{y}$, we define cosine similarity as

$$\cos(\mathbf{x}, \mathbf{y}) \;=\; \frac{\mathbf{x}^\top \mathbf{y}}{\|\mathbf{x}\|_2 \, \|\mathbf{y}\|_2} \in [0, 1].$$

We compute the (unweighted) average similarity between the French/EU reference and the origin's stock and define regulatory distance as its complement:

$$\eta_{pot}^{\text{TBT}} \;\equiv\; 1 \;-\; \frac{1}{|\mathcal{S}_{pot}|} \sum_{s \in \mathcal{S}_{pot}} \cos\Big(\text{Text}_{pt}^{\text{EU/France}},\, \text{Text}_s\Big),$$

where $|\mathcal{S}_{pot}|$ is the number of documents in $\mathcal{S}_{pot}$ and s indexes individual TBTs. We use an unweighted average for simplicity and tractability. In principle, measures could be weighted by enforcement stringency, product coverage, or recency, though we find our results are robust to alternative specifications.

Properties and interpretation. By construction, $\eta_{pot}^{\text{TBT}} = 0$ when texts are (near) identical. This occurs mechanically in EU-harmonised sectors where all member states apply the same regulation. The index increases with textual divergence in technical requirements, labelling standards, testing procedures, or performance criteria.

For example, if the EU introduces a TBT requiring 30% recycled content in batteries while China's existing standards specify only 10% recycled content, the textual divergence in these requirements will be captured through low cosine similarity between the EU measure and China's standards, yielding a high η_{pot}^{TBT} for Chinese origins. Conversely, if Germany already has a measure nearly identical to the new EU requirement, η_{pot}^{TBT} for German origins will be close to zero. The index thus varies across origins, product and time and naturally accommodates multiple measures per origin by averaging over $\mathcal{S}_{pot}$.

A.3 Tariff Database

WITS database contains information on the effectively applied tariffs (defined as the lowest available tariff between preferential and MFN). To be consistent with the import data, micro-level French data aggregated at the legal unit, HS-4 and year level, we use HS 4-digit tariff data as a weighted average tariff within HS-4 headings (directly provided by WITS).[24]

A.4 Theoretical Framework

In this section we detail the model of global value chains developed by Grossman et al. (2024).

[24]HS-4 digit tariff data is a weighted average tariff within HS-4 headings of the HS-6 tariff level data, this aggregation is directly provided by WITS, using EU import data as a weight. Unfortunately, the database has many empty entries, to avoid mis-interpolation we download data without interpolation and we only perform carry-forward interpolation, similarly to Teti (2024).

Setup Firms in a monopolistically competitive industry combine labour and a composite intermediate good to produce differentiated products. The intermediate good requires a continuum of inputs, that are combined using a Leontief technology in fixed proportions. Each firm can produce any input it needs using a backstop technology or it can search for an external supplier of that input at home or in a foreign market of its choice. When firms locate a supplier, it learns the productivity of the potential match by undergoing an investment which entails a sunk cost. It can then bargain with the supplier over a short-term (but renewable) contract, or it can choose to resume its search.

Preferences and Demand Consumers demand a homogeneous good and an array of differentiated products. Preferences are characterised by:

$$\Omega(X, Y) = Y + U(X) \tag{12}$$

Where $\Omega(X, Y)$ is the quasi-linear utility of the representative individual, Y is its consumption of the homogeneous good, and X is an index of consumption of differentiated varieties. We take the mass of consumers to measure one and the sub-utility $U(.)$ to have constant utility:

$$U(X) = \begin{cases} \dfrac{\varepsilon}{\varepsilon - 1}\left(X^{\frac{\varepsilon-1}{\varepsilon}} - 1\right) & \text{for } \varepsilon \neq 1 \\ \log X & \text{for } \varepsilon = 1 \end{cases} \tag{13}$$

The consumption index takes the form:

$$X = \left[\int_o^n x(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{1}{1-\sigma}} \tag{14}$$

where $x(\omega)$ is the consumption of variety ω, n is the measure of varieties available in

the home country, and σ is the constant elasticity of substitution between any pair of brands. The corresponding real price index is:

$$P = \left[\int_{o}^{n} p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}} \tag{15}$$

where $p(\omega)$ denotes the per-unit price of brand ω. In order to focus most sharply on the supply chains, we assume that the differentiated final goods are not tradable; allowing us to ignore the determinants of foreign demand for home brands. The representative home consumer purchases differentiated products up to the point where $U'(X) = P$ or $X = \chi(P) \left[\frac{p(\omega)}{P} \right]^{-\sigma}$. Each individual demands variety ω as a function of its price and aggregate price index as follows:

$$x[p(\omega), P] = \chi(P) \left[\frac{p(\omega)}{P} \right]^{-\sigma} \tag{16}$$

The demand for brand ω declines with its own price and increases with the price index for competitor brands, i.e.: $\sigma > \varepsilon$.

