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Ad-valorem equivalents of NTMs in ASEAN

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Abstract

To obtain country specific estimates of ad-valorem equivalent (AVE) of Non-Tariff Measures (NTMs), we propose a new measure that relies on the estimation of bilateral trade flows on two-way panels (product X importer X exporter) at the HS 2 -digit level with importer, exporter and product fixed effects and interaction terms between NTM variables and a full vector of country-specific characteristics. Our results show that AVEs for TBT measures on manufactured products, both for ASEAN countries and for the sample as a whole, are at 4.5 percent and 5 percent, respectively. As for SPS measures on agriculture and food products, tariff AVEs, for ASEAN countries and the sample as a whole 6.5 percent and 6.7 percent, respectively. However, it should be noted that AVEs can mean very different things depending on whether they have a counterpart in the correction of a market failure. This depends on the technical capabilities of domestic regulatory agencies.

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1. Introduction

As discussed by Swinnen (2016), while the regulation of products and measurement units and tools goes back to ancient times, the recent spread of regulations has triggered a debate among economists about their effect on international trade. A number of papers have suggested that non-tariff measures (NTMs), a broad aggregate of measures that includes not only regulations (sanitary and technical) but also more directly trade-related measures such as quantitative restrictions or anti-dumping, have spread as substitutes for declining tariffs (Moore and Zanardi, 2011; Aisbett and Pearson, 2012; Beverelli et al., 2014; Orefice, 2015). In the same line of reasoning, many studies view regulations as devices often imposed to protect domestic producers (Fischer and Serra, 2000; Anderson et al., 2004; Maertens and Swinnen, 2007; van Tongeren et al., 2009; Marrette and Beghin, 2010; Beghin et al., 2012).

Partly as a result of these concerns, non-tariff measures are addressed specifically in the "deep-integration" clauses of a number of regional agreements (Dür et al., 2014; Cadot and Gourdon, 2016) and in recent negotiations such as RCEP (Egger et al., 2015; Berden and Francois, 2015). A related strand of the literature surveyed by Swinnen (2016), going back to the work of Otsuki, Wilson and Sewadeh (2001), emphasizes the compliance costs imposed by regulations, in particular on exporters from developing and emerging countries (Swinnen, 2007; Henson and Jaffee, 2007; Fontagné et al., 2016; Swinnen et al. 2015).

However, looking at product regulations through a "trade-only" lens and branding them as hidden protectionism whenever they raise the price of imported products is a potentially misleading approach. In many historical cases, product regulations were imposed, after public scandals, under pressure not from domestic producers, but from consumers—those who are predicted to lose from higher prices (McCluskey and Swinnen, 2011; Mo et al., 2012; Meloni and Swinnen, 2015, 2016). Markets for consumer goods are rife with market failures—adverse selection, moral hazard, externalities—calling for government intervention, and the determination of optimal regulation in their presence is often a complex problem (van Tongeren et al., 2009; Sheldon, 2012; Li and Beghin, 2014; Xiong and Beghin, 2014; Swinnen, 2016).

The issue of whether NTMs should be viewed exclusively or primarily through the prism of business compliance costs is not just academic. While deregulation has been on the agenda of conservative governments since the 1980s, some have recently pushed forward a new and radical deregulatory agenda. For instance, in 2011, the British government adopted a law requiring one regulation to be eliminated for each new one adopted, in any area of government action, a law that was subsequently tightened to two, then to three regulations to be eliminated for each one adopted.[1] The U.S. government adopted a similar approach in an Executive Order issued by the White House in January 2017 stipulating that "[u]nless prohibited by law, whenever an executive department or agency (agency) publicly proposes for notice and comment or otherwise promulgates a new

[1] *The New York Times*, Editorial, 22 June 2017.

regulation, it shall identify at least two existing regulations to be repealed."[2] The justification provided in para. (b) of the executive order is exclusively focused on the capping of business costs, stating that "[f]or fiscal year 2017, which is in progress, the heads of all agencies are directed that the total incremental cost of all new regulations, including repealed regulations, to be finalized this year shall be no greater than zero, unless otherwise required by law or consistent with advice provided in writing by the Director of the Office of Management and Budget (Director)". The executive order makes no mention of the cost of non-regulation in the face of market failures. This stands in contrast with the approach adopted in the "regulatory lookback" initiative adopted under the Obama administration (also by executive order), which promoted the systematic use of ex-post impact evaluation (Sunstein, 2013).

This paper takes a balanced view of NTMs, in the spirit of Swinnen (2016), and suggests a way to implement it empirically. It contributes to a literature that has recently attempted to estimate NTM compliance costs through their ad-valorem equivalent (AVE) (Kee and Nicita, 2006; Kee, Nicita and Olarreaga, 2009; Dean et al., 2009; Rickard and Lei, 2011; Nimenya et al., 2012; Cadot and Gourdon, 2015, 2016; Grübler, Ghodsi, and Stehrer, 2016). These attempts have encountered a number of difficulties, some relating to data, some to estimation. As for data, until recently there was no comprehensive cross-country NTM database, so researchers had to rely on WTO notifications, "special trade concerns", and other partial databases. This problem has been largely overcome thanks to a large-scale effort by multilateral institutions, in particular UNCTAD and the World Bank, as well as regional ones, in particular ERIA. There is now a consistent database, collected according to similar protocols across countries, available for 85 countries. The database relies on the MAST classification of NTMs, which is also used for WTO for notifications since 2012. This is the database we use here.

As for estimation, the early literature exploited variation in dollar trade values to infer the AVE of NTMs, using estimates of the price elasticity of import demand at the product level from the World Bank (Kee, Nicita, and Olarreaga, 2006). However, when the price elasticity of import demand is unity, trade values do not vary with compliance costs; thus, it is mathematically impossible to retrieve AVEs from variations in trade values. Recent papers (Bratt, 2014; Kee and Nicita, 2016; Grübler et al., 2016) have thus turned to a different approach identifying AVEs from variation in trade *volumes* rather than values but using the same conversion formula. However, as we will argue below, this leads to wrong identification if, by AVE, one means the tariff equivalent of compliance costs. We propose here a different approach relying on trade unit values that makes it possible to disentangle compliance-cost effects from demand-enhancing effects stemming from the correction of market failures.

Another problem is that the traditional approach relies on the estimation of import functions or bilateral trade flows at the product level on cross-sections of countries. This approach can only yield average effects across countries, not individual country effects. Papers like Kee et al. (2009)

[2] Executive Order of January 30, 2017, Section 2 (a). See https://www.whitehouse.gov/the-press-office/2017/01/30/presidential-executive-order-reducing-regulation-and-controlling.

offer a smart way out of this problem by interacting NTM variables with country variables such as GDP per capita or endowments, making it possible to simulate country-specific AVEs on the basis of country characteristics. However, these are simulated values, not truly country-specific estimates. We propose an alternative approach that relies on the estimation of bilateral trade flows on two-way panels (product × importer × exporter) at the HS paper level (HS2) with importer, exporter and product fixed effects and interaction terms between NTM variables and importer dummies. Thus, instead of interacting NTM variables with a single, continuous country-characteristic variable (say, GDP per capita), we interact them with a full vector of importer dummies. This allows us to get truly country-specific effects.

Our basic explanatory variable is the number of NTMs of the same type imposed by an importing country on a product. The reason for using the count of NTMs is that anecdotal evidence suggests that it is their cumulative burden the private sector is most concerned about. For instance, Cass Sunstein, Administrator of the U.S. Office for Information and Regulatory Affairs from 2009 to 2012, noted that

> "[a] special problem, and one that makes the project of simplification all the more imperative, is that agencies currently impose high cumulative burdens on the private sector. Requirements may be sensible taken individually, but taken as a whole, they might be redundant, inconsistent, overlapping, and immensely frustrating, even crazy-making (to use the technical term). In fact the problem of cumulative burdens may have been the most common complaint that I heard during my time in government." (Sunstein, 2013: p. 588)

One drawback of our approach based on trade unit values is that unit values are undefined for zero trade flows. Thus, we identify AVEs only at the intensive margin, on existing (nonzero) trade flows. There is unfortunately no fix for this problem. Moreover, our approach yields average effects across products within each chapter, not individual product effects. Thus, compared to Kee et al. (2009), there is a trade-off: Whereas they obtain product-specific but not country-specific estimates, we obtain country-specific but not product-specific estimates. Which one is the most appropriate ultimately depends on the user's needs.

