NUPI

Norwegian Institute
of International
Affairs

Trade barriers or trade facilitators? On the heterogeneous impact of food standards in international trade

Hege Medin and Arne Melchior

NUPI Working Paper 855

Publisher: Norwegian Institute of International Affairs

Visiting address: C.J. Hambros plass 2d
Address: P.O. Box 8159 Dep.
NO-0033 Oslo, Norway
Internet: www.nupi.no
E-mail: post@nupi.no
Fax: [+ 47] 22 99 40 50
Tel: [+ 47] 22 99 40 00

Trade barriers or trade facilitators? On the heterogeneous impact of food standards in international trade

Hege Medin[a] and Arne Melchior[b]

Norwegian Institute of International Affairs, and TIK Centre, University of Oslo

[a]Email: hege.medin@nupi.no, Phone: +47 920 98 864
[b]Email: arne.melchior@nupi.no, Phone: +47 997 91 209

Abstract

Recent research shows that food standards can be heterogeneous across sectors or countries: they sometimes act as barriers to trade, but in other cases may lead to increased trade. We present empirical evidence from Norwegian seafood export data showing that food standards, measured by SPS and TBT notifications, generally have a negative impact on total exports, the number of exporters and their average exports. However, for fresh seafood, the impact of SPSs is positive. We present a theoretical explanation for this, suggesting that food standards reduce consumer uncertainty about quality and safety and therefore increase demand.

Published by Norwegian Institute of International Affairs

Contents

1. Introduction

According to the WTO (2012), international food trade is characterised by the growing importance of non-tariff measures (NTMs) like sanitary and phytosanitary (SPS) measures or technical barriers to trade (TBT) related to health or food quality. Using recent, precise data collected for two dozen countries, Gourdon and Nicita (2012) found that 60 per cent of trade in food-related products was affected by SPS measures. At times, food standards can act as severe trade barriers. With some inspiration from early literature such as Deardorff and St¬¬ern (1998) and international data collection exercises, efforts were made to estimate the tariff equivalents of NTMs, see e.g. Kee et al. (2009). This contributed to consolidating a 'standards-as-barriers' approach to SPS and TBT, where NTMs are technically considered as resembling tariffs. From the outset, however, it has been recognised that standards are not necessarily introduced for protectionist purposes: food standards may be good for health, and in some cases there may be a welfare gain even if trade is reduced (Disdier and Marette, 2010). Hence there is a cost–benefit aspect to standards that has to be accounted for.

Contrary to the standards-as-barriers perception, some authors have argued that standards may sometimes promote trade.

One possibility is that there is a direct demand enchancing effect: There may be asymmetric information in the Akerlof sense, whereby consumers have less information about product quality than do the producers. In this situation, standards may reveal the quality of products and thereby directly increase demand. Leland (1979) examined the impact of food standards in one market and concluded that minimum standards could in many situations boost sales and raise welfare. In the context of international trade, this argument was presented by Thilmany and Barrett (1997), who argued that we cannot be sure whether food standards reduce or increase trade. If consumers care not only about the quality of products but also about aspects of the production process, such as labour rights or environmental issues, this creates another channel whereby compliance with standards may promote trade. For example, Teisl et al. (2002) found that eco-labels signalling that no dolphins were killed during tuna fishing increased demand for canned tuna in the USA.

Another possibility is that there is a trade distortion effect: In the context of international trade, countries may differ in their capacity to comply with foreign standard requirements (Jaffee and Henson, 2004). Such requirements may therefore create competitive advantage in countries that invest in capacity to meet them. Casella (1996) holds that standards requirements vary across countries and that they should do so, due to differing preferences or levels of development. A concern may be that rich countries are better able to adapt to strict standards and can thereby obtain competitive advantages. Some case studies (e.g. Wei et al., 2012) have shown that developed-country food standards act as a barrier to developing-country exports. This has also been supported by econometric studies; for instance, Disdier et al. (2008) found that intra-OECD agricultural trade was not impeded by SPS and TBT, whereas developing country exports to the OECD were indeed affected.

In the recent literature on NTMs and food standards, therefore, the 'standards-as-barriers' perception is gradually challenged by the 'two faces of standards' approach. Thus, even if there is a cost involved in complying with standards, the trade-enhancing effects may be even larger. This is exactly what was found by Xiong and Beghin (2014), who distinguished between the trade-reducing and trade-enhancing effect of standards. The trade-reducing impact was greater for developing-country exports, while the demand-growth effect was stronger for exports from developed countries. Mangelsdorf et al. (2012) found that Chinese food standards promoted Chinese food exports. In this paper we present a theoretical foundation for the 'two faces of standards'-hypothesis by slightly modifying the Melitz (2003)/Chaney (2008) heterogeneous-firms trade model. We let trade costs consist of different parts where some capture the costs of compliance with a standard, and we include a mechanism whereby demand may respond positively to the imposition of a standard.

The ambiguous trade impact of standards is also illustrated by the fact that the impact of NTMs appears to differ across subsectors in international food trade. Disdier et al. (2008) found that even if NTMs on the whole can be said to have a trade-reducing impact, there was a statistically significant trade-enhancing effect for many sectors. When the impact of NTMs was estimated separately for 30 subsectors of agricultural trade, the impact was found to be significantly negative (trade-reducing) for nine sectors, and significantly positive (trade-enhancing) for eight sectors (ibid., p. 346).

Some evidence indicates that NTMs are particularly prevalent for seafood. For example, Jaud et al. (2012, p. 131) found that for SPS sanitary risk alerts in the EU during 2001–2005, 23 per cent concerned unprocessed fish and seafood alone. Disdier and van Tongeren (2010) found that NTMs covered a large share of seafood trade, but there were few trade frictions or concerns. The number of notified NTMs was high for processed seafood but low for other fish and seafood. Shepotylo (2015) explored SPS and TBT notifications on seafood among WTO members and showed that SPSs affected 15.4 per cent of all possible bilateral seafood exports, while TBTs affected 3.1 per cent. Whereas SPSs were more common for live and fresh products, the opposite was true for TBTs. This high incidence of NTMs for seafood and the fact that seafood products are an important subset of international food trade, representing about 10 per cent of global food trade, motivates further study of international trade in seafood.

In this paper we study the impact of food standards in a panel of firm-level data for seafood export from a highly developed country, namely Norway. We focus on effects for different subgroups of products. Norway is currently the world's second-largest exporter of seafood, with a share of 9 per cent of world exports in 2010–2012. For Norwegian seafood exports, some earlier survey evidence revealed that adaptation to foreign standards was a very important part of export costs, and exporters expressed very strong interest in international harmonization of standards (Medin and Melchior, 2002). For about 20 countries, with the USA, Russia and Brazil on top, the exporting firms had experienced that veterinary standards had hindered exports (ibid., p. 61). More recently for Russia, Norwegian salmon exports and later other seafood products were subject to a more restrictive SPS regime (Holm and Kokkvold, 2007). Another case is China, where extended veterinary inspections were introduced after the controversial Norwegian award of the Nobel Peace Prize to a Chinese dissident in 2010 (Chen and Garcia, 2015).

Following the recent literature on trade with firm heterogeneity (initiated by Melitz, 2003), an important distinction is made in this paper between the extensive and intensive margins of trade, where the former captures the number of exporters or changes in export due to exit and entry, and the latter captures average export value or changes for already-established trade flows. In this way we attempt to distinguish changes in export due to fixed compliance costs from those due to variable compliance costs. Shepotylo's (2015) analysis of international seafood trade with aggregate data finds that SPSs increase the extensive and reduce the intensive margin trade, whereas the converse holds for TBTs. He also finds considerable heterogeneity in responses across products.

We present descriptive evidence showing that firms already exporting a given product to a given country accounted for the major changes in Norwegian seafood export. There are also considerable changes due to entry and exit, but these almost cancel out, so the net impact is modest. In an econometric analysis we focus on how Norwegian exports of different products to different countries are affected by NTM measures imposed by the importing countries. Using data on WTO notifications of SPSs and TBTs, we find that on average for all products, SPSs have a significant trade-reducing effect. The effect is negative for the number of exporters as well as for their average exports, suggesting that compliance costs are mainly variable, not fixed. Although the effects are negative when averaged over all products, there are strong differences across subsectors: for fresh seafood products, the effects are positive. This study therefore adds to the literature suggesting that the impact of

NTMs on trade varies across products, and NTMs in general cannot be seen as trade-reducing tariff-equivalents.

The paper proceeds as follows: section 2 presents the model, section 3 the empirical evidence, while section 4 sums up the results and suggests that further research and better data are needed to draw more firm conclusions about the exact underlying mechanisms for our results.

2. Food standards, firm heterogeneity and the extensive and intensive margins of trade

Here we present a slightly modified version of the Melitz (2003)/ Chaney (2008) model. As opposed to that model, both variable and fixed trade costs contain elements reflecting the costs of compliance with food standards. Furthermore, demand may increase as a consequence of such compliance. This provides a theoretical foundation for the 'two faces of standards'-hypothesis, and we examine under which circumstances a standard will be trade-reducing and under which it will be trade-enhancing. We also separate the effect on total trade into the extensive margin (the number of firms that export a particular product to a particular country) and the intensive margin (their average exports). Comparing the two margins gives an indication of whether compliance costs are mainly variable or mainly fixed.

2.1. The model setup

We operate with a total number of M countries that trade with each other and a total number of S product groups (or sectors) in each country. An individual product group is denoted by s, where s=0 denotes a freely traded homogeneous product produced under constant returns to scale. We assume that parameters in the model are such that this product is produced in all countries, which assures that wages are equalised (we normalised them to 1). s>0 denotes groups of products that are differentiated and produced under increasing returns to scale. In country j there is an exogenous mass of n_j^s firms, each producing a unique variety of a product belonging to group s. n_j^s is proportional to the country's labour force and given by

(1) $n_j^s = a_j^s L_j$

Utility in country i, U_i, is given by a two-level function, where the upper level is a Cobb-Douglas aggregate of all product groups, with expenditure share for a given group equal to β_i^s, $\sum_{s=0}^{S_i} \beta_i^s = 1$. For differentiated product groups, there is a lower-level subutility function given by a CES aggregate with elasticity of substitution: σ^s>1.

$$(2)\quad U_i = \left(\sum_{j=1}^{M} x_{ji}^{0} \right)^{\beta_i^0} \prod_{s=1}^{S_j} \left(\sum_{j=1}^{M} \int_{\omega^s \in \Omega_{ji}^s} \left(q_{ji}^s x_{ji}^s \left(\omega^s \right) \right)^{\frac{\sigma^s - 1}{\sigma^s}} d\omega^s \right)^{\beta_i^s \frac{\sigma^s}{\sigma^s - 1}} \quad , \; u_{ji}^s \geq 1$$

$x_{ji}^s \left(\omega^s \right)$ denotes consumption of variety ω^s. The first subscript (*j*) refers to the country of production and the second (*i*) to the country of consumption, while the superscript (*s*) refers to the product group. Ω_{ji}^s is the set of varieties from product group *s* produced in country *j* available for consumption in country *i*. q_{ji}^s is a quality-perception parameter related to food standards, and $q_{ji}^s > 1$ implies that consumers will demand more of products that comply with a food standard, either because the standard actually improves the quality and safety of the product, or because it reduces consumer uncertainty about it.[1]

In the following, we focus on one differentiated sector, as the other differentiated sectors are analogous; hence we drop the superscript *s*. Production of a given variety ω in country *j* incurs constant marginal costs, $c(\omega)$, which denotes the variable labour requirement for producing one unit of the final product. $c(\omega)$ varies across firms and is randomly drawn from a probability distribution with density given by $g_j(c)$. Since varieties produced by firms with the same $c(\omega)$ are symmetric, it is sufficient to index firms by c, and we therefor disregard ω in the following.

There is a fixed labour requirement of supplying each country, equal for all firms and given by $f_{ji}>0$ (which also accrues in the home market). Selling abroad involves a variable trade cost of the iceberg type, equal for all firms and given by $t_{ji} \geq 1$. Unity indicates no costs, and $t_{jj} = 1$.

It is well-known that (2) gives the following demand faced by a firm:[2]

$$(3)\quad x_{ji} = t_{ji} p_{ji}^{-\sigma} B_i$$

p_{ji} is the consumer-price, and B_i reflects demand parameters:

---

1 See e.g. Venables (1987) for a similar formulation of demand.

2 See e.g. Helpman and Krugman (1985, p. 120). Note that (5) denotes demand faced by the firm; thus, we have corrected for the fact that t_{ji} units of x_{ji} disappear in transport.

