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Trade Restrictiveness Indices in Presence of Externalities:

An Application to Non-Tariff Measures

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Abstract:

We extend the trade restrictiveness index approach to the case of market imperfections and domestic regulations addressing them. We focus on standard-like non-tariff measures (NTMs) affecting cost of production and potentially enhancing demand by increasing product quality or reducing negative externalities. We apply the framework to the database of Kee et al. (2009) and derive ad valorem equivalents (AVEs) for NTMs. Half of the product lines affected by NTMs exhibit negative AVEs, indicating a net trade-facilitating effect of NTMs. Accounting for these effects significantly reduces previous measures of countries' trade policy restrictiveness obtained while constraining NTMs to be trade reducing.

Keywords: Non-tariff measures, externalities, ad valorem equivalents, trade restrictiveness indices

JEL code: F13, F18, Q56

1. Introduction

Standard-like non-tariff measures (NTMs) are playing an increasing role in international trade. Some of them have protectionist purposes, especially in a context of decreasing tariff barriers. However, some others are adopted by policymakers to address market imperfections (externalities, information asymmetries). In such cases, NTMs may be trade facilitating and welfare enhancing. The literature measuring the restrictiveness of the trade policy, through the computation of various indices, has failed to consider these effects. Our paper fills this gap.

With global sourcing, it becomes challenging to guarantee products' safety and quality and to mitigate negative externalities. Standards and regulations affecting quality help overcome asymmetric information issues. Occasional recalls by toy, pharmaceutical and food companies illustrate the importance of various safety concerns, such as led paints in children toys (Lipton and Barboza, 2007). Consumers may also care about global commons and avoid purchasing products obtained using unsustainable environmental practices. To preserve their reputation, large firms (e.g. Home Depot, IKEA, etc.) have shown strong support for forest certification (McDermott and Cashore, 2009). Similarly, consumer welfare is improved by quality requirements limiting residues of dangerous pesticides and antibiotics in food products (Disdier and Marette, 2010).

In this context, regulatory interventions have strong economic and political support, despite risks of inefficiency and distortions. The effects of these regulatory instruments are indeed complex not only because instruments are imperfect but also because they impact costs of heterogeneous foreign and domestic producers. Meeting the NTMs is costly for both domestic and foreign suppliers and often more so for the latter. While a regulation may thwart a market failure and facilitate trade between countries, it may also reduce market access for foreign

producers who cannot easily comply with this regulation. To illustrate, between October 2006 and 2007, the U.S. Consumer Product Safety Commission (CPSC) announced 473 products recalls of which 389 cases involved imported products (CPSC, 2008). This last effect may outweigh the "legitimate action" to mitigate a market failure. Both trade and welfare impacts of regulation are ambiguous and in general hard to evaluate. A rigorous empirical measure of these impacts therefore requires a consistent framework, as proposed here.

We consider a small open economy, distorted, first, by arbitrary tariffs and other domestic price policy distortions, and second by market imperfections and existing NTMs allegedly addressing them. We pay particular attention to NTMs and their protective effects against import competing products, as well as their potential demand enhancing effects when NTMs reduce information asymmetries and trade cost. We then extend the trade restrictiveness index (TRI) approach of Anderson and Neary (2005) to this more general and realistic case encompassing market failures and the existing domestic regulations addressing them.

The TRI approach of Anderson and Neary (1992, 1994, 1996, 2003, and 2005) provides a welfare-based consistent aggregation of various trade distortions into a scalar uniform surtax factor, equivalent to these distortions in terms of their welfare effects. The TRI approach is a concept applying to a whole economy because it relies on the balance of trade approach. Nevertheless, it has been applied successfully to partial equilibrium and multi-market situations. Feenstra (1995) has proposed some simplifying assumptions greatly fostering the applicability of the approach by reducing the number of price responses to estimate or calibrate in the implementation. The TRI and its extensions such as the Mercantilist TRI (MTRI) of Anderson and Neary (2003) have been used to derive the tariff equivalent of arbitrary tariff structures (Anderson and Neary, 1994), tariffs and quotas (Anderson and Neary, 1992 and 2005), tariffs

and domestic production subsidies (Anderson et al., 1995; Anderson and Neary, 2005; Beghin et al., 2003), and tariffs and AVEs of other NTMs (Hoekman and Nicita, 2011; Kee et al., 2009; Lloyd and MacLaren, 2008; and Bratt, 2012), among others. As shown in these applications, the TRI approach provides a consistent aggregation of distortionary effects of various policy instruments into a single "total" AVE within a given sector. The latter property explains the recent success and popularity of the approach in empirical investigations of NTMs in presence of tariffs and other price policies at the sector level.

The novelty of the present paper is to allow for market imperfections and trade facilitating effects of NTMs in the TRI framework. Despite its inherent ability to capture second-best situations, the determination of the TRI under market failure has been overlooked in the trade literature. The only related effort in this direction is from Chau et al. (2007) who develop a quantity-based distance function, a trade restrictiveness quantity index, in presence of environmental externalities but abstracting from existing policy interventions. Outside of the TRI literature, recent empirical investigations note that NTM regimes can facilitate trade (see Cadot and Gourdon, 2013, for a review). Reputation and certification processes increase trust in exchange (Blind et al., 2013); quality standards help reputation and reputation loss can be detrimental to trade (Jouanjean, 2012); and transparency provisions in trade agreements can facilitate regulated trade flows (Lejárraga et al., 2013).

We fill this gap in the TRI-related trade literature: we consider the TRI of arbitrary tariffs, domestic production subsidies, and NTMs in presence of possible external effects.[1] This

[1] Several investigations using the standard gravity equation approach find some trade facilitating effects of NTMs but without a rationalization based on some demand increasing effect or market imperfection presumably mitigated by the NTMs being analyzed (see Li and Beghin, 2012).

undertaking is a substantive step forward for two reasons. First, trade policy reforms often occur in the context of market imperfections such as asymmetric information or negative externalities imposed on some agents. Accounting for these imperfections is relevant and has been the central pillar of the trade and environment literature using the dual approach to trade (Copeland, 1994; and Beghin et al., 1997). Surprisingly, this case has eluded the TRI literature. Second, numerous NTMs have been emerging in the last 15 years for several reasons, including potential protectionism, but also to address consumer and retailer concerns for health and the environment and associated external effects. A priori, excluding potential market imperfections when analyzing NTM policy reforms biases results and could lead to erroneous policy recommendations. Not surprisingly, sectoral AVEs and TRI estimates are likely to exhibit upward bias when they are econometrically constrained to treat all policies as trade-reducing. We depart from this restrictive premise and start from an agnostic prior on the impact of NTM policies on trade and welfare.

We then apply the proposed framework to the NTM global database of Kee et al. (2009) consisting of a large cross section of products (at the 6-digit level of the Harmonized System – HS – classification) and importing countries. We derive ad valorem equivalents (AVEs) for NTMs and other policy distortions (tariffs and domestic production subsidies). 20% of HS 6-digit lines are affected by NTMs and nearly half of these (10% of the lines) exhibit negative AVEs of NTMs, indicating a net trade-facilitating effect of NTMs in those sectors. These AVEs are then used to evaluate the restrictiveness of the trade policy defined by countries. TRIs computed with these AVEs reflect the frequent trade facilitating effect of NTMs. Accounting for these trade-facilitating effects significantly reduces previous measures of trade policy restrictiveness for most countries obtained while forcing NTMs to be trade reducing. These

trade-facilitating effects cast doubt on the predominant presumption that NTMs are exclusively protectionist and cannot possibly boost trade, let alone welfare.

Our paper proceeds as follows. We present the framework in Section 2. We then describe the data and detail the econometric approach in Section 3. Section 4 presents the estimation results of AVEs and TRIs. We conclude in Section 5.

2. The TRI framework with market imperfection

We follow the standard TRI approach with the balance of trade function derived from the dual approach to trade for a small open distorted economy. We build on the usual framework with a negative externality affecting the representative consumer as in Copeland (1994). The externality is assumed exogenous to the consumer but influenced by the policymaker via some NTM regulations such as standard-like regulations. These regulations may not be set optimally and may be set at a protectionist level as in Fisher and Serra (2000).

2.1. Market demand and supply, and balance of trade function

The utility of the representative consumer is *u(x,H(NTM))* with non negative market goods *x* and negative externality *H* influenced by a vector of NTM policies, *NTM*, and with the usual definitions and properties:[2]

$$u_x = \partial u / \partial x > 0 \text{ and } u_H = \partial u / \partial H < 0;$$
$$H = H(NTM) \text{ with } \partial H / \partial NTM < 0.$$

All domestic consumer prices *p* are inclusive of the exogenous world price *wp*, a tariff τ,

[2] We could complicate the model by assuming that imports *m* influence the health externality or *H*(*m*(*NTM*), *NTM*). This would make health depends on all the arguments influencing imports and generate clutter with multiple feedback effects of all policies through health. The effect of *NTM* alone on health generates the possibility of trade enhancements which is what we are after.

and the unit cost equivalent of the domestic *NTM* on foreign suppliers to sell in the domestic market, or $p = wp + \tau + t(NTM)$.[3]

Given domestic prices p, the associated expenditure function is:

$$e(p,\overline{u},\overline{H}) = \underset{x}{Min}(p'x \mid u \geq \overline{u}; H \leq \overline{H}),$$

with the usual derivative properties:

$$e_p = \delta e / \delta p = x(p,u,H(NTM)) \geq 0, \text{ and } e_H = \delta e / \delta H \geq 0.$$

Expenditure function e exhibits all the usual homogeneity and curvature properties in prices, implying $p'e_{pp}=0$, $e_H=p'e_{pH}$, $e_u=p'e_{pu}$; $e_{pNTM} = e_{pH}\, H_{NTM}$, and $f'e_{pp}f \leq 0$ for any arbitrary vector f of similar dimension as p. The marginal damage e_H of the negative externality is positive for any given utility level. To keep utility constant, expenditure has to increase when the negative externality increases. Partial derivative e_u is the inverse of the marginal utility of income assumed positive. We eventually simplify preferences to follow Feenstra (1995) in the empirical investigation section.

The impact of the NTM policy encompasses several possible cases. The demand enhancing case is $e_{pNTM} = e_{pH}\, H_{NTM} < 0$. Protectionism of the NTM is implied by $H_{NTM} = 0$ because the policy does not address an externality or is not based on science. Another special case could be that the *NTM* policy affects H ($H_{ntm}<0$) but that *H(NTM)* does not affect a particular demand (particular good n) directly, or $e_{p_nH} = 0$. In this case, the policy is not protectionist per se but addressing the market imperfection has no bearing on that particular demand for good n. These last two cases show the difficulty to gauge revealed protectionism.[4]

[3] Domestic and foreign firms have heterogeneous cost of meeting the NTM standard as explained later in the production component of the model and we assume that domestic firms are more efficient at meeting these NTMs.

[4] Demand not being enhanced by the NTM policy is not sufficient although suspicion of protectionism may arise.

For integrability of the Hicksian demands into the expenditure function, at least one of the demands represented by *x* has to be influenced by the external effect *H*. To illustrate, *H* could be the negative health effect of consuming products that are hazardous if minimum quality standards are not imposed on their production. The standard reduces the occurrence of sickness which may affect the demand for these products, and possibly other demands via better health (reduced medical expenditure, more active leisure activities) or none other at all (all other demands independent of health status). Similar examples can be constructed with environmental external effects such as global commons or consumer packaging waste in retail consumption.

