Effect of non-tariff measures on extensive and intensive margins of exports in seafood trade

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Abstract

This paper explores the effects of non-tariff measures (NTM) on extensive and intensive margins of global exports of seafood in 1996-2011. The main result of this study is the differential and opposite effect of SPS and TBT measures. While SPS measures largely increase extensive margins of export and reduce intensive margins, TBTs mostly reduce exports at extensive margins and increase exports at intensive margins. Specific trade concerns (STC) have larger effect on exports than SPS and TBT notifications, both economically and statistically. Finally, there is substantial heterogeneity of response of exports to NTMs across HS six digit product lines, but the central tendency remains the same as for aggregated data.

Keywords: seafood, gravity, SPS, TBT, export

1. INTRODUCTION

Non-tariff measures (NTM) have always been important elements of trade policy. With global reductions in tariff measures, they are becoming even more important policy tools shaping World Trade. NTMs come in different forms and address different policy concerns, which makes it very hard to evaluate unambiguously their effect on social welfare. While the consensus view on the tariff measures is in favor of reduction as the way to increase global social welfare, the view on NTMs is more nuanced.

Increased public concerns about health and safety issues stimulate governments to regulate quality and safety of goods by means of sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT). The number of tariff lines and share of trade covered by NTMs have considerably increased over the last two decades (World Trade Report, 2012). As the World Trade Report (2012) points out, there is an upward trend in all types of NTMS, including SPS and TBT notifications and specific trade concerns (STC)[1]. In particular, 2010 has shown both

[1] Each WTO member has to notify the other members about introduction of new or any changes in the existing laws or regulations affecting their external trade. These notifications are recorded by the WTO and are included in the database of notifications. In addition, a WTO member can raise a specific trade concern (STC) about measures maintained by other members against its exports.

the maximum number of SPS and TBT notifications, while the highest number of STCs has been raised in 2014.

The effect of NTMs on trade is not straightforward. The direction and size of the effect depends on whether NTMs discriminate against foreign producers. It also depends on the relative importance of NTMs for production and transportation costs. In the framework of Melitz (2003), introduction of a non-discriminatory NTM may equally increase costs of production for domestic firms and foreign producers. Tougher technological or sanitary measures would tend to increase productivity thresholds for the least productive domestic firms on the market, causing them to shut down, which would make more room to import for highly productive foreign firms. If foreign firms are more productive relative to the domestic ones, the introduced NTM would have a smaller effect on foreign producers. It would result in a positive link between technical and sanitary requirements in a country that imposes the NTM and intensive (and potentially on extensive) margins of trade.

However, if the NTM is applied only against foreign firms, or if NTMs are applied selectively, the increase in production and transportation costs, caused by tougher regulations, would lead to the exit of the least productive foreign firms from the market, reducing extensive margins of trade. It would also force the remaining foreign firms to cut their imports, causing reduction of trade at intensive margins.[2]

A negative effect on trade could occur if NTMs effect transportation costs more than production costs. For instance, an increase in the variable trade costs would lead to a reduction in imports per firm, but also would cause the least productive foreign producers to exit from the market, redistributing market shares towards more productive foreign and domestic firms. The overall effect on trade would be ambiguous.

In addition, other factors may play a role in determining changes in extensive and intensive margins of trade caused by new NTMs. An introduction of a barrier directed against a specific country will tend to divert trade leading to an increase on the extensive margins. The recent seafood trade ban, which Russia imposed against a group of countries that include

[2] Moreover, even a non-discriminatory measure can be applied in a discriminatory way, if it is enforced only selectively and for reasons that are not related to consumer welfare concerns. According to Besedina and Coupe (2015), Russia Federation is one of the most active users of non-tariff barriers in the world. They found statistical evidence that Russian NTMs are set for protection of domestic producers and, more importantly, for imposing political pressure appear on their trading partners. Over the last decades, depending on improving or worsening diplomatic relationships, Russian SPS authorities imposed bans of seafood from Latvia, mineral water from Georgia, chocolate from Ukraine, and tulips from the Netherlands.

Canada and Denmark, caused diversion of trade towards imports from Greenland, the Faroe Islands, and even Belarus, which is a landlocked country.[3] Finally, higher technical and safety barriers may increase demand from consumers who are concerned about quality and safety attributes of products. Firms that are able to overcome higher trade barriers would signal quality and safety improvements, which would lead to expansion of trade at both extensive and intensive margins.

Most studies have found a negative effect of NTMs on trade. (i.e. Fontagne et al., 2005; Otsuki, Wilson, and Sewadeh, 2001; Peterson and Orden, 2005). Debaere (2010) has shown that the international differences in food-safety standards reduced Thai, Vietnamese, and Chinese shrimp exports to Europe and shifted them to the United States where standards were not as strict. Guillotreau and Peridy (2000) looked at the effects of EU policies in seafood on imports to EU countries and found no significant effects of NTMs on imports. However, Jaffee and Henson (2004) argue that NTMs can be barriers as well as catalysts to exports. For poor countries with lack of capacity to comply with the stringent regulations NTM can increase trade costs to the levels that effectively shut down their exports. However, other countries may use this to their advantage and capture a larger market share due to increased demand for safer and better quality products. Anders and Caswell (2009) investigated the effect of a Hazard Analysis Critical Control Points (HACCP) food safety standard for seafood imports. Results indicate that HACCP had a negative impact on the overall imports. However, a decomposition of the effect by exporting countries' level of development brought highly heterogeneous results. The effect for developing countries was negative, while the effect for developed countries was positive. Regardless of the level of development, leading seafood exporters generally experienced a positive HACCP effect. The results can be explained within a framework of the heterogeneous producer model. The HACCP has imposed additional costs on all exporters, but it may have made costs prohibitively high for the least productive exporters, while allowing more productive ones to take the opportunity and expand their market share.

