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The Role of Non-Tariff Measures in Export Competitiveness in the Wine Industry

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Abstract: Among firms, policymakers, and researchers in trade policy instruments, the resurgence of protectionism has sparked renewed interest, particularly in non-tariff measures (NTMs) in agri-food industries such as sanitary and phytosanitary measures (SPSs) and technical barriers to trade (TBTs). Existing research suggests that the effect of NTMs on export competitiveness is unclear and calls for further investigation. This study aims to contribute to filling this gap by examining, with specific respect to the wine industry, the impact of importers' NTMs on the export competitiveness of their trading partners. The results of our research indicate that the subcategories of SPSs and TBTs have a heterogeneous effect on export participation and export market share and treating them as if they were similar may lead to misleading or even erroneous conclusions. Nonetheless, the majority of SPSs and TBTs do promote export participation, though the effect of many of these measures on market share is limited.

Keywords: International Trade, Competitiveness, Public Policy, Gravity Model, Fractional Regression Model

1 Introduction

The global economy is experiencing a resurgence of trade frictions, including both tariffs and non-tariff measures (NTMs) (Dhingra et al., 2023; Fontagné et al., 2022). Countries and industries are trying to garner larger shares of the world market by gaining an economic edge over rivals in a highly competitive global market (European Commission, 2024b). These trade frictions influence the competitive dynamics of the world economy and the business environment (Yu et al., 2023). For agri-food products such as wine, where safety, quality, and sustainability are key differentiators, NTMs, especially sanitary and phytosanitary measures (SPSs) and technical barriers to trade (TBTs), are a central determinant of competitiveness, influencing firms' ease of market entry and export performance (Crivelli, Gröschl, 2016; Beghin, Schweizer, 2021).

The present study of how NTMs affect export competitiveness in the global wine industry focuses on two key research questions: (RQ1) How do NTMs affect export participation (i.e., the probability of successfully entering a destination market)? (RQ2) How do NTMs affect export shares once entry occurs?

In our model, export competitiveness is assessed using the concept of export market share, a bounded measure of competitiveness ranging from zero (0 = no exports at all) to unity (1 = full market dominance) (Wijnands et al., 2008; Carraresi, Banterle, 2015; Macedo et al., 2019b). Given the high frequency of zero trade values, the analysis employs a two-part fractional regression model (2P-FRM), a technique originally developed by Papke and Wooldridge (2008). Inspired by the gravity approach and adapted to focus on market share, the empirical framework combines data from 2007 to 2021 on the world's 15 major wine producing countries and their 185 wine-trade partners, with SPSs, TBTs, and control variables (purchasing power, regional trade agreements, tariffs, and exchange rates) identified as explanatory factors.

NTMs affect trade through three main channels: supply shifting, demand-shifting, and trade cost effects (Fugazza, Maur, 2008; Jafari, Britz, 2018). Supply shifting occurs when the effect of compliance is to modify production processes and costs. While meeting stricter safety and labeling rules can raise short-term costs and reduce exports, it may also foster technological progress and longer-term competitiveness (Melitz, 2003; Beghin, Schweizer, 2021). Demand-shifting effects stem from the signaling role played by NTMs. When standards credibly convey information about safety, quality, or environmental performance they can increase consumer trust and willingness to pay, and conversely burdensome or inconsistent regulations may suppress demand (Santeramo, Lamonaca, 2019). By raising trade costs (e.g., certification, documentation requirements), NTMs can hinder entry, but also may enhance transparency and predictability (Crivelli, Gröschl, 2016; Beghin, Schweizer, 2021).

Market share reflect the influence of these three channels. The balance between their cost-raising and trust-enhancing effects determines whether NTMs operate as barriers or facilitators of trade. In agri-food markets, where consumers are highly sensitive to safety and sustainability attributes, this balance is particularly delicate.

NTMs are especially relevant in agri-food trade, where they regulate safety, quality environmental and ethical standards (Livingston et al., 2008; Santeramo, Lamonaca, 2019; Garcés, Vogt, 2025). Many NTMs pursue legitimate societal goals, such as protecting the environment and promoting social welfare, and are consistent with the sustainable trade agenda of the European Union (EU), which aims to reconcile agricultural competitiveness with global protectionism and ecological challenges (Emlinger, Guimbard, 2025; Santeramo et al., 2025). The positive impact of NTMs may be related to their demand-shifting effect, particularly when they provide information to consumers. However, other NTMs may act as disguised protectionism, distorting competition and imposing disproportionate compliance costs on exporters (Disdier, Marette, 2010; Nicita, Gourdon, 2013; Cadot et al., 2018; Disdier, Fugazza, 2020). Distinguishing between these effects is vital for understanding how NTMs reshape the geography of agri-food competitiveness.

The globalized wine industry offers an appropriate case for such analysis. Wine is a high-value, highly differentiated product in which quality and reputation are central to consumer choice. Wine production is simultaneously rooted in European tradition and increasingly globalized (Castillo et al., 2016; Anderson et al., 2018). Because wine markets are characterized by both high tariffs and dense networks of SPSs and TBTs, they provide a natural setting for examining how regulatory heterogeneity affects export performance. Existing studies report mixed results - some finding that NTMs hinder trade, others that they facilitate it, underlining the need for a more disaggregated and theoretically grounded approach (Dal Bianco et al., 2016; Santeramo et al., 2019).

Basing itself on data from the wine industry our research advances the literature on NTMs, agri-food competitiveness, and trade policy by distinguishing between effects on countries' export participation and market share. First, it provides rare empirical evidence on the heterogeneous impacts of NTMs on agri-food trade, showing that while some facilitate trade, others act as barriers. Second, using data on market share rather than aggregate flows, permits a more precise assessment of exporters´ relative positions to be made. Together, these contributions yield important insights for scholars but also for regulators who seek to balance legitimate public and social objectives with fair market participation and for exporters aiming to enhance competitiveness in an increasingly regulated trade environment.

The remainder of this study is structured as follows. In Section 2, we review the relevant literature. Section 3 provides an overview of NTMs found in the wine industry over the study period. In Section 4 we present the data and model framework used. In Section 5 the results are presented. In Section 6, we conclude the paper by providing some implications of the research for management decision-making and policy formulation.

2 Literature Review

The analysis of NTMs has gained prominence since the entry into force of the World Trade Organization (WTO) Agreements on SPSs and TBTs in 1995, which formalized member countries' notification obligations, and clarified the scope of their regulatory intervention in trade. Despite persistent reporting delays and omissions, these agreements have improved transparency and fostered a clearer understanding of how regulatory policies shape international trade dynamics. NTMs imposed by importers are now seen as important determinants of exporters' performance, particularly in industries where product safety, quality, and sustainability are key sources of competitiveness, as is the case of agri-food industries in general and particularly the globalized wine trade (Beghin, Schweizer, 2021).

From the perspective of "new" trade theory, such as Melitz's (2003) model in which firm-level data is central, enterprise heterogeneity is assumed, and trade strategies are fully costed, NTMs are now understood to be factors that alter the market-access conditions faced by exporters. According to Melitz (2003), only the most productive firms can overcome the fixed costs of exporting associated with acquiring regulatory knowledge, adjusting production processes, obtaining certifications, and complying with labeling and/or testing requirements. SPS and TBT measures often raise these costs, especially in the production and marketing of items such as wine, where food safety, additive controls, labeling, and geographical indications are strictly regulated. As a result, NTMs can generate a *screening process*, whereby less productive firms are deterred from exporting, while more efficient firms remain in foreign markets and may further expand their export activities.

This screening process suggests that NTMs influence both export participation and market share. Higher fixed compliance costs may lead to higher per-unit costs, discourage upscaling, and/or divert resources from expansion into new markets, reducing the ability of firms to enter new markets or attain higher export levels. Also, additional variable costs, such as those resulting from recurrent testing and from changes in documentation requirements, may reduce export competitiveness. However, NTMs may also enhance exports when they signal quality, safety, or sustainability, reducing information asymmetries and building consumer trust. This dual nature – cost-raising but trust-enhancing – frames much of the empirical debate on the overall impact of NTMs.

Empirically-based opinions differ on whether NTMs operate as barriers or facilitators of export performance. Ghodsi et al. (2017) estimate that 60% of SPS and TBT effects are trade-impeding, particularly via quotas and TBTs. Conversely, other studies report that well-designed NTMs can in fact promote trade (Crivelli, Gröschl, 2016; Shepotylo, 2016; Gourdon et al., 2020; Santeramo, Lamonaca, 2022a). A meta-analysis by Santeramo and Lamonaca (2019) confirms that NTM impacts are heterogeneous according to which product is examined, and which methodology is used. Few studies, however, jointly examine export participation and market share (Ferro et al., 2015; Crivelli, Gröschl, 2016; Shepotylo, 2016).