We find that, in ASEAN countries, the compliance costs associated with SPS measures on agri-food products range, on average, between 3.7 percent of their CIF import price (the Philippines) and 16.6 percent (Viet Nam). CLM countries tend to have high estimated compliance costs, which stand in contrast with the limited capabilities of their SPS infrastructures. Among the larger ASEAN economies, for which data is probably most reliable, we find fairly high compliance costs for animal products (primarily meat), in particular in Thailand (21.2 percent) and Indonesia (16.1 percent). We also find high compliance costs for fats & oils in Viet Nam (38.8 percent). For food, beverages and tobacco, the highest compliance costs are found in Singapore (11.3 percent), in line with what can be expected in a high-income country.

Our estimates of the compliance costs associated with TBT measures imposed by ASEAN countries on manufactured products are, ranging from an average of 2.8 percent (Cambodia) to 5.7 percent

(Indonesia). We find fairly high compliance costs in the textile sector in Singapore (9.9 percent) and Malaysia (9.4 percent). Besides CLM countries, we also find relatively high compliance costs in the automobile sector in Viet Nam (12.9 percent) and in Thailand (8.7 percent). By and large, although these estimates should be interpreted cautiously, it is fair to say that, as in Ing et al. (2016), we do not find patterns very suggestive of strong lobbying interference.

The rest of this paper is organized as follows. Section 2 explains conceptual issues in the measurement and interpretation of NTM AVEs in the presence of market failures. Section 3 discusses data and data sources. Section 4 discusses econometric estimation issues and our proposed approach to have country specific AVE of NTMs. Section 5 presents the estimation findings for the 10 ASEAN countries. Section 6 concludes.

2. Interpreting NTM AVEs

As discussed in the introduction, if one leaves aside political-economy issues, technical measures (SPS and TBT) are, in many cases, primarily domestic instruments aimed at correcting market failures, although they affect trade incidentally when they are applied to tradable goods. In order to lay down the issues in a simple framework, in this section we cast the problem of how a benevolent government should set the level of stringency of an NTM as an optimal-standard problem in the presence of market failures.

Let a representative consumer *i* in the domestic economy maximize a quasi-linear utility function of two goods,[3] an imported good *x* of quality *q*, and a composite *z* of other goods

$$U^i\left(z_i, q, x^i\right) = z_i + u\left(qx^i\right) \qquad (1)$$

where $u' > 0$ and $u'' < 0$. The composite good is taken as the numéraire and accordingly has a unit price. The world price of good *x*, p^*, is constant (consumer *i*'s country of residence is small). Its domestic price is $p = p^*\left(1+a\right)$ where a is the ad-valorem equivalent of the NTM imposed by the government. There is only one variety of good *x* available on the market, and it is characterized by a level of quality *q*. Assume that it is a credence good, i.e. one for which consumers cannot observe quality at the time of purchase. Consumer *i* thus maximizes her utility only by choice of the quantity consumed x^i and not by choice of quality. For brevity, we do not model the supply side (including quality choice by foreign producers) and simply note that there is no mechanism to ensure that the market delivers the optimal level of quality. The only instrument at the government's disposal is a standard *s* with $a = a\left(s\right), a' > 0$, where a higher value of *s* means a stricter standard.

[3] With a quasi-linear utility function, the marginal utility of income is constant at one, simplifying the optimal-standard problem.

Consider first a case where the standard affects good *x*'s price while failing to affect its quality, say because it is not properly designed. At the consumer's optimum, $u'\left(x^i\right)=p^*\left[1+a\left(s\right)\right]$ and

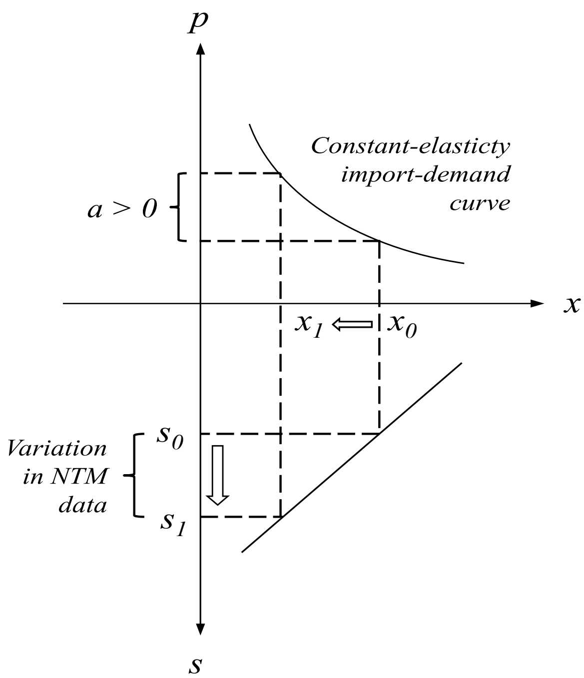
$$\frac{dx^i}{ds}=\frac{p^*a'\left(s\right)}{u''\left(x^i\right)}<0. \qquad (2)$$

Let $v^i=v\left(p,y^i\right)$ be consumer *i*'s indirect utility function given an income y^i. A benevolent government maximizing a Rawlsian welfare function solves $\max_s \sum_{i=1}^N v^i$. By the envelope theorem,

$$\sum_i \frac{\partial v^i}{\partial s}=-Np^*a'<0 \qquad (3)$$

implying a corner solution at *s* = 0 (the standard is a pure deadweight loss). This is the way trade economists typically look at NTMs and is illustrated in Figure 1. Suppose that there are two countries with the same preferences but different standard stringency levels. Starting from the bottom axis (pointing South), the downward shift from s_0 to s_1 is the variation in standard stringency between the two. The induced leftward shift in *x*, from x_0 to x_1, on the horizontal axis pointing East, is given by the trade data. Combining the two with the elasticity of import demand in the figure's upper quadrant gives the standard's AVE (on the vertical axis pointing North).

Figure 1: AVE determination in the absence of market failure



Source: Authors.

Consider now a richer case where the standard raises the quality of good *x*: $q = q(s), q' > 0$. Now the standard enters directly the utility function:

$$U^i\left(z^i, s, x^i\right) = z^i + u\left[q(s)x^i\right]. \tag{4}$$

At consumer *i*'s optimum, $q(s)u'\left(x^i\right) = p^*\left[1 + a(s)\right]$, so

$$\frac{dx^i}{ds} = \frac{p^*a'(s) - q'(s)u'\left(x^i\right)}{qu''\left(x^i\right)} \tag{5}$$

which can be positive if the marginal effect of the standard on quality *q'* is sufficiently strong. Applying again the envelope theorem, at the optimum standard *s**, the government's first-order condition is

$$\sum_i \frac{\partial v^i}{\partial s} = Nx^i\left[q'(s)u'\left(x^i\right) - p^*a'(s)\right] = 0 \ . \tag{6}$$

Comparing (6) with (5), it is clear that, at the optimum standard, $dx^i/ds\big|_{s=s*} = 0$. Moreover, small deviations from this indicate whether the applied standard is higher or lower than the optimum:

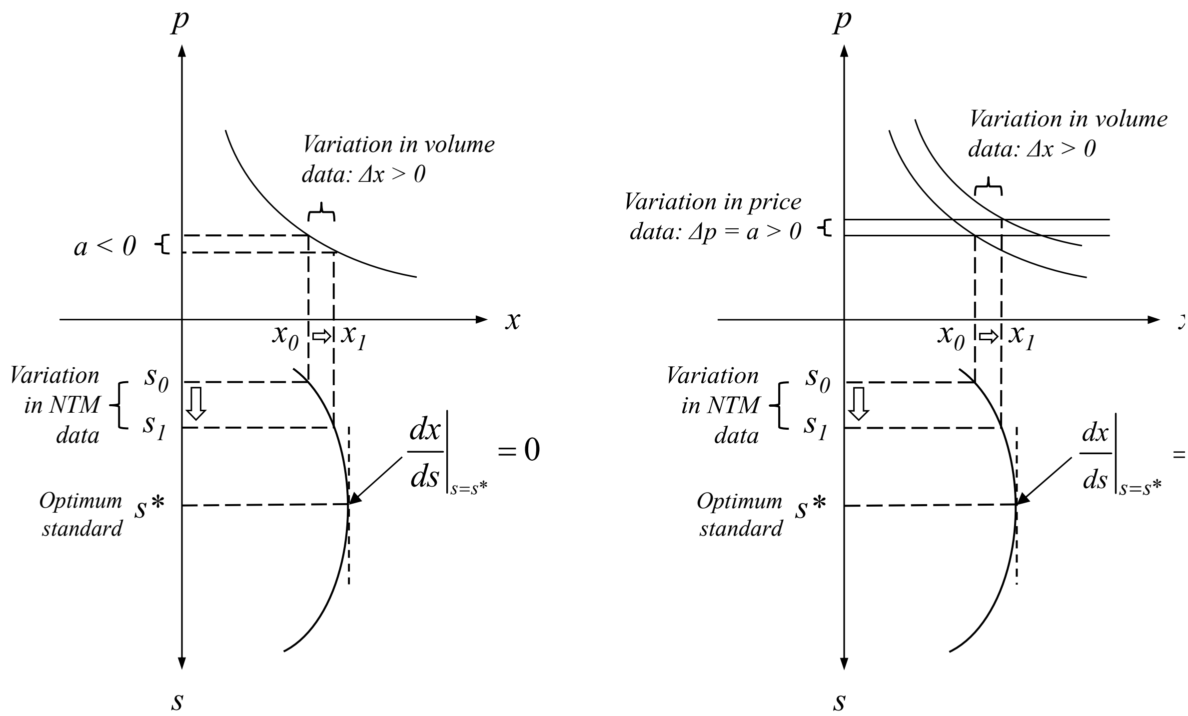
$$\frac{dx^i}{ds} > 0 \ \Rightarrow \ p^*a'(s) < q'(s)u'\left(x^i\right) \ \Rightarrow \ \frac{\partial v^i}{\partial s} > 0 \ \Rightarrow \ s < s^*. \tag{7}$$

Thus, in this setting a stricter standard can encourage consumption (and thus imports) of good *x*, in spite of a positive AVE; and if it does so, by (7) we know that it is not strict enough. This case is illustrated in Panel (a) of Figure 2, which also shows the problem that this situation raises in interpreting standard econometric results. Suppose that we compare again two situations, one with a lenient standard s_0 and one with a slightly stricter standard s_1, shown again along the lower axis pointing South. Now, instead of a monotone relationship between standard stringency and imports *x*, (5) and (6) imply a non-monotone relationship with a stationary point at s^* (where the curve is vertical in the figure) at which *x* does not react to *s*. As both s_0 and s_1 are lower than *s**, *x* rises with *s*, as shown on the horizontal axis. This yields a *negative* AVE shown on the vertical axis pointing North.

Yet, the reality is not that the AVE is negative: It is that a positive AVE is more than offset by the benefits that the standard confers in overcoming a market failure. The problem with Panel (a) of Figure 2 (and with the estimation of AVEs from variation in trade volumes, using the elasticity of import demand to retrieve the AVE) is that it assumes an unchanged demand. But the formulation in (4), in which utility directly depends on *s*, is inconsistent with the assumption of an unchanged demand.

Figure 1: Negative measured AVE in the presence of asymmetric information

(a) Demand curve assumed constant (b) Demand curve not assumed constant



Source: Authors.

Panel (b) of Figure 2 shows how the problem can be fixed. Instead of relying on the variation in trade volumes, the estimation of AVEs should rely on the variation in prices, which, under the small-country assumption (i.e. with a flat foreign supply curve, as shown in the figure) correctly gives the AVE even when the demand curve is shifting. Variation in volumes can then be used, separately, to assess whether or not the stricter standard (s_1) is closer to the optimum than the more lenient one (s_0). If the AVE is positive and the variation in volumes is also positive, as illustrated in Figure 2, a tightening of the standard from s_0 to s_1 brings it closer to the optimum. If the AVE is positive and the variation in volumes is negative (not illustrated), a tightening of the standard brings it away from the optimum.

Finally, consider a case where the utility of individual *i* depends not only on the quantity and quality of good *x*, but also on the quantity consumed by other consumers $j \neq i$ through a negative externality. Now

$$U^i\left(z^i, s, x^i, x^{-i}\right) = z^i + u\left[x^i q(s); x^{-i}\right] \tag{8}$$

where $x^{-i} = \sum_{j \neq i} x^j$, $u_1 = \partial u^i / \partial\left(x^i q\right) > 0$, and $u_2 = \partial u / \partial x^{-i} < 0$. Without an adequate policy instrument, consumers do not internalize the externality their consumption exerts on others and (5) still applies. By contrast, the government takes it into account and sets

$$\sum_i \left\{ \frac{\partial v^i}{\partial s} + \sum_{j \neq i} \frac{\partial v^i}{\partial x^j} \frac{dx^j}{ds} \right\} = \sum_i \left\{ x^i \left[q'(s) u_1 \left(x^i \right) - pa'(s) \right] + u_2 \sum_{j \neq i} \frac{dx^j}{ds} \right\} = 0 \qquad (9)$$

At the optimum standard s^*, $dx^j / ds = 0 \; \forall \; j$, so the term in u_2 vanishes and (9) boils down to (6) with *u*′ replaced by u_1. Thus, the optimal level of the standard does not change in the presence of the externality because, at the optimum, it does not affect consumer behavior (its AVE just offsets its marginal benefit) which implies that it cannot "correct" excessive consumption. The only change between the cases with and without externality is that deviations from the optimum standard are costlier in the presence of the externality (a standard that is too lenient has now two distinct negative effects on welfare: the old asymmetric information problem is not corrected, and, in addition, there is too much consumption of good *x*).

In such a situation, the appropriate policy response is to add a second instrument (say, a Pigovian tax) to deal specifically with the externality, in addition to the standard which deals with the asymmetric information problem. This case helps explain why, in the data, some products are affected by several NTMs at the same time. Multiple NTMs may reflect bureaucratic proliferation and redundancy, as discussed in the introduction, but it is important to keep in mind that when there are several market failures, several instruments are called for.

The simple analytics presented in this section suggests a number of observations. First, AVEs should be estimated only from variation in price data, that is, empirically, from variation in trade unit values. This will yield valid estimates of AVEs under two key assumptions: (i) the importer country is small (i.e. the foreign supply curve is infinitely elastic), and (ii) NTM compliance costs are borne by the producer and passed through in the form of a proportional increase in the export price; this is a plausible assumption for technical measures (TBT and SPS) and for anti-dumping measures subject to price undertakings; but not for quantitative restrictions or other measures affecting only the domestic retail price.

Second, estimation of the elasticity of trade volumes to changes in the stringency of NTMs does not yield information on AVEs, but it yields information on whether standard-type ("technical") measures are more or less stringent than the optimum in the presence of market failures. If trade volumes are increasing in measure stringency, measures are looser than the optimum; if they are decreasing, measures are stricter than the optimum.