Production The homogeneous good is produced competitively with labour alone and is freely tradable. By choice of units and numeraire, one unit of good Y requires one unit of labour and bears a normalised price of one. This fixes the home wage rate at one in units of the homogeneous good. Firms in the imperfectly-competitive sector produce unique varieties of the differentiated final good using labour, l, and bundles of a composite intermediate good, m, subject to a constant-returns-to-scale production function $z(l, m)$. The composite intermediate good comprises a unit continuum of inputs indexed by j in fixed proportions, with one unit of each input needed for each unit of the composite. Following GHR, we assume that the marginal cost of any differentiated product takes the

form $c(\phi) = \phi^{\alpha}$, with $0 < \alpha < 1$.

In addition to variable costs, a firm producing any variety ω bears a one-time entry cost of F_e units of home labour, as well as recurring fixed operating cost of f_o. Moreover, it bears a cost of finding partners for its global value chain.

Search and Match The creation of supply chains requires that producers locate suppliers. We suppose that firms can search for potential suppliers in one or more countries $i \in \{1, ..., I\}$. One value of i represents the home country, so that producers of differentiated products might seek out domestic outsourcing relationships. With the symmetry that we impose across inputs, it is always optimal for a firm to search for all of its suppliers in a single country, although that target country might change following the imposition of a TBT. With free trade, the optimal location for any supply chain is the country that has the lowest (efficiency-adjusted) wage.

Search requires home labour. A firm ω seeking for a supplier for input j can take a draw from a cumulative distribution $G(.)$ at a capital cost of F. The realisation of this draw, a, reveals the quality of the match between the producer and a supplier. A potential supplier with match-specific productivity a can produce a unit of j for brand ω at a cost of aw. The firm producing ω decides whether to negotiate a short-term but renewable contract to buy input j from the potential supplier or whether to continue its search by taking another, independent, draw from $G(.)$ at an additional cost of F. For simplicity, we abstract from the time that may elapse between draws and assume that all search takes place in an instant. We assume that $g(a) \equiv G'(a) > 0$ for all $a \in (0, 1]$ and $g(a) = 0$ for all $a > 1$.

The optimal search strategy involves a reservation stopping rule that we denote with $\bar{a}$, such that firm takes another draw for the input j if and only if all of its prior draws for

that input had inverse match productivities that exceed $\bar{a}$. Thus, all of a firm's suppliers will have inverse productivities in the range $[0, \bar{a}]$, with densities given by $\frac{g(a)}{G(\bar{a})}$. Given the continuum of inputs and the independence across them, the search process leads to a deterministic cost for a given quantity of the composite intermediate, m.

We can calculate the total cost of a firm's search effort, $S(\bar{a})$, as a function of the stringency of its stopping rule. When a firm takes its first draw, it pays F. Then, with probability $G(\bar{a})$, it achieves at least its reservation level of match productivity, in which case there are no further search costs. With the remaining probability, $1 - G(\bar{a})$, it encounters a supplier with $a > \bar{a}$, in which case it finds itself facing again a search cost of $S(\bar{a})$. It follows that:

$$S(\bar{a}) = \frac{F}{G(\bar{a})} \tag{17}$$

Bargaining We assume Nash bargaining with exogenous weights β for the buyer and $1 - \beta$ for the seller and define $\rho(a)$ the agreed price per unit of an input produced with inverse productivity a.[25]

The seller has no outside option. Therefore, a seller with match productivity a earns a surplus from the relationship equal to the difference between its revenues $\rho(a)m$ and its production costs, wam, considering that the m units of the composite require m units of each of its components.

The buyer's outside option is to resume its search for an alternative supplier.[26] Thus, the outside option for the buyer is the expected cost of finding a new supplier plus the

[25] We assume negotiation occurs only over prices, since quantities demanded of the intermediate inputs are fixed by the Leontief technology. This means, that once the once a firm has decided to purchase m units of every input from its many other suppliers, it has no use for any more than this amount from the individual supplier with whom it is bargaining.