The focus of this paper is on the effect of SPS and TBT measures on extensive and intensive margins of seafood trade. The empirical approach is close to Crivelly and Groschl (2012) who have investigated the effect of the SPS measures on trade in agriculture and food using the methodology developed by Helpman, Melitz and Rubistein (2008, hereafter HMR). They found that conformity assessment related SPS measures have a negative impact on

[3] I would like to thank a referee for this comment.

intensive margins of exports, while concerns related to product characteristics influence intensive margins of exports positively. The effect of SPS on the intensive margin of exports in their work is negative. Recently, Natale et al. (2015) followed a similar methodological approach to look at determinants of the aggregate seafood trade, and found that seafood trade is driven by consumer preferences and by low labor costs. They also found that the determinants vary substantially across products.

The high degree of heterogeneity of the impact of NTMs on trade and differential effects of SPS and TBT measures requires studying the effect of NTMs at high level of disaggregation, which requires a careful modelling of the binary decision about whether to export or not. To deal with this issue, the estimation methodology is mostly build on the HMR methodology, adding the panel dimension to their approach.[4] It also addresses the issue of endogeneity using the Hausman-Taylor approach of estimating a panel data model (Hausman and Taylor, 1981). It treats NTMs as endogenous variables that largely depend on existing trade patterns. In particular, NTMs are more likely between countries that trade more intensively, that would generate a positive correlation between trade flows and NTMs.

The rest of the paper is structured as follows. Section 2 develops the methodology. Section 3 introduces data used in the study. Section 4 presents results. Section 5 concludes.

2. THEORY AND METHODOLOGY

The model describing export decisions within the seafood industry should take into account the mechanism of selection of firms into exporters and unobserved firm-level heterogeneity, present in the data. It assumes that the seafood industry is monopolistically competitive. Consumer preferences are identical and homothetic across countries and are described by a constant elasticity of substitution utility function, with elasticity of substitution across different varieties of seafood, $\sigma > 1$. Exporting country i has N_k^i firms that produce differentiated products. Firms are heterogeneous in productivity.

The presence of fixed costs may introduce prohibitively high trade barriers, leading to zero trade flows that play a dominant role in highly disaggregated data. Moreover, some countries, i.e. landlocked countries, do not have sufficient capacity to produce seafood. Export from those countries is expected to be zero as well.[5] The HMR two-stage procedure allows to dissect the effect of NTMs on export into two components – the effect of NTMs on value of trade between two countries (intensive margins) and

[4] See Shepotylo (2010) for detailed discussion of the econometrics methodology.

[5] Practically, a country that does not produce seafood can re-export it. For instance after Russia imposed a ban on the EU food products in 2014, Belarus, which is a landlocked country and, together with Russia, a member of Eurasian Economic Union, started to export oysters to Russia.

the effect of NTMs on the probability of a positive export (extensive margins). The latter is important because, as shown in the Melitz model, imposing new trade barriers causes the changes in extensive margins of trade.

The HMR estimation procedure is modified to introduce a time dimension of the data and control for endogeneity of policy variables by the Hausman-Taylor method (Hausman and Taylor, 1981). It allows the NTM to be endogenous, and it is instrumented by the time-invariant bilateral characteristics (i.e. geographical distance, contiguity, common legal system etc.), deviations of exogenous variables from their means, as well as period-average values of time-varying variables (level of economic development, market size).

The probability of positive trade is defined as

$$\rho_t^{ij} = \Phi(\zeta_0 + \zeta_1 \ln w_t^i - \zeta_2 \ln dist^{ij} + R_t^{ij}\gamma + \phi^i + \phi^j + \kappa\phi^{ij}) \quad (1)$$

where w_t^i is marginal cost in exporting country *i* at time *t*, $dist^{ij}$ is distance between *i* and *j*, R_t^{ij} is a vector of control variables, and ϕ^i, ϕ^j and $\kappa\phi^{ij}$ are country specific and country-pair specific fixed effects. Equation (1) is a probit model with unobserved non-linear country-pair heterogeneity and potential autocorrelation in the error term. The model has additional complications because of its time dimension. First, there is high level of persistence in trade between country pairs. In addition, an error term may contain an autocorrelation due to macroeconomic and other unobservable shocks. To account for the panel dimension of the data in the probit specification, the methodology outlined in Wooldridge (2005) is used. It deals with both a dynamic aspect of trade and with autocorrelation in the error term. The identifying assumption here is that the unobserved heterogeneity is random, potentially depends on initial trade status, observable trade costs and other observable characteristics of countries *i* and *j*, and has a normal conditional density function. In practical terms, (1) is estimated with additional variables controlling for the initial state of countries trade, $Trade_{ij,t0}$ and for period average values for all time-varying independent variables.

For better identification, several variables that affect fixed costs but have no effect on the volume of trade (and thus are included in the selection equation but not in the gravity equation) are needed. Based on the HMR results,, pair-specific fixed costs are controlled by including a common religion dummy as one of the variables that affects the decision of a firm to trade but has no significant impact on the volume of trade. Number of documents required to export from country i and number of documents required to import to country j control for the exporter and importer country-specific fixed costs. These two variables do not vary with volume of exports per transaction and, almost by definition, are counted as the transaction fixed costs.

