Bank i Kredyt 48(1), 2017, 45-72

BANK I KREDYT
BANK & CREDIT

Tariffs and non-tariff measures: substitutes or complements. A cross-country analysis

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Submitted: 29 April 2016. Accepted: 3 November 2016.

Abstract

Alongside the global tariff liberalization, a growing body of evidence demonstrates the rise in the use of non-tariff measures (NTMs), which suggests a substitution effect between these two import policy instruments. Yet, detailed economic data reveals that in countries with lower tariff rates (developed countries), the use of NTMs is significantly lower compared to developing countries, which implies a possible complementary effect between tariffs and NTMs across nations. Using a dataset of Kee, Nicita and Olarreaga (2009) on *ad valorem* tariff equivalents of NTMs, at a very disaggregated product level, this paper explores the determinants of NTMs and their substitutability/complementarity relations with tariff barriers. While exploiting the country variation, it demonstrates the decreasing trend of substitutability between the two import policy instruments with the rise in economic development. In particular, a significant complementarity correlation exists between the two trade measures among the wealthiest nations, implying a stronger commitment to freer trade.

Keywords: non-tariff measures, technical barriers to trade, WTO

JEL: F13, F14, F53

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1 Introduction

Over the past two decades, international trade has increased rapidly, largely due to a significant gradual elimination of tariff protection. Tariff reduction has been achieved either by successive rounds of multilateral trade negotiations, by unilateral liberalization, or by the creation of preferential trade agreements (PTAs). Since a notable share of PTAs was among developing countries, which originally commenced with higher tariff levels, it is no surprise that these countries in particular have pursued more far-reaching tariff elimination. Yet, the average tariff levels in low-income countries are still significantly higher than developed countries (WTO 2016).

Alongside the reduction of tariff rates, accumulated evidence shows a growing propensity in the use of non-tariff measures to trade (NTMs[1]) by many countries, which partially offsets the advancements achieved by lowering tariffs. Contrary to tariff measures, which were originally introduced in order to realize economic and trade objectives, the purported intention behind the imposition of NTMs was to design public objectives which are non-protectionist by nature. These policy measures often serve as the first-best instrument to advance various social, political or environmental protection objectives, as well as health and consumer protection. Nevertheless, these instruments have become popular in achieving economic goals, mainly claiming to correct market inefficiencies which arise from information asymmetries or imperfect competition. However, as the imposition of such procedures creates a beneficial advantage for players who participate in the trade arena, it is no wonder that the use of NTMs has expanded. The political economy literature demonstrates how policymakers, who face pressures to protect domestic producers, may choose to use NTMs more extensively. At the same time, it claims that NTMs are merely alternative channels of protectionism in disguise. These actions may even be intensified when the reduction of tariffs adversely affects the local producers' performances or in times of economic downturn.

The use of NTMs varies considerably across countries, differing according to the specific type chosen, affecting diverse products, and fluctuating over time. Nevertheless, a common motive in various approaches which study their incidence validates the accelerated expansion of NTMs over time. In particular, some practices such as technical barriers to trade (TBTs) and sanitary and phytosanitary (SPS) measures, which account for a large share of all NTMs, have been on the rise since the mid-90s, as shown in the increasing number of notifications of SPS and TBT measures reported to the WTO (Figure 1). Moreover, this upward direction is well demonstrated by the substantial increase in the use of anti-dumping measures over the last two decades, mostly by developing countries.

As the continuous reduction of tariffs and the expanding use of NTMs move in opposite directions, increasing attention has been drawn to the possible substitution effect between these two import policy measures. The common consensus shared among scholars and supported by several empirical analyses claims that NTMs often enable countries to enhance restrictiveness, manipulate the terms-of-trade and reclaim possible economic losses due to tariff liberalization. These studies, which focus mostly on specific countries or particular NTMs, demonstrate the substitutability relation between tariffs and NTMs. This negative correlation emphasizes that new NTM restrictions simply replace the traditional ones (namely tariffs), in order to achieve similar objectives.

[1] Despite minor differences, the terms non-tariff measures and non-tariff barriers are often used interchangeably. In this paper the term non-tariff measures will be used.