[26] The firm could also choose to produce input j domestically.

payment it would expect to make to this new supplier. Continued search engenders an expected capital cost of $S(\bar{a})$. The expected payment to an alternative supplier is $\mu_\rho(\bar{a})m$, where

$$\mu_\rho(\bar{a}) = \frac{1}{G(\bar{a})} \int_0^{\bar{a}} \rho(a)g(a)da \tag{18}$$

is the expected price of an input drawn randomly from the truncated distribution with domain $[0, \bar{a}]$. Then the Nash bargaining consists in solving

$$\rho(a) = \arg\max_q (qm - wam)^{1-\beta}[\mu_\rho(\bar{a})m + S(\bar{a}) - qm]^\beta. \tag{19}$$

The Nash bargaining solution implies that

$$\rho(a) = \beta wa + (1-\beta)w\mu_a(\bar{a}) + \frac{1-\beta}{\beta}\frac{F}{mG(\bar{a})} \tag{20}$$

and

$$\mu_\rho(\bar{a}) = w\mu_a(\bar{a}) + \frac{1-\beta}{\beta}\frac{F}{mG(\bar{a})} \tag{21}$$

Where $\mu_a(\bar{a})$ is the conditional mean of a for $a \leq \bar{a}$. When the producer follows the same search strategy and bargaining process for all of its inputs, it pays $\mu_\rho(\bar{a})$ per unit for its composite intermediate good plus the fixed cost of search, $F/G(\bar{a})$.

To minimise cost, the firm chooses the optimal search strategy $\bar{a}$ for producing m units of the intermediate, and the optimal factor mix, m and l, producing x units of its brand. The factor mix minimises $l + w\mu_a(\bar{a})m + F/\beta G(\bar{a})$, subject to $z(l, m) \geq x$, where $c(\omega) = w\mu_a(\bar{a})$ is the perceived marginal cost of a unit of m. Shephard's Lemma then gives us the factor demands, so that $m = xc'$ and $l = x(c - w\mu_a c')$

Regarding the optimal search strategy, each firm chooses $\bar{a}$ to minimise the aggregate payment to suppliers and the cost of search, $\bar{a} = \arg\min_a [mw\mu_a(a) + F/\beta G(a)]$. The first-order condition implies

$$mw\mu_a'(\bar{a}) = \frac{Fg(\bar{a})}{\beta G(\bar{a})^2} \tag{22}$$

Substituting (22) into (21), we can re-write the negotiated price of an input with inverse productivity a:

$$\rho(a) = \beta wa + (1-\beta)w\bar{a} \tag{23}$$

It represents a weighted average of the supplier's production cost and the cost of producing the input with the reservation match productivity.

To derive an expression for the stopping rule, we follow GH and assume the distribution function takes the form $G(a) = a^\theta$, $\theta > 1$, where θ seizes the inverse spread of productivities. We can re-write the conditional mean as $\mu_a(\bar{a}) = \frac{\theta}{\theta+1}\bar{a}$ and $g(\bar{a})/G(\bar{a})^2 = \theta/\bar{a}^{-\theta+1}$. Then first-order condition (22) can be written as:

$$\bar{a}^{\theta+1} = \frac{F(\theta+1)}{\beta mw} \tag{24}$$

Intuitively, when search draws are more costly or when the distribution of productivities is more concentrated, the stopping rule is more tolerant, i.e.: higher $\bar{a}$. On the contrary, search costs are greater, i.e.: lower $\bar{a}$, when the foreign wage is higher, the scale of production is larger, or the buyers have more bargaining power. In this situation, the producers have more at stake in the search process. The greater is the search effort, the lower are the resulting transaction prices of all inputs.

Profit Maximisation The firms in the differentiated-products sector face a constant elasticity of demand. They maximise profits, by charging a proportional markup over marginal cost,

$$p = \frac{\sigma}{\sigma - 1} c(\phi) \tag{25}$$

In a symmetric equilibrium, all firms charge the same price, p, re-writing equation (15) implies

$$P = n^{-\frac{1}{\sigma - 1}} p \tag{26}$$

The index increases linearly with the price of a brand, but decrease with the number of brands.