Employing the framework provided by Helpman et al. (2008), Ferro et al. (2015), find that restrictive food safety standards reduce the likelihood but not the intensity of trade, whereas tariffs reduce both. Crivelli and Gröschl (2016), applying a Heckman model (1979), show SPSs tend to lower the probability of successful market entry but increase export by signaling safety to consumers; conformity assessments act as barriers, while labeling and residue limits foster consumer trust. Shepotylo (2016) similarly finds SPSs raise demand but also increase variable costs, whereas TBTs primarily elevate fixed costs. Collectively, these findings suggest that rather acting exclusively to impede or facilitate trade, NTMs are highly context-dependent policy instruments.

The heterogeneous impacts of SPSs and TBTs stem from their differing purposes, compliance requirements, levels of severity, and strictness of application. On the supply side, measures like pesticide residue limits or hygiene controls raise production costs (Disdier et al., 2008; Beghin et al., 2015), while compliance regulations can also drive innovation and quality upgrading, improving long-term competitiveness (Melitz, 2003). On the demand side, labeling or certification requirements may enhance perceived quality and foster consumer trust (Xion, Beghin, 2014), whereas meeting opaque or excessively stringent regulations may lead to consumer confusion or disinterest. The overall impact depends on consumers' valuation of regulated attributes such as safety, quality, or sustainability (Anders, Caswell, 2009). Furthermore, the magnitude of trade cost-effects depends on procedural requirements – whether they entail fixed certification costs or less predictable cumulative costs resulting from recurrent testing and documentation – and the extent to which they vary from firm to firm, disproportionately burdening smaller and less experienced exporters (Shepherd, Wilson, 2013).

Research on the impact of NTMs on wine exports, while limited, nevertheless offers valuable insights into the heterogeneity of their effects. Dal Bianco et al. (2016) analyze bilateral trade in bottled wine between 12 countries over the period 1997-2010 and find that SPS measures do not seem to obstruct wine exports, whereas some TBT measures exert negative effects. In contrast, Santeramo et al. (2019), examining wine imports by 24 countries in four product categories over the period 1991-2016, concluded that NTMs often promote imports, and that SPSs enhance imports of sparkling, bulk, and bottled wines in particular, while TBTs appeared to only facilitate imports of bottled wine imports. Macedo et al. (2021) studied the impact of NTMs exclusively on Port wine exports to 60 countries between 2006-2018 and concluded that only part of the NTMs were trade deterrent. While divergent, these findings reflect the distinct effects of NTMs on the international wine trade and justify our focus on identifying the details of this duality.

Most empirical analyses of NTMs impact rely on the gravity model of international trade, a standard tool for evaluating bilateral trade flows. More recent research has used structural gravity models with high-dimensional fixed effects (Anderson, van Wincoop, 2003; Silva, Tenreyro, 2006; Anderson, Yotov, 2012; Baier et al., 2019) that add consistency to the underlying theory and improve the robustness of estimation. These models incorporate bilateral, exporter-time, and importer-time fixed effects as a means of controlling for persistent costs and multilateral resistance, while accommodating zero trade flows and allowing margin decomposition (Yotov et al., 2016; Heid et al., 2021). These advances allow a more detailed analysis of NTMs.

Overall, the literature stresses the frequently high level of heterogeneity of NTMs impact that results from the type of measure in force, the characteristics of the exporting firms, and the methodological approach adopted. SPSs and TBTs often raise compliance costs and restrict entry, yet they can also enhance consumer trust and facilitate trade under credible regulatory regimes. Evidence for specific products, particularly wine, remains limited and inconclusive, highlighting the need for further research that disentangles fixed cost effects from variable cost effects and jointly examines export participation and market share. Structural gravity models offer a promising avenue for this purpose, as they provide theoretically consistent estimates and accommodate heterogeneity across products, countries, and policy regimes.

3 Non-Tariff Measures in Wine

The most pervasive technical measures affecting the wine trade fall under categories A and B, namely TBTs and SPSs (Disdier et al., 2008; Mariani, Pomarici, 2019), covering a wide array of regulations that vary in both scope and type (Table 1). A key aspect of our analysis – unlike studies focusing on global trade – is that NTMs applied to wine are most often also applied to other products, more frequently to other alcoholic beverages.[1] Since only a very small number of SPSs and TBTs specifically target wine, this suggests that such NTMs were not implemented in reaction to wine trade flows (e.g. to restrict rising imports). Rather, they appear to reflect broader regulatory practices not directed at this particular product. Furthermore, it should be noted that when countries impose NTMs, they usually do so without discriminating between exporters.

Table 1. Subcategories of sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT)

SPSs subcategories	TBTs subcategories
A1 - Prohibitions/restrictions of imports for sanitary and phytosanitary reasons	B1 - Import authorization/licensing related to technical barriers to trade
A2 - Tolerance limits for residues and restricted use of substances	B2 - Tolerance limits for residues and restricted use of substances
A3 - Labeling, marking and packaging requirements	B3 - Labeling, marking and packaging requirements
A4 - Hygienic requirements related to sanitary and phytosanitary conditions	B4 - Production or post-production requirements
A5 - Treatment for elimination of plant and animal pests and disease-causing organisms in the final product or prohibition of treatment	B6 - Product identity requirements
A6 - Other requirements relating to production or postproduction processes	B7 - Product quality, safety or performance requirements
A8 - Conformity assessment related to sanitary and phytosanitary conditions	B8 - Conformity assessment related to technical barriers to trade
A9 - Sanitary and phytosanitary measures not elsewhere specified[2]	B9 - Technical barriers to trade measures not elsewhere specified[3]

Source: UNCTAD (2019)

Figure 1 shows that the average number of NTMs imposed by 185 wine-importing countries in our sample of 15 wine exporters rose sharply over the period covered by our study (2007-2021). Wine is a highly differentiated product in which quality standards are central to consumer choice and, as a food product and especially as an alcoholic beverage, it is associated with potential health externalities that justify regulatory oversight. The rise in NTMs reflects stricter SPS standards, more rigorous labeling and quality requirements driven by consumer demand for transparency and sustainability, and the growing use of NTMs by emerging wine-importing countries (including nascent wine producers) to regulate domestic markets (Dal Bianco et al., 2016; Mariani, Pomarici, 2019; Santeramo et al. 2019).

[1] Consulting the TRAINS database, we observe that among the SPSs imposed on our sample of exporting countries since 2007, only 5 out of 955 were exclusively applied to wine (HS code 2204 or more disaggregated). A similar observation holds for TBTs, with only 9 out of 441.

[2] Such as the broad biosafety regulations for genetically modified organisms that set general requirements for management or approval, rather than applying to a specific disease or food product.

[3] Such as the pre-import sealing of goods to ensure tamper-proof packaging or integrity of the products, without being tied to a specific product standard or labeling rule.

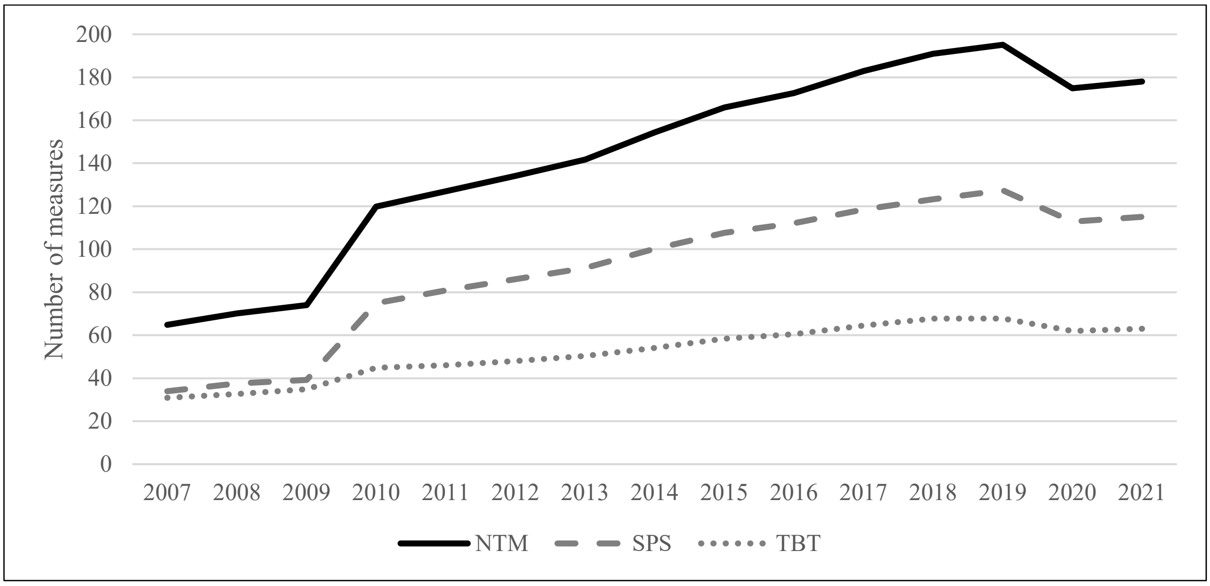

Figure 1. Average number of non-tariff measures (NTMs), by sanitary and phytosanitary measures (SPSs) and technical barriers to trade (TBTs), imposed on wine exports