On the production side, domestic supply decisions in competitive industries are derived from the *gdp* function:

$$gdp(p^p, \bar{z}) = \max_y (p^p{}' y \,|\, g(y, \bar{z}) \le 0),$$

with y denoting the net output vector, z the vector of fixed national endowments, and p^p the vector of producer prices. Producer prices include production subsidies, s, such as farm subsidies, not seen by consumers, $p^p = wp + \tau + t(NTM) + s$. World prices can be normalized to 1 so the distortions s, t, and τ are viewed indifferently as either ad valorem or specific policy distortions. For simplicity we assume that domestic firms already meet the standards implied by *NTM* but that foreign firms may not. A more complicate framework affecting both domestic and foreign firms could be included but the essence here is that *t(NTM)* captures the asymmetric protective effect of *NTM* at the border on foreign industries.[5] The *gdp* function has the usual envelope and homogeneity properties:

[5] *NTM* would then enter the GDP function and the derivative $gdp_{pNTM} = y_{NTM}$ would represent the leftward shift of domestic supplies caused by the NTM policies. The unit cost equivalent of y_{NTM} would be assumed to be smaller than *t(NTM)* to indicate a net protective effect of *NTM* on domestic suppliers as in Fisher and Serra (2000).

$gdp_p = \partial gdp / \partial p^p = y;\ p^p{}' gdp_p = gdp; p^p{}' \partial y / \partial p^p = p^p{}' gdp_{pp} = 0;$ and $f' gdp_{pp} f \geq 0$ for any f.

For convenience we also define compensated excess demand functions *m*, with $m(p, p^p, H(NTM), u, \bar{z}) = x(p, u, H(NTM) - y(p^p, \bar{z})$, with partial derivatives indicated by the appropriate subscript as for functions *e* and *gdp*.

Now we have all the elements to develop the balance of trade function *B*:

$$\begin{aligned} &B(p, p^p, wp, NTM, \bar{z}, H, u) = \\ &e(p, u, H(NTM)) - gdp(p^p, \bar{z}) - \tau'(x(p, u, H) - y(p^p, \bar{z})) + s' y(p^p, \bar{z}). \end{aligned} \tag{1}$$

Variable *B* indicates the amount of foreign exchange necessary to sustain utility *u* given *NTM*, *wp*, *z*, *s*, and τ. Homogeneity in prices and envelope properties of *e* and *gdp* lead to a simpler formulation of (1) seemingly omitting tariff revenues and production subsidy costs.

$$B(p, p^p, wp, \bar{z}, H(NTM), u) = (1 + t(NTM))'(x(p, u, H(NTM)) - y(p^p, \bar{z}). \tag{1'}$$

2.2. Trade restrictiveness indices with externality

The TRI problem in our case is to find a scalar *T* equivalent to standard-like policies, tariffs, and production subsidies to apply as a tariff surcharge on world prices such that:

$$\begin{aligned} &B(wp(1+T), wp(1+T), wp, \bar{z}, H(0), u_0) = \\ &B(wp + \tau_0 + t(NTM_0), wp + \tau_0 + t(NTM_0) + s_0, wp, \bar{z}, H(NTM_0), u_0) = B_0. \end{aligned} \tag{2}$$

The tariff surcharge accounts for several components: tariffs τ, domestic production subsidies *s*, the demand shift via *H*(*NTM*), and the protective effect from raising foreign cost to satisfy technical measure *NTM*, that is, *t*(*NTM*).

Next, while holding *u* constant, we differentiate equation (2) with respect to *T*, τ, *s*, and *NTM* to derive the relative change in *T* rather than *T* as it is customarily done in the TRI literature. This step yields:

$$(B_p' wp + B_{p^p}' wp)dT = (B_p' + B_{p^p}')(d\tau + \partial t / \partial NTM \ dNTM) + B_{p^p}' ds + B_H H_{NTM} dNTM, \quad (3)$$

with subscripts denoting the variable involved in the partial derivative of *B*. Solving for *dT* yields:

$$dT = (1/(B_p' wp + B_{p^p}' wp))[(B_p' + B_{p^p}')d\tau + B_{p^p}' ds + ((B_p' + B_{p^p}')\partial t / \partial NTM + B_H H_{NTM})dNTM], \quad (4)$$

with partial derivatives B_i:

$$B_p' = -\tau' e_{pp};$$
$$B_{p^p}' = (\tau + s)' gdp_{pp};$$
$$B_H = (wp + t(NTM))' e_{pH} > 0.$$

Equation (4) shows that the TRI has three policy components corresponding to the tariff, subsidy, and NTM policies. The *NTM* component is the sum of a demand effect via reduced externality *H*, and a NTM protectionist effect relative to foreign goods (through a tariff equivalent *t* increasing in *NTM*). While the sign of this protectionist effect on imports is clear, the combined effect of *NTM* on *m* via the externality *H* and the protectionist effect *t(NTM)* is ambiguous as their relative magnitude is unknown analytically. For example, a pure protectionist NTM policy imposing useless labeling requirements would raise *t(NTM)* and have no effect on consumers' perception and would lead to a welfare loss and trade contraction. Conversely, standards requiring safe goods including imported ones are likely to lead to a net demand-enhancing effect lowering transaction costs for consumers. The latter NTM policy would be trade and welfare enhancing. The econometric investigation will sort the NTM regimes into trade reducing and trade facilitating since we do not impose any "protectionist" NTM prior.

Next, to further elucidate these effects and undertake our empirical investigation, we assume a simplified structure for the Hessian matrix of cross-price responses (e_{pp} - gdp_{pp}) as in Feenstra (1995), and others. The Hessians e_{pp} and gdp_{pp} are each assumed to be diagonal and

constant, which leads to $B_p^{'} > 0$ and $B_{p^p}^{'} > 0$ if τ and s are non negative.[6] From these conditions we derive an implementable framework to approximate the sector total AVE corresponding to all policy types τ, s and *NTM* as well as the implied TRI and the MTRI. In general, if the Hessian matrices of price responses of imports (or demand and supply responses) are not constrained to be diagonal, off-diagonal elements can be positive or negative and it is impossible to *a priori* sign elements of $B_p^{'}$ and $B_{p^p}^{'}$ and therefore the change in the TRI, *dT*. The computation of *T* is obviously cumbersome in the presence of cross-price effects and non-constant slopes.

We recover TRI *T* from *dT* as in Feenstra (1995) and Kee et al. (2009), which is equivalent to the initial tariffs, subsidies, and NTMs relative to a world with all policies set to 0 by integrating both sides of (4) with respect to *T* going from zero to *T* and policies going from (0,0,0) to (τ, *s*, *NTM*). The latter approach works only if *dT* is non-negative. This step yields:

$$T = \sqrt{(1/wp'(gdp_{pp} - e_{pp})wp}\sqrt{(B'_p + B'_{p^p})\tau + B'_{p^p}s + B'_{NTM}NTM}, \quad (5)$$

with $B_{NTM} = (B_p^{'} + B_{p^p}^{'})\partial t / \partial NTM + B_H H_{NTM}$ whose sign is undetermined. The original formula in Feenstra (1995) contains the first positive element from tariffs abstracting from *s* and *NTM*. Here, two additional components originate from production subsidies (positive contribution to the TRI), as long as subsidies are positive, and from NTM policies (ambiguous sign). The formula in Kee et al. (2009) has the protectionist effects of tariffs and subsidies and a protectionist effect of NTMs. No externality or demand enhancement appears in their equation. This additional effect included in our equation (5) can potentially facilitate trade and complicates the simple narrative of obstructive NTM policies and their tax equivalent. Equation (5) is in

[6] This simplification reduces price effects to the own-price effect, and homogeneity holds implicitly by defining prices relative to a numéraire good.

essence the square root of a weighted sum of deadweight losses from tariff, production subsidies, and the welfare effects of NTMs. If the latter is a pure protectionist policy, then $B_H H_{NTM}$ is zero (no demand shift) and the dead weight loss from the tariff equivalent *t(NTM)* is added to the sum of deadweight losses. If the NTM policy facilitates trade, then the latter maps into a welfare gain. Removing the NTM decreases the TRI as welfare falls with its removal. If the latter effect dominates the distortionary effect of tariffs and subsidies, then dT is negative and T cannot be recovered using (5). Instead, dT is the form of choice as in the early TRI investigations (e.g., Anderson et al., 1995).

These effects are illustrated in partial equilibrium in Figure 1. Figure 1 shows the two effects of the NTM policies, that is, the demand enhancement shift (from x to x' with greater utility achieved with reduced health hazard), and the increase in border price ($wp+t(NTM)+\tau$) reflecting the international cost of meeting the country's standard and the tariff, and their total effects on imports m. In previous investigations only the border price effect of *NTM*, *t(NTM)*, was considered and the trade (and welfare) impact of *NTM* on imports was detrimental by assumption.

Insert Figure 1 here

Along with the TRI, we consider the MTRI, which holds aggregate imports ($wp'm$) constant. The MTRI yields the tariff equivalent to all distortions holding aggregate trade unchanged but allowing for welfare variation. The MTRI is derived in Anderson and Neary (2003) and Kee et al. (2009) who call it the overall TRI (OTRI). The derivation of the MTRI follows the spirit of the derivation of the TRI and we only present its final formula in equation (12). We refer readers to Anderson and Neary (2003) for details.

An important consequence from the potential presence of trade-enhancement effects and

negative AVEs from NTMs is that our TRI and MTRI estimates will be equal or smaller than the TRI and MTRI where all policies are constrained to be trade reducing. We discuss this important point in the empirical section.

2.3. The import equation to estimate

Next, we derive the import equation to estimate and the AVEs of all policy instruments. Totally differentiation of *m* (holding *u* constant) for changes in exogenous variables leads to a change in imports of good *n* in any country equal to:

$$dm^n = (\partial m^n / dp^n)d\tau^n - (\partial y^n / \partial p^n)ds^n + [(\partial m^n / dp^n)(\partial t^n / \partial NTM^n) + (\partial x^n / \partial H)(\partial H / \partial NTM^n)]dNTM^n - (\partial y^n / \partial z^n)dz^n. \quad (6)$$

Equation (6) and *m* provide a way to estimate the response of imports to tariffs, subsidies, and NTM policies, and other variables as in Feenstra (1995). We then derive the estimate of the AVE to the net effect of NTM policies on good *n*. Unfortunately we cannot separately identify the individual effects of *NTM* on *m* in (6), but we can estimate their net effect. Following a common practice we move the tariff effect on the left hand side of (6) and the general specification for the import demand of good *n* in country *c* (as indicated by superscript *n*,*c*) is:

$$\ln m^{n,c} - \varepsilon_{n,c} \ln(1+\tau^{n,c}) = \beta_n + \sum_k \beta_k^z z_k{}^{n,c} + \beta_{n,c}^S s^{n,c} + \beta_{n,c}^{NTM} NTM^{n,c}. \quad (7)$$

Elasticity $\varepsilon_{n,c}$ is the own-price response of import of good *n* in country *c*. $\beta_{n,c}^{NTM}$ is the sum of two AVE components (the tariff equivalent of *NTM* on world prices, and the ambiguous import subsidy/tax effect of *NTM* via decreased externality). Note that the latter AVE component is bound to the left to -100% as prices are non-negative. This non-negative constraint provides a lower bound of -100% on $\beta_{n,c}^{NTM}$ if we further assume that there is no trade impediment effect of the NTM policy (*t(NTM)=0*) at the border. This is a limit case to establish the lowest non-

negative prices faced by agents in the economy.

Equation (7) once estimated provides the basis for the total AVE of NTM policies on good *n*, AVE_{total}^{NTM}, which is:

$$AVE_{total}^{NTM} = \beta_{n,c}^{NTM} / \varepsilon_{n,c}, \text{with} -1 \leq AVE_{total}^{NTM}. \quad (8)$$

An AVE is developed similarly for production subsidies, based on the fact that $(1-\gamma)AVE_{n,c}^{S} = \beta_{n,c}^{S} / \varepsilon_{n,c}$, with ($\gamma = {}^{\partial x/\partial p}\!/_{\partial m/\partial p}$). Unfortunately, parameter γ is not readily known as we only have estimates of import demand price elasticities and not the underlying output and demand price responses. Hence, we estimate a lower bound to the production subsidy AVE by abstracting from fraction (1-γ). Alternatively, the production subsidy AVE estimate could be seen as a market price support subsidy, affecting both consumer and producer prices. This assumption is common although not fully accurate.