In this paper, we define the AVE of NTMs as the tariff equivalent of their compliance costs, and we estimate them using price data, leaving the exploration of variations in trade volumes for future research.

3. Data

We use three primary sources of data. Our NTM data come from two sources. For ASEAN countries, it is the ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, http://asean.i-tip.org. For other countries, the NTM data are from the UNCTAD NTM database, available on the World Bank's WITS portal. Both databases are fully consistent and the data collection for ASEAN countries was coordinated by ERIA and UNCTAD. For trade unit values, we use the CEPII's TUV database (see Bertou and Emlinger, 2011). In order to clean out outliers in terms of unit values, we run an auxiliary OLS regression of unit values on product dummies at the HS–6 digit level (5,050 dummies), retrieve the residuals, rank them by centile, and drop observations falling in the top and bottom centile of the distribution of residuals.

We work with 85 countries with 5,050 products at the HS–6 digit level (or 98 at the HS–2 digit level). The data on imports are the average value of imports from 2013-2015. This results on 12,267,986 observations.

A widely discussed issue in gravity estimation is how to handle zero trade flows. This is typically done by using estimators which can handle zero flows, such as zero-inflated Poisson or negative binomial estimators. In the case of unit values, "zero flows" are not observations where the dependent variable is zero, but where it is undefined. This means that information from dyad-product combinations where no trade takes place cannot be used to retrieve NTM compliance costs and has to be discarded. Thus, our compliance-cost estimates use only information retrieved from the "intensive margin" of trade, i.e. from variation in the terms of transactions actually taking place.

4. Estimation

Let *i* and *j* designate respectively the origin and destination countries of a trade flow, and *k* a product (at the HS–6 digit level in the data). Our basic unit of observation is an (*i*,*j*,*k*) triplet. Let *m* index NTM types defined according to the MAST classification (at the two- or one-digit level, depending on the case). Time is not indexed as there is only a single year of data. Let p_{ijk} be the CIF unit value of product *k* exported from *i* to *j*. Let $\mathbf{G}_{ij}$ be a vector of gravity-like determinants of trade unit values including the log of distance and other determinants of trade costs between *i* and *j* excluding tariffs and NTMs (entered separately) as well as *i*'s and *j*'s log-GDP per capita, which are absorbed by exporter and importer fixed effects respectively. Let τ_{ijk} be the bilateral tariff applied by *j* on product *k* imported from *i* (MFN or preferential, depending on the case). Let x_{jkm} be an integer variable recording the number of NTMs of type *m* imposed by country *j* on product *k*. Finally, let δ_i, δ_j and δ_k be exporter, importer and product fixed effects respectively. In order to avoid cluttering the notation, let us omit chapter indices, keeping in mind that estimation is performed at the chapter level, so everything in equations (10)–(14) is chapter-specific. Our baseline equation, for a given chapter, is

$$\begin{aligned}\ln p_{ijk} &= \mathbf{G}_{ij}\cdot\boldsymbol{\beta}_1 + \beta_2 \ln\left(1+\tau_{ijk}\right) + \sum\nolimits_m \beta_{3m} x_{jkm} \\ &+ \sum\nolimits_j \sum\nolimits_m \beta_{4jm}\left(x_{jkm}\delta_j\right) + \sum\nolimits_i \delta_i + \sum\nolimits_j \delta_j + \sum\nolimits_k \delta_k + u_{ijk}.\end{aligned} \tag{10}$$

To derive the proportional effect of an additional NTM of type *m* on the price of good *k*, let

$$z_{ijk} = \mathbf{G}_{ij}\cdot\boldsymbol{\beta}_1 + \beta_2 \ln\left(1+\tau_{ijk}\right) + \sum\nolimits_i \delta_i + \sum\nolimits_j \delta_j + \sum\nolimits_k \delta_k + u_{ijk} \tag{11}$$

and note that

$$\begin{aligned}\ln p_{ijk}\left(x_{jkm}\right) &= z_{ijk} + \sum\nolimits_m \beta_{3m} x_{jkm} + \sum\nolimits_j \sum\nolimits_m \beta_{4jm}\left(x_{jkm}\delta_j\right) \\ \ln p_{ijk}\left(x_{jkm}-1\right) &= z_{ijk} + \sum\nolimits_{m'\neq m} \beta_{3m'} x_{jkm'} + \beta_{3m}\left(x_{jkm}-1\right) \\ &+ \sum\nolimits_j \sum\nolimits_{m'\neq m} \beta_{4jm'}\left(x_{jkm'}\delta_j\right) + \beta_{4jm}\left[\left(x_{jkm}-1\right)\delta_j\right]\end{aligned} \tag{12}$$

so

$$\Delta \ln\left(p_{ijk}\right) = \ln\left[\frac{p_{ijk}\left(x_{jkm}\right)}{p_{ijk}\left(x_{jkm}-1\right)}\right] = \beta_{3m} + \beta_{4jm}\delta_j \tag{13}$$

which implies that

$$AVE_{jm} = \frac{\Delta p_{ijk}\left(x_{jkm}\right)}{p_{ijk}\left(x_{jkm}-1\right)} = \frac{p_{ijk}\left(x_{jkm}\right)}{p_{ijk}\left(x_{jkm}-1\right)} - 1 = \exp\left(\beta_{3m} + \beta_{4jm}\delta_j\right) - 1. \tag{14}$$

We estimate (10) on exporter-importer-product panels, using fixed effects by exporter, importer, and product, chapter by chapter, in order to limit the size of the database. As the 'within' transformation raises complex issues in two-way panels (Baltagi, 2005: p. 160), estimation by chapter reduces the data's dimensionality by limiting the number of product fixed effects. It also allows us to disaggregate to the two-digit level only the most relevant NTMs for the chapters under estimation (for instance, SPS for food products) while keeping other NTMs at the one-digit level.

In what follows, we will report as importer-specific AVEs the sum of the direct and interacted terms in (10). That is, let *s* be a section and *c* a chapter, let $s(c)$ be the section to which chapter *c* belongs, and w_{cs} be the share of chapter *c* in section *s*, using world trade flows. Let also $\hat{\beta}_{3cm}$ be the direct effect of NTM *m* on unit values estimated on chapter *c* and $\hat{\beta}_{4jcm}$ the interacted effect of NTM *m* imposed by importing country *j*, also estimated on chapter *c*. Re-introducing chapter indices, the AVEs reported at the chapter level (i.e. the raw estimates from chapter panels) are

$$AVE_{jcm} = 100 \times \exp\left[\left(\hat{\beta}_{3m} + \hat{\beta}_{4jm}\right) - 1\right] \quad (15)$$

For readability, we will mostly report section averages in which chapter AVEs are aggregated into section averages using world trade weights:

$$AVE_{jsm} = 100 \times \exp\left\{\left[\sum_{c \in s} w_{cs}\left(\hat{\beta}_{3cm} + \hat{\beta}_{4jcm}\right)\right] - 1\right\}. \quad (16)$$

Note that, as AVEs are estimated here directly from variation in unit values, the price elasticity of import demand does not enter the formula (unlike in the case of estimation from dollar trade values or volumes).