Gravity equation

Gravity equation that explains exports of seafood at intensive margins is given by

$$\ln X_t^{ij} = \ln s_t^i + \ln Y_t^i + \ln Y_t^j - \rho \ln dist^{ij} - R_t^{ij}\gamma + \ln V_t^{ij} - (1-\sigma)\ln P_t^j - \ln MRT_t^i + u_t^{ij} \quad (2)$$

$$= Z_t^{ij}\pi + u_t^{ij}$$

where s_t^i is share of seafood in total export, Y_t^i is gross domestic product. $V^{ij} = \int_{a_{\min}}^{a^{ij}} a^{1-\sigma} dG\ (a)$, where a is a firm-specific cost parameter with the cumulative distribution function $G(a)$ over support $[a_{min}, a_{max}]$ and a^{ij} is the cost parameter of the least productive firm that still finds it profitable to export. P_t^j is price index in the destination country j and $\ln MRT_t^i = \ln\left(\sum_{j=1}^{C}\left(\frac{T_t^{ij}}{P_t^j}\right)^{1-\sigma} Y^j V_t^{ij}\right)$ is the multilateral resistance term (MRT), an integral measure of trade barriers of a country vis-à-vis all its trading partners (Anderson and van Wincoop, 2003), which accounts for the endogenous and simultaneous determination of trade flows across all countries. The MRT is not observable and according to the theory is simultaneously determined for all countries.

The unobserved heterogeneity is treated semi-parametrically, using the information acquired at the first stage of the estimation by identifying $E(\ln V_t^{ij} + u_t^{ij} \mid X_t^{ij} > 0) = b_0\hat{\eta}_t^{ij} + \sum_{m=1}^{3} b_m(\hat{\psi}_t^{ij})^m$, where $\hat{\eta}_t^{ij}$ is the inverse Mills ratio that accounts for the sample selection bias and the polynomial of degree three in $\hat{\psi}_t^{ij} = \hat{\eta}_t^{ij} + \Phi^{-1}(\hat{\rho}_t^{ij})$ corrects for the firm-level heterogeneity. As shown by HMR, the polynomial of degree 3 is a sufficiently flexible and accurate approximation of the underlying unknown function of the distribution of productivity $G(a)$.

Equation (2) is estimated on a panel data by the Hausman-Taylor method (Hausman and Taylor, 1981) that uses time-varying variables that are not correlated with u_t^{ij} as instruments for endogenous components of Z. The multilateral resistance term is controlled for as in Baier and Bergstrand (2009). As a robustness check, the results with country-pair fixed effects are also presented.

3. DATA

Export data

Seafood products are defined as HS two-digit section 03 (Fish and crustaceans, mollusks and other aquatic invertebrates) product lines and HS four-digit 1603 (Extracts and juices of meat, fish or crustaceans, mollusks), 1604 (Prepared or preserved fish; caviar and caviar substitutes), and 1605 (Crustaceans, mollusks, prepared or preserved) product lines. Exports from country *i* to country *j* of a

seafood product *k* at time *t*, exp_{ijkt}, measured in thousands of current US dollars are taken from the COMTRADE database. The time span is limited to 1996-2010.[6]

World exports of seafood in 1996-2010 have been growing rapidly, averaging 9 percent per year. Figure 1 reports value of seafood trade for high-income countries and low and middle-income countries in 1996-2010. The seafood export form high income countries has been growing 5.8 percent on average, while the seafood export from the low and middle income countries has been growing 13.9 percent on average. Exports form the least developed countries have been growing even at higher rate of 26 percent on average. That allowed exports from the group of low and middle-income countries to exceed the export from the group of high-income countries in 2009.

[Figure 1 is about here]

Table 1 gives a brief description of each product category and the value of exports in 1996-2010. Over the period, export of seafood products totaled 0.9 trillion US dollars or 60 billion US dollars per year on average. The most exported seafood was the product line 0306 Crustaceans, with the annual average export of 11.5 billion US dollars (out of which frozen shrimps and prawns, HS code 030613, took the major part of 7.5 billion US dollars per year on average). Other popular exported products were 030420 (frozen fillets, 6.3 billion US dollars) and 030212 (fresh or chilled: Pacific salmon, Atlantic salmon, and Danube salmon, 3.0 billion US dollars).

NTM data

NTM data for this study come from the WTO Integrated Trade Intelligence Portal (I-TIP). It includes members' notifications as well as specific trade concerns about SPS measures.[7] Notifications are self-reported changes into the legislation affecting trade.[8] Under the GATT rules countries are obliged to report the other WTO members about these changes. However, there is an issue with countries' compliance in reporting these measures, as has been discussed for instance at the Uruguay Round of the multilateral trade negotiations with the Decision on Notification Procedures signed by the WTO members. Reporting countries have no incentives to provide most accurate and up-to-date information on non-tariff measures and compliance systematically vary across countries. Countries that are affected by such decisions, on the other hand, have incentives to file a complaint. These complaints are recorded

[6] Trade data in COMTRADE is missing for a large group of countries prior to 1996, which would introduce a highly-nonlinear measurement error in the estimation procedure, caused by not being able to discriminate missing observations from truly zero exports.

[7] I-TIP reports STCs about both SPS and TBT measures. However, there were no TBT STCs for seafood products during the investigated period.

[8] Examples of notifications include labelling requirements, food safety measures on the level of polychlorinated dibenzofuran congeners in fishery products, technical requirements for the identification and maintenance of quality levels of fishes, sardines, tuna-fish and bonito-fish, etc.

as STCs in the I-TIP. However, these concerns do not cover the whole universe of SPS and TBT measures. STCs are the NTB measures with the largest negative impact that introduces a negative selection bias into the estimation of the effect of NTBs on trade.

Both notifications and STCs are used when estimating the effect of NTBs on seafood exports. The initial data includes 335 SPS and 78 TBT measures for seafood products notified to the WTO and 40 STCs raised by the WTO members from 1996 till 2010. Based on the information about the initiating and affected countries and about the products affected, SPS, TBT, and STC binary variables are constructed. Each of these variables take value of 1 if an importing country j has a corresponding measure for product line k (HS six-digit level) against an exporting country i at time t and takes value of 0 otherwise. When constructing the data, all possible combinations of bilateral trade flows are included, regardless of whether exports took place or not.