Next, we specify $\beta_{n,c}^{NTM}$ as a transformation of an exponential such that it satisfies a lower bound on the total AVE of the *NTM* effects as before and in addition allowing for fixed effects per commodity and interaction terms with country-specific exogenous shifters (endowments) *z*. For a continuous *NTM* variable, this leads to $\beta_{n,c}^{NTM} = a - \exp(\beta_{n}^{NTM} + \sum_{k} \beta_{nk}^{NTM} z_{k}^{n,c})$, with parameter *a* constrained such that the AVE of *NTM* is lower bounded at -1 or -100%. The corresponding value is $a=\varepsilon_{n,c}$. If *NTM* is approximated by a dichotomous variable, then the various partial derivatives of *m*, and *t* with respect to *NTM* do not exist and are replaced by the first difference of *m* for *NTM* equal to one and zero. This leads to an alternative formula of the total *NTM* AVE ($AVE_{total}^{NTM_{dum}}$) following Halvorsen and Palmquist (1980):

$$AVE_{total}^{NTM_{dum}} = [\exp(\beta_{n,c}^{NTM}) - 1] / \varepsilon_{n,c}, \text{ with} -1 \leq AVE_{total}^{NTM_{dum}}. \quad (9)$$

The lower bound condition in (9) is slightly more cumbersome with a dichotomous *NTM*.

The intuition is that $\exp(\beta_{n,c}^{NTM})-1$ cannot be too large of a positive number to keep producer and consumer prices non-negative (or that $\exp(\beta_{n,c}^{NTM}) \leq 1+\left\|\varepsilon_{n,c}\right\|$ or $\beta_{n,c}^{NTM} \leq \ln(1+\left\|\varepsilon_{n,c}\right\|)$). Using the same specification as for the continuous variable case of $\beta_{n,c}^{NTM}$, we specify the lower bound constraint for the dichotomous case using parameter *a* in $\beta_{n,c}^{NTM} = a - \exp(\beta_n^{NTM} + \sum_k \beta_{nk}^{NTM} z_k^{n,c})$ with $a = \ln(1+\left\|\varepsilon_{n,c}\right\|)$. For small values of $\left\|\varepsilon_{n,c}\right\|$, the dichotomous and continuous values of *a* are approximately equal.

A parallel formulation is used for $\beta_{n,c}^{S} = -\exp(\beta_n^{S} + \sum_k \beta_{nk}^{S} z_k^{n,c})$. As production subsidy *s* is positive, presumably its AVE would not lead to negative producer price issues.

The total AVE of all distortions, that is, tariffs, NTMs, and subsidies for good *n* in country *c* is then (assuming the normalization *wp*=1):

$$TOT_{n,c} = \tau_{n,c} + AVE_{n,c}^{NTM} + AVE_{n,c}^{s}. \tag{10}$$

The TRI in equation (5) translates into:

$$T_c = \left(\frac{\sum_n (\partial m_{nc} / \partial p_{nc}) TOT_{n,c}^2}{\sum_n (\partial m_{nc} / \partial p_{nc})} \right)^{1/2}. \tag{11}$$

Again, if (4) gives a negative *dT*, then (11) cannot be used and the change in TRI, *dT,* is kept to express the change in the index equivalent to the welfare impact of the policy interventions. Recall that *dT* is expressed as a sum of consumer welfare changes, and that *T* is the square root of a positive sum of deadweight losses.

As noted above, we use the same data and AVE estimates to compute the MTRI, T_c^{merc}:

$$T_c^{merc} = \left(\frac{\sum_n (\partial m_{nc} / \partial p_{nc}) TOT_{n,c}}{\sum_n (\partial m_{nc} / \partial p_{nc})} \right). \quad (12)$$

3. Data and econometric specification

We use the UNCTAD[7]-Comtrade database of Kee et al. (2009)[8] as well as their import demand estimates (Kee et al., 2008) to estimate the import demand equation (7), recover AVEs (equations (9) and (10)) at the 6-digit level of the Harmonized System (HS), and compute the MTRI and TRI, (and dTRI) equivalents to the three types of distortions (tariffs, NTMs and subsidies) as in equations (11) and (12) (or (4) for negative dTRI) for each country.

3.1. Data

Trade data come from the Comtrade database. We use the average of imports at the HS 6-digit line by importing country between 2001 and 2003. Imports demand elasticities are extracted from Kee et al. (2008). Tariff data are taken out from the UNCTAD and the World Trade Organization (WTO). Tariffs are for the most recent year for which data are available between 2000 and 2004. For specific tariffs, ad valorem equivalents are used. Data on NTMs are from the UNCTAD TRAINS (Trade Analysis and Information System) database and the following NTMs are selected: price control measures, quantity restrictions, monopolistic measures, and technical regulations. A dummy is set to one if the importing country imposes at least one NTM on a given HS6 product. Regarding production subsidies, the dataset of Kee et al. (2009) covers agricultural

[7] United Nations Conference for Trade and Development.

[8] As recently pointed by Breaux et al. (2013), the new NTM data collection effort under the interagency MAST project seems to be problematic and less promising than one could have hoped. The older TRAINS database appears more reliable than the new MAST dataset.

domestic support. The source is the WTO domestic agricultural support notifications. This continuous variable is in dollars and its log form is used in the estimations.

Countries' characteristics are measured by the economic size (gross domestic product – GDP), and relative factor endowments (agricultural land over GDP, capital over GDP, and labor over GDP). Data are extracted from the World Development Indicators of the World Bank. Two geographical variables are also introduced: a dummy for islands and a measure of remoteness (average distance to world markets defined as the import-weighted distance to each trading partner). Our sample includes 93 importing countries and 4,941 products (HS6 lines).

3.2. Econometric specification

We run estimations HS 6-digit line by HS 6-digit line. To control for the potential endogeneity of NTMs and production subsidies, we instrument them using exports, GDP-weighted average of the NTM dummy variable at the HS 6-digit of the 5 closest neighbors (in terms of geographic distance) and the GDP-weighted average of the agricultural domestic support at the HS 6-digit of the 5 closest neighboring economies (Kee et al., 2009). The instrumented estimation is performed in two stages. We first estimate a probit where the dependent variable is the presence or the absence of a NTM and the explanatory variables are the instruments. The mills ratio derived from this first stage is then included in the second stage equation. If one (or more) country provides production subsidies, instruments for this variable (exports, GDP-weighted average of the agricultural domestic support of the 5 closest neighbors) are also included in the second stage equation.

The quantity impact of NTMs and production subsidies is then transformed into price-equivalents (AVEs) using the provided import demand elasticities. AVEs are calculated for each

importing country and HS6 line. We impose a positive cap AVEs at 50 for a few extreme values. To ease result interpretation, we compute the mean over all importing countries at the HS6 and HS2 levels. Following our estimation, 10% of AVEs for NTMs at the HS 6-digit level are negative, i.e., highlighting trade-facilitating NTMs. Without constraint on the sign of the AVEs, our procedure allows us to keep these negative values in our sample. AVEs of NTMs, tariffs and production subsidies are then aggregated at the country level to derive the trade restrictiveness indices corresponding to all three types of policy interventions.

Finally, we use bootstrapping to compute the standard deviations of the AVEs. The main advantage of this procedure is to account for sampling and estimation errors of the AVEs. We draw (with repetition) 200 random samples from our dataset and perform the AVEs estimation for each of these samples. Estimations are run HS6 line by HS6 line. We then compute the bootstrap standard errors as the standard deviations of these 200 AVEs.

4. Results

We first present the results on AVEs of NTMs in the presence of externalities. We also provide comparisons with the AVEs obtained when the latter are constrained to be trade reducing.

4.1. AVEs of NTMs

We focus the discussion on the results obtained for the first 20 HS sections.[9] Qualitative conclusions are unchanged if the discussion of results is performed at the HS 2-digit level (with 96 sectors, see Table A.1 of the Online Appendix attached for review). Table 1 first reports the simple frequency ratio of NTMs for each HS section, i.e., the share of HS6 lines within each HS section for which at least one importing country of our sample imposes at least one NTM. The

[9] Section XXI (objects of art and antiques) has very few HS6 lines with NTMs and is not reported.

frequency ratio of NTMs should be interpreted as follows: for section I "live animals, animal products", the value 0.458 means that 45.8% of HS6 lines included in HS section I are affected by at least one NTM in at least one importing country.

Results suggest that agricultural and food products (sections I through IV) are more affected by NTMs than manufactured products. The frequency ratio is indeed larger for these products. These industries have high numbers of countries' notifications of sanitary and phytosanitary measures to the WTO. According to the results presented in the Online Appendix (Table A.1), for some HS 2-digit sectors, such as live animals, meat, dairy products, edible fruit and nuts, more than half of the HS6 lines are subject to at least one NTM in one importing country. By contrast, for a number of manufactured products, the share of HS6 lines impacted by a NTM is lower to much lower. A strong exception is "pharmaceutical products (HS30)" (frequency ratio of 52.7%). Many chemical and allied industries (section VI) have frequencies between 15 and 30%. Interestingly, textiles and apparel (section XI) and footwear and headgear (section XII) for which the competition between Northern and Southern countries has been historically contentious, are subject to many NTMs suggesting that some of them may be protectionist measures.

The next column of Table 1 reports the average AVE of NTMs for each HS section allowing for the presence of externalities. The mean is computed over all importing countries and HS6 lines within each section. The mean AVE on the whole sample is equal to 0.035, but strong differences can be observed across sections. First, the magnitude of the mean AVE varies significantly across sectors and is much higher for agricultural products and footwear/headgear than for other products. Second, almost all sections exhibit a positive average AVE, indicating that NTMs have, on average, a net negative impact on trade flows. However, for three sections

(chemicals and allied industries, pearls and precious metals and stones, and arms and ammunition[10]), the average AVE is negative, suggesting that NTMs are trade-facilitating either by improving quality, reducing information asymmetries or by being anti-protectionist. Not accounting for these positive trade effects will therefore bias the computation of AVEs, TRIs, and MTRIs. In our sample, 20% of HS6 lines are affected by NTMs and half of them exhibit negative AVEs of NTMs. These negative AVEs are spread over all HS sections (and HS2 sectors as shown in Table A.1 of the Online Appendix). Column (3) of Table 1 underlines the upward bias affecting the estimation of AVEs when NTM are constrained to be trade-reducing. As expected, the average AVE for each HS section is systematically higher than the average AVE obtained in column (2).

As highlighted with the frequency ratio, the share of HS6 lines subject to at least one NTM greatly differs across section and could therefore bias the average AVE calculated using all HS6 lines. To control for this bias, columns (4) and (5) of Table 1 report the average AVE computed only on HS6 lines on which at least one NTM is applied. Column (4) allows for the presence of market imperfections and trade-facilitating NTMs, while column (5) does not. As expected, the average AVE computed only on HS6 lines subject to a NTM is always higher in absolute value than the one based on all HS6 lines (with or without a NTM). However, the ranking of sections is now slightly different. AVEs of NTMs are still high for several agricultural products (especially for fats and oils, and live animals and animal products). However, the magnitude of the mean AVE is also notable for some manufactured products (e.g. machinery, electrical and video equipment). Furthermore, the difference between the AVEs computed using

[10] The sector of arms and ammunition is least likely to observed commercial trade and standards like NTM policies. Most of the negative AVES are for 9306 sub-sectors including cartridge for pellet guns and sports guns.

all HS6 lines and using only lines with a NTM cannot only be explained by the frequency of NTMs. For example, the frequency ratio of NTMs is relatively similar for pulp of wood, paper and printing (section X, ratio: 13.1%) and optical, photographic and medical instruments (section XVIII, ratio: 13.2%). However, the difference between the average AVE based on HS6 lines subject to a NTM and the one based on all HS6 lines is higher for optical, photographic and medical instruments than for pulp of wood, paper and printing (0.489 vs. 0.423 in the constrained estimation and 0.089 vs. 0.061 in the unconstrained one). This result is also observed at a more disaggregated level (see Table A.1 in the Online Appendix). This divergence of AVEs can be rationalized by the difference in the shares of trade reducing and facilitating NTMs across sections as well as in the magnitudes of the AVEs of these NTMs.