This paper tests the proposition that although from the broad perspective a negative correlation may be found, a deeper analysis would reflect heterogeneity among countries. In particular, it will verify the diminishing trajectory of the substitutability between the two import policy instruments with the rise in GDP *per capita*. It will provide evidence that the more developed a country is, the less likely that NTM practices occur. In low-income countries, the substitutability effect is dramatically high; however, the rationalization is counter-intuitive, since high levels of applied tariffs are found alongside a modest imposition of NTMs. Low levels of NTMs are the outcome of the complexity and high costs associated with operating administrative and regulatory systems. Secondly, low-income countries are more revenue oriented, thus depending mostly on tariff income. Thirdly, their dependency on world trade as well as their commitment to freer trade is less robust than the richest countries. Lastly, low-income countries enjoy greater flexibility in terms of binding overhang gaps, which significantly decreases their motivation to impose NTMs. The binding overhang gaps are essentially the differences between the bound levels and applied tariff rates on each product granted to countries under WTO rules.

On the other hand, high-income countries that generally levy lower levels of tariffs are comparatively more committed to transparency and non-discrimination practices that result in lower levels of NTMs. Those developed countries are generally at the frontline of WTO discussions, hence they are more involved in the process of eliminating TBT and SPS measures. This means taking upon themselves the removal of trade barriers more extensively than elsewhere. Moreover, since high-income countries tend to rely more profoundly on international trade, it leads them to seek better conditions, both for domestic importers, as well as for their local exporters in foreign markets. Such interests co-exist with the necessity to attract imports at the lowest costs possible for the benefit of domestic consumers as well as for importers of intermediate goods. These reasons are expected to lead to less substitutability or even a greater complementarity correlation between the two import policy measures.

The proposition mentioned above is further supported by evidence based on a recent dataset of Kee, Nicita and Olarreaga (2009) accompanied by the authors' calculations. Figure 2 portrays how countries with lower levels of tariffs also impose lower NTMs. This cross-country analysis demonstrates that complementary correlation exists between the two import measures, alongside negative correlation with the level of economic development. Moreover, data on NTMs coverage ratio draw similar conclusions regarding the positive correlation of tariff levels and the number of products affected by NTMs. Additionally, a strong correlation is found between the average number of NTMs at the chapter level and the tariffs (UNCTAD 2013). Taken together, these results demonstrate how a low tariff regime may be paired with a less stringent NTM policy. Such findings reinforce the complementary relation between the two import policy instruments, hence creating a paradox with the shared consensus on substitutability.

Despite their significant impact on trade and the reporting requirements to notify NTMs to the WTO with clear information regarding the products affected, systematically collected data regarding their implications is still hardly available. Economic studies address NTMs in a narrow setting, mainly in a qualitative approach, whereas in practice NTMs are broadly employed and change over time alongside the constant appearance of new types of NTMs that may require other analytic methodologies. Throughout the years, several attempts were made in order to collect information on NTMs (i.e. MAST, TRAINS). Nevertheless, to some extent, these quantifications usually address specific types of measures, countries, and products, and it is still not sufficiently comprehensive or lacks the broader perspective.

Recently, this gap has been addressed by Kee, Nicita and Olarreaga (2009) who tried to overcome various challenges and created a unique dataset of *ad valorem* equivalents (AVE) of NTMs at a disaggregated level (i.e. the 6-digit level of the HS classification). Their work provides estimations for tariff equivalents of NTMs of 104 countries (developing and developed), while comprising information regarding more than 30 types of NTMs. Among these measures are price control, quantity restrictions, monopolistic measures and technical regulations, agricultural domestic support and others. The extensive data set consists of observations on ad valorem equivalents of NTMs expressed as a percentage of the value of the product, making them directly comparable with tariffs.

The possible direct comparison provides the starting point for this paper, as it allows an econometric-based analysis of the substitutability/complementarity correlation of NTMs and tariff barriers to be undertaken. Moreover, the current analysis will outline the heterogeneity across countries and emphasize the diminishing negative correlation between the two import measures with the rise in countries' level of economic development. By performing an in-depth and comprehensive analysis which differentiates between country groups, this paper aims to add an important dimension to the basic correlation analysis offered by Kee, Nicita and Olarreaga (2009), which focuses on the broad perspective. Secondly, it will contribute to the existing knowledge by investigating some additional determinants of NTMs, providing a more precise characterization and motivation behind their pervasiveness. One imperative explanatory variable for that matter is the binding overhang ratio, which represents the flexibility between bound and applied tariffs, and in turn the incentive to alternate to NTMs. Other control factors which are taken into consideration and influence the restrictiveness of NTMs are trade openness, import revenues, and others.