(4) $$B_i = \frac{\beta_i y_i}{P_i^{1-\sigma}}$$

P_i is the ideal price index following from (2). Countries are considered small enough not to influence y_i and $P_i^{1-\sigma}$ of their trading partners; thus B_i is considered exogenous.[3]

Firms engage in monopolistic competition. Together with CES utility and iceberg trade costs this leads to the recognised fact that the consumer-price of a given variety in country i will be a constant mark-up over marginal production costs, adjusted for variable trade costs and q_{ji}. Furthermore, in this type of models q_{ji} works in the exact opposite direction of t_{ji} (see Venables, 1987).

(5) $$p_{ji} = \frac{\sigma}{\sigma - 1}\frac{t_{ji}c_j}{q_{ji}}$$

The two types of trade costs each consist of two parts:

(6) $$t_{ji} = T_{ji}^{\mu_{ji}} \tau_{ji}^{1-\mu_{ji}}$$

(7) $$f_{ji} = F_{ji}^{\lambda_{ji}} \varphi_{ji}^{1-\lambda_{ji}}$$

T_{ji} and F_{ji} are, respectively, the variable and fixed costs of compliance with a standard imposed by the importer. These are equal to or larger than 1, where unity indicates no such costs. τ_{ji} and φ_{ji} capture all other trade costs (variable and fixed, respectively). The parameters μ_{ji} / λ_{ji} indicates the amount of the total trade cost that is due to compliance costs.

q_{ji} is given by:

(8) $$q_{ji} = T_{ji}^{\varepsilon_{ji}} F_{ji}^{\eta_{ji}}$$

$\varepsilon_{ji} \geq 0$ and $\eta_{ji} \geq 0$. Complying with a food standard increases demand in the importing country as long as ε_{ji} and η_{ji} are strictly posi-

3 Chaney (2008) assumes a global distribution mechanism for firm profit ensuring that y_i is proportional to L_i. He further assumes that P_i is unaffected by t_{ji} and f_{ji} (see footnote 20 in ibid.).

tive. The higher the ε_{ji} and η_{ji}, the more demand increases when a standard is imposed (for a given level of compliance costs). T_{ji} and F_{ji} can be viewed as costs of actual quality upgrades, e.g. by requiring firms to use better cooling arrangements when transporting their products. Alternatively, they can be viewed as investments in schemes that reduce uncertainty or improve the reputation and attractiveness of products: a better reputation may reduce the probability of being subjected to costly and tedious border controls where there is a food standard.

Using eq. (3), (5), (6) and (8) and rearranging, the export revenue of an individual firm can be expressed as:

(9) $$r_{ji} = \left(T_{ji}^{\mu_{ji}-\varepsilon_{ji}} \tau_{ji}^{1-\mu_{ji}} F_{ji}^{-\eta_{ji}} c\right)^{1-\sigma} B_i \left(\frac{\sigma}{\sigma-1}\right)^{(1-\sigma)}$$

The elasticities of r_{ji} with respect to T_{ji} and F_{ji} are

(10) $$E_{T_{ji}}\left(r_{ji}\right) = \left(\varepsilon_{ji} - \mu_{ji}\right)\left(\sigma - 1\right)$$

(11) $$E_{F_{ji}}\left(r_{ji}\right) = \eta_{ji}\left(\sigma - 1\right)$$

Firms may freely establish sales; thus, the highest-cost firm from country *j* selling in country *i* earns zero profits from those sales and sells least. We refer to this firm as the 'cutoff exporter', and its marginal cost, $\bar{c}_{ji}$, defines the cutoff cost for sales from *j* to *i*. $\bar{c}_{ji}$ is found by setting $r_{ji}(\bar{c}_{ji}) = f_{ji}$ in eq. (9) and using eq. (7):

(12) $$\bar{c}_{ji} = T_{ji}^{\varepsilon_{ji}-\mu_{ji}} F_{ji}^{\frac{\lambda_{ji}+\eta_{ji}(1-\sigma)}{1-\sigma}} \tau_{ji}^{-(1-\mu_j)} \varphi_{ji}^{\frac{1-\lambda_{ji}}{1-\sigma}} \frac{\sigma}{\sigma-1} B_i^{-\frac{1}{(1-\sigma)}}$$

From eq. (12) we can find the elasticities of $\bar{c}_{ji}$ with respect to T_{ji} and F_{ji}:[4]

(13) $$E_{T_{ji}}\left(\bar{c}_{ji}\right) = \varepsilon_{ji} - \mu_{ji}$$

[4] We implicitly assume that firms consider T_{ji} and F_{ji} as exogenous. Hence, firms do not choose values of these variables in order to upgrade the quality or reduce the uncertainty about their products.

(14) $$E_{F_{ji}}\left(\overline{c}_{ji}\right)=\frac{\eta_{ji}\left(\sigma-1\right)-\lambda_{ji}}{\left(\sigma-1\right)}$$

The above model reduces to the Melitz (2003)/Chaney (2008) model if compliance costs (variable as well as fixed) are the only trade costs and standards have no effect on demand (i.e. $\mu_{ji}=\lambda_{ji}=1$ and $\varepsilon_{ji}=\eta_{ji}=0$). In that model, the effects of imposing of a food standard on a firm's export and the cutoff cost level are unambiguous. Here, however, the signs of eq. (10), (11), (13), and (14) are uncertain and depend upon the size of ε_{ji}, η_{ji}, μ_{ji}, and λ_{ji}. To discuss the circumstances under which the expressions have a certain sign, we divide effects into cost and demand effects, further subdivided into two cases: variable and fixed compliance costs.

The 'cost effect' refers to the fact that a food standard requires firms to bear compliance costs. It is captured by the parameters reflecting the amount of total trade costs that is due to such costs (μ_{ji} in the case of variable compliance costs and λ_{ji} in the case of fixed compliance costs). This effect is also present in the standard Melitz (2003)/Chaney (2008) model. Our introduction of the parameter q_{ji} and its link to compliance costs, however, creates a demand effect not captured by that model. This 'demand effect' refers to the fact that the imposition of a food standard increases demand in the importing country, and it is captured by the parameters reflecting how much demand increases due to the food standard (ε_{ji} in the case of variable compliance costs and η_{ji} in the case of fixed compliance costs).

The cost effect dominates when compliance costs constitute large parts of the total (μ_{ji}/λ_{ji} is large) and/or there is no or little increase in demand when a food standard is imposed ($\varepsilon_{ji}/\eta_{ji}$ is zero or small). In this case, imposition of a food standard leads to a decrease in the cutoff cost. This happens independently of whether compliance costs are variable or fixed (both eq. 13 and 14 are negative). The effect on a firm's export, on the other hand, depends on the nature of compliance costs. For variable costs, export declines (eq. 10 is negative). For fixed costs, export will either not be affected (for $\eta_{ji}=0$ F_{ji} is not part of eq. 9, and eq. 11 is zero) or increase slightly (eq. 11 is slightly positive).

The demand effect dominates when demand is sensitive to the imposition of a food standard ($\varepsilon_{ji}/\eta_{ji}$ is large) and/or compliance costs constitute small parts of total trade costs (μ_{ji} / λ_{ji} is small). In this case, it is not important whether compliance costs are variable or fixed. In both cases, the imposition of a food standard leads to an increase in the cutoff cost (both eq. 13 and 14 are positive) and an increase in export (both eq. 10 and 11 are positive).

Summing up, defining a variable z equal to either T_{ji} or F_{ji}, we see the sign of $E_z\left(\bar{c}_{ji}\right)$ is the same as that of $E_z\left(r_{ji}\right)$ in all cases except when the cost effect dominates and compliance costs are fixed. In this case $E_z\left(r_{ji}\right)$ is either zero or positive, but very small, whereas $E_z\left(\bar{c}_{ji}\right)$ is negative.

2.2. Aggregation

To find the effects on total export and the two margins of trade, we follow the discussion in Lawless (2010). The extensive margin (the number of exporters) is given by:

(15) $$n_{ji} = n_j \int_0^{\bar{c}_{ji}} g_j(c)dc$$

The elasticity of n_{ji} with respect to z is given by

(16) $$E_z\left(n_{ji}\right) = \frac{n_j}{n_{ji}} g_j(\bar{c}_{ji})\bar{c}_{ji} E_z\left(\bar{c}_{ji}\right)$$

Eq. (16) shows that sign of the elasticity for the extensive margin is equal to the sign of the elasticity for the cutoff cost.

Total export is given by:

(17) $$R_{ji} = n_j \int_0^{\bar{c}_{ji}} r_{ji}(c) g_j(c)dc$$

And the elasticity is

(18) $$E_z\left(R_{ji}\right) = \frac{n_j}{R_{ji}} \left[r_{ji}(\bar{c}_{ji}) g(\bar{c}_{ji}) \bar{c}_{ji} E_z\left(\bar{c}_{ji}\right) + z \left(\int_0^{\bar{c}_{ji}} \frac{1}{z} r_{ji}(c) g_j(c)dc \right) E_z\left(r_{ji}\right) \right]$$

The first part of (18) denotes the change in total exports due to changes in export of firms that start or stop exporting; the second part denotes changes of incumbent exporters.

Again, the effect of imposing a food standard is unclear and will depend on the magnitude of cost and demand effects discussed in relation to eq. (10), (11), (13) and (14). If the cost effect dominates, $E_z\left(\bar{c}_{ji}\right)<0$ and $E_z\left(r_{ji}\right)$ is either negative (in the case of variable compliance costs) or zero/slightly positive (in the case of fixed compliance costs). Consequently, in this case $E_z\left(R_{ji}\right)$ as well as $E_z\left(n_{ji}\right)$ are negative, regardless of the nature of compliance costs. Total exports and the extensive margin will decline; since the cutoff cost level will decrease, fewer firms will find it profitable to export, whereas export of incumbent exporters will either decline (in the case of variable compliance costs) or change very little (in the case of fixed compliance costs). If the demand effect dominates, the opposite applies: $E_z\left(\bar{c}_j\right)>0$ and $E_z\left(r_{ji}\right)>0$ thus $E_z\left(R_{ji}\right)$ as well as $E_z\left(n_{ji}\right)$ are positive (both when compliance costs are variable and when they are fixed). Total exports and the extensive margin will increase.

The intensive margin (average exports per firm) is given by:

$$I_{ji}=\frac{R_{ji}}{n_{ji}} \tag{19}$$

and

$$\begin{aligned} & E_z\left(I_{ji}\right)=E_z\left(R_{ji}\right)-E_z\left(n_{ji}\right) \\ & =\frac{n_j}{R_{ji}}\left[\left(n_{ji}r_{ji}(\bar{c}_{ji})-R_{ji}\right)\frac{g_j(\bar{c}_{ji})\bar{c}_{ji}}{n_{ji}}E_z\left(\bar{c}_{ji}\right)+z_{ji}\left(\int_0^{\bar{c}_{ji}}\frac{r_{ji}(c)g_j(c)}{z_{ji}}dc\right)E_z\left(r_{ji}\right)\right] \end{aligned} \tag{20}$$

where we have used eq. (16) and (18) in the second equality. We know that $n_{ji}r_{ji}(\bar{c}_{ji})-R_{ji}<0$ because the number of exporters times the export revenue of the cutoff exporter must be lower than total export revenue (since the cutoff exporter is the firm that exports least). Consequently, the first part of the last equality in eq. (20) has the opposite sign of $E_z\left(\bar{c}_{ji}\right)$. The second part has the same sign as $E_z\left(r_{ji}\right)$. From the discussion above, we know that $E_z\left(\bar{c}_{ji}\right)$ and $E_z\left(r_{ji}\right)$ have the same sign for all cases except when the cost effect dominates and compliance costs are fixed. Thus, for all other cases, $E_z\left(I_{ji}\right)$ is undetermined: the change in the intensive margin when a food standard is imposed can go in either direction. In the case of a dominant cost effect and variable compliance costs, each firm will export less, which will tend to decrease the intensive margin. At the same time, the cutoff costs level will decrease, so the least-selling exporters will stop exporting, and this will tend to increase the intensive margin. In the case of a dominant demand effect, whether due to variable or fixed compliance costs, the converse is true. In the case of a dominant cost effect and fixed compliance costs, however, $E_{T_{ji}}\left(r_{ji}\right)$ is either zero or positive, but very small, thus the sign of $E_{T_{ji}}\left(I_{ji}\right)$ is the opposite of that of $E_{T_{ji}}\left(\overline{c}_{ji}\right)$. Then each firm's export is unaffected (or slightly increased), but the cutoff cost level decreases, and so the least-selling exporters quit exporting. Consequently the intensive margin increases (Lawless, 2010).

Table 1 summarises the effects of the imposition of a food standard on total export and the two margins of trade under the four different scenarios: variable and fixed compliance costs for dominant cost and demand effects. Cost and demand effects have opposite signs on total export and the extensive margin of trade. Thus, any trade-reducing effects from standards may be offset if the imposition of a standard has a positive effect on demand. Consequently, the model provides a theoretical foundation for the demand explanation of the 'two faces of standards' hypothesis.