Insert Table 1 here

Table 2 distinguishes between trade-reducing and trade facilitating NTM estimates using results from the unconstrained estimation (allowing for external effects). Again results are summarized by HS section. The first column of Table 2 provides the share of NTM-ridden observations with positive AVEs (trade-reducing NTMs). This share varies across sections, from 18.3% (arms and ammunition) to 65.3% (fats and oils). For 15 out of 20 sections however, the majority of NTMs are trade-reducing (with a share above 50%). In total, 51.8% of NTM-ridden lines at the HS6 level are negatively affected by NTMs.

The last 2 columns of Table 2 show the mean AVE for trade-reducing NTMs and that of trade-facilitating NTMs by HS section. We previously noticed that NTMs were more numerous on agricultural products. According to the second column of Table 2, the AVEs of trade-reducing NTMs on agricultural and food products are however not necessarily higher than the ones

obtained on manufactured products. For example, the average AVE for mineral products (1.279) is slightly larger than the ones observed for vegetable products (1.047) or prepared foodstuffs, beverages, spirits and tobacco (1.130). The average positive AVE for the whole sample is equal to 1.111. In the last column of Table 2, AVEs of trade-facilitating NTMs are non positive, and because of the non-negative price constraint, they are included in the interval [-1;0]. Interestingly we observe that the magnitude of these AVEs is high in absolute value. The minimum in absolute value per section is equal to -0.803 (prepared foodstuffs, beverages, spirits and tobacco), and the maximum (-0.974) is reached for pearls, precious metals and stones. The mean over all sections is -0.840. Table A.2 of the Online Appendix presents the results at the HS 2-digit level. Previous conclusions are still valid and some heterogeneity is also observable across HS2 sectors in the magnitude of the AVEs of trade reducing and facilitating NTMs.

Insert Table 2 here

Figures 2 and 3 provide further insights on the NTM AVES. Figure 2 shows the scattered plot of AVEs at HS6 level, average over all countries and sorted by HS2 line (x-axis numbered from 1 to 96 for 96 HS2 lines). The plot shows the non-negative price constraint (lower bound at -1) and the density of negative (and positive[11]) AVEs for most HS2 lines, and in particular for fish and crustaceans (line 3), inorganic and organic chemicals (lines 28 and 29), and iron and steel and articles of iron and steel (lines 72 and 73), nuclear reactors, electrical machinery and equipment (lines 84 and 85), and optical, photographic, measuring, precision and medical instruments (line 90). The plot also shows the presence of large positive outliers for many HS6 lines. Figure 3 shows two central values (median and mean) of the HS6 AVE averages by HS2

[11] The plot is truncated from above at AVE=3 for better clarity but misses less than 0.3% of the AVE estimates.

line. Most of the within-HS2 means are higher than the corresponding medians, which is motivated by the constraint on non-negative prices and the presence of large positive outliers. Many medians and some means are negative suggesting again the presence of a number of trade-facilitating NTM regimes in sector like food, chemicals, and precious stones and metals. To offset that, positive AVEs also abound suggesting trade-reducing effects in various sectors most visibly in dairy products (line 4), various textiles and apparel, and footwear and headwear (lines 64 and 65). These sectors are known for their history of protectionism in many countries.

To sum up, our results suggest the presence of both trade reducing and facilitating NTMs, with substantial trade effects. Next, these AVEs of NTMs are further used to calculate the TRI and MTRI.

Insert Figures 2 and 3 here

4.2. Trade restrictiveness indices

Table 3 reports summary figures of the results for country-level MTRIs, TRIs and changes in TRIs. Three calculations are performed based on (i) tariffs only, (ii) overall protection using AVEs from the constrained estimation, and (iii) overall protection using unconstrained AVEs. The latter two sets of measures are also summarized for all AVE estimates and for the subset of significant AVE estimates based on the bootstrap standard errors. The summary statistics are presented for all 93 countries, OECD countries, Least Developed Countries (LDCs), and then BRIC (Brazil, Russia, India and China) countries.

The tariff only MTRI and TRI (1st and 6th columns in Table 3) represent the uniform tariff that would provide the same level of imports (MTRI) and welfare (TRI) as the initial tariff structure. OECD countries where in most cases except Japan and South Korea tariffs have been

significantly reduced, exhibit smaller tariff-MTRIs than the 93-country averages, LDCs' and especially the BRICs' averages. According to detailed country results reported in Table A.3 of the Online Appendix, India has the highest tariff-MTRI (0.257) among the 93 countries; South Korea and Brunei have the highest tariff-TRI at or above 0.5. Hong-Kong and Singapore have zero tariff indices as they do not impose border tariffs.

Columns (2) and (7) show the MTRI and TRI estimates including all distortions based on the AVEs from the estimation constraining NTMs to be trade reducing. As expected, MTRIs and TRIs exhibit larger values than in columns (1) and (6) than those obtained using AVEs from the unconstrained estimation (see columns (4) and (9)). For example for the 93-country summary, the median and mean values of the MTRIs are respectively 0.133 and 0.167 with constrained estimates and only 0.019 and 0.011 with unconstrained estimates. Similarly, for the TRI the median and mean values are 0.350 and 0.357 (constrained estimation) versus 0.220 and 0.255 (unconstrained estimation). In other words, for all countries included in our sample, the MTRIs based on overall protection (tariffs, production subsidies, and NTMs) and allowing for negative AVEs are equal or smaller than the MTRIs based on overall protection computed with the constrained AVEs. This last result suggests that some NTM regimes have trade facilitating effects for most countries. Finally, regardless of the estimation method, when comparing results using all AVE estimates or only the significant ones based on the bootstrap standard errors, one notes with the latter that ranges are reduced for all indices except one (MTRI under the unconstrained estimation approach).

Countries' grouping also highlights interesting patterns. The OECD group exhibit negative MTRI values with a mean near zero. The LDC group also exhibit negative MTRI values in its range. This result may seem surprising but is consistent with the integration of LDCs in

European trade following a sequence of structural adjustment policies that removed many protectionist NTMs and expanded preferential trade agreements. The latter induced upgrades of SPS regulations and improved food safety in countries like Sénégal and Côte d'Ivoire among others (FAO, 2003; Colen et al., 2012; and Maertens et al., 2012). Intuitively, many countries with low tariff-MTRIs exhibit negative total MTRIs because small tariffs do not counterbalance negative NTM AVEs.

Lastly, using more disaggregated results by country (see Table A.3 of the Online Appendix), we note that only 14 over 93 countries the MTRI values including overall protection based on unconstrained estimates are higher than the values based on tariffs only. If we abstract from production subsidies from the computation, the share is even smaller (only 9 countries over 93). [12] The analysis of the TRIs shows 45 countries with total TRIs smaller than the tariff-only TRI based on unconstrained estimates. These results show that positing protectionism NTMs strongly biases the evaluation of the restrictiveness of NTM trade policies.

As previously mentioned, if equation (4) provides a negative dT (cf. supra), then the TRI level T cannot be computed using (5). The last columns of Tables 3 report the change in TRI, dT, i.e., the change in the index equivalent to the welfare impact of the policy interventions. Country-level results suggest that for 27 over 93 countries, the change in TRI is negative (Table A.3 of the Online Appendix). Furthermore, for 45 over 93 countries, these values are smaller than the ones obtained when tariffs only are included in the computation (column (7) of Table A.3). These two last results highlight that some NTMs can have positive welfare effects. Not surprisingly, Singapore, Hong-Kong, and many OECD countries exhibit negative dTRIs. This

[12] For three countries, the AVEs of farm subsidies are larger under the unconstrained estimation than under the constrained estimation.

result is consistent with Disdier et al. (2008)'s results showing intra-OECD agri-food trade being enhanced by NTM regimes. Singapore's consumer valuation for risk-averting regulations and orderly markets has been documented elsewhere (Tan, 1999). Several LDC countries also exhibit negative dTRIs and these can be rationalized by opportunities created with the agri-food trade integration and policy reforms as noted earlier.

Insert Table 3 here

5. Conclusion

We extend the TRI approach to a small distorted open economy to account for market imperfections (externalities, asymmetric information) and NTM domestic regulations addressing them. Up to date, the presence of externalities and potential anti-protectionist effects of NTMs has been ignored in TRI application. Allowing for such occurrence, we derive the AVEs of NTMs, as well as the TRIs and MTRIs equivalent to all policy interventions (tariffs, NTMs and production subsidies). We show that in general the impact of NTMs on import demand is ambiguous depending on the relative strength of the import-facilitating effects of NTMs via a shift in import demand, and the protective effect of the same NTMs at the border. We then apply the approach to the UNCTAD-Comtrade database built by Kee et al. (2009). In our sample, 20% of HS6 lines are affected by NTMs and about half of these (10% of all HS6 lines) show negative AVEs of NTMs. The MTRI and TRI results show the non trivial sizeable changes in estimated aggregate trade and welfare effects of existing trade policies. Policy recommendations on the impacts of NTMs will be biased by overstating their trade reducing and welfare decreasing effects.

Although we show it is possible to rationalize and econometrically identify trade-facilitating effects of NTMs mitigating external effects and other market imperfections or having

anti-protectionist effects on domestic suppliers, we do so using relatively simple NTM proxies. It would be interesting to refine these results and use more detailed NTM measures and focus on a subset of sectors for which we identify negative NTM AVEs. Nevertheless our results corroborate the trade-facilitating effects found in the literature for some products and countries (e.g. Disdier et al., 2008; Moenius, 2004). The value added of our analysis is to formalize the possibility of anti-protectionist effects or external effects and their mitigation through regulations affecting quality of products and identify their effects on trade restrictiveness. Our analysis also extends the applicability of the TRI framework to more plausible market conditions and lets the data reveal unconstrained patterns.

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References

Anderson, J.E., G.J. Bannister, and P. Neary (1995). "Domestic Distortions and International Trade," *International Economic Review* 36(1): 139-157.

Anderson, J. and P. Neary (1992). "Trade reforms with quotas, partial rent retention and tariffs," *Econometrica* 60(1): 57-76.

Anderson, J. and P. Neary (1994). "Measuring the restrictiveness of trade policy," *World Bank Economic Review* 8(2): 151-169.

Anderson, J. and P. Neary (1996). "A new approach to evaluating trade policy," *Review of Economic Studies* 63(1): 107-125.

Anderson, J. and P. Neary (2003). "The mercantilist index of trade policy," *International Economic Review* 44(2): 627-649.

Anderson, J. and P. Neary (2005). *Measuring the Restrictiveness of Trade Policy*, Boston: MIT Press.

Beghin, J.C., J.C. Bureau, and S.J. Park (2003). "Food Security and Agricultural Protection in South Korea," *American Journal of Agricultural Economics* 85(3): 618-632.

Beghin, J.C., D. Roland-Holst, and D. van der Mensbrugghe (1997). "Trade and Environment Linkages. Piecemeal Reform and Optimal Intervention," *Canadian Journal of Economics* 30(2): 442-455.

Blind, K., A. Mangelsdorf, and J.S. Wilson (2013). "Mutual Recognition of Accreditation: Does it Matter to Trade? Evidence from the Food, Beverage, and Tobacco Industry," chapter 12 in J.C. Beghin (ed.) *Nontariff Measures with Market Imperfections: Trade and Welfare Implications (Frontiers of Economics and Globalization, Volume 12)***,** Emerald Group Publishing Limited, pp. 291-310.