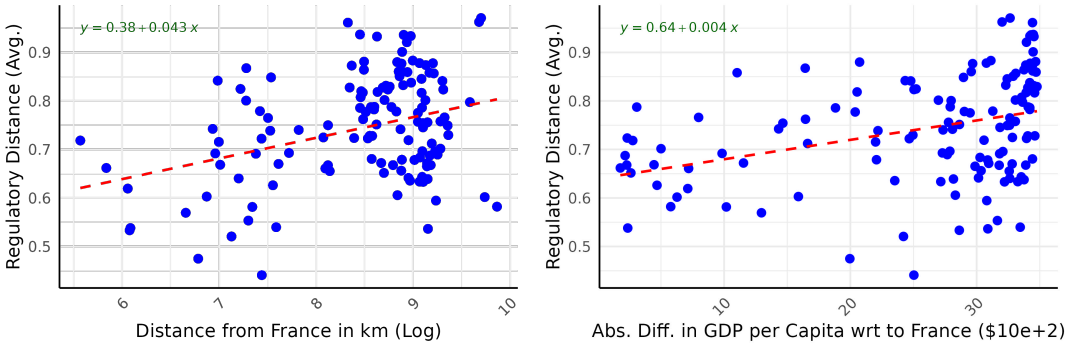
In a monopolistically-competitive equilibrium with free entry, the present value of operating profits matches the fixed costs of entry and of search:

$$\pi_o = F_e + \frac{F}{G(\bar{a})} \tag{27}$$

where F_e denotes the one-time entry cost and $F/G(\bar{a})$ represents the debt service on the sunk search costs. The model determines along with n, x and p, the demand for intermediate m, and the search intensity $\bar{a}$, which results from the creation of supply chains.

A.5 Additional Figures

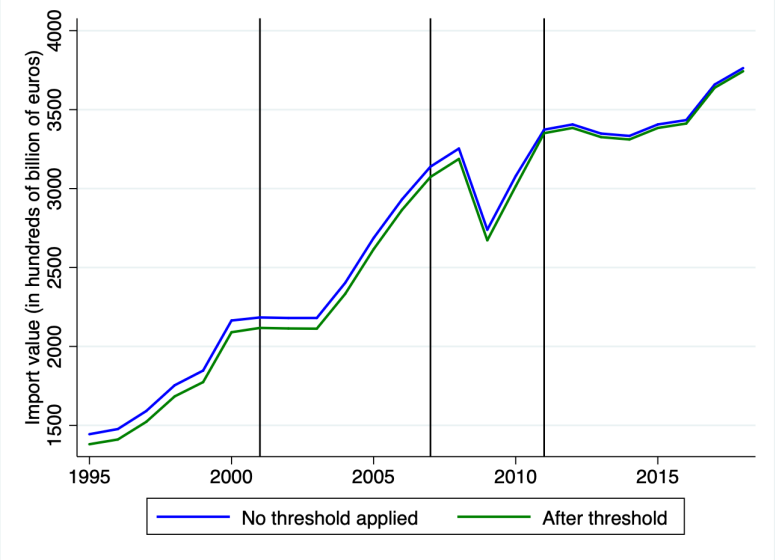
Figure A.1: Regulatory Dissimilarity vs. Geographical and GDP per Capita Distances



(a) vs. Distance (km)

(b) vs. Distance in $GDPPC$

Figure A.2: Evolution of imports by year - With and without $> 1,000$ Euro threshold



A.6 Additional Tables

Table A.1: Annual Average Share of HS4 Products Covered by New TBTs, by Sector

Sector	**Avg. (SD)**	**Sector**	**Avg. (SD)**
Animal Products	0.56 (0.08)	Plastics/Rubbers	0.27 (0.09)
Chemicals	0.24 (0.04)	Raw Hides, Skins, Leathers	0.52 (0.19)
Foodstuffs	0.51 (0.11)	Stone/Glass	0.25 (0.09)
Footwear/Headgear	0.48 (0.16)	Textiles	0.36 (0.12)
Machinery/Electrical	0.23 (0.05)	Transportation	0.27 (0.07)
Metals	0.20 (0.08)	Vegetables	0.59 (0.11)
Mineral Products	0.28 (0.10)	Wood Products	0.28 (0.10)
Miscellaneous	0.18 (0.07)		

Notes: Entries show the annual average share of HS4 product lines covered by new TBTs across countries in each sector, with standard deviation in parentheses.