Source: authors' computation based on TRAINS and WITS data for 185 importing countries and 15 exporting countries

The most prevalent NTMs are SPSs. The average number of SPSs increased by 239% over the period of study. Throughout, growth was steady, except in 2020, and occurred in most importing countries. Focusing on the main wine importers in Figure 2,[4] the members of the EU (treated as a group because they share a common trade policy) became some of the countries imposing the most SPSs from 2010 onwards, reaching 17 in 2021. Among the importing countries analyzed, the USA consistently imposed the highest number of SPSs, rising from 23 in 2007 to 40 in 2021. China progressively increased its use of SPSs and ended 2021 with 22 – slightly higher than Switzerland, which remained between 19 and 21 throughout the entire period. Japan and Russia increased their use of SPSs from 2014 and by 2021 had reached 7 and 14, respectively. In Brazil, SPSs rose gradually, from 1 in 2007 to 13 in 2021. The number of SPSs imposed by Hongkong remained stable, between 10 and 13, while in Norway it stayed at 6 from 2010 onwards. Finally, Canada imposed only 2 SPSs during the whole period.

4 In Figures 2 and 3, it is referred to average trade value between 2007 and 2021 in relation to our sample of 15 exporting countries.

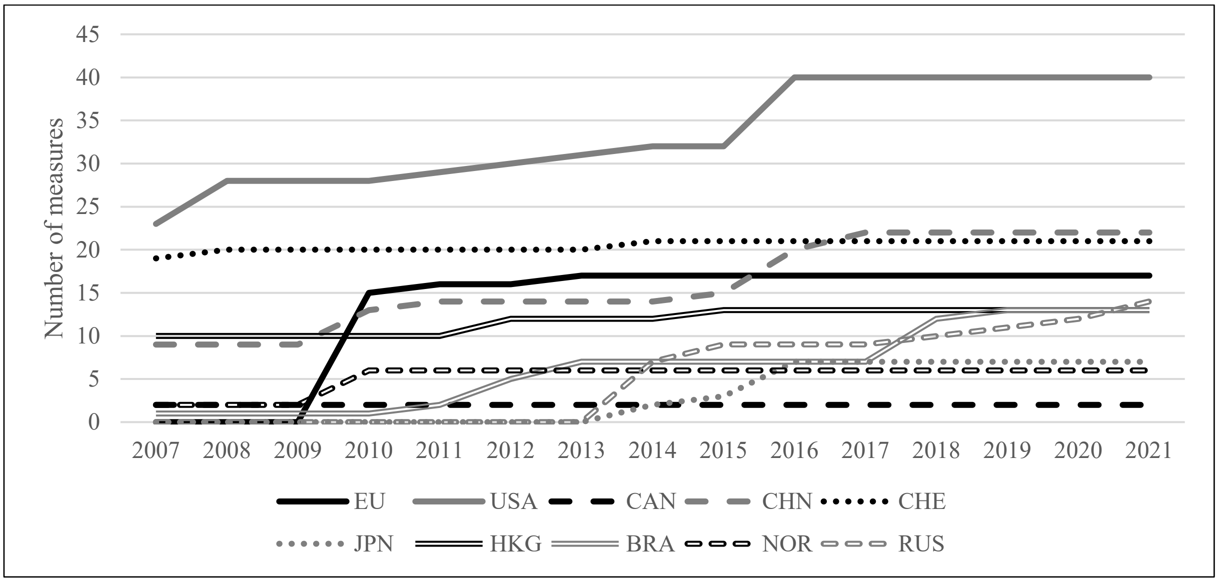

Figure 2. Evolution of the number of sanitary and phytosanitary measures imposed by the 15 main importing countries

Notes: main wine importers based on average value between 2007 and 2021; EU = European Union; CAN = Canada; CHN = China; CHE = Switzerland; JPN = Japan; HKG = Hongkong; BRA = Brazil; NOR = Norway; RUS = Russia.
Source: authors' computation based on TRAINS and WITS data

Regarding TBTs, the average number also increased between 2007 and 2021. This global growth of 104% was steady, except in 2020. Figure 3 shows that members of the EU increased TBTs in 2010, but unlike SPSs, the number of TBTs remained relatively low (4). Among the importing countries analyzed, China imposed the highest number of TBTs throughout most of the study period, rising from 17 in 2007 to 45 in 2021. When it was not China, Canada held the lead, reaching 27 TBTs from 2014 onwards. In the USA, TBTs were relatively less common than SPSs but still high compared with the other countries (26 in 2021). In Brazil, TBTs rose gradually, from 11 in 2007 to 20 in 2021. By contrast, they remained stable in Switzerland, ranging from 14 to 16. As with SPSs, TBTs imposed by Russia rose in 2014, reaching 4 by 2021. Finally, Hongkong imposed 11 TBTs over the whole period, Norway 4, and Japan only 1 or 2.

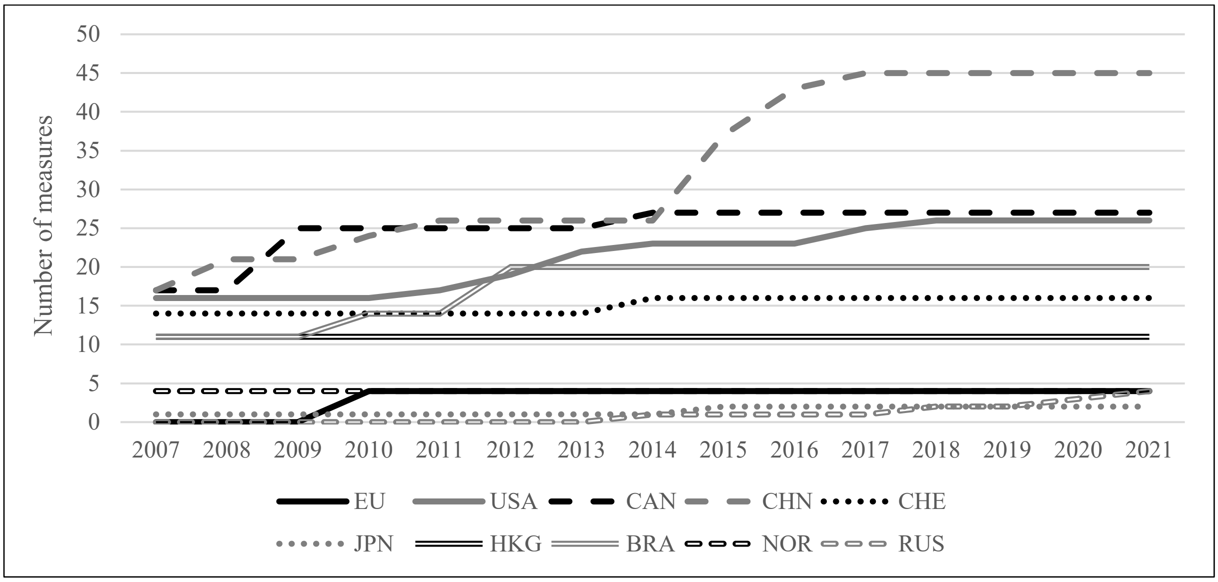

Figure 3. Evolution of the number of technical barriers to trade imposed by the main wine importers

Notes: main wine importers based on average value between 2007 and 2021; EU = European Union; CAN = Canada; CHN = China; CHE = Switzerland; JPN = Japan; HKG = Hongkong; BRA = Brazil; NOR = Norway; RUS = Russia.
Source: authors' computation based on TRAINS and WITS data

To provide a comprehensive account of the NTMs affecting the 15 countries under study, it should be noted that certain measures are more widely applied than others. Table A.1 in the Appendix reports the average number of SPS and TBT measures encountered by exporting countries, disaggregated by year and by subcategory. However, it remains perfectly possible for a single measure from a single sub-category to exert a greater trade impact than multiple measures from other sub-categories.