Bratt, M. (2012). "Estimating the Bilateral Impact of NTMs," Manuscript, University of Geneva.

Breaux, M., Y. Cabral, M.J. Ferrantino, and J.E. Signoret (2013), "Quality-Adjusted Handicraft Estimates of NTM Price Gaps," Manuscript, U.S. International Trade Commission.

Cadot, O. and J. Gourdon. (2013). "Assessing the price-raising effect of non-tariff measures," Manuscript, University of Lausanne.

Chau, N.H., R. Färe, and S. Grosskopf (2007). "Trade Restrictiveness and Pollution," WP 2007-15, Department of Applied Economics and Management, Cornell University, Ithaca, New York.

Colen, L., M. Maertens, and J. Swinnen (2012). "Private Standards, Trade and Poverty: GlobalGAP and Horticultural Employment in Senegal," *The World Economy* 35(8): 1073-1088.

Copeland, B.R. (1994). "International Trade and the Environment: Policy Reform in a Polluted Small Open Economy," *Journal of Environmental Economics and Management* 26(1): 44-65.

CPSC, U.S. Consumer Product Safety Commission (2008). "Import Safety Strategy," Manuscript, Washington D.C.

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 and Welfare Approaches for Evaluating Non-Tariff Measures," *American Journal of Agricultural Economics* 92(3): 713-726.

FAO (2003). *WTO Agreement on Agriculture: The Implementation Experience - Developing Country Case Studies*. Commodity Policy and Projections Service Commodities and Trade

Division FAO, Rome, 2003.

Feenstra, R.C. (1995). "Estimating the effects of trade policy," in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, vol. 3, Elsevier, Amsterdam.

Fisher, R. and P. Serra (2000). "Standards and protection," *Journal of International Economics* 52(2): 377-400.

Halvorsen, R. and R. Palmquist (1980). "The Interpretation of Dummy Variables in Semilogarithmic Equations," *American Economic Review* 70(3): 474-475.

Hoekman, B. and A. Nicita (2011). "Trade Policy, Trade Costs, and Developing Country Trade," *World Development* 39(12): 2069-2079.

Jouanjean, M.A. (2012). "Standards, reputation, and trade: evidence from US horticultural import refusals," *World Trade Review* 11(03): 438-461.

Kee, H.L., A. Nicita, and M. Olarreaga (2008). "Import Demand Elasticities and Trade Distortions," *Review of Economics and Statistics* 90(4): 666-682.

Kee, H.L., A. Nicita, and M. Olarreaga (2009). "Estimating Trade Restrictiveness Indices," *The Economic Journal* 119: 172-199.

Lejárraga, I., B. Shepherd, and F. van Tongeren. (2013). "Transparency in Nontariff Measures: Effects on Agricultural Trade," chapter 4 in J.C. Beghin (ed.) *Nontariff Measures with Market Imperfections: Trade and Welfare Implications (Frontiers of Economics and Globalization, Volume 12)***,** Emerald Group Publishing Limited, pp. 99-125.

Li, Y. and J.C. Beghin (2012). "A Meta-Analysis of Estimates of the Impact of Technical Barriers to Trade," *Journal of Policy Modeling* 34(3): 497-511.

Lipton, E. and D. Barboza (2007). "As More Toys Are Recalled, Trail Ends in China," *The New York Times*, Web Edition, June 20th.

Lloyd, P. and D. MacLaren (2008). "An Estimated Trade Restrictiveness Index of the Level of Protection in Australian Manufacturing," *Australian Economic Review* 41(3): 250-259.

Maertens, M., B. Minten, and J. Swinnen (2012). "Modern Food Supply Chains and Development: Evidence from Horticulture Export Sectors in Sub-Saharan Africa," *Development Policy Review* 30(4): 473-497.

McDermott, C. and B. Cashore (2009). "Forestry Driver, Mapping Project - Global and US Trade Report," Yale University, School of Forestry & Environmental Studies, GISF Research Report 012.

Moenius, J. (2004), "Information versus Product Adaptation: The Role of Standards in Trade," Northwestern University, Kellogg School of Management, International Business and Markets Research Center Working Paper.

Tan, S. J. (1999). "Strategies for reducing consumers' risk aversion in Internet shopping," *Journal of Consumer Marketing* 16(2): 163-180.

Table 1: Frequency ratios and AVEs of NTMs, by HS section

HS section codes	HS section names	Simple frequency ratio of NTMs	AVE of NTMs all HS6 lines (mean)		AVE of NTMs if NTM=1 (mean)	
			Unconstrained estimation[a]	Constrained estimation[b]	Unconstrained estimation[a]	Constrained estimation[b]
I	Live animals, animal products	0.458	0.185	0.361	0.405	0.788
II	Vegetable products	0.420	0.100	0.265	0.239	0.632
III	Fats and oils	0.370	0.212	0.348	0.573	0.942
IV	Prepared foodstuffs, beverages, spirits, tobacco	0.422	0.126	0.302	0.299	0.715
V	Minerals	0.096	0.026	0.069	0.266	0.722
VI	Chemicals, allied industries	0.196	-0.030	0.091	-0.151	0.467
VII	Plastics, rubber	0.160	0.036	0.105	0.223	0.655
VIII	Hides, leather, furskins	0.123	0.019	0.072	0.150	0.584
IX	Wood and wood articles	0.160	0.033	0.089	0.205	0.552
X	Pulp of wood, paper, printing	0.131	0.009	0.063	0.070	0.486
XI	Textiles, apparel	0.276	0.032	0.161	0.117	0.581
XII	Footwear, headgear	0.239	0.095	0.169	0.399	0.708
XIII	Stone, cement, ceramic articles, glass	0.109	0.031	0.074	0.287	0.678
XIV	Pearls, precious metals and stones	0.015	-0.005	0.004	-0.364	0.273
XV	Base metals and articles	0.120	0.016	0.067	0.129	0.557
XVI	Machinery, electrical and video equipment	0.174	0.059	0.121	0.339	0.695
XVII	Vehicles, aircraft, vessels	0.198	0.014	0.113	0.073	0.571
XVIII	Optical, photo., medical instr.	0.132	0.014	0.074	0.103	0.563
XIX	Arms, ammunition	0.306	-0.191	0.057	-0.625	0.186
XX	Miscellaneous (furniture, toys, others)	0.144	0.057	0.111	0.398	0.769
	All sections	0.206	0.035	0.127	0.170	0.617

[a] Unconstrained estimation means that impact of NTMs on trade is not restricted in the econometric estimation.
[b] Constrained estimation means that NTMs are constrained to have a non positive impact on trade in the estimation.

Table 2. AVEs of trade-reducing and trade-facilitating NTMs, by HS section

HS section codes	HS section names	Share of trade-reducing in NTM- ridden observations	Mean AVE trade-reducing NTMs (AVE>0)	Mean AVE trade-facilitating NTMs (AVE≤0)
I	Live animals, animal products	0.606	1.204	-0.826
II	Vegetable products	0.579	1.047	-0.873
III	Fats and oils	0.653	1.315	-0.824
IV	Prepared foodstuffs, beverages, spirits, tobacco	0.570	1.130	-0.803
V	Minerals	0.523	1.279	-0.847
VI	Chemicals, allied industries	0.352	1.177	-0.871
VII	Plastics, rubber	0.552	1.067	-0.818
VIII	Hides, leather, furskins	0.530	1.081	-0.899
IX	Wood and wood articles	0.598	0.899	-0.828
X	Pulp of wood, paper, printing	0.504	0.950	-0.825
XI	Textiles, apparel	0.488	1.113	-0.834
XII	Footwear, headgear	0.597	1.214	-0.807
XIII	Stone, cement, ceramic articles, glass	0.567	1.141	-0.831
XIV	Pearls, precious metals and stones	0.364	0.703	-0.974
XV	Base metals and articles	0.532	0.971	-0.828
XVI	Machinery, electrical and video equipment	0.606	1.088	-0.810
XVII	Vehicles, aircraft, vessels	0.431	1.248	-0.815
XVIII	Optical, photo., medical instr.	0.503	1.052	-0.858
XIX	Arms, ammunition	0.183	0.748	-0.931
XX	Miscellaneous (furniture, toys, others)	0.592	1.281	-0.881
	All sections	0.518	1.111	-0.840

Table 3. Trade restrictiveness indices, summary statistics

Indices	MTRI (T^{merc})	T^{merc}	T^{mccr}	T^{merc}	T^{merc}	TRI (T)	T	T	T	T	TRI change (dT)	dT	dT	dT
Protection	tariffs	overall protection				tariffs	overall protection				overall protection			
Estimation		constrained[b]		unconstrained[a]			constrained[b]		unconstrained[a]		constrained[b]		unconstrained[a]	
Estimates	all	all	signif.	all	signif.	all	all	signif.	all	signif.	all	signif.	all	signif.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
All 93 countries														
Minimum	0.000	0.014	0.009	-0.454	-0.016	0.000	0.086	0.066	0.025	0.029	0.007	0.004	-0.452	-0.030
Maximum	0.257	0.519	0.393	0.195	0.252	0.572	0.847	0.658	0.938	0.733	0.717	0.432	0.879	0.538
Mean	0.081	0.167	0.133	0.011	0.072	0.141	0.357	0.290	0.255	0.171	0.154	0.102	0.043	0.039
Median	0.072	0.133	0.121	0.019	0.066	0.122	0.350	0.257	0.220	0.129	0.123	0.066	0.027	0.015
Std. dev	0.056	0.110	0.084	0.111	0.053	0.097	0.163	0.135	0.173	0.126	0.139	0.095	0.154	0.079
OECD countries														
Minimum	0.008	0.023	0.021	-0.150	0.008	0.042	0.094	0.071	0.025	0.049	0.009	0.005	-0.123	-0.008
Maximum	0.151	0.303	0.267	0.162	0.146	0.505	0.589	0.549	0.938	0.505	0.347	0.301	0.879	0.255
Mean	0.040	0.102	0.081	-0.003	0.034	0.110	0.342	0.251	0.328	0.130	0.133	0.073	0.080	0.021
Median	0.027	0.083	0.062	0.003	0.021	0.069	0.346	0.239	0.338	0.092	0.120	0.057	0.055	0.005
Std. dev	0.035	0.064	0.055	0.059	0.032	0.101	0.128	0.101	0.195	0.104	0.090	0.065	0.180	0.049
LDCs														
Minimum	0.030	0.042	0.032	-0.194	0.006	0.049	0.086	0.066	0.072	0.049	0.007	0.004	-0.123	-0.030
Maximum	0.177	0.468	0.351	0.124	0.154	0.225	0.678	0.595	0.255	0.316	0.460	0.354	0.065	0.100
Mean	0.104	0.184	0.149	0.047	0.089	0.132	0.287	0.241	0.171	0.140	0.113	0.084	0.012	0.020
Median	0.097	0.148	0.118	0.076	0.095	0.113	0.237	0.204	0.186	0.121	0.056	0.042	0.022	0.014
Std. dev	0.044	0.130	0.094	0.098	0.043	0.054	0.183	0.170	0.068	0.074	0.143	0.112	0.051	0.031
BRICs														
Minimum	0.102	0.205	0.173	0.013	0.092	0.125	0.365	0.325	0.216	0.150	0.133	0.106	-0.008	0.022
Maximum	0.257	0.317	0.305	0.172	0.252	0.297	0.668	0.658	0.601	0.572	0.446	0.432	0.361	0.328
Mean	0.150	0.266	0.223	0.081	0.140	0.188	0.485	0.440	0.359	0.264	0.248	0.210	0.117	0.102
Median	0.120	0.270	0.206	0.069	0.109	0.166	0.453	0.388	0.261	0.168	0.207	0.152	0.058	0.028
Std. dev	0.073	0.050	0.058	0.067	0.076	0.081	0.132	0.151	0.210	0.206	0.139	0.151	0.166	0.151

[a] Unconstrained estimation means that impact of NTMs on trade is not restricted in the econometric estimation.