Table A.2: Coverage comparison

	Pronto Database	Our Database
Original notifications	7,989	8,262
WTO-interpreted	8,635	9,251
Pre-processing	36	**3,546**
Product description	3176	**2,492**
ICS/CAS Matching	894	**1,945**
String set/ Algorithm	1,585	**2,805**

Table A.3: PTA Database Variables

Variable	Description	
Mutual recognition	Standards Technical regulations	Is mutual recognition/Equivalence in force?
	Standards Technical regulations	Is there a time schedule for achieving mutual recognition?
Harmonisation	Standards Technical regulations	Are there specified existing standards to which countries shall harmonise?
	Standards Technical regulations	Is the use or creation of regional standards promoted?
	Standards Technical regulations	Is the use of international standards promoted?
Conformity assessment	Mutual recognition	Is mutual recognition/Equivalence in force?
	Harmonisation	Are there specified existing standards to which countries shall harmonise? Is the use or creation of regional standards promoted? Is the use of international standards promoted?

Table A.4: List of countries with whom the EU have harmonised TBTs

Country	Year
Chile	2003
Jordan	2002
Morocco	2000
San Marino	2014
Tunisia	1998
Turkey	1996

Table A.5: Number of times the objective appears in lists and notifications

Objective	**Frequency**
Protection of human health or safety	1,875
Protection of the environment	743
Labelling	738
Prevention of deceptive practices and consumer protection	672
Food standards	529
Quality requirements	329
Consumer information	309
Other	270
Harmonisation	154
Protection of animal or plant life or health	124
Metrology	101
Trade facilitation	96
Nutrition information	45
Packaging	34
Organic agriculture	27
National security requirements	25
Cost saving and increasing productivity	16
Genetically modified organisms	12
Animal welfare	5

Table A.6: List of non-harmonised or partially harmonised sectors

Nace Code	Description
10.89	Manufacture of other food products n.e.c.
12.00	Manufacture of tobacco products
13.10	Preparation and spinning of textile fibres
13.20	Weaving of textiles
13.30	Finishing of textiles
13.91	Manufacture of knitted and crocheted fabrics
13.93	Manufacture of carpets and rugs
13.94	Manufacture of cordage, rope, twine and netting
13.95	Manufacture of non-woven and articles made from non-woven, except apparel
13.96	Manufacture of other technical and industrial textiles
13.99	Manufacture of other textiles n.e.c.
14.11	Manufacture of leather clothes
14.20	Manufacture of articles of fur
15.11	Tanning and dressing of leather; dressing and dyeing of fur
15.12	Manufacture of luggage, handbags and the like, saddlery and harness
15.20	Manufacture of footwear
16.10	Saw-milling and planing of wood
16.21	Manufacture of veneer sheets and wood-based panels
16.22	Manufacture of assembled parquet floors
16.23	Manufacture of other builders' carpentry and joinery
16.24	Manufacture of wooden containers
16.29	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials
17.11	Manufacture of pulp
17.12	Manufacture of paper and paperboard
17.21	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
17.22	Manufacture of household and sanitary goods and of toilet requisites
17.23	Manufacture of paper stationery
17.24	Manufacture of wallpaper
17.29	Manufacture of other articles of paper and paperboard
18.11	Printing of newspapers
18.12	Other printing
18.13	Pre-press and pre-media services
18.14	Binding and related services
18.20	Reproduction of recorded media
19.10	Manufacture of coke oven products
23.19	Manufacture and processing of other glass, including technical glassware
23.41	Manufacture of ceramic household and ornamental articles
23.44	Manufacture of other technical ceramic products
23.49	Manufacture of other ceramic products

Table A.7: List of non-harmonised or partially harmonised sectors

Nace Code	Description
23.69	Manufacture of other articles of concrete, plaster and cement
23.70	Cutting, shaping and finishing of stone
23.91	Production of abrasive products
23.99	Manufacture of other non-metallic mineral products n.e.c.
24.31	Cold drawing of bars
24.32	Cold rolling of narrow strip
24.33	Cold forming or folding
24.34	Cold drawing of wire
25.12	Manufacture of doors and windows of metal
25.40	Manufacture of weapons and ammunition
25.50	Forging, pressing, stamping and roll-forming of metal; powder metallurgy
25.71	Manufacture of cutlery
25.72	Manufacture of locks and hinges
25.73	Manufacture of tools
26.52	Manufacture of watches and clocks
26.70	Manufacture of optical instruments and photographic equipment
26.80	Manufacture of magnetic and optical media
27.52	Manufacture of non-electric domestic appliances
29.20	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
29.31	Manufacture of electrical and electronic equipment for motor vehicles
29.32	Manufacture of other parts and accessories for motor vehicles
30.99	Manufacture of other transport equipment n.e.c.
31.01	Manufacture of office and shop furniture
31.02	Manufacture of kitchen furniture
31.03	Manufacture of mattresses
31.09	Manufacture of other furniture
32.11	Striking of coins
32.12	Manufacture of jewellery and related articles
32.13	Manufacture of imitation jewellery and related articles
32.20	Manufacture of musical instruments
32.91	Manufacture of brooms and brushes
33.11	Repair of fabricated metal products
33.12	Repair of machinery
33.13	Repair of electronic and optical equipment
33.14	Repair of electrical equipment
33.15	Repair and maintenance of ships and boats
33.16	Repair and maintenance of aircraft and spacecraft
33.17	Repair and maintenance of other transport equipment
33.19	Repair of other equipment
33.20	Installation of industrial machinery and equipment