4 Data and Methodology

4.1 Data

The sample includes the 15 main wine *producers*[5] at the global level (Argentina, Australia, Chile, China, France, Germany, Greece, Hungary, Italy, Portugal, Romania, Russia, Spain, South Africa and the USA) and 185 wine-importing countries, which together constitute over 90% of international trade in bottled wine in the 2007-2021 period.[6] Data for wine exports and the total volume of wine imports of each destination country (in millions of US dollars) come from the UN's Comtrade database accessed through WITS.

In our study, MS is defined as the percentage contribution by an exporting country *i* of a given product (in this case wine) to the total exports to (or in the total imports received by) a given country *j*. Using MS instead of trade values offers an alternative perspective on competitiveness (Wijnands et al., 2008; Carraresi, Banterle, 2015; Macedo et al., 2019b). MS reflects how successfully an exporter is able to compete in a given market, independent of market size, and

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[5] To limit bias, the sample focuses on the main wine producers rather than on the main wine exporters. Data on the global wine trade are not completely trackable and, consequently, do not distinguish export from re-export. For that reason, countries such as United Kingdom, Switzerland and Hongkong appear among the main wine exporters in the Comtrade UN's database though their own wine production is negligible.

[6] Data on tariffs are much scarcer before 2007, with gaps for several countries. This was the principal reason for setting 2007 as the starting point for our data collection.

this shifts the focus toward key factors in a country's competitiveness. Unlike raw export flows, market shares are zero-sum: an increase experienced by one exporter necessarily implies a decrease suffered by another, even if that exporter is outside the group of 15 we have analyzed. In contrast, gross export flows can rise simultaneously for all exporters if overall demand in country *j* increases. If a specific variable in country *j* (such as the use of NTMs) reduces total imports from all trade partners, trade values will only capture the aggregate contraction, while market shares will reveal how the losses are distributed among exporters. This distinction is policy-relevant because, from a strategic perspective, an exporter may be less concerned over market shrinkage if its relative MS increases in compensation.

Wine trade studies typically include NTMs alongside variables such as GDP per capita, exchange rates, regional trade agreements (RTAs), tariffs, production levels, and wine categories as explanatory factors. GDP per capita often increases the propensity to import but also spreads demand across a larger set of suppliers, while wine domestic production signals greater cultural openness to wine consumption along with a preference for variety (Macedo et al., 2019b). Currency depreciation can boost MS by lowering prices abroad, but under fixed costs and liquidity constraints, it may reduce asset value overseas and limit foreign market access (Chaney, 2016). RTAs generally lower trade costs and foster exports. By contrast, tariffs increase costs and deter trade (Dal Bianco et al., 2016, 2017), though appellations of origin and geographical indications may offset this effect (Gouveia et al., 2018; Macedo et al., 2019a, 2020).

The explanatory variables were collected from different sources: per capita GDP in current US dollars and nominal exchange rate in local currency units per US dollar (used to compute the exchange rate of exporting countries per 1 currency unit of importing countries) came from World Development Indicators; wine production data was sourced from the International Organisation of Vine and Wine (OIV); and we used the Gravity database from *Centre d'Études Prospectives et d'Informations Internationales* (CEPII) to collect bilateral data on the presence of RTAs.

Under the Harmonized System of tariff nomenclature, the wine exports considered in our study are represented by the code 220421. Through this code, *ad valorem* equivalent tariffs were taken from the Market Access Map and the NTMs applied to wine imports from UNCTAD, TRAINS NTMs database. Following Murina and Nicita (2017) and Peci and Sanjúan (2020), in our model the NTM variable acts as a count variable. All the variables considered in the econometric estimations are described in Table 2, while Table 3 presents their main descriptive statistics (supplementary descriptive statistics can be found in Table A.2 of the Appendix).

Table 2. Description of the variables

Explained variable	
MS	**Market share of the exporting country *i* in importing country *j***
Explanatory variables	
GDP pc	Per capita gross domestic product of the importing country *j*
Prod. Imp. (t-1)	Wine production in the importing country *j* in year t-1
Exch. Rate	Annual average exchange rate between the currency of importing country *j* and exporting country *i* (the value of the exporter currency per 1 unit of the importer currency)
RTA	Dummy variable =1 if a regional trade agreement is established between countries *i* and *j*, otherwise =0
Tariffs	Ad valorem equivalent tariffs imposed by the importing country *j* on the exporting country *i*
SPS	Number of SPSs with subcategory $k = (A1, A2, A3, A4, A5, A6, A8, A9)$ imposed by the importing country *j* on the exporting country *i*
TBT	Number of TBTs with subcategory $k = (B1, B2, B3, B4, B6, B7, B8, B9)$ imposed by the importing country *j* on the exporting country *i*

Source: authors' computation

Table 3. Descriptive statistics

Variables	**Unit**	**Mean**	**SD**
MS	%, decimal form	0.1	0.1
GDP pc *j*	US dollars	15081.0	21254.8
Prod. Imp. *j* (t-1)	1000 hl	1516.0	6211.1
Exch. Rate	*j*'s direct quote	22.7	101.4
RTA	Binary	0.3	
Tariffs	%, decimal form	0.4	1.4
SPS	Count	6.4	8.4
TBT	Count	3.6	5.2
A1	Count	0.9	1.3
A2	Count	1.1	2.2
A3	Count	1.5	2.2
A4	Count	0.6	1.0
A5	Count	0.1	0.4
A6	Count	0.4	0.8
A8	Count	1.8	2.5
A9	Count	0.0	0.2
B1	Count	0.2	0.6
B2	Count	0.1	0.3
B3	Count	1.9	2.4
B4	Count	0.2	0.6
B6	Count	0.2	0.6
B7	Count	0.3	0.7
B8	Count	0.8	1.9
B9	Count	0.1	0.5

Notes: number of observations = 37,251; SD = standard deviation; for the binary variables the mean represents the percentage of observations equal to one; *j* = importing country; (t-1) = period t-1.
Source: authors' computation

4.2 Methodology

Following the method adopted by several researchers (Papke, Wooldridge, 1996, 2008; Ramalho et al., 2011; Macedo et al., 2019b), the FRM approach was used, since MS is a proportion that falls within the interval $0 \leq MS \leq 1$. The FRM is a non-linear model that does not require transformations for boundary values, effectively accounting for the non-linearity in the data, while being fully robust under the assumptions of a generalized linear model (Gallani et al., 2015). Assuming that $E(Y|X) = G(X\beta)$, it includes observations at the extremes of the distribution, with fitted values guaranteed to remain within the unit interval by $0 \leq G(\cdot) \leq 1$. The quasi-maximum likelihood (QML) method is suggested by Papke and Wooldridge (1996) to estimate β, a method based on maximizing the Bernoulli log-likelihood function.

Additionally, when there is a high concentration of observations at the boundary value of 0,[7] Ramalho et al. (2011) recommend considering a two-part model. The 2P-FRM consists of a binary model for the discrete component (0 or 1) and constitutes the first part; a fractional model for the continuous component constitutes the second part. The choice between one-part and two-part models depends on how the zeros are interpreted, specifically whether they result from two distinct decision processes for zeros and for positive values. In the context of international trade, such a two-part model assumes that a country, aggregating the decisions of all of its firms, makes two separate decisions: first, whether to establish a trade relationship with another country (export propensity) and second, how much to trade (export intensity). If none of the firms in country i find it profitable to export to country j and decide not to, then the decision for country i is not to export to country j.

To summarize the detailed explanation of the 2P-FRM provided by Ramalho et al. (2011) and Macedo et al. (2019b), the first part of our estimates of the factors that influence the likelihood of country *j* importing wine from country *i* are presented. In the second part of the model, only positive outcomes are considered when estimating the factors that influence the size of the MS of country i in country j. We consider the same regressors in both parts, and, for each part, five alternative non-linear conditional mean specifications are tested for the link functions: cauchit, logit, probit, log-log, and complementary log-log. Preference between these functions is determined by using RESET and Goodness-of-functional-form (GOFF) tests (Ramalho et al., 2011).