After the NTBs were constructed at the HS six-digit level, they were aggregated to the HS 4-digit level according to the following rule

$$NTB_{ijh,t} = \frac{\sum_{k \in J_h} NTB_{ijk,t}}{J_h}, \quad (3)$$

where h is HS four-digit product code, k is HS six-digit product code, J_h is a set that includes all six-digit product lines that belong to h, J_h is the number of six-digit product lines in J_h, and $NTB = \{SPS, TBT, STC\}$.

Table 1 presents summary statistics for all measures of NTB in columns 4-6. SPS measures are the most widespread, affecting 15.4 percent of all possible bilateral exports. Live and fresh fish product categories are affected by SPS measures more frequently than frozen, semi-processed (salted, dried, or smoked), and cooked seafood products. TBT measures, on the other hand, affect 3.1 percent of bilateral exports and are more widespread for cooked and processed seafood products. STCs are the least frequent, affecting only 0.2 percent of bilateral exports. It is partially due to the fact that SPS and TBT notifications are recorded in I-TIP as affecting all trading partners (meaning that if EU introduces an SPS measure it affects all of its trading partners in a non-discriminatory manner), while STC are raised by a specific exporting country against a specific importing country. It does not mean that an STC measure has no effect on other countries, but the information on other potentially affected countries is not available.

[Table 1 is about here]

Gravity model variables

Table 2 reports control variables that are used in the empirical analysis. The data on Gross Domestic Product (GDP) and GDP per capita in current US dollars are from the World Development Indicators (WDI) 2012 published by the World Bank. Geographical characteristics and distance between countries are taken from the Centre D'Etudes Prospectives et D'Informations Internationales (CEPII, see Head, Mayer, and Ries, 2010 for detailed description of the data). Colony and contiguity dummy variables (whether one of the countries in the country-pair was ever a colony of the other country and whether countries share a common border) are used to control for pair-specific trade costs that are not directly related to distance. The same language dummy variable captures the effect of cultural similarities on trade. The dummy on common legal origin captures the compatibility of the legal systems of trading partners. Finally, the data on different dimensions of trading across borders, which are used for assessment of the impact of trade facilitation on exports – cost of shipping a container from exporting country, cost of shipping a container to importing country, and number of documents required to export and import – are computed as the period average, using the Doing Business database produced by the World Bank. The methodology of computing the trade facilitation variables is described in Djankov, Freund and Pham (2010).

[Table 2 is about here]

Selection Variables

For identification of the first stage parameters, three variables that enter the selection equation, but not the gravity equation. are chosen. The common religion dummy controls for the pair-specific fixed costs related to adapting to cultural and linguistic barriers between two countries (culture, tastes, language, advertising). The number of documents required to export from country i and the number of documents required to import to country j, collected by the Doing Business surveys since 2004, control for country-specific fixed costs related to regulatory quality in exporting and importing countries. Finally, log GDP per capita in the exporting country is included as a proxy for the factor unit cost parameter. All these variables are more likely related to a binary choice decision – to export or not – rather than influence intensive margins of trade.

4. RESULTS

Aggregate results

Table 3 reports the results of the first (probit) and second (HT and FE) stages of estimating the effect of STB/TBT on exports for the samples of aggregate seafood trade (all product categories), raw and semi-processed seafood (HS two-digit code 03), and processed seafood (HS four-digit codes 1603, 1604, and

1605). The dependent variable in the probit model is the probability of positive export from country i to country j at time t. The dependent variable in HT and FE models is the natural logarithm of exports from country i to country j at time t.

For the probability of trade, where the marginal effects are reported in the first column of Table 3, SPS measures and STCs enter the equation with mostly positive and significant coefficients, while TBT measures are significantly negative for the processed seafood sample only. The positive effect of SPS measures and STCs points to the endogeneity problem. SPS are more likely to be imposed by countries that import seafood products from more countries. STCs are more likely to be raised if the NTBs affect existing export flows. The positive news is that those measures do not create prohibitive trade barriers on the extensive margins of seafood trade. Perhaps it indicates that the SPS and STC have small impact on fixed costs of exporting and fixed cost of compliance are small. TBT measures have influence seafood exports on the extensive margins negatively, but not significantly in two out of three samples. However, coefficients on TBT is negative and statistically significant for the processed seafood, meaning that TBT measures reduce exports on the extensive margins, perhaps by having a higher fixed costs of compliance.

[Table 3 is about here]

Other coefficients have expected signs. Countries with larger market size are more likely to attract positive trade flows as indicated by the positive coefficient of $\ln(GDP_{j,t})$. Distance reduces the likelihood of positive exports. Positive exports show strong persistence and strongly depend on the initial conditions as indicated by large and significant coefficients of $Trade_{ijh,t-1}$ and $Trade_{ijh,1996}$. Trade facilitation measures of the exporting country, measured by cost of shipping a container and number of documents required to export, have a strong negative effect on the likelihood of exports, while trade facilitation measures of the importing country enter both positively (number of documents required to import) and negatively (cost of shipping a container to country j). Countries that share a common language, have common border, colonial ties, and common legal origin are more likely to trade seafood products. Multilateral and bilateral trade agreements promote seafood trade on the extensive margins.

Table 3 also reports the estimates of the effect of NTBs on seafood exports at the intensive margins of trade, using the Hausman-Taylor specification (HT) and country-pair fixed effects (FE). The HT method is more efficient, but can produce biased estimates if the endogenous variables are not properly instrumented. Both methods produce results that indicate that SPS measures and STCs have a negative effect on the value of trade, while TBTs have positive effect on the value of trade. This is consistent with the story that SPS measures influence variable trade costs, while TBT measures have larger effect on

fixed exporting costs that cut off the least efficient counties from exporting and, hence, increase the export of the most efficient producers. As a result, imposing a TBT sets prohibitive barriers to trade for all firms in some countries and narrows the set of exporters from other countries – only the most productive firms are able to export with non-negative profits but at larger quantities. It also may indicate that TBT are more frequently applied against countries that import seafood more intensively.