The paper is comprised of five sections. Following an introduction, the second section portrays the characterization of the use of NTMs across countries. The third section outlines the literature review, starting with the relations between tariffs, NTMs and trade, followed by a description of the approaches used to quantify the restrictiveness of NTMs, succeeded by the particular methodology of Kee, Nicita and Olarreaga (2009) which served for obtaining the data on AVE of NTMs in the analysis. The fourth section presents the methodology which was chosen to conduct the econometric analysis in the paper, accompanied by a discussion of the results of the estimations, along with several robustness checks. The last section of the paper underlines the main conclusions which can be drawn from the research.

2 The characteristics of the use of NTMs across countries

The scope of use of non-tariff measures varies significantly according to their type, nature or the objectives to be achieved. Evidence indicates that, in general, the average country imposes technical barriers to trade (TBT) on about 30% of products and trade. Sanitary and phytosanitary (SPS) measures, which are exclusively related to agriculture and food products, are imposed on more than 60% of agricultural products, which in fact represents slightly less than 15% of overall trade. Among non-technical measures, pre-shipment inspections, for example, affect on average approximately 20% of trade and products (UNCTAD 2013).

NTMs also differ considerably across countries, depending much on each country's comparative advantage and political economy preferences. NTMs imposed on agricultural products are likely to be greater and more restrictive in countries with a stronger comparative advantage in producing

agricultural products. These factors are demonstrated in the use of SPS measures and quantity and price control measures, which tend to be more predominant in developing countries. Countries, which rely heavily on domestic production of traditional sectors such as agriculture will use these instruments more extensively compared to developed countries. At the same time, richer countries, which are often concerned about shielding import-competing industries, or preserving the interests of infant industries, are found to impose TBTs more extensively than elsewhere.

The descriptive statistics presented in Table 2 point out the differences between the impositions of NTMs across country groups. They provide a snapshot of the average statistics on various variables such as tariffs, NTMs, and others. These figures are grouped according to the level of economic development of the countries (based on GDP *per capita* categories). The figures indicate that except for the lowest income group, the richer a country is in terms of GDP *per capita*, the lower its use of NTMs. While the AVE of NTMs in lower-middle income countries is roughly 15%, in upper-middle income countries and in high-income countries the average is 10% and less than 9%, respectively. The exception to this rule is the case of low-income countries, where although the average AVE of NTMs is relatively low (4%), as demonstrated in Figure 3, there is a large variance across these countries. For example, in the African continent, Rwanda (0.3%) and Kenya (1.3%) are at the lowest end, while Sudan and Nigeria are on the highest end with an average AVE of NTMs which reaches 40%. Complementary studies show that although on average NTMs are utilized for slightly less than half of the list of 5,000 products, in the African continent Tanzania and Senegal use NTMs substantially less than Egypt or Uganda. In Latin America, the imposition of NTMs by Argentina is double that of Chile or Paraguay. More examples could be found in Asia, where Bangladesh, Syria and the Philippines utilize NTMs much more than Cambodia or Indonesia.

Furthermore, as seen in the descriptive statistics, richer countries are more committed to the reduction of all types of barriers to trade, as internationally agreed under the general principles of the WTO. Therefore, the average use of NTMs among the richest countries is the lowest found across all countries. These countries are typically more open and dependent on international trade, and consequently are less likely to employ NTMs compared to countries, which are more self-reliant. On the other hand, with some exceptions, the less developed a country is, the less likely it will be open to competing for import flows. The low-income countries, which rely profoundly on revenue generating tax measures such as import tariffs, will prefer not to operate a costly and complex administration. Furthermore, low-income countries also enjoy a bigger overhang gap (the difference between bound and applied tariffs), which allows them the flexibility to increase their level of actual tariffs legally.

While exploring the use of NTMs across countries, it is essential to tackle specific characteristics of countries such as export performances as well as those who are the natural trading partners. In general, high-income countries tend to export more than lower income countries (by share of GDP), and their exports are mostly directed to other rich nations. The low and middle-income countries still trade mostly among themselves, though in the last decade these countries increasingly expand their exports to higher income countries at the expense of their traditional markets. Trade data shows that the developing countries' share in world merchandise exports have expanded dramatically from 17% to 43% during the last 25 years (WTO 2016).