5. Results

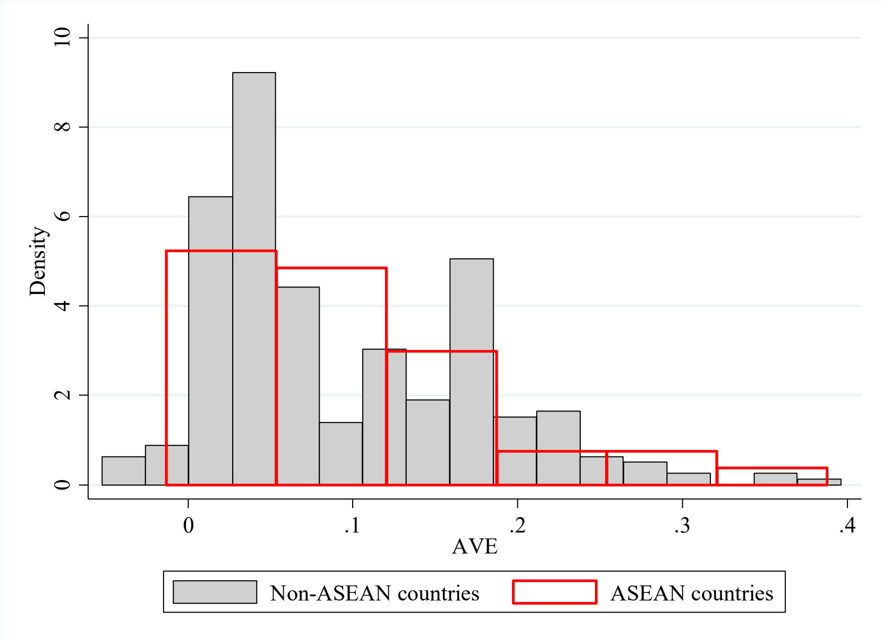
5.1. Food and agricultural products

We start with an analysis of food and agricultural products, for which we focus on SPS measures (type A in the MAST classification), after which we will turn to manufactured products, for which we will focus on TBT measures (type B).

Figure 3 shows the overall distribution of AVEs for SPS measures, by importing country and by HS section, for sections 1–4 only, for ASEAN members (in empty red bars) and other countries (in grey bars).[4] It can be seen that the two distributions are quite similar (the one for ASEAN countries is coarser because there are fewer countries in that category), implying that SPS measures do not seem to have very different compliance costs in ASEAN countries compared to elsewhere. At the importer-section level, 99.1 percent of the AVEs are nonnegative, as predicted by intuition and the model of Section 2. The median AVE at the country-section level is 6.24 percent and the simple average (across all non-ASEAN importers and sections) is 6.58 percent. For ASEAN countries, the median and mean AVEs are respectively 6.51 percent and 6.69 percent.

[4] HS sections 1–4 are respectively animal products (1), vegetable products (2), fats & oils (3), and food, beverages & tobacco (4). They correspond to chapters 1–24.

Figure 3: Distribution of average AVEs, SPS measures on HS sections 1-4



Note: Estimation carried out on exporter-importer-product panels at the HS6 level, by chapter, for chapters 1-24 (sections 1-4), using robust standard errors. Chapter estimates aggregated to sections by averaging. Estimation includes fixed effects by importer, exporter, and HS6 product. Estimates with p-values over 0.1 are set to zero. AVEs in algebraic form, so .2 = 20%. Density in percent on the vertical axis.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, and the CEPII's TUV and BACI databases.

Table 1 shows a breakdown of average AVEs for SPS measures, by HS section and ASEAN importer, for agri-food products (sections 1–4). Across all sections, the highest averages are observed for Viet Nam (16.6 percent), Myanmar (12.1 percent), Lao PDR (11.9 percent), and Thailand (11.7 percent). The highest AVEs are observed, for animal products (section 1) and fats & oils (section 3). For animal products, the highest AVE is observed in Lao PDR (26 percent) and Cambodia (23.4 percent). Such high compliance costs are noteworthy in view of the limited technical capabilities of those countries' SPS enforcement and monitoring infrastructures, suggesting bureaucratic friction (especially in contrast with Singapore's eight percent, given that Singaporean consumers are likely to be more safety- and quality-sensitive for meat and fish products). To some extent, the same remark applies to Indonesia (16.1 percent) and Viet Nam (17.2 percent). For fats & oils, Myanmar's 26.3 percent and Viet Nam's 38.8 percent suggest the same remark.

Table 1: Average AVEs, SPS measures, by section and importer (percent)

HS section	BRN	IDN	KHM	LAO	MMR	MYS	PHL	SGP	THA	VNM
Animal products	12.4	16.1	23.4	26.0	8.9	6.2	9.2	8.0	21.2	17.2
Vegetable products	6.0	4.4	2.8	4.4	8.9	5.7	0.5	7.4	5.8	5.1
Fats & oils	14.0	6.0	0.1	18.5	26.3	18.4	0.0	16.1	11.5	38.8
Food, bev. & tobacco	3.1	3.8	4.0	-1.3	4.3	4.9	4.9	13.8	8.1	5.5
Simple average	*8.9*	*7.6*	*7.6*	*11.9*	*12.1*	*8.8*	*3.7*	*11.3*	*11.7*	*16.6*

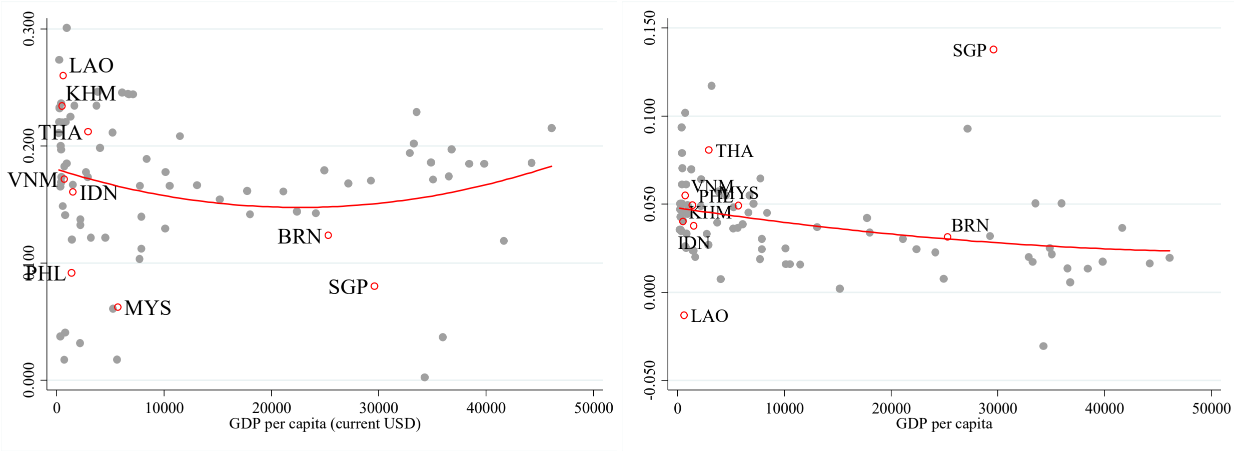
Note: AVEs are in percent. BRN: Brunei Darussalam; IDN: Indonesia; KHM: Cambodia; LAO: Lao PDR; MMR: Myanmar; MYS: Malaysia; PHL: the Philippines; SGP: Singapore; THA: Thailand; VNM: Viet Nam. Estimates that are exactly equal for two countries correspond to cases where the interaction terms are not significant, leaving only the direct term which is common to all countries. AVEs in algebraic form, so .2 = 20%.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, and the CEPII's TUV and BACI databases.

In order to get a feel for where ASEAN countries stand relative to the rest of the world in terms of compliance costs for SPS measures on agri-food products, Figure 4 shows estimated AVEs against GDP per capita for two important sections: Animal products (section 1, which includes meat and fish products), and food, beverages & tobacco (section 4, which includes all manufactured food products). For animal products, whereas one would expect a rising curve reflecting a higher valuation of food safety by affluent consumers, the curve is U–shaped. This striking pattern suggests that there may be overkill in terms of SPS measures in poor countries. Note, however, that an AVE is the proportional rise in the price of a product due to the imposition of an NTM. If NTMs compliance costs are the same irrespective of the product (the price of maintaining a strict cold chain is the same for cheap or for expensive seafood), AVEs will appear higher, in percentage terms, for low-unit value products. We know from Hallak and Schott (2011) that unit values rise with the importing country's GDP per capita. Thus, there is some logic in observing high AVEs for poor countries. However, this statistical explanation is likely to be only part of the story, as anecdotal evidence on the ground does suggest bureaucratic redundancy and illogical enforcement in poor countries. Figure 4(a) suggests that, within ASEAN, this applies to Lao PDR and Cambodia. As for prepared foods, panel (b) suggests a negative relationship between SPS AVEs and GDP per capita, with Singapore standing as a strong outlier. There is no obvious explanation for this finding, which deserves further scrutiny.