Furthermore, if there is a dominant costs effect so that the extensive margin declines, the sign of the effect on the intensive margin will indicate whether compliance costs are mainly fixed or variable. A negative effect on the intensive margin would indicate that compliance costs are mainly variable, because the effect should be positive if compliance costs were mainly fixed.[5]

[5] This holds when we do not make any assumptions about $g_j(c)$. In the case of Pareto-distributed firm productivity, the effect on the intensive margin for a dominant cost effect and variable compliance costs is zero (see discussion in Lawless, 2010). The same is true for a dominant demand effect, independently of whether compliance costs are variable or fixed.

Table 1. Effects on the different margins of export

	Dominant effect			
	Cost		Demand	
	Compliance costs are		Compliance costs are	
	variable	fixed	variable	fixed
Total export	–	–	+	+
Extensive margin (number of exporting firms)	–	–	+	+
Intensive margin (average export per firm)	?	+	?	?

2.3. Differences between countries and products

Whether cost or demand effects will dominate depends on characteristics of products and export destinations.[6] For some products-groups or export destinations, compliance costs may be mainly variable; for others, they may be mainly fixed. Furthermore, due to differences in factors like preferences, technology, knowledge, and reputation, parameters like T_{ji}, F_{ji}, ε_{ji}, n_{ji}, μ_{ji} and λ_{ji} may vary. For example, for fresh food, transport costs are particularly high, as these require costly cooling arrangements during transport, and air shipment is likely. Then cost of compliance may constitute a small part of the total (low μ_{ji}/λ_{ji}). In addition, uncertainties about quality and safety are probably more pronounced for fresh food, and demand may be more sensitive to reputation. The Norwegian seafood industry has made large investments in generic marketing that extols the high quality, clean and healthy aspects of Norwegian seafood, and the products have a good reputation in many countries. We could therefore expect that Norway has high compliance capacity for seafood, and in particular for fresh products (low T_{ji}/F_{ji} together with high ε_{ji}/n_{ji}). This could imply a dominating demand effect.

In addition, Norway is a highly developed country, which could imply a favourable distortion effect. As pointed out in section 1, foreign standards more often lead export decline in developing countries than in developed ones. In terms of the model presented above, there may be various reasons for this. Products from developing countries may be further away from complying with the standard at the outset, or low technology levels may make it particularly costly to comply with the standard. Products may also have a poor reputation, making them subject to costly border controls. In all these cases, compliance may re-

6 For simplicity, we have assumed that there is only one differentiated goods product-group in the model presented above. However, the model can easily be extended to several product-groups with different ε_{ji}, n_{ji}, μ_{ji}, and λ_{ji}.

quire considerable increases in T_{ji} and/or F_{ji} without necessarily leading to any significant increase in demand (ε_{ji} and/or η_{ji} are low). Finally, poor knowledge about foreign rules and laws can make compliance costs constitute a large part of the total, in which case μ_{ji} and/or λ_{ji} will be high. In all cases, total export and also the extensive margin are likely to decrease as a consequence of the imposition of a standard. If the extensive margin declines in a large number of (developing) countries, the competitive advantage of countries that do not experience such decline is strengthened. To demonstrate, let us assume that cost and demand effects exactly cancel out in a given country *j'* exporting to country *i*, and that only variable compliance costs affect the quality-perception parameter ($q_{j'i}$) so that $\varepsilon_{j'i} = \mu_{j'i}$ and $\eta_{j'i} = 0$. The ideal price index of an importer for a given good, P_i^s, following from (2), is given by:

$$P_i = \left[\sum_{j=1}^{M} n_j \int_0^{\bar{c}_{ji}} p_{ji}(c)^{1-\sigma} g_j(c)dc \right]^{\frac{1}{1-\sigma}}$$

(21)
$$= \left[\sum_{j=1}^{M} n_j \frac{\sigma}{\sigma-1} T_{ji}^{(\mu_{ji}-\varepsilon_{ji})} F_{ji}^{-\eta_{ji}} \tau_{ji}^{(1-\mu_{ji})} \int_0^{\bar{c}_{ji}} c_j^{(1-\sigma)} g_j(c)dc \right]^{\frac{1}{1-\sigma}}, \text{ where } \partial P_i / \partial \bar{c}_{ji} < 0$$

We have inserted from eq. (1), (5), (6) and (8) in the last equality. From the discussion above, we know that in countries where the cost effect dominates, an increase in T_{ji}/F_{ji} induces a decrease in $\bar{c}_{ji}$. From (21) it is easily seen that if $\bar{c}_{ji}$ decreases in a large number of countries, P_i and hence B_i can no longer be considered exogenous. The number of firms exporting to *i* will decrease, and this will induce an increase in P_i and hence B_i (see eq. 4). From eq. (9) and (12) we can easily see that the elasticities of $\bar{c}_{ji}$ and r_{ji} with respect to B_i are, respectively, $E_{B_i}\left(\bar{c}_{ji}\right) = \frac{1}{\sigma-1}$ and $E_{B_i}\left(r_{ji}\right) = 1$. These are positive. Consequently, even though there is no dominant demand effect in country *j'*, this country will experience an increase in total export and the extensive margin due to the increase in B_i.[7] The reason is that the competitive advantage in country *j'* improves due to the diversion of demand away from countries where the cost effect is dominant. The model thus also

7 The effects are analogous to those from T_{ji} and/or F_{ji} in the case of a dominating demand effect, thus the effect on the intensive margin is ambiguous.

provides a theoretical foundation for the distortion explanation of the 'two faces of standards' hypothesis.

In the next section I test how foreign standards affect Norwegian seafood export. As demonstrated above, both the demand effect and a favourable distortion effect would tend to increase total exports and the extensive margin of trade. This could be particularly likely to happen for fresh Norwegian seafood products. I therefore test whether the impact of foreign standards differ for such products.

3. Empirical evidence: Norwegian seafood exports, and the role of SPS and TBT

3.1. The dataset

The dataset for Norwegian seafood exports has been provided by Statistics Norway and covers firm-level exports during 1996–2013. The data do not include evidence on other (non-trade) firm characteristics such as employment or domestic sales. Exporters include fish-farming producers, fish companies based on catch, seafood processing firms and pure trading companies. The Norwegian seafood export business is relatively fragmented, with above 400 exporters each year throughout the period, selling to between 124 and 162 export destinations.[8] Table A1 in Appendix 1 presents some key figures. The average exporter exported to seven countries, with average value per country increasing from NOK 11 to 19 million over the period. The top exporter in 2013 had an export value of more than USD one billion. Contrary to what might be expected in light of globalisation, the total number of destination countries declined slightly over time, despite a strong increase in exports.

Export data are disaggregated by destination country as well as by product, and we define a 'market' as a product-country combination: for example, the exports of fresh salmon fillet to Sweden. Product classifications change considerably over time; and unless this is corrected for, there will be a lot of 'spurious' entry and exit.[9] We therefore reclassify to make classification consistent over time, thereby reducing the number of products from 560 to 230. Table A2 in Appendix 1 presents key data on 53 main products (e.g. sales and growth rates), covering 90–93 per cent of exports in each year. The largest product in 2013 was fresh farmed salmon, which represented more than half of total seafood exports in 2013. For total seafood exports, the annual growth rate was 3.2 per cent; but, for more than half of the selected products

8 Throughout the period, the total number of export destinations amounted to more than 200, so Norway exported to practically all countries in the world.

9 National classifications build on the internationally agreed HS (Harmonised System) tariff nomenclature maintained by the WCO (World Customs Organization). The HS system has been revised several times: for this period one has HS1996, HS2002, HS2007 and HS2012. Especially in 2012, there were many classification changes for the seafood sector. The most disaggregated HS level is at six digits; the Norwegian system has further subdivisions at the eight-digit level. Some of the classification changes over time are due to national changes at the eight-digit level.

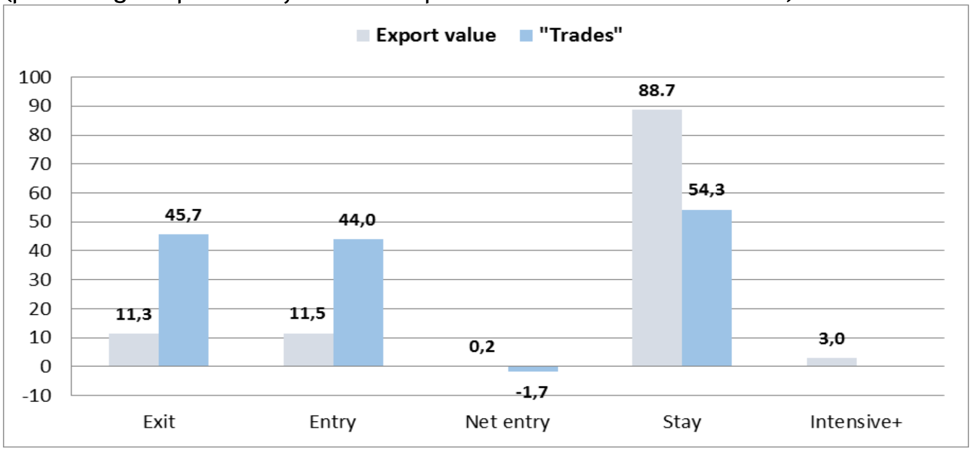
(29 products), the export growth rate during the period was actually negative. Hence we note a wide range of outcomes, with an upward trend for farmed fish (salmon and trout, recently also some species of whitefish) and deteriorating performance for many types of catch-based and processed exports. In 2013, total Norwegian seafood exports stood at NOK 62 billion, of which NOK 42 billion were salmon and trout products, with fresh products representing 37 billion. In the regression analysis presented in the next section, we look for separate effects for fresh seafood. Fresh salmon will be the largest subcomponent.

3.2. Extensive vs. intensive market growth

Figure 1 decomposes the change in exports over the whole time period into the extensive and intensive margins, based on firm-level data. Note that due to the use of diaggregated date here we define the two margins somewhat differently than in section 2 and 3.3 (also see footnote 4). Using the term 'trades' for firm-product-country combinations, the intensive margin is defined as changes in export for trades surviving from one year to the next. In the Figure, this is decomposed into 'stay' (the percentage of trades or export value that survives), and 'Intensive+' (the percentage value increase for surviving trades). The extensive margin is defined as the percentage change in trades or export value due to firm-product-country entry and exit. In the Figure we show both entry and exit in addition to net entry, the latter being the sum of the first two. For all categories the Figure shows results based on the number of trades and the value of exports for these trades (except for Intensive+, where the change in the number of trades is zero, per definition). Whereas the number of trades declined from 12 193 in 1996 to 9 027 in 2013, the export value increased from NOK 38 to 62 billion.[10] Figure 1 shows average rates of change for the years 1997–2013, expressed in percentage of the total number of trades or the total export value in the preceding year.

10 Measured in 2013 NOK, using the Norwegian GDP deflator.

Figure 1: Extensive and intensive margins of trade: Average change 1997–2013
(percentage of previous year total export value or number of 'trades')



Note: The Figure is based on firm level data on Norwegian seafood exporters provided by Statistics Norway. '*Trades*' refers to firm-product-country combinations. *The extensive margin* is *Net entry*, which denotes the increase in the number of trades/export value due to *trades* entrants (*Entry*) minus the loss due to trades exits (*Exit*). *The intensive margin* is described by *Stay* and *Intensive +,* the first denoting changes in number of trades or export value for trades surviving from one period to the next, and the latter denoting the value increase for these surviving trades.

As to the number of trades (the darker columns), we note that almost half (45.7 per cent) of the trades from the preceding year do not survive from one year to the next. However, there is considerable entry (44.0 per cent), so net entry is modest (−1.7 per cent annual average).

We now turn to export value, which was much larger for incumbent trades; even if only 54.3 per cent of the trades survived from one year to the next, these trades represented 88.7 per cent of the export value of the preceding year. Furthermore, the export value of the incumbent trades increased on average by a value equivalent to 3.0 per cent of the preceding year's total exports. This may be compared to the export value change due to entry and exit, which averaged 0.2 per cent per year. Aggregating over the whole period 1996–2013, we find an export value growth of NOK 24 billion. Out of this, 22 billion was due to stay (the intensive margin), and 1.6 billion was due to net entry (the extensive margin).[11] On the whole, therefore, the major changes in export were at the intensive margin.