[b] Constrained estimation means that NTMs are constrained to have a non positive impact on trade in the estimation.

OECD: all OECD members included in our sample. BRICs: Brazil, Russia, India and China. LDCs: Burkina Faso, Bangladesh, Ethiopia, Madagascar, Mali, Malawi, Rwanda, Sudan, Senegal, Uganda, Zambia.

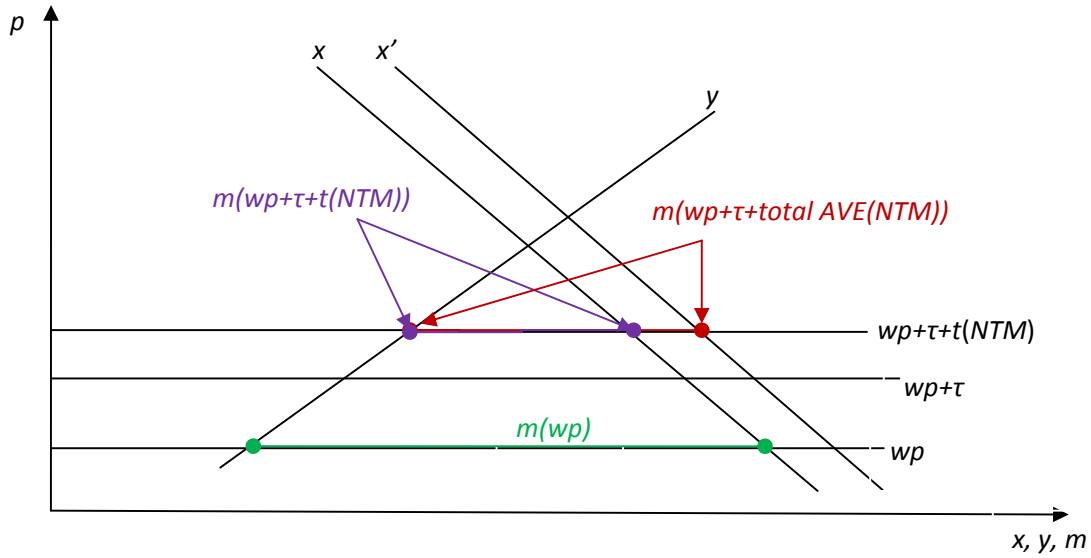

Figure 1. The impact of NTMs on demand, supply and imports

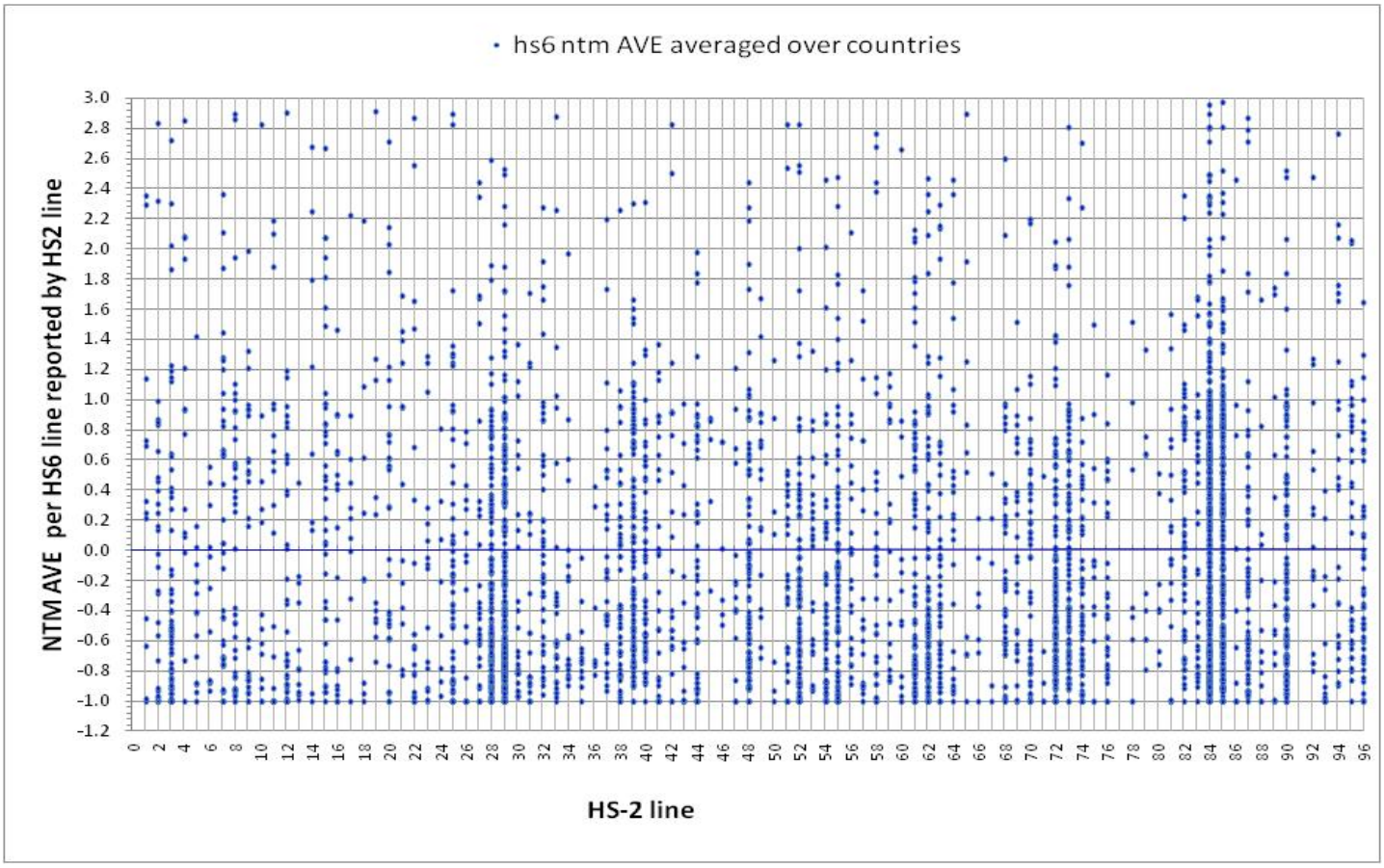

Figure 2. Scattered plot of HS6 level NTM AVES averaged over countries and shown by HS2 line

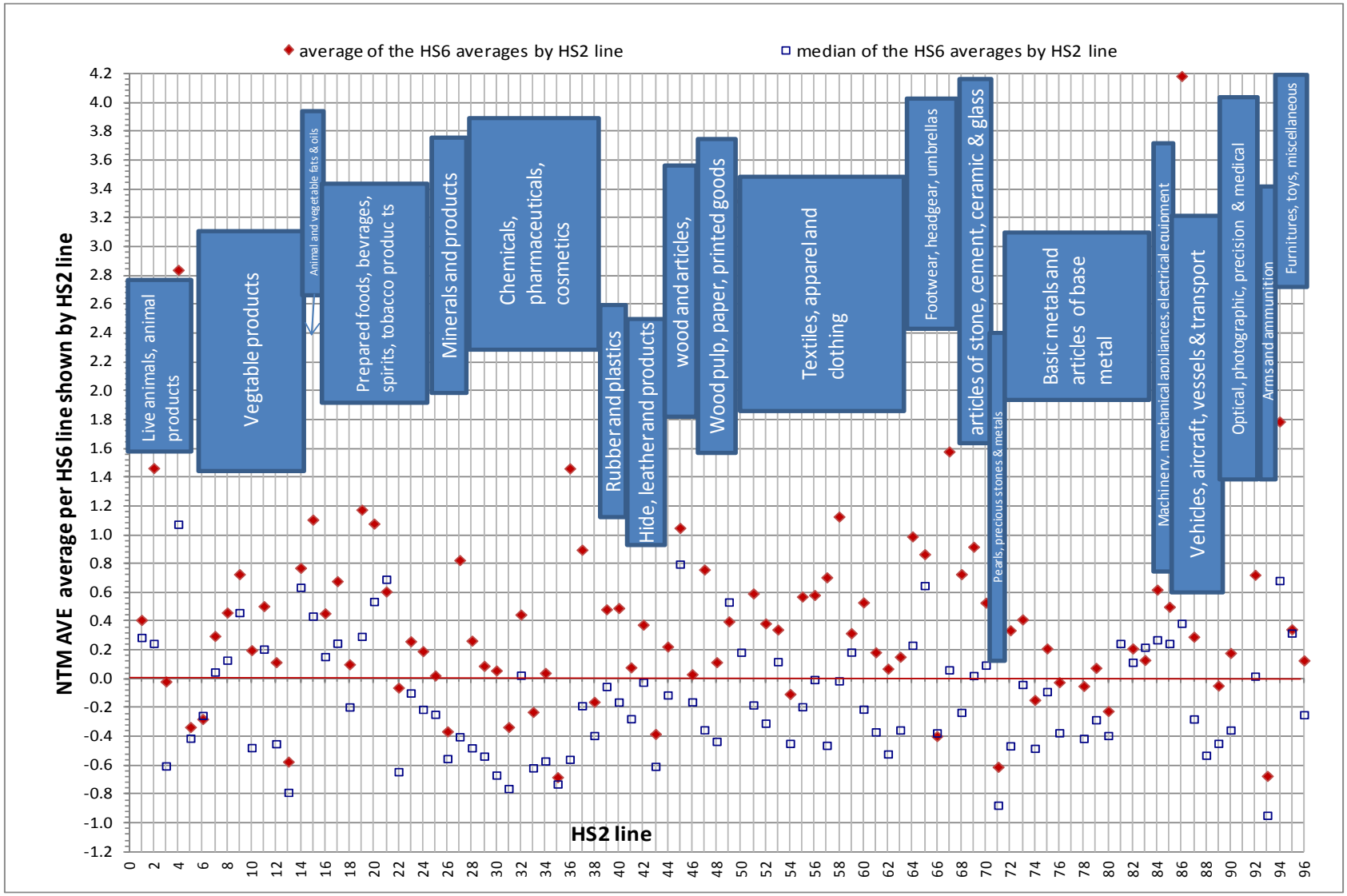

Figure 3. Mean and median (by HS2) of HS6 NTM AVEs average

Online Appendix (for review only)