Due to the non-linearity of the model, an adequate interpretation of the estimated coefficients requires estimating average partial effects (APE) for each part of the model (Ramalho et al., 2011). In the first part, they will represent the impact of a covariate on the likelihood of a wine from *i* being exported to *j* (i.e. export participation), and in the second part the impact of a covariate on the size of the MS of country i in country j. Furthermore, the model requires the calculation of the total partial effect (TPE), which estimates the impact of a covariate on the size of any MS, including zero, that country i may have in country j. It can be interpreted as a global view of the effect of explanatory variables in both parts of the model.

Following the gravity model literature (Baier et al., 2019), we also controlled for outward and inward multilateral resistance terms. In the specific case of trade models, these are typically captured using three types of fixed effects (FEs), namely exporter-time FEs, importer-time FEs, and time-invariant bilateral (or pair) FEs.[8] Our study therefore used exporter-year FEs to control for time-varying factors specific to exporting countries (for example, wine production), but

[7] The share of zero observations is non-negligible, supporting the use of a two-part model, and relatively stable over time (ranging between 39% and 42%), but varies across exporters and especially across importers, reflecting differences in trade patterns and market access.

[8] Under certain circumstances, fixed effects might be disaggregated by product or activity, but here it is not relevant as our research focuses exclusively on wine.

the use of importer-time and bilateral FEs was restricted by the type of dataset we were able to assemble, as we explain below.

As noted earlier, nearly all NTMs are imposed by importing countries non-discriminatorily across the 15 exporting countries in the sample. This makes the inclusion of importer-year FEs unreliable, as they would be nearly collinear with the NTMs. As an alternative, importer FEs were employed, which are less restrictive because they control for fixed characteristics of j, but not their variation in time. Additionally, unlike typical dependent variables in gravity equations, i.e. raw trade flows, market shares partially account for inward multilateral resistance terms by normalizing these flows by the total imports of j. This approach effectively removes the influence of variations in importer j's overall demand, thereby allowing the analysis to concentrate on the relative capacity of exporters to compete with each other for j's market.[9]

Furthermore, bilateral FEs are particularly restrictive, especially for the first stage of the model, as they require within-pair variation in the dependent variable. Consequently, pairs of countries reporting only zeros or positive values from 2007 to 2021 must be excluded.

In contrast, in the second stage, where the dependent variable is MS-conditional on positive trade, bilateral FEs are less restrictive due to variation in the export share. However, when combined with exporter-year and importer FEs, a substantial number of observations are lost. Since including bilateral FEs would reduce the sample by 66% in the first stage and 74% in the second stage, severely limiting the scope of the estimations, we opted not to include them.

Time-invariant variables such as geographical distance, common language, co-religionism and cultural proximity cannot be included in the model because they are highly collinear with the specified FEs. The level of wine production in the exporting country cannot be included either, due to the use of exporter-year FEs. Nonetheless, since importer-year FEs are not considered, the model can still incorporate the importing country's GDP per capita and level of wine production.

NTMs are often considered potentially endogenous with trade flows (Santeramo et al., 2025); however, as shown in Section 3, they appear to reflect broader regulatory frameworks that do not specifically target wine, thereby arguing against reverse causality. Among the remaining control variables, it is unlikely that importers' GDP per capita or bilateral exchange rates are driven by market shares in a given activity such as wine production. Since RTAs follow a similar logic to NTMs, tariffs and domestic wine production are left as the only potential sources of endogeneity. Lagging these control variables mitigates some concerns, but their results should be interpreted as associations rather than causal impacts. Though lagging tariffs resulted in the loss of one year's data, the resulting estimates were consistent, and so we retained the level of tariffs in the compilation of our results.

To summarize the analytical framework, MS can be expressed as $MS_{ij} = \frac{X_{ij}}{M_j} = \frac{X_{ij}}{\sum_k X_{kj}}$, where X_{ij} are the wine exports from i to j and M_j are the total wine imports by j from all countries k (or, equivalently, the total wine exports of the latter to j). The impact of an NTMs is expressed by $\frac{\partial MS_{ij}}{\partial NTM} = \frac{1}{M_j}\left(\frac{\partial X_{ij}}{\partial NTM} - s_{ij}\sum_k \frac{\partial X_{kj}}{\partial NTM}\right)$, which shows that there is a direct impact, $\frac{1}{M_j}\frac{\partial X_{ij}}{\partial NTM}$, of an NTMs on the exports of a country i, but also a competitive impact, $\frac{s_{ij}}{M_j}\sum_k \frac{\partial X_{kj}}{\partial NTM}$, because the NTMs also affects exports from competing countries (remind that NTMs in the wine sector generally do not discriminate between exporters). Therefore, the influence of NTMs on MS_{ij} depends on the interplay between supply shifting, demand-shifting, and trade-cost effects, but

[9] In short, importer FEs and the normalization of the dependent variable control for time-invariant importer characteristics (e.g. geography and culture) and for aggregate demand variation in the importing country, but not time-varying shocks specific to each importer (e.g. new wine consumption trends or domestic regulatory changes).

it is necessary to consider the competitive impact beyond the direct impact. This means that a direct impact may be compensated for or even reversed by a competitive impact. For example, if j imposes a new NTMs, compliance costs for i will increase, which would have a negative direct impact on MS_{ij}. However, compliance costs may rise more sharply in competing wine-exporting countries, leading to a positive competitive impact on MS_{ij}. Consequently, MS_{ij} may increase or decrease depending on which impact is stronger.

5 Results

The 2P-FRM was estimated assuming five alternative non-linear conditional mean specifications (cauchit, logit, probit, log-log, and complementary log-log) for the link functions. Based on RESET and Goodness-of-functional-form (GOFF) tests (Ramalho et al., 2011), the results suggest adopting the complementary log-log specification in both parts of the model (estimations with remaining link functions were rejected by the above-mentioned tests; see Tables A.3 and A.4 in the Appendix). The results of these estimations are presented in Table 4, in which columns (1) and (3) refer to the coefficients estimated for export participation and MS, respectively.[10] Table 4 also presents the estimations of two APEs for each explanatory variable: in column (2) the effect on the probability of wine of country i being imported by a certain country j; and in column (4) the effect on the magnitude of a non-zero MS of country i's wine in country j (Equation 6). Column (5) includes the TPE. To avoid a log of zero outcome, importer and exporter-year fixed effects were considered, standard errors used to account for intra-group correlation, and a small constant added to some of the variables (tariffs, NTMs, and wine production) before computing the log-form.

[10] Problems of NTMs multicollinearity were avoided by conducting diagnostics using the Variance Inflation Factor and the Condition Index, following the rule of thumb suggested by Belsley et al. (2004).

Table 4. Two-part fractional regression model estimations, average partial effects (APE) and total partial effect (TPE)

	(1)	(2)	(3)	(4)	(5)
	Export participation		Export market share		TPE
VARIABLES	β_1	APE	β_2	APE	
GDP pc *j* (log)	0.615***	0.090***	-0.311***	-0.025***	-0.007**
	(0.104)	(0.015)	(0.071)	(0.006)	(0.003)
Prod. Imp. (t-1) *j* (log)	0.141***	0.021***	-0.079*	-0.006*	-0.002**
	(0.038)	(0.006)	(0.043)	(0.004)	(0.001)
Exch. rate (log)	-0.058**	-0.009**	0.028	0.002	0.001
	(0.024)	(0.004)	(0.022)	(0.002)	(0.002)
RTA	0.422***	0.062***	0.528***	0.043***	0.031***
	(0.088)	(0.013)	(0.105)	(0.008)	(0.002)
Tariffs (log)	-0.116***	-0.017***	-0.139***	-0.011***	-0.008***
	(0.013)	(0.002)	(0.013)	(0.001)	(0.000)
A1 (log)	-0.079	-0.012	0.099	0.008	0.004
	(0.087)	(0.013)	(0.073)	(0.006)	(0.004)
A2 (log)	0.172**	0.025**	0.084	0.007	0.006*
	(0.073)	(0.011)	(0.087)	(0.007)	(0.003)
A3 (log)	0.411***	0.060***	0.294***	0.024***	0.019***
	(0.089)	(0.013)	(0.079)	(0.006)	(0.004)
A4 (log)	-0.292**	-0.043**	-0.236**	-0.019**	-0.015***
	(0.119)	(0.017)	(0.097)	(0.008)	(0.004)
A5 (log)	-0.130	-0.019	-0.020	-0.002	-0.003
	(0.251)	(0.037)	(0.133)	(0.011)	(0.008)
A6 (log)	-0.534***	-0.078***	-0.207*	-0.017*	-0.017***
	(0.124)	(0.018)	(0.110)	(0.009)	(0.005)
A8 (log)	0.194***	0.028***	-0.019	-0.002	0.002
	(0.065)	(0.010)	(0.066)	(0.005)	(0.003)
A9 (log)	-0.201	-0.029	0.028	0.002	-0.001
	(0.191)	(0.028)	(0.166)	(0.013)	(0.013)
B1 (log)	0.266**	0.039**	0.127	0.010	0.010*
	(0.120)	(0.017)	(0.107)	(0.008)	(0.006)
B2 (log)	0.948***	0.139***	-0.102	-0.008	0.008
	(0.311)	(0.045)	(0.149)	(0.012)	(0.008)
B3 (log)	-0.147**	-0.022**	-0.118	-0.010	-0.008**
	(0.073)	(0.011)	(0.088)	(0.007)	(0.004)
B4 (log)	0.586**	0.086**	-0.061	-0.005	0.005
	(0.180)	(0.026)	(0.100)	(0.008)	(0.005)
B6 (log)	-0.066	-0.010	0.100	0.008	0.004
	(0.158)	(0.023)	(0.149)	(0.012)	(0.007)
B7 (log)	0.127	0.019	-0.141	-0.012	-0.005
	(0.132)	(0.019)	(0.094)	(0.008)	(0.005)
B8 (log)	-0.171*	-0.025*	-0.007	-0.001	-0.003
	(0.099)	(0.015)	(0.091)	(0.007)	(0.004)
B9 (log)	-0.179	-0.026	0.134	0.011	0.004
	(0.159)	(0.023)	(0.178)	(0.014)	(0.009)
Constant	-6.590		0.180		
	(1.044)		(0.881)		
Observations	37,251		21,784		
RESET	2.335		1.412		
	[0.127]		[0.235]		
GOFF	1.692		0.345		
	[0.193]		[0.557]		