While the *net* effect of exit and exit was modest, Figure 1 demonstrates that the *gross* magnitude was very large, with massive 'churning' in exports. This is an interesting issue for further research. It should also

11 While the extensive margin was negative measured by the number of trades, entering trades had larger sales than exiting trades, so the extensive margin was positive when measured by export value.

be noted that entrants may increase their export gradually over some years, whereas measurement from one year to the next does not capture this impact of entry over time.[12]

3.3. The impact of SPS and TBT on seafood exports: Econometric evidence

This section aims to provide new econometric evidence on the impact of SPSs and TBTs in international seafood trade. Based on the theory framework presented in section 2, we perform an econometric gravity analysis for one exporter and many importers, hypothesising that Norwegian export to a country is a function of exporting costs to that country and its GDP level (see UNCTAD and WTO, 2012 for an introduction to econometric gravity analysis).

3.3.1 Dependent variables

For use as dependent variables in the regression analyses, three aggregated variables were constructed for each product-country combination reflecting different measures of export: total export value of product *v* to country *i* ($export_{ivt}$), the number of firms exporting product *v* to country *i* ($extensive_{ivt}$), and their average export value ($intensive_{ivt}$). Export values are measured in current NOK. Following the tradition in the gravity literature, we use the logs of the variables in the estimation.

In line with some other studies (e.g. Buono and Lalanne, 2012; Besedina, 2015), we use aggregated variables based on firm-level data. An advantage of this approach is to reduce the influence of data noise, which is generally higher, the more disaggregated the data are. For example, if a firm changes identification number due to data inaccuracy but the underlying activity is unchanged, this will appear as entry and exit in the microdata, but the aggregate variables (number of firms, average sales) will be unaffected. Furthermore, the proportion of zeros in the data is reduced. An alternative could be to use the firm-level data directly, as in Kneller et al. (2008) or Chen et al. (2008). The advantage of this is that entry and exit is measured more accurately (provided that the data are correct), and that we get a larger number of observations.[13]

We do not have data for the firms' total production or domestic sales. However, this is not a major limitation, as we do not analyse entry and

[12] For example, among Colombian firms Eaton et al. (2008) find that most new exporters sell a very small amount to only one foreign country and soon give up exporting. But that those that survive often experience a rapid expansion in their export values as well as in the number of countries to which they export.

[13] By definition, firm-level data reflect gross exit and entry, whereas aggregate data on the number of firms reflect only net entry, unless special variables on entering and exiting firms are created.

exit into exports as such but entry into individual export markets, and 90–95 per cent of Norway's seafood production is exported.[14]

3.3.2 Explanatory variables

SPS and TBT

In order to measure food standards, we use notification data on regular SPSs and TBTs from the WTO Integrated Trade Intelligence Portal (I-TIP database).[15] We construct one dummy variable for SPS notifications, sps_{ivt}, and one for TBT notifications, tbt_{ivt}. The dummies are equal to 1 from year t and onwards if importing country i imposed at least one SPS/TBT on product v in year t. Over one third –35.5 per cent – of the observations included in the main analysis presented in section 3.3.5 are covered by at least one SPS and 7.2 per cent by at least one TBT.[16] As pointed out in sections 1 and 2, standards can be both trade-restricting and trade-enhancing. Effects may vary across products, and stricter standards may have a greater impact on demand for fresh products (see discussion in section 2.3). We therefore interact sps_{ivt} and tbt_{ivt} with a dummy for fresh seafood products (*fresh*).

Withdrawals of SPSs and TBTs are not reported in the data, thus sps_{ivt} and tbt_{ivt} are always weakly increasing in t. The number of notifications has increased considerably over time, which probably reflects notification practice rather than policy change. The quality of notifications in terms of accuracy and completeness has been questioned (Bacchetta et al., 2012). However, the potential 'notification bias' originating from these issues is limited, as we operate with a short time period (2001–2011). There is also little reason to believe that heterogeneity across sectors – which is a main focus of this paper – should be affected by the potential 'notification bias'. It should be noted, however, that WTO notifications do not measure the strictness or restrictive impact of SPS or TBT.

Control variables

While the impact of SPSs/TBTs is our main focus, we include several control variables. These are *ad valorem* tariffs ($tariff_{ivt}$), two dummies for free trade agreements (FTAs): eea_{it} for membership in the European Economic Area (EEA) and fta_{it} for other free trade agreements (to capture effects from FTAs that go beyond tariff reductions, such as reduc-

---

14 This information was provided orally by the Norwegian Seafood Export Council.

15 http://i-tip.wto.org/goods/default.aspx?language=en

16 In some cases, a country has not reported the HS categories at which the regulation is imposed. In these cases we use the WTO-interpreted HS categories reported in the database. Few notifications are reported at the detailed six-digit level; most are reported at the four-digit level, and some only at the two-digit level. In the two latter cases we assume that the regulation affects all corresponding six-digit subcategories. However, for HS chapters that also include non-seafood products (chapters 5, 15, 16 and 23) we do not include the notification if it is evident from the product and/or measure description that it does not concern seafood.

tions in non-tariff barriers), costs related to procedures for importing a container (*$impcost_{it}$*), an index of good regulatory quality (a higher index indicates better regulatory quality) (*$regqual_{it}$*), GDP (*gdp_{it}*), GDP per capita (*$cgdp_{it}$*), the per cent growth in the exchange rate between NOK and the local currency (*$gexch_{it}$*), and per capita (apparent) consumption of seafood in kg (*$cons_{it}$*).

To be able to take advantage of the longer time-series of our export and SPS/TBT notification data, we use extra- or interpolation for control variables where not all years are covered. The most important variable where this is done is *$tariff_{ivt}$*, where we only have data for years 2001, 2004 and 2007, due to the use of the MacMap database (see Appendix 2 for details).[17] We linearly interpolate *$tariff_{ivt}$* for the interim missing years and set the value for years after 2007 equal to the 2007 level. This should be a fairly good approximation, due to the stepwise reduction of tariffs agreed upon in the Uruguay Round and the fact that all commitments of tariff reductions were completed by 2005. We do not extrapolate for years before 2001, as major changes in tariffs following commitments from the Uruguay Round were made prior to that year. In section 3.3.6 we perform two different sensitivity analyses of the treatment of the tariff variable. Both show that main results are fairly robust.

In addition to *sps_{ivt}* and *tbt_{ivt}*, *$tariff_{ivt}$* is the only explanatory variable that varies in the product dimension (in addition to the country dimension).[18] See Appendix 2 for detailed descriptions of all variables.

3.3.3. Estimation method

Inserting from eq. (1), (9) and (12) in, respectively, eq. (15), (17), and (19), we can express the three dependent variables as functions of different types of trade costs and demand conditions. In addition, we know from the discussion in section 2.3 that effects may differ between product-groups. We therefore estimate the following reduced forms of equations (15), (17), and (19):

$$\text{(22)} \quad \ln\left(y_{ivt}\right) = \begin{array}{l} \alpha + \beta^{sps} sps_{ivt-1} + \beta^{sps*fresh} sps_{ivt-1} * fresh + \beta^{tbt} tbt_{ivt-1} \\ + \beta^{tbt*fresh} tbt_{ivt-1} * fresh + \beta^{tarff} \ln\left(tariff_{ivt-1}\right) + \boldsymbol{\gamma}\mathbf{x_{it}} + \mathbf{d_t} + \varepsilon_{ivt} \end{array}$$

[17] We use this database because it is constructed for analytical purposes and thereby contains better information on applied tariffs than other sources. It also contains the *ad valorem* tariff equivalent of quotas and other kinds of tariffs. Quotas are important, for example for Norwegian export to the EU countries.

[18] The product dimension of these variables is given at six-digit HS level, whereas that of the dependent variables is given at the eight-digit level. We have chosen to operate with different aggregation levels in order to be able to correct for unobserved heterogeneity at the most disaggregated level possible (see below).

'where y_{ivt} indicates either $export_{ivt}$, $extensive_{ivt}$ or $intensive_{ivt}$. Our main explanatory variables of interest are sps_{ivt-1} and tbt_{ivt-1}. The vector $\mathbf{x}_{it}$ represents the set of control variables that vary only in the country dimension. $\mathbf{d}_t$ is a vector of year-dummies.

In our main estimation model we follow the tradition in the gravity literature of taking the natural logarithms y_{ivt}, and then estimating (22) using OLS. Unlike most other studies, we apply a within/fixed effects estimation, due to the possible incidence of unobserved heterogeneity across countries and products that is correlated with the other explanatory variables. [19] Such heterogeneity may arise due to differences across countries as to how committed they are to report correct notifications and at a sufficiently detailed level, or due to differences in demand and trading conditions not captured by the explanatory variables. For example, countries where consumers have strong preferences for a particular seafood product will have high demand for this product and may also be more concerned with the safety and quality of the product. These countries may therefore be more likely to impose an SPS on the product. In this case, unobserved consumer preferences for particular products would be positively correlated with the dependent variables as well as with the SPS variable. In the presence of such heterogeneity, estimating (22) using pooled OLS or random effects would yield biased coefficient estimates. In section 3.3.6 we perform a sensitivity test showing that there is in fact such correlation, necessitating the within/fixed effects estimation method. This approach implies assuming that the error term consists of two terms, $\varepsilon_{ivt}=e_{iv}+u_{ivt}$, where e_{iv} captures time-invariant differences between countries and products. The e_{iv} are then included as dummies in the OLS estimation of (22). The fixed effects are at the country-product level, which implies that we cannot include time-invariant country and product variables (including dummies), as these will be soaked up by the fixed effects.

Cross-sectional heteroscedasticity is a common problem in trade data (see e.g. Flam and Nordström, 2011). We therefore compute cluster-robust standard errors at the country level.[20] In other words, we assume that standard errors are independently, but not necessarily identically, distributed. This also allows for interdependence of intracountry errors such as serial correlation.

---

19 Also Buono and Lalanne (2012) use this method.

20 Cameron and Miller (2011) suggest several guidelines for determining the appropriate level of clustering. First, if one is interested in the estimated coefficient for an aggregated explanatory variable, one should cluster at the level of aggregation of that variable. Our main explanatory variables of interest are the SPS and TBT variables. As explained above, most of these are reported at the four-digit or two-digit HS product level. Second, clusters should be implemented at the most aggregate level where intracluster serial correlation is likely to occur. By clustering at the country level, we account for serial correlation both within countries and within country-product groups over time. See also Angrist and Pischke (2008), pp. 237–238.

It should be emphasised that that using the within/fixed effects estimation method implies looking for an impact on export of a given product to a given country over time. We do not investigate whether the level of Norwegian export is different in countries that impose SPSs and/or TBTs on particular products, but rather whether, on average, Norwegian export of a particular product to a particular country changes when the country imposes a TBT and/or SPS.

sps_{ivt}, tbt_{ivt} and $tariff_{ivt}$ may suffer from contemporaneous endogeneity: a positive shock to export may induce a country to impose an SPS or TBT or to raise tariffs. For this reason we lag these three variables one year. However, we might still have a problem with violation of the strict exogeneity assumption underlying the within/fixed effects model. This assumption requires the u_{ivt}s to be uncorrelated with the explanatory variables in any year. In the presence of contemporaneous endogeneity, lagging the endogenous variables will per definition lead to correlation between the errors in year t and the endogenous variables in year t+1 – which is a violation of the strict exogeneity assumption. There is also a potential problem with feedback going back more than one period: an unexpected positive shock to Norwegian export in period t may induce a country to impose an SPS, TBT or tariff in, say, year t+2. However, as pointed out by Wooldridge (2012, ch. 11.6), lagging variables that are contemporaneously endogenous will mitigate the endogeneity problem. Furthermore, given that contemporaneous exogeneity holds, violation of the strict exogeneity assumption is often less severe in the within/fixed effects model when the total number of time periods, T, is large (Wooldridge, 2012, pp. 323–324). In our analysis T=10, which is fairly large. However, in section 3.3.6 we perform a test of the strict exogeneity assumption, and do not find indications that the assumption is violated.[21]

Using the natural logarithm of $export_{ivt}$, $extensive_{ivt}$ or $intensive_{ivt}$ as dependent variables in our main estimation forces us to drop all observations where Norwegian export of a particular product to a particular country is zero (since the log of zero is not defined). Therefore, the main model may suffer from sample selection bias. UNCTAD and WTO (2012, ch. 3a and b) discuss various methods of including the zero trade flows in the gravity model. In section 3.3.6 we apply a panel version of the

21 Another alternative would be to estimate the model in first differences. As the within/fixed effects model, this model also allows for unobserved heterogeneity to be correlated with the explanatory variables. For example, Besedina (2015) applies a first-differences model investigating the impact of SPS and TBT measures for some exporting countries. In a gravity model of multiple exporters and importers Kohl (2013) finds that the strict exogeneity assumption is violated in a within model/fixed effects, but not in a first-differences model. He therefore chooses the latter. However, violation of the strict exogeneity assumption is often more severe in first-differences models than in fixed-effects models (Wooldridge 2012, pp. 323–324). Since we find no sign of violation of the strict exogeneity assumption in the estimation of (1), we choose the fixed effects approach.