Table A.1. Frequency ratios and AVEs of NTMs, by HS 2-digit sector

HS sections	HS2 codes	HS2 names	Simple freq. ratio of NTMs	AVE of NTMs all HS6 lines (mean)		AVE of NTMs if NTM=1 (mean)	
				Unconstr. estimation*	Constrained estimation#	Unconstr. estimation*	Constrained estimation#
I	01	Live animals	0.507	0.157	0.349	0.310	0.688
	02	Meat & edible meat offal	0.502	0.351	0.496	0.699	0.988
	03	Fish and crustaceans	0.451	0.013	0.267	0.028	0.591
	04	Dairy products, eggs	0.528	0.501	0.564	0.949	1.069
	05	Products of animal origin	0.244	-0.012	0.106	-0.047	0.435
II	06	Live trees & other plans, bulbs, roots	0.489	-0.087	0.125	-0.178	0.255
	07	Edible vegetables	0.489	0.119	0.290	0.242	0.592
	08	Edible fruit and nuts	0.507	0.177	0.353	0.349	0.698
	09	Coffee, tea, maté	0.428	0.088	0.288	0.205	0.673
	10	Cereals	0.425	0.055	0.311	0.130	0.731
	11	Products of the milling industry	0.371	0.247	0.298	0.665	0.804
	12	Oil seeds & oleaginous fruits	0.343	0.038	0.214	0.110	0.625
	13	Lac, gums & resins	0.309	-0.164	0.053	-0.530	0.173
	14	Vegetable plaiting materials	0.158	0.130	0.149	0.827	0.944
III	15	Animal or vegetable fats and oils	0.370	0.212	0.348	0.573	0.942
IV	16	Preparations of meat, of fish	0.525	0.106	0.302	0.202	0.576
	17	Sugars	0.463	0.191	0.316	0.411	0.682
	18	Cocoa	0.414	0.083	0.268	0.201	0.647
	19	Preparations of cereals, flour, starch or milk	0.452	0.344	0.510	0.762	1.128
	20	Preparations of vegetables, fruit, nuts	0.452	0.184	0.354	0.406	0.784
	21	Miscellaneous edible preparations	0.500	0.287	0.424	0.574	0.849
	22	Beverages, spirits and vinegar	0.361	-0.072	0.180	-0.199	0.499
	23	Residues and waste from the food industries	0.200	-0.011	0.125	-0.054	0.625
	24	Tobacco	0.466	-0.001	0.223	-0.002	0.478
V	25	Salt	0.084	0.012	0.055	0.147	0.650
	26	Ores, slag and ash	0.047	0.014	0.028	0.293	0.584
	27	Mineral fuels, mineral oils	0.163	0.062	0.135	0.382	0.831
VI	28	Inorganic chemicals	0.149	-0.005	0.082	-0.035	0.549
	29	Organic chemicals	0.195	-0.036	0.089	-0.184	0.455
	30	Pharmaceutical products	0.527	-0.101	0.234	-0.191	0.444
	31	Fertilizers	0.281	-0.043	0.125	-0.154	0.446
	32	Tanning or dyeing extracts	0.167	0.035	0.110	0.209	0.658
	33	Essential oils and resinoids	0.287	-0.118	0.085	-0.409	0.296
	34	Soaps	0.232	-0.071	0.080	-0.305	0.347
	35	Albuminoidal substances	0.203	-0.119	0.038	-0.586	0.188
	36	Explosives	0.201	0.023	0.134	0.112	0.667
	37	Photographic or cinematographic goods	0.107	0.016	0.068	0.152	0.636
	38	Miscellaneous chemical products	0.162	-0.034	0.066	-0.212	0.411
VII	39	Plastics and articles	0.162	0.041	0.104	0.251	0.640
	40	Rubber and articles	0.155	0.026	0.106	0.168	0.686
VIII	41	Raw hides and skins	0.117	0.030	0.085	0.253	0.722
	42	Leather	0.147	0.018	0.081	0.122	0.553
	43	Fur skins and artificial fur	0.102	-0.003	0.033	-0.033	0.319
IX	44	Wood and articles of wood	0.171	0.022	0.087	0.131	0.509
	45	Cork and articles	0.107	0.152	0.156	1.422	1.454

	46	Straw	0.113	0.006	0.029	0.050	0.257
X	47	Pulp of wood	0.090	0.028	0.059	0.308	0.653
	48	Paper	0.137	-0.002	0.064	-0.012	0.465
	49	Printed books, newspapers	0.134	0.054	0.067	0.405	0.501
XI	50	Silk	0.175	0.086	0.154	0.490	0.882
	51	Wool	0.246	0.093	0.182	0.378	0.739
	52	Cotton	0.257	0.020	0.145	0.079	0.562
	53	Other vegetable textile fibres	0.219	0.068	0.134	0.308	0.609
	54	Man-made filaments	0.303	0.002	0.146	0.005	0.482
	55	Man-made staple fibres	0.279	0.042	0.152	0.151	0.546
	56	Wadding	0.289	0.055	0.193	0.192	0.668
	57	Carpets	0.258	0.113	0.238	0.439	0.922
	58	Special woven fabrics	0.242	0.083	0.184	0.345	0.760
	59	Impregnated, coated, covered or laminated textile fabrics	0.259	0.091	0.196	0.352	0.759
	60	Knitted or crocheted fabrics	0.256	0.079	0.182	0.310	0.710
	61	Apparel & clothing accessories, knitted/ crocheted	0.286	0.024	0.153	0.083	0.535
	62	Apparel & clothing access., not knitted/ crocheted	0.321	-0.019	0.155	-0.060	0.483
	63	Other made-up textile articles	0.273	0.009	0.169	0.033	0.620
XII	64	Footwear	0.362	0.068	0.188	0.187	0.518
	65	Headgear	0.130	0.207	0.230	1.587	1.764
	66	Umbrellas	0.097	-0.007	0.032	-0.077	0.332
	67	Feathers	0.088	0.132	0.146	1.494	1.659
XIII	68	Stone articles	0.087	0.017	0.058	0.198	0.668
	69	Ceramic products	0.128	0.032	0.073	0.250	0.568
	70	Glass articles	0.119	0.044	0.088	0.365	0.743
XIV	71	Pearls, precious stones and metals	0.015	-0.005	0.004	-0.364	0.273
XV	72	Iron & steel	0.123	0.001	0.064	0.008	0.520
	73	Articles of iron or steel	0.147	0.021	0.077	0.141	0.523
	74	Copper	0.092	-0.008	0.045	-0.090	0.490
	75	Nickel	0.047	0.025	0.042	0.533	0.893
	76	Aluminum	0.128	-0.004	0.048	-0.031	0.376
	78	Lead	0.050	0.009	0.035	0.184	0.701
	79	Zinc	0.086	0.018	0.060	0.210	0.700
	80	Tin	0.063	-0.006	0.023	-0.091	0.359
	81	Other base metals	0.058	0.066	0.079	1.123	1.354
	82	Tools	0.150	0.043	0.090	0.286	0.598
	83	Miscellaneous articles of base metal	0.132	0.023	0.078	0.174	0.590
XVI	84	Nuclear reactors	0.167	0.062	0.121	0.373	0.723
	85	Electrical machinery & equipment	0.186	0.052	0.120	0.280	0.647
XVII	86	Railway	0.078	0.082	0.094	1.055	1.204
	87	Vehicles	0.277	-0.005	0.143	-0.018	0.515
	88	Aircraft	0.122	0.007	0.071	0.059	0.586
	89	Ships, boats	0.080	0.011	0.044	0.138	0.547
XVIII	90	Optical, photog., measuring, prec., medical instr.	0.184	0.017	0.103	0.091	0.559
	91	Clocks and watches	0.000	-	-	-	-
	92	Musical instruments	0.068	0.022	0.043	0.317	0.639
XIX	93	Arms and ammunitions	0.306	-0.191	0.057	-0.625	0.186
XX	94	Furniture	0.149	0.127	0.174	0.853	1.171
	95	Toys	0.162	0.042	0.106	0.262	0.656
	96	Miscellaneous manufactured articles	0.126	0.019	0.068	0.150	0.542

*Unconstrained estimation means that impact of NTMs on trade is not restricted in the econometric estimation.

[#]Constrained estimation means that NTMs are constrained to have a non positive impact on trade in the estimation.

Table A.2. AVEs of trade-reducing and trade-facilitating NTMs, by HS 2-digit sector

HS2 codes	HS2 names	Share of trade-reducing in NTM-ridden observations	Mean AVE trade-reducing NTMs (AVE>0)	Mean AVE trade-facilitating NTMs (AVE≤0)
01	Live animals	0.628	1.026	-0.901
02	Meat & edible meat offal	0.706	1.301	-0.746
03	Fish and crustaceans	0.436	1.181	-0.862
04	Dairy products, eggs	0.860	1.223	-0.734
05	Products of animal origin	0.431	0.909	-0.770
06	Live trees & other plans, bulbs, roots	0.507	0.441	-0.815
07	Edible vegetables	0.639	0.863	-0.857
08	Edible fruit and nuts	0.559	1.317	-0.876
09	Coffee, tea, maté	0.544	1.095	-0.856
10	Cereals	0.543	0.935	-0.828
11	Products of the milling industry	0.853	0.928	-0.861
12	Oil seeds & oleaginous fruits	0.438	1.422	-0.912
13	Lac, gums & resins	0.258	0.636	-0.935
14	Vegetable plaiting materials	0.800	1.264	-0.920
15	Animal or vegetable fats and oils	0.653	1.315	-0.824
16	Preparations of meat, of fish	0.620	0.857	-0.866
17	Sugars	0.701	0.917	-0.773
18	Cocoa	0.549	1.005	-0.775
19	Preparations of cereals, flour, starch or milk	0.583	1.763	-0.638
20	Preparations of vegetables, fruit, nuts	0.629	1.114	-0.795
21	Miscellaneous edible preparations	0.628	1.341	-0.723
22	Beverages, spirits and vinegar	0.303	1.464	-0.921
23	Residues and waste from the food industries	0.443	0.922	-0.828
24	Tobacco	0.451	0.933	-0.772
25	Salt	0.502	1.194	-0.908
26	Ores, slag and ash	0.682	0.848	-0.900
27	Mineral fuels, mineral oils	0.506	1.513	-0.775
28	Inorganic chemicals	0.379	1.320	-0.862
29	Organic chemicals	0.343	1.198	-0.906
30	Pharmaceutical products	0.319	1.260	-0.870
31	Fertilizers	0.340	1.146	-0.824
32	Tanning or dyeing extracts	0.484	1.144	-0.667
33	Essential oils and resinoids	0.255	0.897	-0.856
34	Soaps	0.302	0.890	-0.822
35	Albuminoidal substances	0.210	0.598	-0.901
36	Explosives	0.443	1.338	-0.862
37	Photographic or cinematographic goods	0.500	1.190	-0.886
38	Miscellaneous chemical products	0.362	0.975	-0.885
39	Plastics and articles	0.574	1.033	-0.803
40	Rubber and articles	0.509	1.145	-0.844
41	Raw hides and skins	0.525	1.313	-0.919
42	Leather	0.521	1.096	-0.938
43	Fur skins and artificial fur	0.560	0.536	-0.757
44	Wood and articles of wood	0.574	0.850	-0.837
45	Cork and articles	0.935	1.587	-0.968
46	Straw	0.614	0.478	-0.631

47	Pulp of wood	0.527	1.370	-0.877
48	Paper	0.462	0.939	-0.829
49	Printed books, newspapers	0.739	0.798	-0.708
50	Silk	0.619	1.369	-0.941
51	Wool	0.568	1.250	-0.766
52	Cotton	0.458	1.133	-0.810
53	Other vegetable textile fibres	0.635	0.943	-0.797
54	Man-made filaments	0.482	0.935	-0.860
55	Man-made staple fibres	0.549	0.941	-0.810
56	Wadding	0.502	1.174	-0.800
57	Carpets	0.507	1.653	-0.811
58	Special woven fabrics	0.499	1.568	-0.873
59	Impregnated, coated, covered or laminated textile fabrics	0.572	1.249	-0.848
60	Knitted or crocheted fabrics	0.521	1.400	-0.877
61	Articles of apparel & clothing accessories, knitted/ crocheted	0.512	0.982	-0.860
62	Art. of apparel & clothing accessories, not knitted/ crocheted	0.399	1.130	-0.851
63	Other made-up textile articles	0.413	1.247	-0.821
64	Footwear	0.561	0.961	-0.800
65	Headgear	0.760	2.371	-0.901
66	Umbrellas	0.508	0.569	-0.745
67	Feathers	0.867	1.876	-0.987
68	Stone articles	0.486	1.283	-0.829
69	Ceramic products	0.565	1.022	-0.752
70	Glass articles	0.621	1.127	-0.882
71	Pearls, precious stones and metals	0.364	0.703	-0.974
72	Iron & steel	0.458	1.032	-0.858
73	Articles of iron or steel	0.556	0.863	-0.761
74	Copper	0.409	1.063	-0.888
75	Nickel	0.641	1.358	-0.937
76	Aluminum	0.489	0.800	-0.825
78	Lead	0.512	1.197	-0.877
79	Zinc	0.513	1.207	-0.840
80	Tin	0.545	0.601	-0.922
81	Other base metals	0.775	1.707	-0.890
82	Tools	0.629	0.925	-0.801
83	Miscellaneous articles of base metal	0.601	0.852	-0.850
84	Nuclear reactors	0.621	1.092	-0.807
85	Electrical machinery & equipment	0.578	1.079	-0.816
86	Railway	0.826	1.448	-0.810
87	Vehicles	0.387	1.237	-0.810
88	Aircraft	0.473	1.135	-0.906
89	Ships, boats	0.504	1.055	-0.794
90	Optical, photographic, measuring, precision, medical instr.	0.495	1.057	-0.855
91	Clocks and watches	-	-	-
92	Musical instruments	0.652	0.988	-0.940
93	Arms and ammunitions	0.183	0.748	-0.931
94	Furniture	0.676	1.694	-0.904
95	Toys	0.583	1.086	-0.889
96	Miscellaneous manufactured articles	0.528	1.053	-0.859