Moreover, although the low-income countries may enjoy better market access conditions relative to the past, they still face larger financial and manufacturing constraints. These capacity constraints make it even harder for them to overcome the barriers posed by NTMs. Given the fact that low-income

countries specialize in traditional exports such as agriculture, textile, and apparel goods, and suffer from higher capacity constraints, it is even more worrisome that these countries face substantial obstacles in the form of high substitutability of tariffs with NTMs in their main exporting markets. This problem is further amplified by evidence of recent ITC business surveys on NTMs, which indicate that exporters of agricultural products report more problems related to TBT/SPS measures than exporters of manufactured goods – 59% compared to 34% respectively (WTO 2012).

3 Literature review

3.1 NTMs, tariffs and trade in the literature

In recent years, a growing interest has emerged around the characteristics of NTMs and particularly, over their impact on trade restrictiveness and on the welfare of nations. This paper builds both on existing political economy theories, as well as on the empirical literature on the determinants of governments' imposition of NTMs in response to decreasing tariffs. It primarily attempts to contribute to the strand of literature analysing the political economy environment of trade policy, which is based on Grossman and Helpman (1994), and has been tested empirically in several studies. While the authors laid down the foundations of the role of domestic interest groups, others, such as Mansfield and Busch (1995), have focused on the domestic political influence of institutions and the impact of deteriorating macroeconomic conditions. The later found that these factors explain the variance between countries in the demand for NTMs protection by pressure groups. Lee and Swagel (1997) establish that countries pair these two trade measures in order to protect vulnerable industries which are politically important or those threatened by import competition. Yu (2000) highlights the importance of transparency and the presence of informed consumers on the government's decision to substitute voluntary export restraints (VERs) with tariffs. Furthermore, Yu claims that an increase in foreign competition will not cause the government to substitute NTMs for tariffs; however, a rise in the government's valuation of political contribution might do.

The vast majority of the literature suggests that substitutability between NTMs and tariffs exists alongside the implementation of preferential trade agreements (PTAs). These agreements lower the rate of protection, but often do not reduce the domestic pressure for protectionism. The law of constant protection phenomena suggests that producers who are well-protected by tariffs may care less for NTMs relative to industries adversely affected by the economic impact of decreasing tariffs, which may often receive NTMs protection as a substitute (Bhagwati 1988). By employing data on Turkey's tariffs and NTMs, Limao and Tovar (2011) exploit the variation in tariff constraints generated by multilateral agreements and PTAs. They establish a causal impact of the resulting tariff constraints on the likelihood and restrictiveness of NTMs. By considering the differences in the size of EU member states in a PTA, they show that if the common EU tariff had constrained Turkey in its tariff setting, this could have had a causal impact on protection via NTMs on non-EU exporters. They find evidence of policy substitution between tariff commitments imposed via the WTO and the PTA with the EU and the increasing probability of Turkish NTMs.

An important role in the country's decision regarding the extent of the use of NTMs is accredited to the market power it has over its trading partners. Broda, Limao and Weinstein (2008) demonstrate

that significantly higher NTMs are used in import-competing sectors, where there is a greater ability to affect foreign exporters' prices. Moreover, countries with sufficient market power, or even small countries (mainly non-WTO members), who in certain products face lower export supply elasticities (inelastic supply), will charge higher tariffs and also be driven to force a more protectionist approach by imposing NTMs. Aisbett and Pearson (2012) establish the substitutability correlation between SPS measures and tariffs, by suggesting that countries manipulate their environmental and health standards for protectionist purposes. The authors claim that there is a race to the bottom, meaning that tariff liberalization puts downward pressure on standards in countries which already have low standards (namely developing countries) and upward pressure on countries with high-standards (developed countries). Bagwell and Staiger (2014) introduce the globalization fatigue hypothesis and claim that developed countries suffer from insufficient bargaining power in the multilateral and bilateral negotiations arena, relative to developing countries. That, in turn, may trigger them to tighten the imposition of NTMs in order to form trade policy space (or make room) for future negotiations with developing countries.

Using data on specific trade concerns (STCs), Beverelli, Boffa and Keck (2014) find clear substitutability between past reductions in applied tariffs and SPS measures in both developed and developing economies, and same negative correlation between tariffs and TBTs only in developed countries. In line with these results, however, from the exporting country perspective, Orefice (2015) shows that lowering tariff by 10% corresponds to a 0.18% and 0.36% higher probability of observing an STC on SPS and TBT respectively. This figure is even further magnified when the raising and the imposing country belong to the same income group.