Pseudo Poisson Maximum Likelihood method (PPML) proposed by Santos Silva and Tenreyro (2006) to allow for this. Our analysis indicates that the main results are fairly robust to the exclusion of the zero observations.

3.3.4. Sample characteristics

Due to lack of data for tariffs and some of the other variables, we include only data from 2001 to 2011. Furthermore, one year is used to construct lagged values of sps_{ivt}, tbt_{ivt} and $tariff_{ivt}$, so the sample period runs from 2002 to 2011. There is export to practically all countries in the world (176) and of 214 products at the eight-digit HS level during this period. However, the sample is restricted to WTO members, as these are the only countries for which we have data for SPS and TBT notifications. Seven countries joined the WTO during the sample period and are therefore not included in all years. As a consequence of WTO non-membership, observations amounting to approximately 13 per cent of the total Norwegian seafood export value throughout the sample period have been dropped. We also omit observations covering an additional 22 per cent of total export value due to lack of tariff data. Note, however, that results for sps_{ivt-1} and tbt_{ivt-1} are fairly robust to including these observations and at the same time dropping the tariff variable (see section 3.3.6). Our sample covers 64 per cent of total export value, and fresh products comprise 60 per cent of this. The sample consists of an unbalanced panel with 104 countries and 41 products.

In the main analysis presented in section 3.3.5, all observations indicating zero export drop out of the analysis, and the sample consist of 7 545 observations distributed on 1 532 country-product groups. By contrast, in the PPML analysis presented in section 3.3.6, only intragroup observations that are zero for all years are dropped, resulting in a near-doubling of the number of observations included.

3.3.5 Results: The main model

SPSs and TBTs

Results from our main model are shown in Table 2. The main explanatory variables of interest are sps_{ivt-1} and tbt_{ivt-1} (and their interactions with *fresh*). The Table clearly demonstrates direct negative impacts from sps_{ivt-1} on all dependent variables. If an importing country imposes an SPS on a given product, total Norwegian export of the product to the country is reduced by 31.2 per cent.[22] This reduction is due to the reduced number exporters as well as reduced exports per firm, the latter effect being somewhat greater than the former. Also TBTs have a negative impact on export, but significantly so only for $extensive_{ivt}$, and the effect is only about half of than that from SPSs: imposing a TBT is associated with an 8.4 per cent decrease in the number of exporters,

---

[22] To find the estimated percentage change in y_{ivt}, $\%\Delta\hat{y}_{ivt}$, associated with sps_{ivt-1} changing from 0 to 1, we must use the following formula: $\%\Delta\hat{y}_{ivt} = 100*(\exp\hat{\beta}^{sps} - 1)$, where $\hat{\beta}^{sps}$ is the estimated β^{sps} (Wooldridge (2003, p. 184).

whereas imposing an SPS is associated with a decrease of 15.8 per cent. The results from the direct effects clearly show that after a country imposed a food standard, Norwegian export was reduced. The negative (insignificant) estimated coefficient for sps_{ivt-1} (tbt_{ivt}) in the estimation of $intensive_{ivt}$ indicates that SPSs and TBTs mainly represent variable costs of trade (see discussion of Table 1 in section 2). These results are in accordance with survey evidence, which reveal fairly low fixed export costs for Norwegian seafood exporters (Medin and Melchior, 2002).

Whereas the SPS and TBT variables reflect the direct effects for the whole sample, their interactions with *fresh* show large differences across products. Estimated coefficients for both interaction terms are positive and significant in the estimation of all three dependent variables (albeit only at 10 per cent level for tbt_{ivt-1}*$fresh$ in the estimation of $export_{ivt}$ and $intensive_{ivt}$. In fact, for SPSs the estimated effects from the interaction terms are sufficiently large to more than cancel out the direct negative effects. The size of the estimated coefficients reveals that for fresh seafood products, the net increase in total export associated with a country imposing an SPS is as much as 57.1 per cent. Furthermore, the effect on $intensive_{ivt}$ is almost three times larger than the effect on $extensive_{ivt}$. Thus we see that, despite the overall trade-reducing effects, SPSs are trade-enhancing for fresh seafood products. Food standards are probably especially important for such products, as a guarantee of quality and safety. A plausible explanation for our result is therefore that SPSs serve to reduce consumer uncertainty about the quality and safety of fresh seafood products, and thereby increase demand.[23]

That being said, we should not interpret the result to say that SPSs are *always* export-promoting for fresh products. There have been cases where SPS controls and delays have hindered the export of fresh seafood and caused losses – as with fresh salmon exports to Russia from 2006 (Holm and Kokkvoll, 2007) or to China after 2010 (Chen and Garcia, 2015). These cases are not represented in the data: Russia because it was not a WTO member until 2012 and is therefore not included in the SPS/TBT dataset, and China because the notification data do not count unofficial measures like those imposed on Norway after 2010.

In general, the estimated coefficients for tbt_{ivt-1} are less significant than those for sps_{ivt-1}. This is probably due to low variation in the TBT variable: only 2.5 per cent of the observations vary over time, and only these will contribute to the estimation of the coefficients for tbt_{ivt-1} (due to the

---

23 Also note that for the main export market for Norwegian seafood, the EU, there is a strict SPS regime that Norway is part of; this regime may facilitate exports of fresh salmon to the EU. However, our results are not driven by the EU countries: excluding these countries from the data still yields significantly positive net effects from sps_{ivt-1} on $export_{ivt-1}$ and $extensive_{ivt-1}$.

fixed effects/within approach). For sps_{ivt-1}, on the other hand, 26.5 per cent of observations vary over time, and these also consist of diversified countries and products.

Other variables
Increased tariffs have a negative influence on total exports and the number of exporters, but there is no indication of an influence on average exports. This is consistent with the Chaney (2008) model with Pareto-distributed firm productivity (see footnote 10 and Lawless, 2010), or with a model where firms have equal productivity (see Medin, 2013). Buono and Lalanne (2012) investigate the effect of tariff reductions on the extensive and intensive margins of French exporters 1993–2002 using a within/fixed effects estimation as we do. They find that increased tariffs are associated with a decrease in the intensive margin, but not the extensive margin. Hence they conclude that tariff reductions following the Uruguay Round did not help new firms starting to export: they only helped incumbent exporters to export more. Here, we find exactly the opposite: reduced tariffs can indeed be an important policy tool for encouraging firms to export to new markets.

The coefficients for FTAs, whether the EEA or others, are not significant for any of the dependent variables (perhaps except for the estimated coefficient for fta_{it}, significant at the 10 per cent level in the estimation of $extensive_{ivt}$). This indicates that effects from FTAs beyond those from tariff reductions do not influence exports. Other studies vary as regards the effects of FTAs on trade. Kohl (2013) presents a survey of empirical studies using gravity analysis, and finds no effect from FTAs on trade in almost 65 per cent of the cases investigated. Moreover, only about one quarter of the agreements lead to increased trade, and 10 per cent actually had a negative impact.

As to the remaining control variables, there are no significant effects from better regulatory quality, increased costs of importing a container, or a depreciation of the NOK. We find that GDP influences all margins of trade positively, as expected. GDP per capita has a negative influence on total export and $intensive_{ivt}$, and per capita consumption of seafood has a positive impact on $extensive_{ivt}$.

Within R^2 is quite low, ranging from 4–10 per cent. However, R^2 is expected to be low in gravity analyses at such a disaggregated level.

Table 2. Results from within/fixed effects regression

Variable	$\ln(export_{ivt})$	$\ln(extensive_{ivt})$	$\ln(intensive_{ivt})$
sps_{ivt-1}	-0.374***	-0.172***	-0.202**
	(0.110)	(0.052)	(0.084)
sps_{ivt-1} * fresh	0.826***	0.301***	0.525***
	(0.225)	(0.067)	(0.200)
tbt_{ivt-1}	-0.103	-0.088***	-0.015
	(0.098)	(0.032)	(0.085)
tbt_{ivt-1} * fresh	0.318**	0.070*	0.248*
	(0.146)	(0.039)	(0.125)
$\ln(tariff_{ivt-1})$	-1.487**	-0.631***	-0.855
	(0.601)	(0.166)	(0.659)
fta_{it}	0.350	0.139*	0.211
	(0.238)	(0.080)	(0.169)
eea_{it}	-0.085	-0.129	0.044
	(0.230)	(0.086)	(0.177)
$regqual_{it}$	0.184	0.033	0.151
	(0.187)	(0.085)	(0.164)
$\ln(impcosts_{it})$	0.026	-0.031	0.057
	(0.505)	(0.155)	(0.464)
$\ln(gdp_{it})$	2.244***	0.578**	1.666***
	(0.382)	(0.250)	(0.290)
$\ln(cgdp_{it})$	-1.321***	-0.242	-1.079***
	(0.361)	(0.253)	(0.226)
$\ln(cons_{it})$	0.188	0.286***	-0.098
	(0.252)	(0.096)	(0.204)
$gexch_{it}$	-0.001	0.000	-0.001
	(0.002)	(0.001)	(0.001)
constant	-35.469***	-12.808***	-22.661***
	(7.387)	(4.370)	(5.506)
No obs	7,545	7,545	7,545
R^2	0.041	0.097	0.045
No group	1,532	1,532	1,532

Note: $export_{ivt}$ = export value of product v to country i, $extensive_{ivt}$ = number of firms exporting product v to country i, and $intensive_{ivt}$ = their average export value. Estimation method: within/fixed effects OLS (fixed effects at the country-product level). Year-dummies included, but not reported. Std. dev. in parentheses (cluster robust errors with clustering at country level). *, **, *** indicate significance level at 10% , 5% and 1%, respectively.

3.3.6. Results: Robustness checks

In order to test the robustness of the results, especially regarding the impact of SPSs and TBTs, we have run some alternative estimations of (22). Here we give a brief description; detailed results are reported in Appendix 3.

Firstly, we test for sample selection bias by investigating how sensitive the results from the main model are to including the zero trade flows (see section 3.3.3). We apply a panel PPML method, where we, unlike in the main model, use $export_{ivt}$, $extensive_{ivt}$ and $intensive_{ivt}$ as dependent variables, not their logs. The model therefore includes the zero trade flows in a natural way. We use fixed effects/within estimation to correct for time-invariant unobserved heterogeneity at the country-product level, just as in the main model.[24] The results are fairly similar to those from the main model, in terms of sign and significance, especially for sps_{ivt-1} and its interaction with *fresh*.[25] (See Table A3 for details.) The most important difference is that in the PPML model the estimated coefficient for sps_{ivt-1} is not significant in the estimation of $export_{ivt}$. However, it is significant in the estimation of $extensive_{ivt}$ as well as $intensive_{ivt}$, so we do not consider this a major deviation. Furthermore, the estimated coefficients for tbt_{ivt} and its interaction with *fresh* are more often significant and also somewhat larger in the PPML model. For the other explanatory variables, effects are similar in the two models. These results indicate that sample selection bias due to the omission of zero trade flows in the main model is not severe, despite the large number of such flows. Also other scholars have found small selection bias in gravity models (Helpman et al., 2008; Santos Silva and Tenreyro, 2006).

Secondly, we look into the assumption of strict exogeneity implied by the within/fixed effects approach. As pointed out in section 3.3.3, there might be a problem with feedback from sps_{ivt-1}, tbt_{ivt-1} and $tariff_{ivt-1}$. To check for possible violations of the assumption of strict exogeneity, we follow the procedure proposed by Wooldridge (2012, p. 325) and run a regression including the leads of sps_{ivt-1}, tbt_{ivt-1} and $tariff_{ivt-1}$. In other words, we estimate the following equation using within/fixed effects:

---

[24] In the PPML estimation we cluster at country-product level rather than country level as in the main analysis, because Stata estimation of the fixed effects PPML model allows only for clustering at the same level as the fixed effects.

[25] In the PPML estimation $E(y_{ivt}|z_{ivt})=\exp(\alpha+\beta z_{ivt})$, where z_{ivt} is a vector of the independent variables and β is the coefficient vector. Consequently, when a z_{ivt} is given in log, the corresponding β reflects the elasticity, just as in the log-log OLS model (Wooldridge, 2012, p. 726).

$$(23)\quad \begin{aligned} &\ln\left(y_{ivt}\right) = \alpha + \beta^{sps} sps_{ivt-1} + \beta^{sps*fresh} sps_{ivt-1} * fresh + \beta^{tbt} tbt_{ivt-1} + \beta^{tbt*fresh} tbt_{ivt-1} * fresh \\ &+\beta^{tarff} \ln\left(tariff_{ivt-1}\right) + \beta^{'sps} sps_{ivt} + \beta^{'sps*fresh} sps_{ivt} * fresh + \beta^{'tbt} tbt_{ivt} \\ &+\beta^{'tbt*fresh} tbt_{ivt} * fresh + \beta^{'tarff} \ln\left(tariff_{ivt}\right) + \boldsymbol{\gamma}\mathbf{x_{it}} + \mathbf{d_t} + \varepsilon_{ivt} \end{aligned}$$

Detailed results are reported in Table A4; neither of the estimated β's proves significant. Although this cannot be taken as evidence that strict exogeneity holds, at least it does not indicate any violation of the strict exogeneity assumption. See also Baier and Bergstrand (2007) and Kohl (2013) for discussion of endogeneity problems in gravity models.