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Figures in [ ] indicate p-values; Exporter-year and importer fixed effects are considered; GOFF is a goodness-of-functional-form test; I = exporting country; j = importing country; (log) = log-form; (t-1) = period $t-1$.
Source: authors' computation

Regarding export participation, a heterogeneous effect of SPSs and TBTs can be observed. Measures A2 (tolerance limits for residues and restricted use of substances), A3 (labeling, marking, and packaging requirements), and A8 (conformity assessment related to SPS conditions) are all SPSs with a positive and significant effect, meaning that they increase the likelihood of wine from an exporting country i being imported by a given country j. TBTs such as B1 (import authorization/licensing related to TBT), B2 (tolerance limits for residues and restricted use of substances), and B4 (production or post-production requirements), also have a positive effect on export participation. In contrast, A4 (hygienic requirements related to SPS conditions), A6 (other requirements relating to production or postproduction processes), B3 (labeling, marking, and packaging requirements), and B8 (conformity assessment related to TBT) are measures with a significant negative impact on export participation.

SPSs and TBTs have less impact on MS, since their estimated APEs are predominantly non-significant or only marginally significant, and are of lower magnitude. A4 and A6 are also measures with a negative impact on MS, while A3 measures have a positive impact. For instance, measures A2, A3, A8, B3, and B8 are among the most frequently imposed by importing countries on wine from our sample of exporting countries (see Table A.1 in the Appendix), which indicates that these are not merely isolated cases of measures exerting an influence on export participation and MS.

In summary, in the first part of the model there are two more SPSs and TBTs with a trade-enhancing effect than those having a negative effect. This could be due to the downward pressure the former exerts on asymmetric information and/or externalities, because in agricultural and food products such as wine, this enhances consumer trust (Santeramo, Lamonaca, 2019), thereby creating an incentive for companies to enter the market. Conversely, the results from the second part of the model suggest that NTMs play a limited role in determining MS. This could be explained by other factors such as demand, production capacity, and pricing driving MS, the combined effects of NTMs through demand-shifting, supply shifting, and trade-cost channels offsetting one another, or even the direct impact of NTMs being counterbalanced by a competitive impact.

To indicate the degree of precision of the APEs, Figure 4 is presented with 95% confidence intervals. It can be noted that the less frequent measures (e.g., A5 and B2) tend to have a wider interval and, therefore, a lower degree of precision of the estimated average effects.[11]

[11] Aggregating the subcategories of SPSs and TBTs yields estimates (Table A.5 in the Appendix) suggesting non-significant effects of NTMs. However, the results in Table 4 show that disaggregating NTMs is preferable, as they have heterogeneous effects that offset each other.

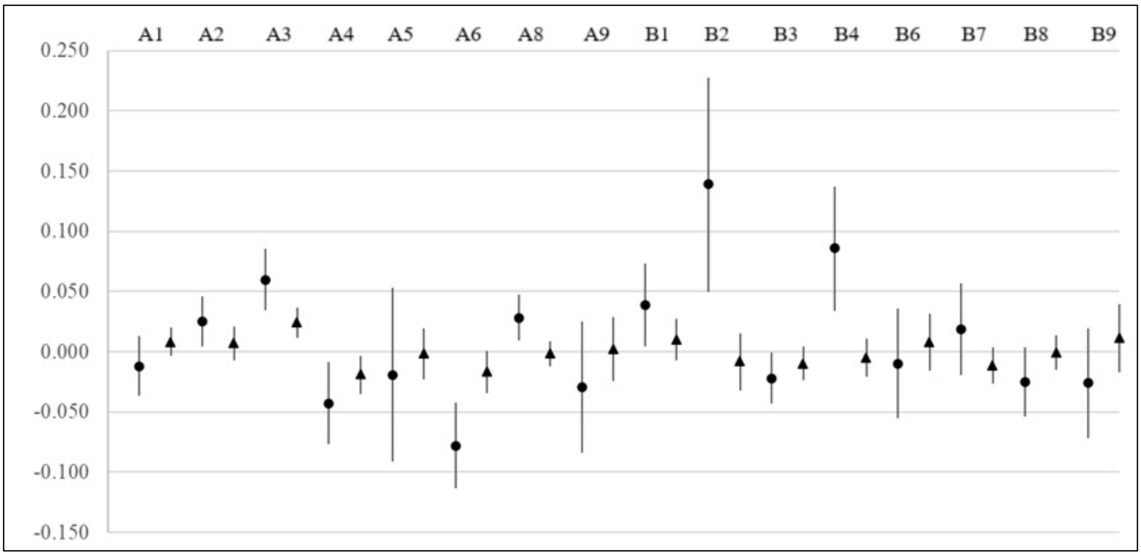

Figure 4. Average partial effects of non-tariff measures on export propensity and intensity

Notes: lines with a circle marker denote export propensity, and those with a triangle marker denote export intensity. The markers represent the predicted means, with lines indicating 95% confidence intervals.
Source: own computation based on results from Table 4

Our findings are that, in contrast to NTMs, tariffs clearly reduce export participation and market share i.e., they impose higher costs on importers and exporters are forced to compete in foreign markets where goods are now more expensive, as Dal Bianco (2016), Ridley et al. (2022), and Zhang et al. (2021) had all found. Among the remaining variables, all coefficients estimated in the first part of the model were statistically significant, and the APEs had the expected signs. In addition to the existence of RTAs, both the GDP per capita and the wine production level of the importing country increased trade propensity. As Chaney (2016) had found, in our case a depreciation of the exporter's currency relative to an importer's currency had a negative effect on export propensity, which was to be expected in the presence of constraints on fixed costs and liquidity.

In the second part of the model, the APEs indicated that the market share of wine from an exporting country i in a given importing country j is negatively affected by GDP per capita and wine production levels of importing countries. RTAs, as in the first part of the model, have a positive effect, while the exchange rate no longer has a significant effect.

Among the control variables, only RTAs and tariffs exhibit consistent signs across both parts of the model, emphasizing their influence in shaping international trade. The sign reversal for GDP per capita – from positive in the first part to negative in the second – supports the hypothesis that higher purchasing power leads importing countries to seek greater variety, sourcing from a wider range of countries. Similar patterns are observed for wine production in importing countries, suggesting that while higher production indicates cultural openness to wine, it also reflects a preference for variety, which reduces individual exporters' market shares (Macedo et al., 2019b).

Since TPE could be interpreted as a global view of the effect of explanatory variables in both parts of the model, the results suggest that, overall, higher GDP per capita and wine production of the importing country, and tariffs damage market shares, while the presence of RTAs has a positive effect. Variables with opposing effects in the two parts of the model often result in non-significant TPEs.