While interest in studying TBT and SPS has been growing in recent years, much of the relationship between tariff liberalization and the detailed level of specific NTMs focus mainly on anti-dumping (AD) measures. Moore and Zanardi (2011), who study how past trade liberalization impacts the decision to adopt antidumping laws, demonstrate that except for heavy users of AD among the developing countries there is no statistically significant substitution effect of trade liberalization on AD initiatives. By contrast, Feinberg and Reynolds (2007), who based their analysis on 24 countries for the period from 1996 to 2003, identify that tariff reductions increased both the likelihood and number of AD petitions, especially for developing countries. Their concept of *quid pro quo* implies a quiet agreement which exists between nations on switching traditional tariff policies by NTMs. They conclude that multilateral trade reductions are the cause of the recent growth in new users of anti-dumping policies. Bown and Tovar (2011) reaffirm the substitution effect by analysing India, which recently became a heavy user of antidumping measures. They demonstrate how India's liberalization reforms in the early 1990s have resulted in a higher probability of AD filings and increased safeguard restrictions.

In the reviewed literature it is not always evident that substitutability between tariffs and NTMs prevails. At times, the two measures follow the same direction, i.e. when countries charge high tariffs, they also employ high NTMs and vice versa. Support for the existence of complementarity correlation is predominantly accredited to the necessity to protect domestic production of sensitive consumer goods, textiles, apparel, and agriculture (Ray 1981). Moreover, Trefler (1993) and Lee and Swagel (1997) provide evidence for the positive correlation, showing that the measures are often used together to increase the protection granted to import-competing sectors. Both argue that NTMs are less likely to be imposed on export-oriented industries, at least partly because of fear of foreign retaliation. Trefler uses a two-equation structural model of the determinants of NTMs and imports across US industries,

taking into account variables such as import penetration and factors like capital and labour. Lee and Swagel (1997) use disaggregated cross-country, cross-industry data for wages, production, trade barriers and trade flows of manufactured goods across 41 countries. After accounting for industry and country--specific factors, countries tend to protect especially the weak industries, declining sectors, politically important sectors or those threatened by import competition. Lee and Swagel conclude that the causality between the motives for using the trade measures might be reversed, or that trade barriers could influence industry conditions rather than policymakers responding to industry-specific calls for protection. Both papers argue that import penetration, or its growth, is positively correlated with the willingness of policymakers to impose NTMs.

Dean et al. (2009), in their cross-country analysis, find that in the case of fruits and vegetables, as well as for apparel products, the joint use of tariffs and NTMs significantly reduces the impact of NTM on price. They use city level retail price data to directly estimate the average impact of core NTMs on the prices of 47 consumer products grouped into four separate sectors for more than 60 countries in 2001. Their model attempts to explain the observed price gaps due to NTMs, given observed differences in local markups, transport costs and differences in tariffs, in addition to some random unexplained factors. Moreover, they suggest that in some sectors, the restrictiveness of NTMs is highly correlated with country income; however, they do not provide interpretations as to this relationship.

Essaji (2010) proves that the motivation to increase the use of TBTs reflect the growing awareness of consumption externalities. His conclusion puts a question mark over the aspiration of governments to protect domestic firms profits in a tariff constrained environment. Essaji uses a two-country Cournot duopoly model in order to demonstrate how governments will choose to increase technical regulations, on condition that the net marginal benefit of the regulation increases with falling tariffs. It further reinforces the intuition that tariffs and regulations may be complements, in cases where tariffs fall and cause a substantial increase in the consumption externalities.

As already seen, the literature review provides various viewpoints regarding the correlation between particular NTMs and individual countries or country groups. Yet it lacks an overall perspective along with an in-depth analysis of the determinants of NTMs, and the correlation between all NTMs with their corresponding tariffs, while differentiating country groups. The current paper aims to address this gap by adding to the existing literature an analysis of the correlation between the use of both trade policy measures, while uncovering the heterogeneity across countries. In particular, it will provide evidence for the diminishing negative trajectory of the correlation between the two import measures, with the rise in the country's level of economic development. Furthermore, it will supplement common knowledge by providing additional determinants for the use of NTMs, such as the overhang gap, which can further explain the motivation behind their occurrence.