Figure 4: AVE of SPS measures and GDP per capita, sections 1 and 4

(a) Animal products (section 1) (b) Food, beverages & tobacco (section 4)



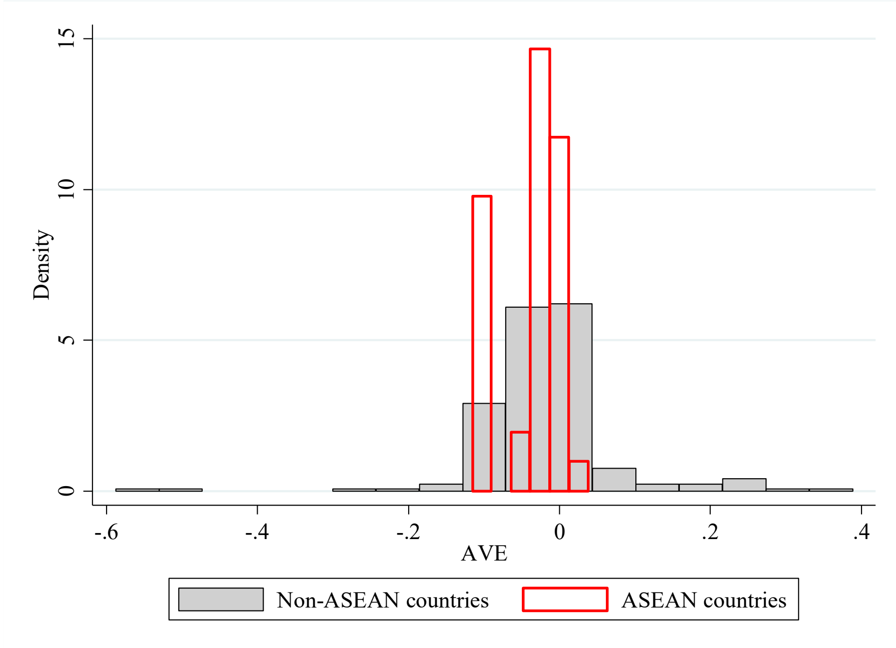
Note: AVEs on the vertical axis in algebraic form, so .2 = 20%.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, and the CEPII's TUV and BACI databases.

Turning to measures other than SPS, induced changes in trade unit values should not be interpreted as compliance costs, but rather as the reaction of foreign producers to measures imposed by the importing country, which depend on the type of measure and underlying market structure. We will henceforth ignore type-C measures (pre-shipment inspection) which typically affect broad swathes of products, rendering identification difficult and somewhat pointless.

Type-D measures (contingent protection, including anti-dumping, safeguard, and countervailing duties) have erratic effects. The same indeterminacy relating to the exact type of measures and the reaction of producers affected applies to type-E measures (quantitative restrictions, henceforth QRs). If QRs are administered via non-automatic import licenses granted to domestic importers, domestic prices rise but there is no reason to expect CIF unit values to rise as well. If, by contrast, measures take the form of Voluntary Export Restraints (VERs), one may reasonably expect producers to raise their prices, as Japanese automakers did in the face of U.S. VERs in the 1980s. Figure 5 shows that in the case of ASEAN importers, there are practically no cases of price rises, suggesting that quantitative restrictions take the former form (import licenses granted to domestic importers).

Figure 5: Distribution of average AVEs, quantitative restrictions on agri-food products



Note: Estimation method is the same as for Figure 3. AVEs in algebraic form, so .2 = 20%.

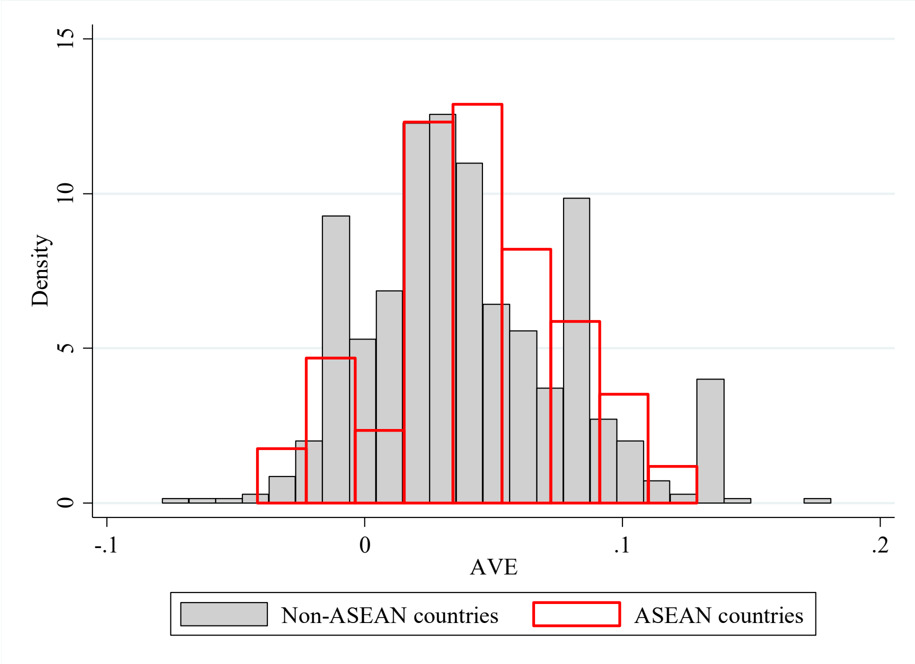
Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, and the CEPII's TUV and BACI databases.

All in all, results for food and agricultural products are in line with intuition. SPS measures impose non-trivial compliance costs, although these are below ten percent for the big three: Indonesia, Malaysia, and Singapore. Among large ASEAN economies, they are over ten percent only for Viet Nam and Thailand. Other measures seem to lead, on average, to reduced trade unit values. Thus, although consumers face higher domestic prices, it seems that those measures do not have negative effects on national welfare, although this conclusion must, of course, be drawn very cautiously because of the numerous measurement issues and confounding influences faced by the estimation.

5.2. Manufactured products

In the case of manufactured products, NTMs of interest are essentially type-B (TBT). Estimation proved trickier than in the case of food products, possibly because of mix-ups between TBT and SPS measures in the data collection and classification. At the importer-section level, 81.2 percent of the AVEs of TBT measures are nonnegative, which is substantially less than in the case of SPS measure on agri-food products. The full distribution is shown in Figure 6. The median AVE at the country-section level is 4.09 percent and the simple average (across all non-ASEAN importers and sections) is 4.51 percent. For ASEAN countries, the median and mean AVEs are respectively 5.06 percent and 5.00 percent.

Figure 6: Distribution of average AVEs, TBT measures on manufactured products



Note: Estimation carried out on exporter-importer-product panels at the HS6 level, by chapter, for chapters 28- 43, 50-89, and 93 (sections 6-8, 11-17, and 19), using robust standard errors. Chapter estimates aggregated to sections by averaging. Estimation includes fixed effects by importer, exporter, and HS6 product. Estimates with p-values over 0.1 are set to zero. AVEs in algebraic form, so .2 = 20%. Density in percent.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, and the CEPII's TUV and BACI databases.