The literature on the international wine trade lacks studies comparable to ours that use market share as the dependent variable. To our knowledge, the study by Macedo et al. (2019b) of trade participation and market share of wine exports between 1999 and 2014, provide the closest comparison, the crucial difference being that they neither consider the impact of NTMs and tariffs nor control for fixed effects. Nonetheless, there is observed convergence regarding the signs and significance of the coefficients estimated for the variables common to both studies (except exchange rate, which in their study had a significant and positive effect on trade intensity). Other comparisons can be drawn with literature on determinants of wine exports, though caution is needed when comparing market share with trade value or volume. For instance, RTAs are frequently found to facilitate trade in wine between members (Dascal et al., 2002; Castillo et al., 2016).

6 Conclusion and Policy Implications

The results of our application of a two 2P-FRM to examine the international wine industry between 2007 and 2021 revealed the heterogeneity of the effects of NTMs: some encourage market entry, others deter it, and some have negligible influence. The majority of NTMs foster export participation but have a limited effect on market share. This lends support to the findings of some contributions to the literature that suggest that, under certain circumstances, NTMs can be trade-facilitating (Disdier et al., 2008; Vollrath et al., 2009; Dal Bianco et al., 2016; Beckman, Arita, 2016; Santeramo, Lamonaca, 2022a; Ridley et al., 2024). Trade-promotion may be the result of NTM-induced reductions in information asymmetries, enhancement of consumer trust, provision of stronger quality guarantees and clearer labeling standards, greater regulatory harmonization and/or gains in efficiency. Overall, NTMs primarily determine market entry decisions but have low impact on market share.

The heterogeneous nature of NTMs effects implies that wineries must evaluate regulations on a case-by-case basis to determine whether they act as catalysts or barriers. While their proliferation has had limited impact on market share, NTMs have facilitated trade participation in most cases. Based on these findings, we argue that efficient, transparent, and equitable international rules for wine – and more broadly for agri-food trade – should be carefully designed and consistently implemented. International organizations, such as the WTO and the OIV, should ensure clarity and fairness in SPSs and TBTs. Key measures in this regard include: i) encouraging compliance with WTO notification and comment procedures (e.g. the EU's Rapid Alert System for Food and Feed); ii) reinforcing reliance on international standards (FAO, WHO, 2025); iii) promoting bilateral and regional trade agreements such as the Comprehensive Economic and Trade Agreement, which reduce market-entry barriers through mutual recognition of labeling and technical standards (European Commission, 2024a).

These results may also be relevant for the EU's Farm to Fork Strategy and the Green Deal, which deploy NTMs to promote safety, sustainability, and fair competition (Santeramo et al., 2025; Lamonaca, Santeramo, 2025). By illustrating how NTMs can influence wine exports, we support the refinement of trade regulations through policies sensitive to inter-industry differences and exporters' capabilities (Cadot, Gourdon, 2016). Recent agreements, such as the 2024 EU–New Zealand Free Trade Agreement, which emphasizes SPS/TBT regulatory cooperation (Emlinger, Guimbard, 2025), highlight this approach.

For policymakers, we stress the importance of harmonized standards. Cooperation on NTMs lowers compliance costs, enhances predictability, and aligns trade with environmental and health objectives (Lamonaca, Santeramo, 2025; IMF et al., 2024; Du et al., 2025). Preferential trade agreements should therefore include enforceable SPS/TBT provisions that account for product-level heterogeneity and exporters' capacities (Santeramo, Lamonaca, 2022b). For wineries, our findings may provide some guidance in selecting target markets, while highlighting that compliance with harmonized standards is essential for competitiveness and market positioning.

Our study has its limitations, notably in data coverage, and especially with regard to tariffs and disaggregated NTMs. In future iterations, expanding the dataset would allow for the inclusion of bilateral fixed effects to better control for unobservable factors. Nonetheless, while retaining a model underpinned by gravity theory, there will be an important place in future studies for complementary data-driven machine learning approaches, such as random forests, gradient boosting or artificial neural networks. Their complex and potentially nonlinear nature is likely to deliver better accuracy than deterministic modelling approaches (Morland et al., 2025), thereby capturing more details of complex dynamics in the wine trade, improving the robustness of the inferences drawn, and better informing both public policy and corporate decision-making.

Data Availability Statement

The data that support the findings of this study are openly available in the GJAE Data Archive (https://doi.org/10.15456/gjae.2026056.1858966940).

Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

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Appendix

Table A1. Average number of sanitary and phytosanitary measures and technical barriers to trade faced by a sample of 15 exporting countries, by year and subcategory of measure

Year	A1	A2	A3	A4	A5	A6	A8	A9	B1	B2	B3	B4	B6	B7	B8	B9
2007	5	7	8	3	0	2	9	1	1	1	13	2	2	3	7	2
2008	6	7	9	3	1	2	10	1	2	1	14	2	2	3	8	2
2009	6	7	9	3	1	2	11	1	2	1	15	2	2	3	8	2
2010	11	12	16	8	1	4	23	1	2	1	24	2	2	3	9	2
2011	11	16	17	8	1	5	23	1	2	1	25	2	2	3	9	2
2012	12	17	18	8	1	5	25	1	2	1	26	2	2	3	10	2
2013	12	15	23	8	1	5	26	1	2	1	27	2	2	3	10	2
2014	14	16	24	9	1	6	29	1	3	1	29	2	2	4	11	2
2015	15	17	26	9	1	7	32	1	2	1	32	3	3	4	12	2
2016	16	18	27	10	1	7	33	1	2	1	32	3	3	4	12	2
2017	16	20	29	10	1	7	35	1	3	1	33	3	3	5	14	2
2018	17	20	30	11	1	8	36	1	3	1	35	3	3	5	14	2
2019	17	21	31	11	1	8	37	1	3	1	35	3	3	5	14	2
2020	16	18	27	10	1	7	34	1	3	1	31	3	2	5	14	2
2021	17	19	27	10	1	7	34	1	3	1	32	3	3	5	14	2

Note: sample of 185 importing countries.
Source: authors' computation

Table A2. Descriptive statistics (supplementary table)

Variables	P50	Min	Max
Market share	0.0	0.0	1.0
GDP pc *j*	5865.5	170.7	133711.8
Production *j* (t-1)	1.0	1.0	54783.0
Exch. Rate	0.3	0.0	2061.7
RTA	0.0	0.0	1.0
Tariffs	0.2	0.0	18.0
SPS	3.0	0.0	79.0
TBT	2.0	0.0	45.0
A1	0.0	0.0	10.0
A2	0.0	0.0	19.0
A3	0.0	0.0	15.0
A4	0.0	0.0	10.0
A5	0.0	0.0	5.0
A6	0.0	0.0	9.0
A8	1.0	0.0	25.0
A9	0.0	0.0	2.0
B1	0.0	0.0	5.0
B2	0.0	0.0	3.0
B3	1.0	0.0	16.0
B4	0.0	0.0	5.0
B6	0.0	0.0	3.0
B7	0.0	0.0	4.0
B8	0.0	0.0	22.0
B9	0.0	0.0	3.0

Notes: number of observations = 37,251; P50=median; Min=minimum value; Max=maximum value; i= exporting country; j= importing country; (t-1)= period $t-1$.
Source: authors' computation

Table A3. Two-part fractional regression model estimations, average partial effects for the first part of the model using alternative link functions