3.2 Quantification of NTMs

The quantification of NTMs is required in order to measure their impact on trade restrictiveness and on welfare as well as their relation with additional macroeconomic variables. Unlike tariffs, for which the available quantitative databases enable the evaluation of their levels and changes, NTMs are much more challenging to quantify. The main explanation for this difficulty is that NTM restrictions may take many different forms and often the information regarding these measurements are not publicly

available or satisfactorily transparent. In order to better investigate aspects regarding the impact of NTMs, one must use reliable methods, which allow the transformation of qualitative practices into measurable quantities. Generally, these methods allow the calculation of the *ad valorem* equivalents of NTMs, i.e. the *ad valorem* tariff rate that would induce the same level of imports.

Approaches for quantification of NTMs

Along the years, several analytical approaches were developed in order to tackle the challenging task of quantification of NTMs. The approaches use various methodologies to overcome the heterogeneous nature of NTMs and particularly the lack of available detailed information regarding their implementation across products. The approaches differ in the various assumptions adopted, as well as by the econometric tools which were used for estimating their value, conclusiveness, and changes over time. The most common methodology is the inventory approach presented by the frequency index and the coverage ratio. This approach allows the quantification of the incidence of NTMs and captures the percentage of products that are subject to one or more NTMs in the case of the frequency index. The coverage ratio basically measures the percentage of imports that are subject to one or more NTMs.

An additional approach, called the price (or wedge) gap, approximates the degree to which a specific regulatory measure or policy intervention raises domestic prices above international prices. These approximations are built on comparing prices of goods affected by an NTM with goods unaffected by the NTM. The main disadvantage of the price gap method is that it is often difficult to create two price measurements for the same good and establish that one fully reflects the effects of an NTM, whereas the other is unaffected. Several price-based econometric techniques attempt to build on the foundations behind the price gap method and expand it to several countries and products simultaneously. An example for such an exercise on various OECD countries is found in Deardorff and Stern (1997).

Alternatively, the literature proposes the quantity-based econometric approaches, which allow the estimation of the impact of trade policies, such as NTMs, on trade flows. These methods usually employ analysis of trade data using the gravity model, factor content model or combinations of features from both models. The trade data may be comprised of import values or quantities, or similarly, export measurements. Helpman, Melitz, and Rubinstein (2008) used the famous gravity equation in their empirical framework, in which given estimations of import demand elasticities serve to drive price effects or *ad valorem* equivalents of NTMs.

Notwithstanding the many advantages of these approaches in the quantification of NTMs, they also attract certain criticism. The most common critique is that estimations of NTMs should be crafted with detailed knowledge of products and markets. Ferrantino (2006) adds that estimations should be done while analysing one product and country at a time; however, the collection of data requires excessive resources and often disallows the capturing of many products and countries at once. This leads to a trade-off between handicraft and mass-produced estimates of NTM effects.

Moreover, in recent years, thanks to technical improvements some computable modelling simulation methods were developed in order to measure the effects of changes in NTMs on a wide variety of economic parameters. These simulations were originally developed in order to estimate the effects of policy changes such as tariffs on prices, production, or on macroeconomic indicators such as GDP or welfare. The most familiar example in that respect is the computable general equilibrium

(CGE) simulation employed by the global trade analysis project (GTAP). Lastly, several external sources of information, such as business surveys, may complement the approaches mentioned above. These surveys aim to address the difficulties that exporting firms face, mainly in developing countries. An example is the International Trade Centre (ITC), which assembles responses from firms to the most burdensome NTMs and ways in which they are affected. Additionally, the CoRe NTMs database assembles information from various sources, among them, the US Trade Representatives – National Trade Estimate Reports on Foreign Trade Barriers and the EU's Market Access Trade Barriers database.

Ad valorem equivalents of NTMs by Kee, Nicita, and Olarreaga

The model that will be employed in the current paper uses observations from a dataset of *ad valorem* tariff equivalent of non-tariff measures (AVE of NTMs) developed by Kee, Nicita, and Olarreaga (2009). The authors estimated the AVE of NTMs using a quantity-impact approach combined with approximations of import demand elasticity of nearly 5,000 products in 104 countries. Their non--linear least square estimation, which is based on the gravity model, allows the capture of information regarding the impact of various NTMs on each country's imports. The NTMs include, among others, price control measures, quantitative restrictions, monopolistic measures, anti-dumping and countervailing measures, technical regulations and agricultural domestic support. The dataset consists of *ad valorem* equivalents of NTMs, specified at the tariff line level (6 digit harmonized system of classifying goods).