A.7 Robustness Tests of Baseline Specification

Table A.8: Estimation of the effect of the Number of TBTs on import expenditures and prices

Dependent Variable	*Imports Value (ln)*			*Import Price (ln)*		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{EU}_{ot}=1\}$	0.007*			0.009***		
	(0.003)			(0.002)		
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{EU}_{ot}=0\}$	-0.010*			0.015***		
	(0.005)			(0.002)		
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{HAR}_{pot}=1\}$		0.016***			0.007***	
		(0.004)			(0.003)	
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{MR}_{pot}=1\}$		-0.008*			0.013***	
		(0.004)			(0.002)	
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{HAR}_{pot}=0,\text{MR}_{pot}=0\}$		-0.011*			0.015***	
		(0.005)			(0.003)	
$\ln(1+\#\text{TBT}_{pt})$			0.016***			0.008***
			(0.003)			(0.002)
$\ln(1+\#\text{TBT}_{pt}) \times \text{Dissimilarity}_{pot}^{TBT}$			-0.024***			0.006***
			(0.004)			(0.002)
Observations	7,892,397	7,892,397	7,892,397	7,892,397	7,892,397	7,892,397
Firm-Origin-Product FE	Yes	Yes	Yes	Yes	Yes	Yes
Origin-Time-HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1), (2), and (3) report estimates for the logarithm of firm–origin–product–year import value, while columns (4), (5), and (6) report estimates for the logarithm of the import price. $\ln(1+\#\text{TBT}_{pt})$ denotes the natural logarithm of one plus the number of TBTs imposed on product p at time t by the EU. The indicator $\mathbb{1}\{\text{EU}_{ot}=1\}$ equals one if the origin country o is an EU member, and zero otherwise. HAR_{pot} and MR_{pot} indicate whether an origin-product combination is subject to harmonisation or mutual recognition standards, respectively, with $\mathbb{1}\{\text{HAR}_{pot}=0,\text{MR}_{pot}=0\}$ corresponding to origin-product combinations not subject to either. $\text{Dissimilarity}_{pot}^{TBT}$ measures the regulatory dissimilarity between new EU TBTs and the existing regulations in the origin country. Standard errors are clustered at the product–origin–time level. Statistical significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.9: Estimation of the effect of the Number of TBTs on supply chains reallocation

Dependent Variable	*Import Quantity (ln)*			*Exit Probability*			*Entry Probability*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{EU}_{ot}=1\}$	-0.003			0.001			-0.002		
	(0.004)			(0.001)			(0.003)		
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{EU}_{ot}=0\}$	-0.025***			0.005*			-0.010***		
	(0.005)			(0.002)			(0.003)		
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{HAR}_{pot}=1\}$		0.009***			0.001*			0.005***	
		(0.002)			(0.001)			(0.001)	
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{MR}_{pot}=1\}$		-0.020***			0.001			-0.012***	
		(0.003)			(0.001)			(0.001)	
$\ln(1+\#\text{TBT}_{pt}) \times \mathbb{1}\{\text{HAR}_{pot}=0,\text{MR}_{pot}=0\}$		-0.026***			0.005***			-0.011***	
		(0.004)			(0.001)			(0.001)	
$\ln(1+\#\text{TBT}_{pt})$			0.008*			0.002			0.006***
			(0.004)			(0.001)			(0.002)
$\ln(1+\#\text{TBT}_{pt}) \times \text{Dissimilarity}_{pot}^{TBT}$			-0.030***			0.001			-0.018***
			(0.004)			(0.002)			(0.003)
Observations	7,892,397	7,892,397	7,892,397	4,587,521	4,587,521	4,587,521	4,702,059	4,702,059	4,702,059
Firm–Origin–Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin–Time–HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1), (2), and (3) report estimates for the logarithm of firm–origin–product–year import quantity; columns (4), (5), and (6) report estimates for the exit probability of an importing firm; and columns (7), (8), and (9) report estimates for the entry probability. $\ln(1+\#\text{TBT}_{pt})$ denotes the natural logarithm of one plus the number of TBTs imposed on product p at time t. The indicator $\mathbb{1}\{\text{EU}_{ot}=1\}$ equals one if the origin country o is an EU member and zero otherwise. HAR_{pot} and MR_{pot} indicate whether an origin-product combination is subject to harmonisation or mutual recognition standards, respectively. $\text{Dissimilarity}_{pot}^{TBT}$ measures the regulatory dissimilarity between new EU TBTs and the existing regulations in the origin country. Standard errors are clustered at the product–origin–time level. Statistical significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.10: IV Estimation of the effect of TBT on the intensive margin