VARIABLES	(1) Cauchit	(2) Probit	(3) Logit	(4) Log-log
GDP pc importer (log)	0.074***	0.087***	0.087***	0.080***
	(0.017)	(0.016)	(0.017)	(0.015)
Prod. Imp. (t-1) (log)	0.011*	0.022***	0.021***	0.021***
	(0.006)	(0.006)	(0.007)	(0.006)
Exch. rate (log)	-0.010	-0.010***	-0.011***	-0.010**
	(0.006)	(0.004)	(0.004)	(0.004)
RTA	0.088**	0.092***	0.089***	0.115***
	(0.039)	(0.014)	(0.015)	(0.015)
Tariffs (log)	-0.020***	-0.018***	-0.018***	-0.020***
	(0.004)	(0.002)	(0.024)	(0.002)
A1 (log)	-0.021	-0.016	-0.017	-0.017
	(0.020)	(0.013)	(0.013)	(0.014)
A2 (log)	0.011	0.023*	0.022*	0.023*
	(0.023)	(0.012)	(0.012)	(0.013)
A3 (log)	0.051**	0.064***	0.064***	0.061***
	(0.024)	(0.014)	(0.015)	(0.014)
A4 (log)	-0.018	-0.042**	-0.064**	-0.038*
	(0.024)	(0.019)	(0.019)	(0.020)
A5 (log)	-0.013	-0.046	-0.042	-0.066
	(0.082)	(0.040)	(0.024)	(0.044)
A6 (log)	-0.080***	-0.083***	-0.084***	-0.089***
	(0.023)	(0.019)	(0.020)	(0.021)
A8 (log)	0.025*	0.034***	0.033***	0.038***
	(0.013)	(0.010)	(0.010)	(0.011)
A9 (log)	-0.040	-0.025	-0.025	-0.026
	(0.035)	(0.030)	(0.029)	(0.035)
B1 (log)	0.032*	0.038**	0.040**	0.029
	(0.017)	(0.018)	(0.018)	(0.020)
B2 (log)	0.167*	0.118**	0.117**	0.112**
	(0.090)	(0.046)	(0.048)	(0.050)
B3 (log)	-0.007	-0.023*	-0.021	-0.021*
	(0.013)	(0.012)	(0.013)	(0.012)
B4 (log)	0.115	0.092***	0.096***	0.096***
	(0.087)	(0.032)	(0.036)	(0.036)
B6 (log)	-0.017	-0.005	-0.007	0.000
	(0.024)	(0.026)	(0.027)	(0.028)
B7 (log)	0.031	0.017	0.018	0.016
	(0.043)	(0.021)	(0.021)	(0.022)
B8 (log)	-0.018	-0.021	-0.021	-0.017
	(0.023)	(0.015)	(0.015)	(0.015)
B9 (log)	-0.035	-0.033	-0.035	-0.038
	(0.024)	(0.026)	(0.026)	(0.030)
Observations	37,251	37,251	37,251	37,251
RESET	296.906***	33.286***	367.520***	1061.592***
	[0.000]	[0.000]	[0.000]	[0.000]
GOFF1	257.219***	53.204***	439.037***	/
	[0.000]	[0.000]	[0.000]	/
GOFF2	270.263***	430.740***	367.462***	1288.153***
	[0.000]	[0.000]	[0.000]	[0.000]

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Figures in [ ] indicate *p*-values; both exporter-year and importer fixed effects are considered; GOFF1 and GOFF2 are goodness-of-functional-form tests; *i*= exporting country; *j*= importing country; (log)= log-form; (t-1)= period t-1; GDP pc is the per capita gross domestic product of the importer; Wine produced in period t-1 in importing countries is represented by Importer production; Exch. Rate is the annual average exchange rate between the currencies of importing countries and exporting countries; RTA is a dummy variable coded 1 if there is a RTA between the exporting and importing countries; Tariffs are ad valorem equivalent tariffs imposed by the importing countries; and A# and B# are NTMs imposed by the importing countries.
Source: authors' computation

Table A4. Two-part fractional regression model estimations, average partial effects for the second part of the model using alternative link functions

VARIABLES	(1) Cauchit	(2) Probit	(3) Logit	(4) Log-log
GDP pc importer (log)	-0.016	-0.021***	-0.021***	-0.019***
	(0.018)	(0.005)	(0.005)	(0.004)
Prod. Imp (t-1) (log)	-0.004	-0.003	-0.003	-0.002
	(0.005)	(0.002)	(0.002)	(0.002)
Exch. rate (log)	0.000	0.003*	0.003	0.003**
	(0.01)	(0.002)	(0.002)	(0.001)
RTA	0.050**	0.040***	0.041***	0.038***
	(0.023)	(0.007)	(0.008)	(0.007)
Tariffs (log)	-0.010***	-0.011***	-0.011***	-0.011***
	(0.003)	(0.001)	(0.001)	(0.001)
A1 (log)	-0.002	0.009*	0.008	0.009*
	(0.008)	(0.005)	(0.006)	(0.005)
A2 (log)	0.006	0.007	0.007	0.008
	(0.011)	(0.006)	(0.007)	(0.006)
A3 (log)	0.019**	0.022***	0.023***	0.020***
	(0.010)	(0.006)	(0.006)	(0.005)
A4 (log)	-0.014	-0.017***	-0.018**	-0.016***
	(0.015)	(0.006)	(0.007)	(0.006)
A5 (log)	-0.018	0.003	0.000	0.005
	(0.013)	(0.010)	(0.010)	(0.009)
A6 (log)	-0.007	-0.015*	-0.015*	-0.013**
	(0.013)	(0.008)	(0.009)	(0.007)
A8 (log)	0.001	-0.002	-0.001	-0.002
	(0.009)	(0.005)	(0.005)	(0.004)
A9 (log)	0.003	0.004	0.003	0.005
	(0.012)	(0.013)	(0.013)	(0.012)
B1 (log)	0.009	0.012*	0.012	0.013**
	(0.009)	(0.007)	(0.008)	(0.006)
B2 (log)	-0.023	-0.009	-0.011	-0.006
	(0.026)	(0.009)	(0.011)	(0.008)
B3 (log)	-0.007	-0.009	-0.008	-0.010*
	(0.013)	(0.007)	(0.007)	(0.006)
B4 (log)	0.000	-0.007	-0.007	-0.006
	(0.010)	(0.007)	(0.008)	(0.006)
B6 (log)	0.015	0.007	0.007	0.006
	(0.024)	(0.009)	(0.011)	(0.008)
B7 (log)	-0.023*	-0.010	-0.012	-0.007
	(0.012)	(0.006)	(0.007)	(0.006)
B8 (log)	-0.001	-0.003	-0.002	-0.003
	(0.012)	(0.006)	(0.007)	(0.005)
B9 (log)	0.020	0.006	0.008	0.005
	(0.021)	(0.011)	(0.013)	(0.010)
Observations	21,784	21,784	21,784	21,784
RESET	4.068**	8.206***	6.242**	13.207***
	[0.044]	[0.004]	[0.013]	[0.000]
GOFF1	17.089***	7.504***	6.764***	/
	[0.000]	[0.006]	[0.009]	/
GOFF2	19.976***	9.794***	2.125	14.916***
	[0.000]	[0.002]	[0.145]	[0.000]

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Figures in [ ] indicate p-values; both exporter-year and importer fixed effects are considered; GOFF1 and GOFF2 are goodness-of-functional-form tests; i= exporting country; j= importing country; (log)= log-form; (t-1)= period $t-1$; GDP pc is the per capita gross domestic product of the importer; Wine produced in period $t-1$ in importing countries is represented by Prod. Imp.; Exch. Rate is the annual average exchange rate between the currencies of importing countries and exporting countries; RTA is a dummy variable coded 1 if there is a RTA between the exporting and importing countries; Tariffs are ad valorem equivalent tariffs imposed by the importing countries; and A# and B# are NTMs imposed by the importing countries.
Source: authors' computation

Table A5. Two-part fractional regression model estimations aggregating sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT), and respective average partial effects

	(1)	(2)	(3)	(4)
	Export participation		Export market share	
VARIABLES	β_1	APE	β_2	APE
GDP pc *j* (log)	0.567***	0.084***	-0.310***	-0.025***
	(0.107)	(0.016)	(0.084)	(0.007)
Prod. Imp. (t-1) *j* (log)	0.188***	0.028***	-0.073*	-0.006*
	(0.040)	(0.006)	(0.042)	(0.003)
Exch. rate (log)	-0.066**	-0.010**	0.026	0.002
	(0.027)	(0.004)	(0.022)	(0.002)
RTA	0.428***	0.063***	0.522***	0.043***
	(0.087)	(0.013)	(0.105)	(0.009)
Tariffs (log)	-0.109***	-0.016***	-0.136***	-0.011***
	(0.013)	(0.002)	(0.013)	(0.001)
SPS (log)	0.033	0.005	0.040	0.003
	(0.046)	(0.007)	(0.038)	(0.003)
TBT (log)	0.161*	0.024*	-0.042	-0.003
	(0.084)	(0.012)	(0.065)	(0.005)
Constant	-6.126***		0.172	
	(1.058)		(0.960)	
Observations	37,251		21,784	
RESET	2.269		1.646	
	[0.132]		[0.200]	
GOFF1	1.607		0.375	
	[0.205]		[0.540]	

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Figures in [ ] indicate *p*-values; Estimations with complementary log-log link functions; Exporter-year and importer fixed effects are considered; GOFF1 is a goodness-of-functional-form test; *i*= exporting country; *j*= importing country; (log)= log-form; (t-1)= period $t-1$; GDP pc is the per capita gross domestic product of the importing country; Wine produced in period $t-1$ in importing countries is represented by Prod. Imp. (t-1) *j*; Exch. Rate is the annual average exchange rate between the currencies of importing countries and exporting countries; RTA is a dummy variable coded 1 if there is a RTA between the exporter and the importer; Tariffs are ad valorem equivalent tariffs imposed by the importing countries.

Source: authors' computation