At the outset, the authors use the following equation:

$$\ln m_{n,c} = \alpha_n + \sum \alpha_{n,k} C_c^k + \beta_{n,c}^{Core} Core_{n,c} + \beta_{n,c}^{DS} \ln DS_{n,c} + \varepsilon_{n,c} \ln(1 + t_{n,c}) + \mu_{n,c} \tag{1}$$

$m_{n.c}$ is the import value of good n in country c evaluated at exogenous world prices, which are all normalized to unity so that imported quantities equal $m_{n,c}$, t is the tariff and $\varepsilon_{n,c}$ is the import demand elasticity, which was obtained extraneously, C_c^k is a set of variables that control for k factor endowments (agricultural land, capital, labour force, GDP, etc.). The effect of core NTMs at the country level is estimated by the interaction term between the NTM dummy (for the presence of an NTM) and the vector of factor endowments of the country C_c^k, while $DS_{n,c}$ denotes the agriculture domestic support given to a product. α are tariff line dummies that capture any good-specific effect, while β is the parameter that captures the impact that the NTM imposed on good k in country i has on the corresponding imports.

At the second stage, the estimators are transformed into price equivalents, using the elasticities of import demand.

$$\frac{\partial \ln m_{n,c}}{\partial \ln Core_{n,c}} = \frac{\partial \ln m_{n,c}}{\partial \ln p_{n,c}^d} \frac{\partial \ln p_{n,c}^d}{\partial \ln Core_{n,c}} = \varepsilon_{n,c} ave_{n,c}^{Core} \tag{2}$$

$$ave_{n,c}^{Core} = \frac{1}{\varepsilon_{n,c}} \frac{\partial \ln m_{n,c}}{\partial Core_{n,c}} = \frac{e^{\beta_{n,c}^{Core}} - 1}{\varepsilon_{n,c}} \tag{3}$$

The main advantage of the model is that it goes beyond the traditional approach relying on coverage and frequency indices. It is far more informative than other gravity-based approaches, which have dominated the evaluation of the effects of specific NTMs. Furthermore, the methodology allows a direct comparison of the relative effects on imports of removing tariffs versus removing NTMs, and providing a particular tariff equivalent of NTMs affecting each product, at any country.

4 Econometric methodology and data

In this research paper, the determinants of the government's use of NTMs are examined as a compensative reaction to the existing low levels of MFN applied tariffs. Moreover, the Government's decision regarding the magnitude of the imposition of NTMs is studied with respect to the extent of the binding overhang, as well as to several supplementary control variables, which are described below. The size of the sample which was developed for this purpose is comprised of approximately 200,000 observations, encompassing data on 61 countries and between 3,500 to 4,500 tariff lines per country. The reason for the exclusion of certain countries from the original dataset is the lack of information on certain independent variables. Moreover, it allows some of the explanatory variables to interact with each other, and improve the goodness of fit of the model.

The sample used in the estimation includes a non-negligible part of the world economy and therefore, it is representative of the world as a whole in some dimensions. The sample comprises 61 countries from all continents, while the average *per capita* GDP in the sample is USD 7,300, which is slightly higher than the world average of USD 6,400. The list of countries comprises 75% of the world's population and close to 80% of its GDP (in PPP). This is due to the fact that it includes 14 out of the world's 20 largest economies, among them the USA, Japan, France, China, Italy, Canada and others.

The econometric methodology used in this analysis is the following:

$$\begin{aligned} &\ln(1+AVE\_NTM_{i,n}) = \alpha_{i,n}^{1} + \alpha_{i,n}^{2}\ln(1+Tariff_{i,n}) + \alpha_{i,n}^{3}\ln(1+OverHang_{i,n}) + \\ &+ \alpha_{i,n}^{4}\ln(Openess_{i,n}) + \alpha_{i,n}^{5}\ln(Cus\_Rev_{i,n}) + \alpha_{i,n}^{6}\ln(1+Tariff)\times(D\_NonAgri) + \\ &+ \alpha_{i,n}^{7}\ln(1+Tariff)\times(D\_Econ\_Dev) + \varepsilon_{i,n} \end{aligned} \tag{4}$$