WTO members export more seafood. WTO members also import more, but it is mostly due to a wider variety of imports from different countries, not due to larger value of import per exporter. RTAs do not robustly promote exports at the intensive margins of trade. On the contrary, the value of trade is lower if countries have a bilateral trade agreement. However, this result cannot be interpreted separately from the fact that the bilateral trade agreement has a strong positive effect on the probability of trade. RTAs reduce fixed costs of trade leading to larger variety of goods exported to more countries but in smaller volumes. Other coefficients have expected signs and work similarly as for extensive margins of trade. Countries that share a common language, have common border, colonial ties, and common legal origin are more likely to trade seafood products. Variables that control for selection and firm heterogeneity are jointly significant, indicating presence of both sources of bias and warranting for their correction.

Table 4 present results with lagged values of NTM variables since the effect of the introduced measures are may be distributed over a period of several years. While the effects of SPS and TBT measures on exports trade usually are more pronounced contemporaneously, STC have a stronger effect with a one-year lag, and then have a tendency to correct itself within a two-year period.

[Table 4 is about here]

Results at 6-digit HS level

The effects of SPS and TBT on export of seafood at 6-digit HS level are also estimated. The summary statistics for coefficients of interest are presented in Table 5.

[Table 5 is about here]

The results are in line with the results based on the aggregated data. On average, SPS have a positive effect at extensive margins and negative effects at intensive margins, while TPT have effects of the opposite signs. Figure 2 presents a matrix of graphs for 4 coefficients of interest. For a majority of

seafood products, SPS at extensive and intensive margins have opposite signs – positive for extensive margins and negative for intensive. These patterns are consistent with the results for the aggregate trade flows.

[Figure 2 is about here]

5. CONCLUSIONS

This paper analyzes the effect of NTMs on extensive and intensive margins of seafood exports at various levels of aggregation. The main result of this study is the differential and opposite effect of SPS and TBT measures. While SPS measures largely increase extensive margins of export and reduce intensive margins, TBTs mostly reduce exports at extensive margins and increase exports at intensive margins. This result is consistent with SPS measures having a positive effect on consumer demand for seafood and increasing variable cost of production, while TBT measures mostly increasing fixed cost of production. Secondly, STCs have larger effect on exports than SPS and TBT. STCs are mostly raised by exporters when their trade is considerably affected by regulations. Finally, there is substantial heterogeneity of response of exports to NTMs across product lines for higher disaggregated data. This implies that the effect of the NTM policy on exports is a composite effect of demand and supply. The main finding is confirmed at both 4 and 6-digit HS levels.

The paper has several limitations. An important issue of NTM endogeneity – political economy concerns of trade policy that depends on the importance of large domestic producers in defining trade policy in importing countries – is not fully resolved. Also, the methodology does not allow to disentangle supply and demand shocks. These issues are left for further analysis.

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Figure 1 Export of seafood in 1996-2011: High income vs. low and middle income countries

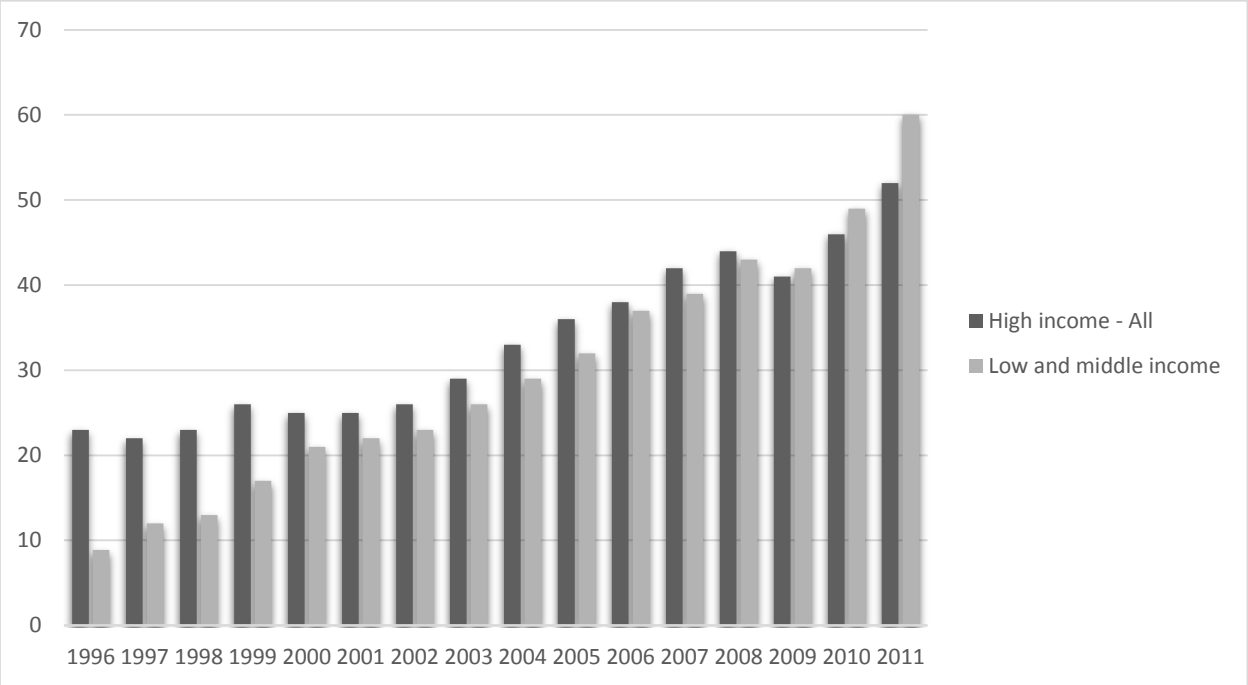

Figure 2 Matrix of graphs for coefficients of SPS and TBT regressions at 6-digit HS level