Table A.3. Trade restrictiveness indices, by country

Country	T^{merc}	T^{merc}	T^{merc}	T	T	T	dT	dT	dT
	Tariffs	Overall protection		Tariffs	Overall protection		Tariffs	Overall protection	
		Constrained estimation[#]	Unconstr. estimation*,[1]		Constrained estimation[#]	Unconstr. estimation*		Constrained estimation[#]	Unconstr. estimation*
Albania	0.117	0.123	0.110	0.134	0.150	0.109	0.018	0.022	0.012
Argentina	0.129	0.178	0.080	0.141	0.341	0.221	0.020	0.116	0.049
Australia◊	0.057	0.126	-0.079	0.095	0.266		0.009	0.071	-0.089
Austria◊	0.016	0.075	0.019	0.053	0.397	0.394	0.003	0.157	0.155
Belgium◊	0.021	0.098	0.018	0.067	0.434	0.369	0.005	0.189	0.136
Burkina Faso♦	0.106	0.152	0.090	0.122	0.257	0.149	0.015	0.066	0.022
Bangladesh♦	0.177	0.246	0.107	0.225	0.386	0.255	0.050	0.149	0.065
Belarus	0.085	0.167	0.074	0.106	0.312	0.176	0.011	0.097	0.031
Bolivia	0.080	0.144	0.065	0.086	0.268	0.105	0.007	0.072	0.011
Brazil⊥	0.105	0.247	0.080	0.128	0.416	0.216	0.016	0.173	0.047
Brunei	0.141	0.205	0.156	0.572	0.847	0.581	0.327	0.717	0.338
Canada◊	0.028	0.057	-0.058	0.076	0.174		0.006	0.030	-0.064
Switzerland◊	0.040	0.066	-0.072	0.192	0.272		0.037	0.074	-0.055
Chile◊	0.069	0.107	0.011	0.069	0.195		0.005	0.038	-0.036
China⊥	0.135	0.205	0.013	0.203	0.365		0.041	0.133	-0.008
Ivory Coast	0.094	0.318	-0.340	0.118	0.524		0.014	0.275	-0.256
Cameroon	0.140	0.165	0.137	0.160	0.226	0.186	0.026	0.051	0.034
Colombia	0.112	0.239	-0.003	0.131	0.443	0.693	0.017	0.197	0.481
Costa Rica	0.040	0.042	0.010	0.072	0.096		0.005	0.009	-0.019
Czech Rep. ◊	0.041	0.048	0.002	0.063	0.094		0.004	0.009	-0.023
Germany◊	0.014	0.068	-0.003	0.049	0.358	0.279	0.002	0.128	0.078
Denmark◊	0.017	0.110	-0.050	0.047	0.493	0.379	0.002	0.243	0.143
Algeria	0.131	0.392	-0.071	0.160	0.582		0.026	0.339	-0.007
Egypt	0.128	0.421	-0.121	0.197	0.691	0.264	0.039	0.477	0.070
Spain◊	0.015	0.078	-0.020	0.055	0.494	0.394	0.003	0.244	0.156
Estonia◊	0.009	0.023	0.003	0.050	0.127		0.002	0.016	-0.001
Ethiopia♦	0.136	0.148	0.075	0.182	0.217		0.033	0.047	-0.003
Finland◊	0.011	0.042	-0.003	0.042	0.252	0.166	0.002	0.064	0.028
France◊	0.013	0.077	-0.002	0.044	0.347	0.243	0.002	0.120	0.059
Gabon	0.153	0.153	0.123	0.175	0.176	0.074	0.031	0.031	0.005
Great Britain◊	0.019	0.081	-0.005	0.090	0.379	0.275	0.008	0.143	0.076
Ghana	0.144	0.185	0.120	0.245	0.354	0.245	0.060	0.126	0.060
Greece◊	0.012	0.065	0.026	0.049	0.546	0.507	0.002	0.298	0.258
Guatemala	0.068	0.171	-0.036	0.096	0.357		0.009	0.128	-0.037
Hong Kong	0.000	0.014	-0.042	0.000	0.108		0.000	0.012	-0.038
Honduras	0.067	0.083	0.075	0.092	0.152	0.138	0.008	0.023	0.019
Hungary◊	0.061	0.113	0.036	0.087	0.249	0.082	0.008	0.062	0.007
Indonesia	0.046	0.082	0.050	0.085	0.355	0.150	0.007	0.126	0.023
India⊥	0.257	0.317	0.172	0.297	0.668	0.601	0.088	0.446	0.361
Ireland◊	0.008	0.040	0.013	0.042	0.234	0.180	0.002	0.055	0.032
Iceland◊	0.029	0.061	0.012	0.122	0.231	0.094	0.015	0.053	0.009
Italy◊	0.017	0.088	0.008	0.072	0.433	0.347	0.005	0.187	0.121
Jordan	0.120	0.262	-0.033	0.163	0.421		0.027	0.177	-0.046
Japan◊	0.078	0.299	0.162	0.323	0.589	0.473	0.105	0.347	0.224
Kazakhstan	0.043	0.149	0.016	0.073	0.350	0.057	0.005	0.123	0.003

Kenya	0.119	0.127	0.110	0.184	0.206	0.178	0.034	0.043	0.032
South Korea$^{\lozenge}$	0.107	0.108	0.107	0.505	0.511	0.510	0.255	0.261	0.261
Lebanon	0.057	0.196	0.042	0.098	0.387	0.175	0.010	0.150	0.031
Sri Lanka	0.074	0.075	0.065	0.138	0.139	0.100	0.019	0.019	0.010
Lithuania	0.021	0.056	-0.052	0.064	0.187		0.004	0.035	-0.058
Latvia	0.027	0.133	0.006	0.073	0.330	0.073	0.005	0.109	0.005
Morocco	0.228	0.471	-0.109	0.275	0.727	0.339	0.075	0.528	0.115
Moldova	0.047	0.072	0.041	0.202	0.239	0.182	0.041	0.057	0.033
Madagascar$^{\blacklozenge}$	0.030	0.042	0.023	0.049	0.107		0.002	0.011	-0.005
Mexico$^{\lozenge}$	0.151	0.303	0.025	0.211	0.490	0.235	0.045	0.240	0.055
Mali$^{\blacklozenge}$	0.097	0.129	0.076	0.112	0.183	0.072	0.012	0.034	0.005
Mauritius	0.122	0.207	0.106	0.233	0.386	0.254	0.054	0.149	0.065
Malawi$^{\blacklozenge}$	0.098	0.149	0.112	0.130	0.243	0.165	0.017	0.059	0.027
Malaysia	0.063	0.315	-0.327	0.269	0.560		0.073	0.314	-0.268
Nigeria	0.221	0.419	-0.180	0.309	0.620		0.096	0.384	-0.026
Nicaragua	0.049	0.133	-0.028	0.079	0.294		0.006	0.086	-0.037
Netherlands$^{\lozenge}$	0.014	0.083	0.010	0.059	0.483	0.414	0.003	0.233	0.171
Norway$^{\lozenge}$	0.045	0.078	0.019	0.255	0.333	0.245	0.065	0.111	0.060
New Zealand$^{\lozenge}$	0.027	0.141	-0.150	0.044	0.397		0.002	0.157	-0.091
Oman	0.117	0.176	0.118	0.257	0.375	0.282	0.066	0.140	0.079
Peru	0.126	0.225	0.073	0.129	0.392	0.218	0.017	0.153	0.047
Philippines	0.037	0.276	-0.360	0.068	0.502		0.005	0.252	-0.313
Pap. N. Guinea	0.029	0.093	0.008	0.152	0.292	0.078	0.023	0.085	0.006
Poland$^{\lozenge}$	0.103	0.144	0.031	0.150	0.270		0.023	0.073	-0.002
Portugal$^{\lozenge}$	0.036	0.131	0.039	0.175	0.452	0.338	0.031	0.205	0.114
Paraguay	0.107	0.200	0.015	0.123	0.386	0.055	0.015	0.149	0.003
Romania	0.120	0.176	0.116	0.157	0.300	0.216	0.025	0.090	0.047
Russia$^{\perp}$	0.102	0.293	0.057	0.125	0.489	0.261	0.016	0.240	0.068
Rwanda$^{\blacklozenge}$	0.088	0.130	0.124	0.113	0.237	0.219	0.013	0.056	0.048
Saudi Arabia	0.142	0.158	0.062	0.348	0.368	0.248	0.121	0.135	0.062
Sudan$^{\blacklozenge}$	0.174	0.468	-0.077	0.214	0.678	0.222	0.046	0.460	0.049
Senegal$^{\blacklozenge}$	0.086	0.374	-0.194	0.108	0.556		0.012	0.309	-0.123
Singapore	0.000	0.222	-0.454	0.000	0.428		0.000	0.183	-0.452
El Salvador	0.064	0.133	0.026	0.096	0.269		0.009	0.072	-0.021
Slovenia$^{\lozenge}$	0.102	0.197	-0.048	0.120	0.346		0.015	0.120	-0.049
Sweden$^{\lozenge}$	0.014	0.059	-0.017	0.052	0.254	0.025	0.003	0.064	0.001
Thailand	0.109	0.132	0.083	0.168	0.248	0.144	0.028	0.062	0.021
Trinidad & T.	0.072	0.082	0.069	0.296	0.315	0.301	0.088	0.099	0.091
Tunisia	0.228	0.363	0.099	0.300	0.525	0.357	0.090	0.276	0.128
Turkey$^{\lozenge}$	0.043	0.105	-0.001	0.095	0.259	0.938	0.009	0.067	0.879
Tanzania	0.137	0.519	0.083	0.160	0.809	0.572	0.026	0.655	0.327
Uganda$^{\blacklozenge}$	0.067	0.067	0.065	0.084	0.086	0.079	0.007	0.007	0.006
Ukraine	0.064	0.285	0.195	0.159	0.519	0.437	0.025	0.270	0.191
Uruguay	0.097	0.208	0.028	0.117	0.408	0.203	0.014	0.166	0.041
United States$^{\lozenge}$	0.024	0.083	-0.138	0.049	0.256		0.002	0.065	-0.123
Venezuela	0.135	0.231	0.017	0.158	0.383	0.034	0.025	0.147	0.001
South Africa	0.069	0.077	0.050	0.131	0.157	0.044	0.017	0.025	0.002
Zambia$^{\blacklozenge}$	0.086	0.116	0.115	0.113	0.205	0.207	0.013	0.042	0.043

*Unconstrained estimation means that impact of NTMs on trade is not restricted in the econometric estimation.

$^{\#}$Constrained estimation means that NTMs are constrained to have a non positive impact on trade in the estimation.

[1] With an externality and some negative AVEs, the MTRI can be smaller or larger than the TRI and the two indices may not have similar signs. $^{\blacklozenge}$: LDCs. $^{\perp}$: BRIC countries. $^{\lozenge}$: OECD countries.