	First Stage		*Second Stage*		
Dependant Variable	$\text{TBT}_{pot}^{Non-EU}$	TBT_{pot}^{EU}	*Imports Value (ln)*	*Import Price (ln)*	*Import Quantity (ln)*
	(1)	(2)	(3)	(4)	(5)
$\text{TBT}_{pt}^{US} \times \mathbb{1}\{\text{EU}_{ot}=1\} * Exp_f^{US}$	0.005***	0.159***			
	(0.001)	(0.013)			
$\text{TBT}_{pt}^{US} \times \mathbb{1}\{\text{EU}_{ot}=0\} * Exp_f^{US}$	0.164***	0.015***			
	(0.012)	(0.003)			
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot}=1\}$			0.315***	-0.002	0.317***
			(0.078)	(0.061)	(0.094)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot}=0\}$			-0.265**	-0.028	-0.237*
			(0.114)	(0.061)	(0.130)
Observations	7,373,795	7,373,795	7,373,795	7,373,795	7,373,795
Firm-Origin-Product FE	Yes	Yes	Yes	Yes	Yes
Origin-Time-HS2 FE	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes
First-stage F-Stat - TBT_{pot}^{Non-EU}	139.15				
First-stage F-Stat - TBT_{pot}^{EU}		152.25			

Notes: The dependent variables are defined as follows: *Imports Value (ln)* is the natural logarithm of firm-origin-product-year import value; *Import Price (ln)* is the logarithm of the import price and *Quantity (ln)* is the logarithm of firm–origin–product–year import quantity. $\text{TBT}_{pt}^{Non-EU} \equiv TBT_{pt} \times \mathbf{1}\{EU_{ot}=0\}$, denotes the interaction between a technical regulation imposed by the EU on product p at time t and a dummy equals one if the product originates from an EU country, while $\text{TBT}_{pt}^{EU} \equiv TBT_{pt} \times \mathbf{1}\{EU_{ot}=1\}$, denotes the interaction between a technical regulation imposed by the EU on product p at time t and a dummy equals one if the product originates from a non-EU country. TBT_{pt}^{US} denotes a technical standard imposed by the US on product p at time t. The indicator $\mathbb{1}\{\text{EU}_{ot}=1\}$ equals one if the product originates from an EU country, and zero otherwise. Exp_f^{US} indicates if firm f exports at least once to the US. Standard errors are clustered at the origin-product-time level. Statistical significance is denoted as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.11: IV Estimation of the effect of TBT on the extensive margin

	First Stage				*Second Stage*	
Dependant Variable	$\text{TBT}_{pot}^{Non-EU}$	TBT_{pot}^{EU}	$\text{TBT}_{pot}^{Non-EU}$	TBT_{pot}^{EU}	*Exit*	*Entry*
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{TBT}_{pt}^{US} \times \mathbb{1}\{\text{EU}_{ot}=1\}_f^{US}$	0.005***	0.159***	0.006***	0.170***		
	(0.001)	(0.014)	(0.001)	(0.014)		
$\text{TBT}_{pt}^{US} \times \mathbb{1}\{\text{EU}_{ot}=0\}_f^{US}$	0.148***	0.022***	0.172***	0.023***		
	(0.012)	(0.003)	(0.013)	(0.003)		
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot}=1\}$					-0.182***	0.318***
					(0.033)	(0.040)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot}=0\}$					-0.024	0.011
					(0.050)	(0.041)
Observations	4,244,264	4,244,264	4,355,170	4,355,170	4,302,447	4,414,063
Firm-Origin-Product FE	Yes	Yes	Yes	Yes	Yes	Yes
Origin-Time-HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-Stat - TBT_{pot}^{Non-EU}	79.16		99.05			
First-stage F-Stat - TBT_{pot}^{EU}		90.35		93.51		