Table 2 shows a breakdown of average AVEs for TBT measures, by HS section and ASEAN importer, for manufactured products (sections 6–16,18, and 20). In the chemicals sector, the highest average AVE is observed in Indonesia (7.3 percent). In the textile sector, the highest are in Singapore (9.9 percent) and Malaysia (9.4 percent). In the steel sector (metal products), the highest are in Indonesia (10.3 percent) and the Philippines (9.3 percent). In the transport equipment sector, which includes automobile, taking apart Myanmar (probably a statistical aberration), the highest average AVE is in Viet Nam (12.9 percent). Across all sections, the highest average AVEs are observed in Indonesia (5.7 percent), Viet Nam (5.4 percent), Malaysia (5.2 percent), and Singapore (5.0 percent).

Table2: Average AVEs, TBT measures, by section and importer (percent)

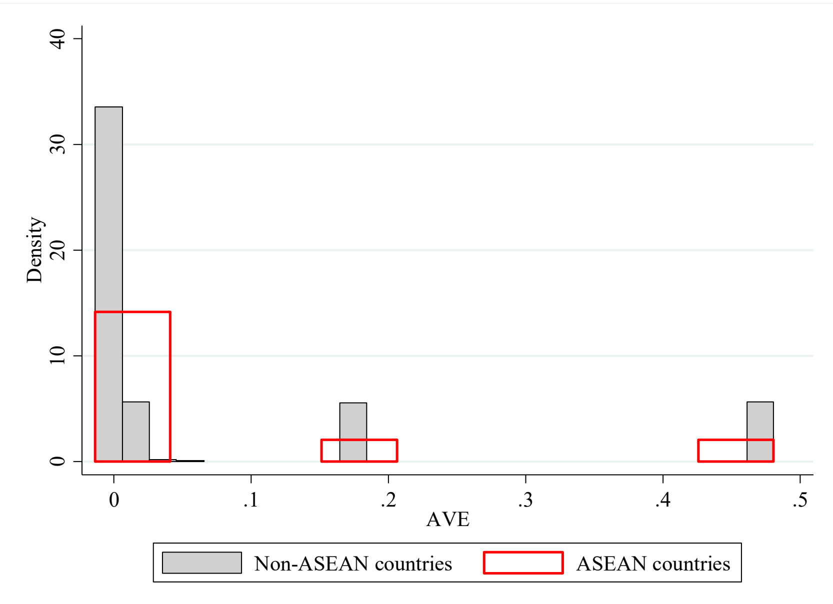
HS section	BRN	IDN	KHM	LAO	MMR	MYS	PHL	SGP	THA	VNM
Chemicals	3.3	7.3	0.8	4.4	-0.9	5.6	-0.4	0.6	0.3	0.7
Plastics & rubber	3.1	5.1	3.1	-2.5	-4.2	3.1	2.4	3.1	7.7	10.5
Leather	4.9	5.7	-1.4	-1.4	-1.4	4.8	-1.9	4.9	-1.4	-1.4
Textile and apparel	4.8	6.9	7.2	7.8	7.8	9.4	6.9	9.9	7.1	7.8
Footwear	2.5	5.1	2.1	2.1	2.1	2.1	1.8	2.5	2.1	2.0
Cement etc.	7.1	5.0	3.9	3.9	3.9	3.9	4.3	9.4	7.8	6.0
Metals & metal prod.	3.6	10.3	4.7	6.6	4.1	5.1	9.3	5.2	4.7	8.6
Machinery	8.1	4.1	-2.8	4.5	3.3	7.0	2.7	3.3	3.3	1.8
Transport equip.	4.8	1.5	7.5	6.9	12.9	6.1	5.5	6.3	8.7	12.9
Simple average	*4.7*	*5.7*	*2.8*	*3.6*	*3.1*	*5.2*	*3.4*	*5.0*	*4.5*	*5.4*

Note: AVEs are in percent. BRN: Brunei Darussalam; IDN: Indonesia; KHM: Cambodia; LAO: Lao PDR; MMR: Myanmar; MYS: Malaysia; PHL: Philippines; SGP: Singapore; THA: Thailand; VNM: Viet Nam. Estimates that are exactly equal for two countries correspond to cases where the interaction terms are not significant, leaving only the direct term which is common to all countries.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, and the CEPII's TUV and BACI databases.

As for other measures than TBT, Figure 7 shows that, upon the imposition of contingent-protection measures, trade unit values tend to rise for ASEAN countries like for others. This may reflect the use of price undertakings, although more research is needed on this issue.[5]

Figure 7: Distribution of average AVEs, contingent-protection measures on manufactured products



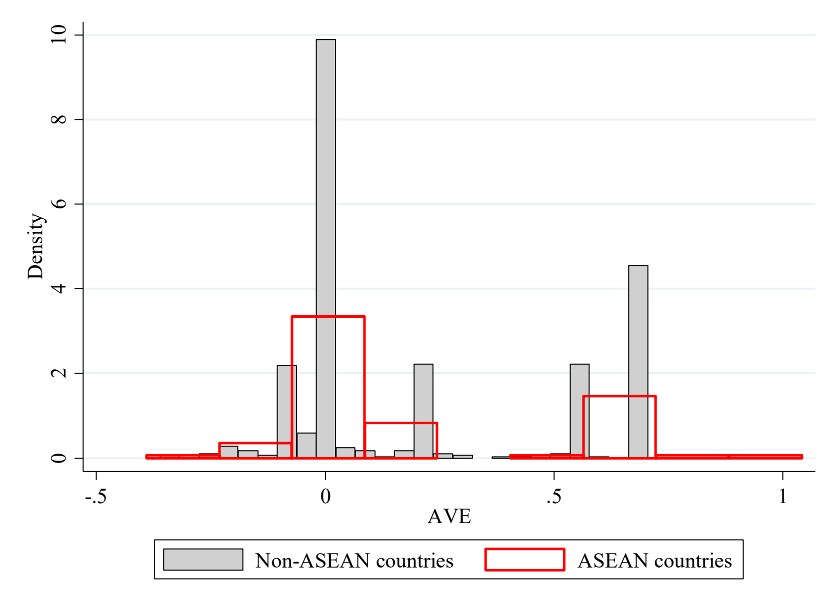
Note: Estimation method is the same as for Figure 6. AVEs in algebraic form. Density in percent.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, and the CEPII's TUV and BACI databases.

[5] The ASEAN Trade Repository contains no information on price undertakings imposed by ASEAN members.

As for QRs, effects are widely spread out, although the majority are positive, suggesting that some market power is conferred to foreign producers (Figure 8).

Figure 8: Distribution of average AVEs, quantitative restrictions on manufactured products



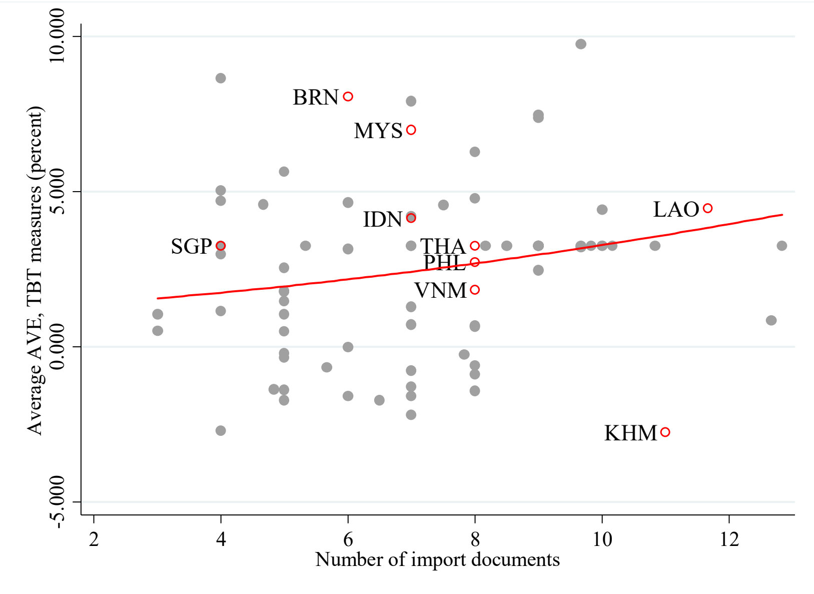
Note: Estimation method the same as for Figure 6. AVEs in algebraic form. Density in percent.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, the CEPII's TUV and BACI databases, and the World Bank's World Development Indicators.