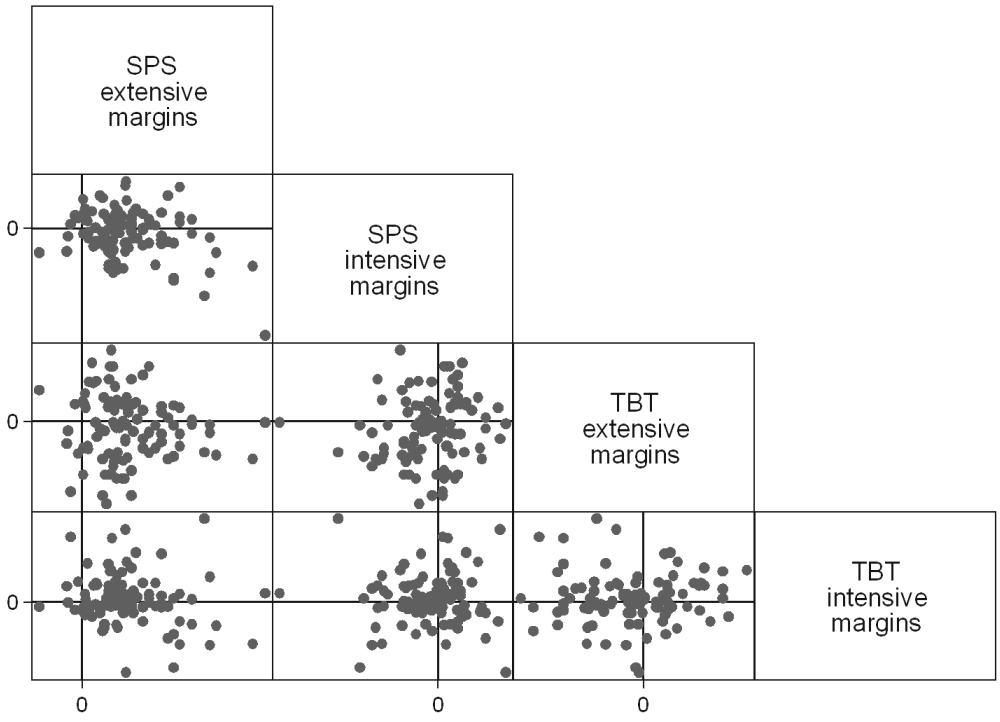

Table **1** *Summary statistics. Seafood exports and non-tariff measures in 1996-2010.*

HS code (HS 1996)	Description	Average export per year in 1996-2010, billion USD	Share of lines with		
			SPS	TBT	STC
0301	Live fish	1.0	0.165	0.019	0.0027
0302	Fish, fresh or chilled	7.5	0.193	0.019	0.0029
0304	Fish fillets and other fish meat	9.8	0.147	0.018	0.0030
0305	Fish, dried, salted or in brine; smoked fish	3.1	0.142	0.022	0.0029
0306	Crustaceans	11.5	0.159	0.024	0.0024
0307	Mollusks and aquatic invertebrates	4.9	0.186	0.020	0.0026
1603	Extracts and juices of meat, fish or crustaceans, mollusks	0.1	0.108	0.076	0.0007
1604	Prepared or preserved fish; caviar and caviar substitutes	7.3	0.106	0.083	0.0009
1605	Crustaceans, mollusks, prepared or preserved	4.9	0.100	0.073	0.0007
Total	**Total average export per year and average NTM in 1996-2010**	**59.1**	**0.154**	**0.031**	**0.002**

Notes: Export statistics is from the COMTRADE database. The share of lines with SPS, TBT, and STC (both SPS and NTB) measures is computed as the ratio of the number of bilateral export lines with a non-tariff measure within an HS four-digit product category to the total number of lines within the same HS category.

Table 2 Gravity model variables: definitions and data sources.

Variable	Description	Source
Dependent variables		
$Trade_{ijk,t}$	Binary variable, equals 1 if export of product k from i to j at time t is positive and zero otherwise	Author's calculations
$Export_{ijk,t}$	Export from i to j of product k at time t, in thousands of current $US.	United Nations Commodity Trade Statistics Database
Endogenous variables		
$SPS_{jk,t}$	Binary variable, equals 1 if country j reported a SPS measure on product k at time t	WTO I-TIP database
$TBT_{jk,t}$	Binary variable, equals 1 if country j reported a TBT measure on product k at time t	WTO I-TIP database
$STC_{ijk,t}$	Binary variable, equals 1 if country i has complained against country j about an SPS or TBT measure imposed on product k at time t	WTO I-TIP database
Independent variables		
share $export_{ki,t}$	Export share of product k in total export of country i at time t.	Author's calculations
$GDP_{i,t}$	Gross domestic product of country i at time t, in current million $US	WDI (2012)
$GDP_{j,t}$	Gross domestic product of country j at time t, in current million $US	WDI (2012)
$distance_{ij}$	Population weighted distance between the biggest cities of countries i and j.	CEPII
Common $border_{ij}$	Binary variable, equals 1 if countries i and j share border	CEPII
$Colony_{ij}$	Binary variable, equals 1 if countries i and j have had colonial ties	CEPII
Common $language_{ij}$	Binary variable indicating whether countries i and j share a common language (a language is spoken by at least 9% of the population in both countries)	CEPII
Common legal $origin_{ij}$	Binary variable, equal 1 if countries i and j share a common origin of the legal system.	CEPII
shipping $cost_i$	Cost of shipping a container from country i, period average	Doing Business (2012)
shipping $cost_j$	Cost of shipping a container to country j, period average	Doing Business (2012)
$WTO_{i,t}$	Binary variable indicating whether country i is a WTO member on or before date t	WTO website
$WTO_{j,t}$	Binary variable indicating whether country j is a WTO member on or before date t	WTO website
$RTA_{ij,t}$	Binary variable indicating whether countries i and j signed a regional trade agreement on or before date t	WTO website
Selection variables		
GDP per $capita_{i,t}$	GDP per capita of country i , in current thousand $US	WDI (2012)
Common $religion_{ij}$	Binary variable, equals 1 if countries i and j share the same religion.	CEPII
doc_i	Number of documents required to export from country i, period average	Doing Business (2012)
doc_j	Number of documents required to import to country j, period average	Doing Business (2012)