Thirdly, we check whether two alternative treatments of the tariff variable influence the results from the main analysis. In the first, we estimate (22) without the $tariff_{ivt-1}$ variable. This leads not only to a substantial increase the total export value covered by the sample, but also to a large increase in the number of eight-digit HS products included: from 41 to 216. Also the number of countries covered by the sample increases, from 110 to 118 (see section 3.3.4). Detailed results, provided in Table A5, show that the effects of sps_{ivt-1}, tbt_{ivt-1} and their interaction with *fresh* are similar to those from the main model. However, they are significant somewhat less often, especially for tbt_{ivt-1}; and estimated coefficients are somewhat smaller. In the second, we estimate (22) for the years 2002–2007 only: this means we do not have to make use of the extrapolated tariffs, only the interpolated ones, which may be more reasonable (see section 3.3.2). Also here, the estimated coefficients for sps_{ivt-1} and tbt_{ivt-1} are similar to those for the main analysis, in terms of significance as well as size. Furthermore, estimated coefficients for the other dependent variables are similar to those from the main analysis (see Table A6 for details). All in all, the two alternative treatments of the tariff variable indicate that the results from the main analysis are fairly robust, especially for sps_{ivt-1}. Results for tbt_{ivt-1} are slightly more sensitive – but also in the main analysis, results for this variable are weaker.

Fourthly, we check whether it would be adequate to use a pooled or a random-effects estimation of (22) instead of the within/fixed effects estimation applied in the main model. In that case the estimated coefficients would reflect differences in SPS and TBT across countries as well as within countries over time.[26] However, in order for estimates to be unbiased, such estimations require the unobserved heterogeneity term (e_{iv}) to be uncorrelated with the other explanatory variables (see section 3.3.3). To test whether there is correlation between e_{iv} and the explanatory variables, we add the time-invariant means of all the independent variables to equation (22) and then estimate it using random effect as

[26] The coefficients from a random-effects estimation are weighted averages between those from a within estimation and those from a between estimation.

in Mundlak (1978) (also see Wooldridge, 2012, p. 332).[27] We find that several of the estimated coefficients for the time-invariant means are significant, indicating correlation (see Table A7 for details) [28]

---

27 In this estimation we include three additional control variables because country-specific effects are no longer captured by the fixed effects (see Appendix 3 for details). As in the main model, we cluster at the country level.

28 Similar results are found in other studies (see e.g. Egger, 2000).

4. Conslusions

In research on international food standards, several recent studies have indicated that the impact of food standards on trade differs across sectors or products. Food standards may act as barriers to trade, but they may also lead to increased trade. This paper has reviewed the evidence, presenting a model where possible explanations of this ‘dual face’ of food standards are addressed, and has offered new empirical evidence on the impact of food standards for Norwegian seafood export.

The explanation suggested for a positive relationship between food standards and trade is that compliance with standards leads to increases in demand. Standards may entail quality upgrades, or may reduce consumer uncertainty about quality and safety of food products. Furthermore, they may improve the competitive advantage of developed countries like Norway, since such countries can be assumed to have better capacity than others for complying with standards.

In the empirical analysis we employed data for Norwegian firm-level seafood export to different markets (i.e. product-country combinations). First, we presented descriptive evidence showing that already existing exporters accounted for most the change in total exports. We also noted massive churning in the markets, with large entry and exit; but these cancel out, so the net impact of entry was modest. Second, we presented a regression analysis investigating how food standards influence total export to a market as well as the number of exporters (the extensive margin) and their average export (the intensive margin). WTO notification data on SPS and TBT were used; the results indicate that these mainly represent increased variable export costs, not fixed ones. On the whole SPSs and TBTs are shown to have a negative impact on exports. However, the impact is heterogeneous across products; and for export of fresh seafood, SPSs have a positive net impact. These results are in line with other studies that indicate that the impact of food standards is heterogeneous across products. Further research should be conducted in order to trace the exact mechanisms underlying this apparently contradictory evidence. Another interesting point for future research is how firm survival over time is affected by standards and non-tariff barriers.

Acknowledgements

We thank Elena Besedina for useful comments, Marcus Gjems Theie for data preparation assistance, and Susan Høivik for excellent copyediting. Research was funded by the Research Council of Norway, project 216742 'Non-tariff barriers, food safety and international food trade'.

References

Angrist J.D. and J.S. Pischke (2008) *Mostly Harmless Econometrics: An Empiricist's Companion,* Princeton University Press

Bacchetta, M., J. Richtering and R. Santana (2012) How much light do WTO notifications shed on NTMs? Chapter 2, pp. 23–55 in O. Cadot and M. Malouche (eds), *Non-Tariff Measures – A Fresh Look at Trade Policy's New Frontier*, Washington DC: Centre for Economic Policy Research (CEPR) and The World Bank, available at www.worldbank.org.

Baier, S. L. and J. H. Bergstrand (2007) Do free trade agreements actually increase members' international trade? *Journal of International Economics* 71(1), 72–95.

Besedina, E. (2015) Technical barriers to trade and SPS measures and exports dynamics. Oslo: Norwegian Institute of International Affairs, Working Paper No. 842.

Buono, I. and G. Lalanne (2012) The effect of the Uruguay round on the intensive and extensive margins of trade, *Journal of International Economics* 86, 269–283.

Cameron, A. C. and D. L. Miller (2011) Robust inference with clustered data, in A. Ullah and D. E. Giles (eds), *Handbook of Empirical Economics and Finance*, Boca Raton FL: CRC Press, 1–28.

Casella, A. (1996) Free trade and evolving standards, Chapter 3, pp. 119–156 in J.N. Bhagwati and R.E. Hudec (eds), *Fair Trade and Harmonization. Prerequisites for Free Trade?* Vol. 1 Economic Analysis. Cambridge MA: The MIT Press.

Chaney, T. (2008) Distorted gravity: the intensive and extensive margins of international trade, *American Economic Review* 98(4), 1707–1721.

Chen, M.X., J.S. Wilson and T. Otsuki (2008) Do standards matter for export success?, *Journal of International Trade and Economic Development* 17(4), 501–523

Chen, X. and R. J. Garcia (2015) China's salmon sanctions, Oslo: Norwegian Institute of International Affairs, Working Paper No. 845.

Deardorff, A.V. and R.M. Stern (1998) *Measurement of Nontariff Barriers*, Ann Arbor, MI: University of Michigan Press.

Disdier, A-C, L. Fontagné and M. Mimouni (2008) The impact of regulations on agricultural trade: evidence from the SPS and TBT agreements, *American Journal of Agricultural Economics* 90(2), 336–350.

Disdier, A.-C. and S. Marette (2010) The combination of gravity andwelfare approaches for evaluating nontariff measures, *American Journal of Agricultural Economics* 92(3), 713–726.

Disdier, A. And F. van Tongeren (2010) Non-Tariff Measures in Agri-Food Trade: What Do the Data Tell Us? Evidence from a Cluster Analysis on OECD Imports, *Applied Economic Perspectives and Policy*, Agricultural and Applied Economics Association, vol. 32(3), pages 436-455.

Egger, P. (2000) A note on the proper econometric specification of the gravity equation, *Economics Letters* 66(1), 25–31.

Felbermayr, G. and W. Kohler (2010) Modelling the extensive margin of world trade: new evidence on GATT and WTO membership, *The World Economy* 33(11), 1430–1469.

Flam, H. and H. Nordström (2011) Gravity estimation of the intensive and extensive margins of trade: an alternative procedure with alternative data, Munich: CESifo working paper, Trade Policy, No. 3387. http://www.econstor.eu/handle/10419/46475 (23.09.14).

Gourdon, J. and A. Nicita (2012) NTMs: interpreting the new data, Chapter 3, pp. 57–79, in O. Cadot and M. Malouche (eds), *Non-Tariff Measures: A Fresh Look at Trade Policy's New Frontier*, World Bank & CEPR.

Helpman, E. and Krugman, P. (1985) *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy,* Cambridge, MA: MIT Press.

Henson, S., A. Brouder and W. Mitullah (2000) Food safety requirements and food exports from developing countries: the case of fish exports from Kenya to the European Union, *American Journal of Agricultural Economics* 82(5) (Proceedings Issue), 1159–1169.

Holm, P. and K. Kokkvold (2007) *Norsk sjømateksport til Russland. Karttlegging og vurdering av handelsrestriksjoner i russisk matimport,* Project Report, January 2007, Norges fiskerihøyskole (Arctic University of Norway, Tromsø).

Jaffee, S. and S. Henson (2004) Standards and agro-food exports from developing countries: rebalancing the debate. Policy Research Working Paper 3348, Washington, DC: The World Bank.

Jaud, M., O. Cadot and A. Suwa-Eisenmann (2012) Sanitary risk and concentration in EU food imports, Chapter 6, pp. 117–140 in O. Cadot and M. Malouche (eds), *Non-Tariff Measures – A Fresh Look at Trade Policy's New Frontier,* Washington DC: Centre for Economic Policy Research (CEPR) and The World Bank, available at www.worldbank.org.

Kee, H. L., A. Nicita and M. Olarreaga (2009) Estimating trade restrictiveness indices, *Economic Journal* 119(1), 172–199.

Kneller, R., M. Pisou and Z. Yu (2008) Overseas business costs and firm export performance, *Canadian Journal of Economics* 41(2), 639–669.

Kohl, T. (2013) Do we really know that trade agreements increase trade? *Review of World Economics* 150(3), 443–469.

Lawless, M. (2010) Deconstructing gravity: trade costs and extensive and intensive margins, *Canadian Journal of Economics* 43(4), 1149–1172.

Leland, H.E. (1979) Quacks, lemons, and licensing: a theory of minimum quality standards, *Journal of Political Economy* 87(6), 1328–1346.

Mangelsdorf, A., J. S. Wilson and A. Portugal-Perez (2012) Do better standards facilitate exports? Evidence from China, Chapter 7, pp. 141–154 in O. Cadot and M. Malouche (eds), *Non-Tariff Measures – A Fresh Look at Trade Policy's New Frontier*, Washington DC: Centre for Economic Policy Research (CEPR) and The World Bank, available at www.worldbank.org.

Mayer, T. and S. Zignago (2011) Notes on CEPII's distances measures (GeoDist). CEPII Working Paper 2011– 25, December 2011. Paris: CEPII.
http://www.cepii.fr/CEPII/en/publications/wp/abstract.asp?NoDoc=3877 (15.06.2015)

Medin, H., (2013) The reverse home-market effect in export. A cross-country study of the extensive margin of exports, NUPI Working Paper 826. Oslo: Norwegian Institute of International Affairs.

Medin, H. and A. Melchior (2002) Learning, networks and sunk costs in international trade: evidence from Norwegian seafood exports, NUPI Report No. 272. Oslo: Norwegian Institute of International Affairs.

Melitz, M.J. (2003) The impact of trade on intraindustry reallocations and aggregate industry productivity, *Econometrica* 71(6), 1695–1725.

Mundlak, Y. (1978) On the pooling of time series and cross section data, *Econometrica* 46(1), 69–85.

Otsuki, T., Wilson, J., and M. Sewadeh (2001) Saving two in a billion: quantifying the trade effect of European food safety standards on African exports, *Food Policy* 26(5), 495–514.

Santos Silva, J.M.C., and S. Tenreyro (2006) The log of gravity, *Review of Economics and Statistics* 88(4), 641–658.

Shepotylo, O. (2015) Effect of non-tariff measures on extensive and intensive margins of export in seafood trade. NUPI Working Paper 856. Oslo: Norwegian Institute of International Affairs.

Teisl, M.F., B. Roe and R.L. Hicks (2002) Can eco-labels tune a market? Evidence from dolphin-safe labeling, *Journal of Environmental Economics and Management* 43(3), 339–359.

Thilmany, D.D. and C. B. Barrett (1997) Regulatory barriers in an integrating world food market, *Review of Agricultural Economics* 19(1), 91–107.

UNCTAD and WTO (2012) A Practical Guide to Trade Policy Analysis. http://vi.unctad.org/tpa/ (23.09.2014).

van Tongeren, F., A. Disdier, J. Komorowska, S. Marette and M. Lampe (2010) Case studies of costs and benefits of non-tariff measures: cheese, shrimp and flowers, OECD Food, Agriculture and Fisheries Papers No. 28. http://dx.doi.org/10.1787/5kmbt57jjhwl-en (15.06.2015).