Notes: The dependent variables are defined as follows: *Exit* is the exit probability; and *Entry* is the entry probability of an importing firm. TBT_{pt}^{Non-EU} denotes the interaction between a technical regulation imposed by the EU on product p at time t and a dummy equals one if the product originates from an EU country, while TBT_{pt}^{EU} denotes the interaction between a technical regulation imposed by the EU on product p at time t and a dummy equals one if the product originates from a non-EU country. TBT_{pt}^{US} denotes a technical standard imposed by the US on product p at time t. The indicator $\mathbb{1}\{\text{EU}_{ot}=1\}$ equals one if the product originates from an EU country, and zero otherwise. Exp_f^{US} indicates if firm f exports at least once to the US. Standard errors are clustered at the origin-product-time level. Statistical significance is denoted as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.12: Control for Trade Facilitation TBTs on Import Margins

	Imports Value (ln) (1)	*Import Price (ln)* (2)	*Import Quantity (ln)* (3)	*Exit* (4)	*Entry* (5)
TBT_{pt}	0.044***	0.016**	0.028**	0.003	0.022***
	(0.009)	(0.007)	(0.011)	(0.004)	(0.005)
$TBT_{pt} \times \text{Dissimilarity}_{pot}^{TBT}$	-0.060***	0.000	-0.061***	0.006	-0.054***
	(0.010)	(0.007)	(0.012)	(0.004)	(0.009)
$TBT_{pt} \times \text{TradeFacil}_{pt}$	0.007	-0.038***	0.045***	-0.011***	0.006*
	(0.006)	(0.004)	(0.007)	(0.002)	(0.003)
Observations	7,892,397	7,892,397	7,892,397	4,521,868	4,631,112
Firm–Origin–Product FE	Yes	Yes	Yes	Yes	Yes
Origin–Time–HS2 FE	Yes	Yes	Yes	Yes	Yes
Control for Tariffs	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are defined as follows: column (1) reports the logarithm of firm–origin–product–year import value; column (2) the logarithm of the import price; column (3) the logarithm of import quantity; column (4) the exit probability; and column (5) the entry probability of an importing firm. Here, TBT_{pt} denotes a technical regulation imposed on product p at time t. $\text{Dissimilarity}_{pot}^{TBT}$ measures the regulatory dissimilarity between new EU TBTs and existing regulations in the origin country, while TradeFacil_{pt} is an indicator capturing trade facilitation-related TBTs. The variable log(Applications) refers to WA-level applications. Standard errors are clustered at the product–origin–time level. Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.13: Estimation of the effect of TBT by development level

	(1) *Import Price (ln)*	(2) *Import Quantity (ln)*	(3) *Exit*	(4) *Entry*
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 1\}$	-0.003	0.019***	0.006*	-0.003
	(0.009)	(0.005)	(0.003)	(0.006)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0, \text{Developed}_{ot} = 1\}$	0.029***	-0.048***	0.010	-0.025**
	(0.008)	(0.017)	(0.006)	(0.012)
$\text{TBT}_{pt} \times \mathbb{1}\{\text{EU}_{ot} = 0, \text{Developing}_{ot} = 1\}$	0.018**	-0.030	0.019***	-0.028***
	(0.009)	(0.019)	(0.007)	(0.008)
Observations	7,858,576	7,858,576	4,570,640	4,682,852
Firm-Origin-Product FE	Yes	Yes	Yes	Yes
Origin-Time-HS2 FE	Yes	Yes	Yes	Yes
Control for tariffs	Yes	Yes	Yes	Yes

Notes: The dependent variables are defined as follows: *Import Price (ln)* is the natural logarithm of the import price; *Quantity (ln)* is the natural logarithm of firm–origin–product–year import quantity; *Exit* is the exit probability; and *Entry* is the entry probability of an importing firm. TBT_{pt} denotes a technical regulation imposed on product p at time t. The indicator $\mathbb{1}\{\text{EU}_{ot} = 1\}$ equals one if the product originates from an EU country, and zero otherwise. $\mathbb{1}\{\text{EU}_{ot} = 0, \text{Developed}_{ot} = 1\}$ equals one if the product originates from a developing non-EU country, and zero otherwise. $\mathbb{1}\{\text{EU}_{ot} = 0, \text{Developing}_{ot} = 1\}$ equals one if the product originates from a developing non-EU country, and zero otherwise. Standard errors are clustered at the origin-product-time level. Statistical significance is denoted as follows: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.