Table 3 *Aggregate seafood trade: effect of NTBs on extensive and intensive margins*

	All Seafood			Raw and semi-processed seafood (HS 03)			Processed seafood (HS 1603, 1604, 1605)		
	Probit	**HT**	**FE**	**Probit**	**HT**	**FE**	**Probit**	**HT**	**FE**
SPS	0.0057***	-0.052	-0.025	0.0028*	0.0016	0.030	0.0093***	-0.038	-0.022
	(0.001)	(0.037)	(0.026)	(0.001)	(0.040)	(0.027)	(0.001)	(0.040)	(0.032)
TBT	-0.0027	0.053	0.10*	-0.0035	0.017	0.031	-0.0040**	0.082	0.11***
	(0.003)	(0.076)	(0.052)	(0.002)	(0.072)	(0.057)	(0.001)	(0.051)	(0.030)
STC	0.10***	-0.27*	-0.12	0.080***	-0.12	0.0053	0.080***	-0.82*	-0.77***
	(0.008)	(0.133)	(0.100)	(0.006)	(0.130)	(0.087)	(0.008)	(0.379)	(0.230)
$RTA_{ij,t}$	0.023***	-0.16**	-0.046	0.019***	-0.11	0.023	0.017***	-0.099	-0.093*
	(0.001)	(0.058)	(0.038)	(0.001)	(0.056)	(0.042)	(0.001)	(0.084)	(0.045)
$WTO_{i,t}$	0.011***	0.30***		0.023***	0.24*		0.0028**	0.49***	
	(0.001)	(0.082)		(0.001)	(0.095)		(0.001)	(0.111)	
$WTO_{j,t}$	0.019***	-0.017		0.0081***	-0.038		0.0049***	-0.021	
	(0.001)	(0.067)		(0.001)	(0.069)		(0.001)	(0.080)	
ln(share $exporti_{k,t}$)		0.42***	0.32***		0.40***	0.32***		0.36***	0.29***
		(0.030)	(0.013)		(0.031)	(0.013)		(0.029)	(0.012)
ln($GDP_{i,t}$)		0.38***	0.37***		0.35***	0.27***		0.29***	0.63***
		(0.023)	(0.034)		(0.019)	(0.038)		(0.029)	(0.045)
ln($GDP_{j,t}$)	0.015***	0.58***	0.87***	0.014***	0.57***	0.88***	0.0095***	0.44***	0.66***
	(0.001)	(0.019)	(0.031)	(0.001)	(0.019)	(0.035)	(0.001)	(0.023)	(0.040)
ln($distance_{ij}$)	-0.015***	-0.61***		-0.013***	-0.59***		-0.011***	-0.40***	
	(0.001)	(0.048)		(0.001)	(0.056)		(0.000)	(0.062)	
ln($shipping\ cost_i$)	-0.039***	-1.15***		-0.029***	-0.67***		-0.036***	-2.09***	
	(0.003)	(0.191)		(0.003)	(0.188)		(0.002)	(0.254)	
ln($shipping\ cost_j$)	-0.0051*	0.38*		-0.0083***	0.097		-0.0028	1.08***	
	(0.002)	(0.163)		(0.002)	(0.152)		(0.002)	(0.197)	
Common $language_{ij}$	0.012***	0.18*		0.012***	0.16*		0.0083***	0.22*	
	(0.001)	(0.073)		(0.001)	(0.077)		(0.001)	(0.095)	
Common $border_{ij}$	0.046***	1.11***		0.047***	0.96***		0.023***	1.09***	
	(0.003)	(0.144)		(0.002)	(0.151)		(0.002)	(0.144)	
Colonial $ties_{ij}$	0.042***	0.37		0.039***	0.24		0.035***	0.34	
	(0.004)	(0.191)		(0.003)	(0.172)		(0.003)	(0.177)	
Common legal $origin_{ij}$	0.011***	0.36***		0.0094***	0.27***		0.011***	0.53***	
	(0.001)	(0.060)		(0.001)	(0.055)		(0.001)	(0.073)	
Remoteness distance		-0.050			0.18			0.45	
		(0.833)			(0.795)			(0.863)	
Remoteness border		9.99*			11.7**			24.0***	
		(4.081)			(4.531)			(5.099)	
Remoteness RTA		1.47*			2.06*			-0.77	
		(0.643)			(0.851)			(0.810)	
Remoteness colony		-5.19			-2.76			3.24	
		(4.007)			(4.763)			(5.667)	
Remoteness legal		10.1***			9.12***			5.01***	
		(1.147)			(1.283)			(1.509)	
η		-0.48**	-0.20		-0.48*	-0.20		-0.15	0.080
		(0.175)	(0.147)		(0.188)	(0.154)		(0.213)	(0.182)