Venables, A. J. (1987) Trade and trade policy with differentiated products: A Chamberlinian-Ricardian Model, *The Economic Journal*, 97(387), 700–717.

Wei, G., J. Huang and J. Yang (2012) The impacts of food safety standards on China's tea exports, *China Economic Review* 23(2), 253–264.

Wooldridge, J.M. (2003) *Introductory Econometrics: A Modern Approach,* 2nd edition, Mason, OH: Thomson South-Western.

Wooldridge, J.M. (2012) Econometric Analysis of Cross Sectional and Panel Data, Cambridge, MA: MIT Press.

WTO (2012) World trade report 2012. Trade and public policies: a closer look at non-tariff measures in the 21st century, Geneva: World Trade Organization. https://www.wto.org/english/res_e/publications_e/wtr12_e.htm (16.06.2015).

Xiong, B. and J. Beghin (2014) Disentangling demand-enhancing and trade-cost effects of maximum residue regulations, *Economic Inquiry*, Western Economic Association International, 52(3), 1190–1203.

Appendix 1. Descriptive data

Table A1: Key figures for Norway's exports of seafood 1996–2013. Value figures in 2013 NOK (using the GDP deflator)

Year	Export value, total	Exporters	Average value per exporter	No of countries exported to	Average no. of countries per exporter
	Billion NOK	Number	Mill. NOK	Number	Number
1996	38.0	516	19.0	162	6.99
1997	40.7	500	20.4	151	7.15
1998	44.8	489	22.4	142	7.32
1999	46.1	468	23.1	143	7.60
2000	47.2	473	23.6	146	7.88
2001	44.2	484	22.1	154	7.60
2002	40.5	509	20.2	143	7.37
2003	36.2	521	18.1	150	7.04
2004	37.9	515	18.9	145	7.11
2005	41.9	499	20.9	139	7.00
2006	44.6	477	22.2	132	7.22
2007	44.4	463	22.1	132	7.12
2008	42.7	467	21.3	132	6.79
2009	48.4	439	24.1	135	7.34
2010	56.6	510	28.2	132	6.41
2011	55.9	527	27.8	124	6.26
2012	54.1	530	26.9	133	6.37
2013	61.9	412	30.7	137	7.79

Table A2. Description and key data for 53 product groups.

HS8 classi-fication	Short description	Export value (million 2013 NOK)		Annual growth rate (%)	Accumulated change in export (million 2013 NOK) 1996–2013 for:				
		1996	2013		Exports	Intensive margin (in-cumbent exporters)	Exit of firms	Entry of firms	Net entry or exit
3021101	Fish-farm bred trout, fresh	37	1557	24.5	1519	1169	1315	1666	350
3021201	Fish-farm bred salmon, fresh	8547	31642	8.0	23095	22757	11116	11455	338
3022102	Halibut, excl. Greenland halibut, fresh	12	115	14.0	103	62	94	135	41
3024003	North Sea herring, fresh	154	121	-1.4	-33	-106	255	327	73
3024004	Other herring, fresh	207	5	-19.6	-202	-180	186	164	-22
3025000	Cod, fresh	384	882	5.0	498	666	1013	845	-168
3026200	Haddock, excl. livers and roes, fresh	171	253	2.3	82	85	301	297	-4
3026300	Coalfish, fresh	269	71	-7.6	-199	-151	286	239	-47
3026903	Red fish, fresh	178	41	-8.3	-137	-108	155	126	-29
3026906	Angler fish, fresh	33	74	4.9	41	32	175	184	9
3032101	Fish-farm bred trout, frozen	668	602	-0.6	-66	-123	2701	2758	57
3032201	Fish-farm bred salmon frozen	1106	1396	1.4	290	177	4314	4428	114
3033101	Greenland halibut, frozen	458	350	-1.6	-108	-83	1535	1509	-25
3035002	Other herring incl.'mussa', frozen	714	1314	3.7	601	64	3155	3691	536
3035003	North Sea herring, frozen	727	200	-7.3	-527	-390	1262	1124	-138
3036000	Cod, frozen	302	1352	9.2	1049	617	1880	2312	433
3037200	Haddock, frozen	318	848	5.9	531	405	1074	1200	126
3037300	Coalfisk, frozen	112	240	4.6	128	73	950	1006	55
3037401	Mackerel <600g, frozen	2292	2690	0.9	398	102	3526	3822	296
3037402	Mackerel >600g, frozen	653	52	-13.8	-601	-637	1199	1236	36
3037902	Red fish, frozen	107	42	-5.4	-65	-76	583	594	11
3038000	Livers and roes	36	94	5.9	59	-41	360	459	100
3041002	Fillets of cod, fresh	87	307	7.7	219	535	896	580	-316
3041005	Fillets of salmon, fresh	772	3831	9.9	3059	2606	1893	2346	453
3042002	Fillets of haddock, frozen	626	119	-9.3	-508	-265	834	591	-243
3042003	Fillets of cod, frozen	2282	488	-8.7	-1795	-580	3959	2744	-1215
3042004	Fillets of coalfish, frozen	713	92	-11.4	-621	-352	1049	780	-269
3042005	Fillets of herring, frozen	788	419	-3.7	-370	-294	1285	1210	-76
3042010	Fillets of salmon, frozen	1007	2386	5.2	1379	1165	3123	3337	214

HS8 classi-fication	Short description	Export value (million 2013 NOK)		Annual growth rate (%)	Accumulated change in export (million 2013 NOK) 1996–2013 for:				
		1996	2013		Exports	Intensive margin (in-cumbent exporters)	Exit of firms	Entry of firms	Net entry or exit
3053003	Salted fillets of herring	53	81	2.6	29	32	95	91	-3
3053004	Salted fillets of cod	198	25	-11.5	-173	-34	550	411	-139
3053005	Salted fillets of ling	29	45	2.7	16	-41	222	279	57
3053008	Dried ling	90	25	-7.3	-65	-89	130	154	24
3054100	Smoked salmon	309	192	-2.8	-117	-28	807	718	-89
3054900	Smoked fish excl. salmon or herring	105	128	1.2	23	30	157	150	-7
3055103	Smoked Lofoten round cod	523	403	-1.5	-120	-232	591	703	113
3055107	Klipfish, cod	2485	1578	-2.6	-907	-791	1937	1821	-116
3055903	Klipfish, coalfish	739	1200	2.9	461	235	941	1167	226
3055905	Klipfish, tusk	288	131	-4.5	-157	-140	256	240	-16
3055906	Klipfish, ling	276	105	-5.6	-172	-138	359	325	-34
3056200	Cod, salted but not dried	1970	660	-6.2	-1309	-1055	2699	2445	-254
3056902	Coalfish, salted but not dried	82	19	-8.2	-63	-133	395	465	71
3061301	Raw shrimps, frozen	237	4	-20.9	-233	-60	910	738	-172
3061302	Boiled shrimps, frozen	41	33	-1.2	-8	-30	371	393	22
3061400	Crabs, frozen	17	138	13.2	121	4	376	493	118
15042031	Herring oil and other fish oils for feed	373	643	3.3	270	175	991	1086	96
15161020	Fish fats and oils, not for feed purposes	520	259	-4.0	-262	-490	1493	1721	229
16041206	Prepared herring, vinegar-cured	57	172	6.7	114	69	49	95	46
16041301	Sardines etc., smoked and preserved	194	1	-27.0	-193	-78	202	87	-115
16042006	Sweet or salt cured roes, frozen	86	9	-12.4	-77	-21	227	172	-56
16052001	Shrimps, shelled and frozen	997	3	-28.8	-994	-662	1359	1027	-332
16052002	Shrimps, shelled and in brine	84	155	3.7	71	81	180	170	-10
23012010	Flours, meals and pellets of fish, for feed	589	223	-5.5	-365	-696	1172	1502	331
Sum 53 products		34100	57813	3.2	23713	23032	66940	67621	681
Total seafood exports		38020	61879	2.9					

Appendix 2. Detailed description of control variables

$tariff_{ivt}$ is taken from the MacMap database, which includes information on applied *ad valorem* tariffs against Norway for each importing country and product at the six-digit HS level.[29] $tariff_{ivt}$ is reported as 1 + the share, thus $tariff_{ivt}$ = 1.01 reflects a one percent *ad valorem* tariff rate. In the data, tariffs for the new EU member states prior to their entry into the EU in 2004 and 2007 are erroneously set equal to the EU level. With the exception of Malta and Cyprus, Norway had free trade agreements with these countries prior to their joining the EU, so we change their tariffs to zero.[30, 31] eea_{it} and fta_{it} are taken from the Norwegian Ministry of Trade, Industry and Fisheries.[32] The variables are set equal to 1 from year t and onwards if the FTA entered into force during the first half of year t, and 0 otherwise. $impcost_{it}$ is taken from the Doing Business database; data are available from year 2005.[33] We set values prior to 2005 equal to the 2005 level. $regqual_{it}$, $gexch_{it}$, gdp_{it} and $cgdp_{it}$ are provided by The World Bank's Governance Indicators (WGI).[34] $cons_{it}$ is taken from the Food and Agriculture Organization of the United Nations (FAO).[35] In the analysis presented in Table A7 we also include three time-invariant trade costs variables: a dummy for landlocked countries ($landlocked_i$), distance from Norway ($dist_i$), and average distance to the rest of the world ($remoteness_i$).[36] Data are taken from the CEPII database *dist_cepii* (Mayer and Zignago, 2011). For $dist_i$ and $remoteness_i$ we use the Great Circle distance measured in kilometres between largest cities (the $dist_i$ variable). In the analyses, we take the natural logarithm of $tariff_{ivt}$, $impcost_{it}$, gdp_{it}, $cgdp_{it}$, $dist_i$, and $remoteness_i$.

---

29 For a further description of the data, see http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=12

30 Regression results are robust to other methods, such as not changing the rates set in the data.

31 We exclude all other countries for which tariffs are lacking some years.

32 http://www.regjeringen.no/en/dep/nfd/selected-topics/free-trade/partner-land.html?id=438843

33 http://www.doingbusiness.org/data/exploretopics/trading-across-borders

34 http://info.worldbank.org/governance/wgi/index.aspx#home. WDI lacks data for $gexch_{it}$ for some countries, in which case we use data from the Central Bank of Norway instead. http://www.norges-bank.no/en/Statistics/exchange_rates/. gdp_{it} and $cgdp_{it}$ are given in current NOK

35 http://faostat.fao.org/site/610/default.aspx#ancor.

36 $remotense_i$ is defined as $\frac{1}{n}\sum_{j=1}^{n} d_{ij}$, where d_{ji} is distance from country i to country j, and n is the number of countries. Internal distance d_{ij} is set equal to the square root of the country's area multiplied by about 0.4.

Appendix 3. Results from robustness checks from within regression

A3. Including zero trade flows

Variable	$export_{ivt}$	$extensive_{ivt}$	$intensive_{ivt}$
sps_{ivt-1}	-0.337	-0.177***	-0.308**
	(0.217)	(0.054)	(0.130)
sps_{ivt-1} * fresh	1.013***	0.260***	0.678***
	(0.358)	(0.095)	(0.223)
tbt_{ivt-1}	-0.345***	-0.141***	-0.151*
	(0.128)	(0.038)	(0.083)
tbt_{ivt-1} * fresh	0.522***	0.128***	0.394***
	(0.085)	(0.040)	(0.088)
ln($tariff_{ivt-1}$)	-0.983	-0.640***	-0.623
	(0.862)	(0.179)	(0.483)
fta_{it}	0.385**	0.210***	0.133
	(0.152)	(0.074)	(0.166)
eea_{it}	0.696**	-0.091	0.357
	(0.342)	(0.104)	(0.283)
$regqual_{it}$	-0.112	0.035	-0.046
	(0.151)	(0.078)	(0.204)
ln ($impcosts_{it}$)	-0.645	-0.086	-0.263
	(0.434)	(0.191)	(0.362)
ln(gdp_{it})	2.901**	0.701***	2.618**
	(1.164)	(0.173)	(1.044)
ln($cgdp_{it}$)	-2.115*	-0.172	-2.010**
	(1.253)	(0.171)	(1.018)
ln($cons_{it}$)	0.577*	0.356***	-0.049
	(0.304)	(0.099)	(0.194)
$gexch_{it}$	-0.002	-0.001	-0.002
	(0.003)	(0.001)	(0.003)
No obs	15,036	15,036	15,036
No group	1,532	1,532	1,532

Note: $export_{ivt}$ = export value of product v to country i, $extensive_{ivt}$ = number of firms exporting product v to country i, and $intensive_{ivt}$ = their average export value. Estimation method: within/fixed effects poisson maximum likelihood (fixed effects at the country-product level). Year-dummies included, but not reported. Std. dev. in parentheses (cluster robust errors with clustering at country-product level). *, **, *** indicate significance level at 10%, 5% and 1%, respectively.