Given that contingent-protection measures and quantitative restrictions both appear to raise the price charged by foreign producers to ASEAN importers, they are likely to be welfare-reducing, in addition to their domestic redistributive effects (from consumers to domestic producers) in the case of contingent protection and to license holders in the case of Quantitative Restrictions.

How do estimated AVEs relate to trade facilitation? Figure 9 shows the correlation between the number of documents needed to import a product, on average, as reported in the World Bank's Doing Business indicator, and the average AVE of TBT measures, in the all-important machinery sector, which includes not just industrial machinery, but a host of household equipment products. The positive correlation suggests that there is a linkage between the documentary burden imposed on producers/traders and the price they charge to their clients. However, this linkage is weak. For instance, in Lao PDR, the ASEAN member with the largest number of import documents, the average AVE in the manufacturing sector is below five percent and barely over that of Singapore, a best-practice country. This, incidentally, suggests an important point to keep in mind in the interpretation of AVEs, in line with the discussion in the introduction. The major differentiating factor between the two cases (Lao PDR and Singapore) is apparently not the *level* of the AVE, but what consumers pay for. Singapore has a competent technocracy capable of enforcing technical regulations; so the AVE can be taken as the price to pay for addressing market failures, in accordance with equation (6). Lao PDR, by contrast, is not yet at the level of Singapore's capabilities, at least in 2017 when this paper is written. Thus, the situation is more likely to correspond to equation (3), a case where the technical regulation serves no purpose.

Figure 9: AVEs of TBT measures and documentation burden across countries, machinery sector

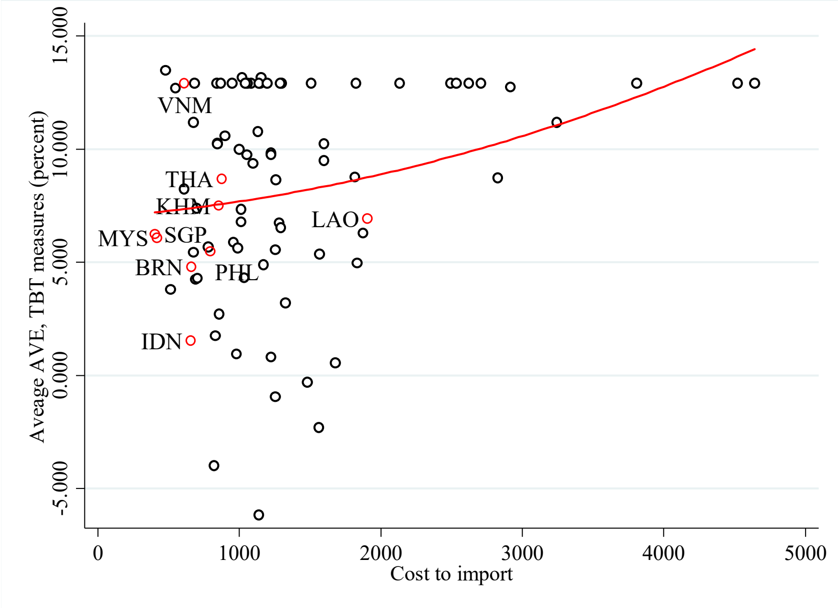


Note: AVEs on vertical axis in percent; 5.000 = 5%.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, the CEPII's TUV and BACI databases, and the World Bank's World Development Indicators.

Figure 10 shows the correlation between the average cost to import a product in the transportation equipment sector (largely dominated by the automobile sector), as reported in the World Bank's Doing Business indicator, and the average AVE of TBT measures. Again, the positive correlation suggests that exporters tend, on average, to pass through the cost of bringing products in a market onto the price charged to buyers in that market. Note, interestingly, that most ASEAN countries are low-cost importers, and that most of them (with the notable exceptions of Viet Nam and Thailand) have lower TBT AVEs than predicted by the fitted curve.

Figure 10: AVEs of TBT measures and cost to import across countries, automobile sector



Note: AVEs on vertical axis in percent. Cost to import in US dollars per container. Points stacked horizontally correspond to country/sections for which the interaction term was not significant at ten percent, leaving only the direct term common to all.

Source: Authors' calculations using ASEAN–ERIA–UNCTAD 2015 Database on Non-tariff Measures, UNCTAD NTM database, the CEPII's TUV and BACI databases, and the World Bank's World Development Indicators.

All in all, while noisier than those for SPS measures on agri-food products, AVE estimates for TBT measures on manufactured products also accord broadly with intuition, except for the 18.8 percent of negative ones, which likely reflect measurement problems. By and large, the cost of complying with TBT measures seems limited and, in many cases, well below ten percent.

6. Concluding remarks

Our findings suggest relatively low AVEs for TBT measures on manufactured products, both for ASEAN countries and for the sample as a whole at 4.5 and 5 percent, respectively. This is true even in sensitive sectors such as chemicals, machinery or transport equipment. In all ASEAN countries, estimated AVEs for TBT measures are well below ten percent. We find slightly higher AVEs for SPS measures on agriculture and food products, both for ASEAN countries and for the sample as a whole at 6.5 and 6.7 percent, respectively, with more dispersion within ASEAN, where countries like Lao PDR, Myanmar, Thailand and Viet Nam have averages over ten percent.

Our estimates fall broadly in the same range as those recently obtained by Grübler et al. (2016), although their estimates are obtained from a very different approach using the variation of trade flows and the PPML estimator, they find an average AVE of 2.9 percent overall (counting non-significant estimates) and 8.2 percent counting only estimates significant at the ten-percent level or more, excluding intra E.U. trade.[6] However, 45 percent of their estimated AVEs are negative, so the average is likely to hide wider dispersion of estimates in their case than in ours.

Our results should be interpreted cautiously for several reasons. First, there remain a number of technical issues. The figures reported in this paper are section-level averages of panel estimates obtained at the chapter (HS2) level. Raw estimates at the chapter level are relatively more erratic than they are once averaged at the section level. They are also fairly sensitive to the estimation approach. For instance, while OLS and weighted least squares (using trade weights) yield somewhat similar estimates, using as the key explanatory variable a dummy variable equal to one when one or more NTM is imposed by a country on a product and zero otherwise, instead of the count of NTMs, yields erratic and somewhat implausible estimates.

Second, as argued in the introduction and in Section 2, even if AVEs accurately represent compliance costs, they can mean very different things depending on whether they have a counterpart in the correction of a market failure. This depends, *inter alia*, on the technical capabilities of domestic regulatory agencies. For instance, we find an AVE of minus one percent on chemicals in Myanmar. Yet, Myanmar has stiff regulations on the importation of pharmaceuticals, covering the conditions in which they are stored, the skills of employees, and so on, which should push up prices. The explanation of this paradox is that the regulations go largely unenforced; according to anecdotal evidence, there is wide circulation of cheap but harmful counterfeit drugs in the country. The juxtaposition of unenforced regulations and cheap imports is just the type of configurations that can produce negative AVEs, but those are meaningless; only a detailed case story can give the true story. In other words, low AVEs do not necessarily reflect smooth, efficient import processes; instead, they may reflect the government's inability to address market failures.

This paper is the first part of a research program that aims to identify separately (i) NTM compliance costs through AVEs estimated on trade unit values, and (ii) NTM stringency, relative to the social optimum, through their effects on volumes imported. Here, we report only the compliance-cost side of the story; the estimation of NTM stringency, which raises specific difficulties, is left for future research.

[6] Grubler et al. (2016) : Table 1.

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"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l'ignore."

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