z		-2.69*	-0.66		-2.49	-0.32		0.34	1.90
		(1.274)	(1.084)		(1.438)	(1.166)		(1.663)	(1.469)
z2		1.89*	0.70		1.77*	0.46		0.039	-0.86
		(0.739)	(0.632)		(0.849)	(0.689)		(1.014)	(0.892)
z3		-0.34*	-0.14		-0.34*	-0.10		0.036	0.19
		(0.140)	(0.121)		(0.163)	(0.134)		(0.208)	(0.178)
ln(GDP per capita$_{i,t}$)	-0.0071***			-0.0046**			-0.0029*		
	(0.002)			(0.002)			(0.001)		
Mean ln(GDP per capita$_i$)	0.015***			0.012***			0.011***		
	(0.002)			(0.002)			(0.002)		
Mean ln(GDP$_j$)	-0.0026			-0.0016			-0.0023		
	(0.001)			(0.001)			(0.001)		
Trade$_{ij,t-1}$	0.23***			0.21***			0.17***		
	(0.001)			(0.001)			(0.001)		
Trade$_{ij,1996}$	0.074***			0.073***			0.051***		
	(0.001)			(0.001)			(0.001)		
ln(docs$_i$)	-0.0048*			0.0040			-0.015***		
	(0.002)			(0.002)			(0.002)		
ln(docs$_j$)	0.016***			0.0055*			0.020***		
	(0.002)			(0.002)			(0.002)		
Common religion$_{ij}$	-0.0032*			-0.0062***			0.0015		
	(0.002)			(0.002)			(0.001)		
Chi-squared	203148.8	71086.7		185543.4	21658.5		146682.0	18324.1	
R^2	0.57		0.29	0.56		0.28	0.59		0.24
Observations	378954	66918	66918	376677	58170	58170	348342	39402	39402

Notes: For probit models marginal effects are reported. Standard errors in parentheses.

* p<0.05, ** p<0.01, *** p<0.001

Table 4 Lagged values of NTM variables

	All Seafood			Raw and semi-processed seafood (HS 03)			Processed seafood (HS 1603, 1604, 1605)		
	Probit	**HT**	**FE**	**Probit**	**HT**	**FE**	**Probit**	**HT**	**FE**
SPS	0.0040	0.0068	-0.0027	0.0029	0.030	0.020	0.013***	-0.13*	-0.14**
	(0.003)	(0.043)	(0.040)	(0.003)	(0.046)	(0.042)	(0.002)	(0.057)	(0.046)
L.SPS	0.0068	-0.019	0.00022	0.0050	0.0057	0.022	-0.0043	0.11**	0.12*
	(0.004)	(0.035)	(0.049)	(0.004)	(0.038)	(0.052)	(0.003)	(0.039)	(0.056)
L2.SPS	-0.0060	-0.10*	-0.060	-0.0063*	-0.074	-0.028	-0.000028	-0.0044	0.014
	(0.003)	(0.046)	(0.039)	(0.003)	(0.045)	(0.041)	(0.003)	(0.048)	(0.046)
TBT	-0.0073	0.14	0.16*	-0.0026	0.096	0.10	-0.0055*	0.11*	0.12*
	(0.005)	(0.085)	(0.073)	(0.005)	(0.070)	(0.076)	(0.002)	(0.044)	(0.047)
L.TBT	0.0090	-0.095	-0.063	-0.0010	-0.100	-0.090	0.0059	-0.054	-0.042
	(0.007)	(0.060)	(0.086)	(0.006)	(0.073)	(0.089)	(0.003)	(0.044)	(0.057)
L2.TBT	-0.0038	-0.0067	0.015	-0.00014	-0.053	-0.039	-0.0037	-0.0061	0.0037
	(0.006)	(0.084)	(0.074)	(0.005)	(0.086)	(0.077)	(0.003)	(0.039)	(0.047)
STC	0.067***	-0.29*	-0.17	0.044***	-0.14	-0.052	0.031	-0.55	-0.49
	(0.014)	(0.120)	(0.118)	(0.011)	(0.114)	(0.105)	(0.018)	(0.338)	(0.286)
L.STC	0.0056	0.13	0.14	0.017	0.052	0.089	0.076**	-0.57*	-0.58
	(0.019)	(0.112)	(0.134)	(0.015)	(0.095)	(0.123)	(0.025)	(0.262)	(0.374)
L2.STC	0.045**	-0.0050	0.018	0.030**	0.077	0.080	-0.025	0.71*	0.70**
	(0.015)	(0.099)	(0.112)	(0.011)	(0.082)	(0.102)	(0.019)	(0.297)	(0.270)
ALL SPS=0	23.1***	6.82	1.89		2.87	0.35		9.5*	3.40*
ALL TBT=0	2.60	4.28	1.85		3.8	0.90		6.91	2.80*
ALL STC=0	168.8***	7.18	0.86		5.31	0.83		9.81*	4.43**
Observations	351497	63786	63786	349396	55481	55481	322997	37504	37504

Notes: Table presents estimation results for models that include current and lagged values of NTMs. Prefix L indicates a lagged value of a variable, while L2 indicates a second lag of a variable. For probit model marginal effects are reported. Standard errors in parentheses.

* p<0.05, ** p<0.01, *** p<0.001

Table 5 Summary statistics of the SPS and TBT regression coefficients at 6-digit HS level

Variable coefficient	Number of 6 digit HS lines	Mean of coefficient	Std. Dev. Of coefficient	Min	Max
SPS extensive margins	102	0.075	0.063	-0.071	0.3
SPS intensive margins	102	-0.042	0.177	-0.79	0.34
TBT extensive margins	102	-0.019	0.079	-0.2	0.17
TBT intensive margins	102	0.049	0.369	-1.04	1.23

Notes: Table presents summary statistics for coefficients of 102 regressions separately estimated for each 6 digit HS product line