A4. Including leads of possible endogenous variables

Variable	ln ($export_{ivt}$)	ln ($extensive_{ivt}$)	ln ($intensive_{ivt}$)
sps_{ivt-1}	-0.333***	-0.168***	-0.165*
	(0.127)	(0.059)	(0.087)
sps_{ivt-1} * fresh	0.582**	0.270***	0.312
	(0.282)	(0.076)	(0.240)
tbt_{ivt-1}	-0.077	-0.054	-0.023
	(0.091)	(0.033)	(0.082)
tbt_{ivt-1} * fresh	0.199	0.016	0.183
	(0.147)	(0.047)	(0.141)
ln($tariff_{ivt-1}$)	-1.000	-0.813**	-0.187
	(0.713)	(0.364)	(0.584)
sps_{ivt}	-0.047	-0.002	-0.045
	(0.112)	(0.053)	(0.090)
sps_{ivt} * fresh	0.357	0.037	0.319
	(0.292)	(0.071)	(0.266)
tbt_{ivt}	-0.026	-0.048	0.022
	(0.121)	(0.040)	(0.101)
tbt_{ivt} * fresh	0.150	0.069	0.081
	(0.203)	(0.054)	(0.179)
ln($tariff_{ivt}$)	-0.531	0.214	-0.745
	(0.815)	(0.335)	(0.673)
fta_{it}	0.356	0.138*	0.219
	(0.241)	(0.081)	(0.171)
eea_{it}	-0.112	-0.128	0.016
	(0.275)	(0.103)	(0.207)
$regqual_{it}$	0.193	0.033	0.160
	(0.187)	(0.087)	(0.164)
ln($impcosts_{it}$)	0.027	-0.033	0.061
	(0.501)	(0.155)	(0.460)
ln(gdp_{it})	2.242***	0.571**	1.671***
	(0.378)	(0.246)	(0.290)
ln($cgdp_{it}$)	-1.310***	-0.239	-1.072***
	(0.353)	(0.249)	(0.223)
ln($cons_{it}$)	0.189	0.282***	-0.093
	(0.249)	(0.097)	(0.201)
$gexch_{it}$	-0.001	0.000	-0.001
	(0.002)	(0.001)	(0.002)
constant	-35.572***	-12.634***	-22.938***
	(7.314)	(4.277)	(5.527)
No obs	7,545	7,545	7,545
R^2	0.041	0.098	0.046
No group	1,532	1,532	1,532

Note: $export_{ivt}$ = export value of product v to country i, $extensive_{ivt}$ = number of firms exporting product v to country i, and $intensive_{ivt}$ = their average export value. Estimation method: within/fixed effects OLS (fixed effects at the country-product level). Year-dummies included, but not reported. Std. dev. in parentheses (cluster robust errors with clustering at country level). *, **, *** indicates significance level at 10%, 5% and 1%, respectively.

A5. Excluding tariffs

Variable	ln (ex-port$_{ivt}$)	ln (exten-sive$_{ivt}$)	ln (inten-sive$_{ivt}$)
sps$_{ivt-1}$	-0.186**	-0.106***	-0.080
	(0.083)	(0.027)	(0.072)
sps$_{ivt-1}$ * fresh	0.599***	0.184***	0.415**
	(0.182)	(0.051)	(0.193)
tbt$_{ivt-1}$	-0.109	-0.040*	-0.070
	(0.082)	(0.024)	(0.068)
tbt$_{ivt-1}$ * fresh	0.148	-0.008	0.156**
	(0.098)	(0.042)	(0.068)
fta$_{it}$	0.239	0.074	0.165
	(0.170)	(0.052)	(0.126)
eea$_{it}$	0.009	-0.050	0.059
	(0.160)	(0.058)	(0.134)
regqual$_{it}$	0.141	-0.017	0.159
	(0.130)	(0.058)	(0.115)
ln (impcosts$_{it}$)	-0.072	-0.071	-0.000
	(0.365)	(0.087)	(0.348)
ln(gdp$_{it}$)	1.497***	0.289***	1.208***
	(0.303)	(0.085)	(0.330)
ln(cgdp$_{it}$)	-0.743***	-0.000	-0.743**
	(0.283)	(0.085)	(0.303)
ln(cons$_{it}$)	0.342**	0.172***	0.169
	(0.144)	(0.061)	(0.127)
gexch$_{it}$	-0.001	-0.000	-0.001
	(0.001)	(0.001)	(0.001)
constant	-21.514***	-7.054***	-14.459**
	(5.559)	(1.585)	(5.706)
No obs	25,948	25,948	25,948
R^2	0.016	0.039	0.019
No group	5,738	5,738	5,738

Note: *export$_{ivt}$* = export value of product *v* to country *i*, *extensive $_{ivt}$* = number of firms exporting product *v* to country *i*, and *intensive$_{ivt}$* = their average export value. Estimation method: within/fixed effects OLS (fixed effects at the country-product level). Year-dummies included, but not reported. Std. dev. in parentheses (cluster robust errors with clustering at country level). *, **, *** indicate significance level at 10%, 5% and 1%, respectively.

A6. Years 2002–2007

Variable	ln (ex-port$_{ivt}$)	ln (exten-sive$_{ivt}$)	ln (inten-sive$_{ivt}$)
sps$_{ivt-1}$	-0.466***	-0.210***	-0.256**
	(0.131)	(0.061)	(0.104)
sps$_{ivt-1}$ * fresh	0.772***	0.303***	0.469**
	(0.212)	(0.091)	(0.188)
tbt$_{ivt-1}$	-0.198*	-0.126***	-0.072
	(0.105)	(0.039)	(0.099)
tbt$_{ivt-1}$ * fresh	0.329*	0.172***	0.157
	(0.180)	(0.056)	(0.158)
ln (tariff$_{ivt-1}$)	-1.660**	-0.547***	-1.113
	(0.755)	(0.149)	(0.739)
fta$_{it}$	0.461**	0.103	0.357
	(0.229)	(0.069)	(0.232)
eea$_{it}$	-0.052	-0.129	0.077
	(0.272)	(0.087)	(0.266)
regqual$_{it}$	-0.031	0.072	-0.103
	(0.181)	(0.068)	(0.170)
ln (impcosts$_{it}$)	-0.529	-0.122	-0.407
	(0.794)	(0.263)	(0.655)
ln(gdp$_{it}$)	2.543***	0.411	2.132***
	(0.907)	(0.489)	(0.540)
ln(cgdp$_{it}$)	-1.498	-0.104	-1.394**
	(0.956)	(0.526)	**(0.606)**
ln(cons$_{it}$)	0.008	0.153	-0.145
	(0.227)	(0.120)	(0.223)
gexch$_{it}$	0.001	0.001	-0.000
	(0.002)	(0.001)	(0.001)
constant	-36.031**	-8.492	-27.539**
	(17.529)	(8.609)	(11.397)
No obs	4,602	4,602	4,602
R^2	0.041	0.071	0.035
No group	1,313	1,313	1,313

Note: *export$_{ivt}$* = export value of product *v* to country *i*, *extensive$_{ivt}$* = number of firms exporting product *v* to country *i*, and *intensive$_{ivt}$* = their average export value. Estimation method: within/fixed effects OLS (fixed effects at the country-product level). Year-dummies included, but not reported. Std. dev. in parentheses (cluster robust errors with clustering at country level). *, **, *** indicate significance level at 10%, 5% and 1%, respectively.

Table A7. Testing for correlation between unobserved heterogeneity and the explanatory variables

Variable	ln (ex-$port_{ivt}$)	ln (exten-$sive_{ivt}$)	ln (inten-$sive_{ivt}$)
sps_{ivt-1}	-0.400***	-0.169***	-0.229***
	(0.111)	(0.051)	(0.087)
mean sps_{iv}	-0.231	0.094	-0.343
	(0.582)	(0.164)	(0.445)
sps_{ivt-1} * fresh	0.770***	0.292***	0.467**
	(0.217)	(0.066)	(0.193)
mean sps_{iv} * fresh	0.824	0.019	0.829**
	(0.529)	(0.153)	(0.418)
tbt_{ivt-1}	-0.088	-0.079**	-0.013
	(0.103)	(0.032)	(0.091)
mean tbt_{iv}	0.279	0.015	0.264
	(0.531)	(0.141)	(0.431)
tbt_{ivt-1} X fresh	0.305*	0.050	0.251*
	(0.175)	(0.046)	(0.149)
mean tbt_{iv} * fresh	-0.849	-0.110	-0.722
	(0.673)	(0.162)	(0.547)
ln ($tariff_{ivt-1}$)	-1.599***	-0.645***	-0.967
	(0.566)	(0.162)	(0.617)
mean ln($tariff_{iv}$)	0.024	0.264	-0.220
	(1.501)	(0.421)	(1.326)
fta_{it}	0.296	0.128	0.161
	(0.254)	(0.082)	(0.187)
mean fta_i	-0.285	-0.185	-0.073
	(0.604)	(0.146)	(0.493)
eea_{it}	-0.152	-0.141	-0.013
	(0.240)	(0.089)	(0.188)
mean eea_i	-0.073	-0.035	-0.043
	(0.714)	(0.199)	(0.592)
$regqual_{it}$	0.248	0.058	0.183
	(0.196)	(0.088)	(0.179)
mean $regqual_i$	-0.279	0.047	-0.326
	(0.315)	(0.127)	(0.267)

Variable	ln (ex-$port_{ivt}$)	ln (exten-$sive_{ivt}$)	ln (inten-$sive_{ivt}$)
ln($impcosts_{it}$)	0.322	0.019	0.294
	(0.509)	(0.159)	(0.437)
mean ln($impcosts_i$)	0.749	0.272	0.491
	(0.718)	(0.217)	(0.607)
ln(gdp_{it})	2.054***	0.516**	1.510***
	(0.348)	(0.221)	(0.271)
mean ln(gdp_i)	-1.604***	-0.350	-1.220***
	(0.356)	(0.218)	(0.283)
ln($cgdp_{it}$)	-1.150***	-0.186	-0.933***
	(0.328)	(0.220)	(0.208)
mean ln($cgdp_i$)	1.052***	0.106	0.916***
	(0.393)	(0.221)	(0.260)
ln($impcosts_{it}$)	0.120	0.261***	-0.152
	(0.246)	(0.090)	(0.200)
mean ln($impcosts_i$)	0.455	-0.152	0.625***
	(0.286)	(0.100)	(0.233)
$gexch_{it}$	-0.001	0.000	-0.002
	(0.002)	(0.001)	(0.001)
mean $gexch_i$	-0.039	-0.006	-0.031
	(0.029)	(0.010)	(0.025)
$remoteness_i$	1.748	0.466	1.301
	(1.415)	(0.389)	(1.195)
ln($dist_i$)	-1.318***	-0.518***	-0.808***
	(0.302)	(0.082)	(0.265)
$landlocked_i$	-0.848***	-0.366***	-0.483**
	(0.319)	(0.112)	(0.235)
constant	-12.792	-4.980	-8.102
	(14.662)	(3.809)	(12.147)
No obs	6,695	6,695	6,695
No group	1,402	1,402	1,402

Note: $export_{ivt}$ = export value of product *v* to country *i*, $extensive_{ivt}$ = number of firms exporting product *v* to country *i*, and $intensive_{ivt}$ = their average export value. Estimation method: random effects (random effects at the country-product level). Year-dummies included, but not reported. Std. dev. in parentheses (cluster robust errors with clustering at country level). *, **, *** indicate significance level at 10%, 5% and 1%, respectively.

Norwegian Institute of International Affairs

Established in 1959, the Norwegian Institute of International Affairs [NUPI] is a leading independent research institute on international politics and areas of relevance to Norwegian foreign policy. Formally under the Ministry of Education and Research, NUPI nevertheless operates as an independent, non-political instance in all its professional activities. Research undertaken at NUPI ranges from short-term applied research to more long-term basic research.

About the Authors
Hege Medin is a Senior Research Fellow at the Norwegian Institute of International Affairs (NUPI). She holds a PhD in economics from the Norwegian School of Economics (NHH) from 2013. Her research focuses on international trade, trade policy, trade costs, and firms' internationalisation behaviour.

Arne Melchior is Senior Research Fellow and head of the international Economics research group at NUPI. His research focuses in international trade and trade policy, economic geography and international and regional inequality.

NUPI
Norwegian Institute of International Affairs
C.J. Hambros plass 2D
PO Box 8159 Dep. NO-0033 Oslo, Norway
www.nupi.no | info@nupi.no