For the purpose of this study, a log-linear transformation of the ordinary least squares (OLS) model has been employed. The dependent variable used in all the specifications is $\ln(1 + AVE\_NTM_{i,n})$, which is the natural logarithm transformation of the *ad valorem* equivalents of NTMs. It is important to note that the number 1 has been added in order to control the zero values. As mentioned previously, the dataset on the AVE of NTMs was obtained from the econometric estimations of Kee, Nicita and Olarreaga (2009). Although the authors use information on NTMs from the period 1992 to 2002, the data on the AVE of NTMs employed in the current analysis is for one particular year during 2001 and 2003, since the original estimation builds on the average trade data between the latter years. Each observation in the current analysis represents a tariff equivalent of NTMs in a specific country *i* on tariff line *n*. Regrettably, since the original dataset on the AVE of NTMs is specified exclusively for one year per country, it lacks the time-series dimension needed for creating a panel data analysis. Consequently, the econometric approach used in this analysis uses a cross sectional dataset based on the cross-country product-level.

The econometric analysis is comprised of a vector of variables, which may account for control variables explaining the use of NTMs. The main control variable in the analysis is denoted as $\ln(1 + Tariff_{i,n})$, which is a vector of the most favoured nations (MFN) applied tariff rates. Similar to the calculation of the dependent variable, the number 1 has been added to the tariff values in order to control the zero values. Data for the variable is provided for each of the countries and expressed at the 6-digit HS level. The data source is the UNCTAD trade analysis and information system (TRAINS) database accessible *via* the World Bank, world integrated trade solution (WITS) software. In order to maintain the required consistency with the methodology used for the calculation of the AVE of NTMs, the tariffs used are for the most recent year for which data is available between 2001 and 2003. As the theory predicts, the correlation between *Tariffs* and NTMs is expected to be negative for the whole sample of countries. However, the heterogeneity among countries when grouped according to their level of economic development is predictably significant. Here, it is anticipated that the less developed group of countries will tend to substitute their tariffs with higher levels of NTMs. As the level of economic development increases, the substitutability decreases and the correlation becomes positive for the richest countries.

The second major control variable used in the analysis is tariff binding overhang (denoted as $\ln(1 + OverHang_{i,n})$, which represents the difference between the MFN applied tariff and the bound tariff. Data on the binding overhang was collected from the world integrated trade solution (WITS), which provides data from two different sources of WTO and TRAINS database (maintained by UNCTAD). Similar to the calculation of the dependent variable, the number 1 has been added to the overhang values in order to control the zero values. In the analysis, a disaggregated data on binding overhang was used at a 6-digit level of HS to be compatible with the data on the AVE of NTMs and *Tariffs*. It measures the degree of flexibility available in each country within its WTO obligations and often-called tariff water. The excess binding overhang is generally low in developed countries and in manufacturing sectors; however, it may reach very high levels in developing economies or in agricultural products. These stylized facts are well demonstrated in the descriptive statistics, where the more advanced the economy, the significantly higher the MFN bound rates are than the MFN applied rates (i.e. higher binding overhang). Moreover, it is expected that in cases of high binding overhang rates, countries may raise tariffs legally without breaking their WTO commitments, hence they will not alternate them by using NTMs.

A third control variable is *Openness*, which represents the share of trade in goods and services as a percentage of GDP. The data is collected from the Global Development Network Growth Database, for the similar specific year of the previous variables. This ratio is frequently used to measure the importance of international transactions relative to domestic transactions. Although this ratio is referred to as trade openness, the term openness may be slightly misleading, since a low ratio does not necessarily imply high barriers to foreign trade, but may refer to factors such as the size of the economy and geographic remoteness from its current and potential trading partners. It is likely that countries that are dependent on international trade (mostly the more developed countries) will employ fewer NTMs compared to countries that are more self-reliant.

The next variable *Cus_Rev* represents the share of revenues of countries from imports taxes, as a percent of their total tax revenues. The data source is the World Bank and refers to each of the countries according to the year specified. In general, NTMs differ from tariffs by the fact that these measures do not generate revenues to countries. Nevertheless, this analysis allows

an examination of whether losses of tariff revenues to countries could explain the motivation for increasing their AVE of NTMs. It is expected that the low-income countries that rely on import revenues are less likely to use NTMs since those are significantly less of a source of income.

Several dummy variables are included in the econometric analysis. These dummies are mostly used in the interaction terms in order to validate the hypothesis that substitutability decreases with the rise in GDP *per capita*. Moreover, these dummies allow an examination of whether there is a substantial difference between the correlation in tariffs and the AVE of NTMs for the agriculture products compared to non-agriculture products. The first dummy variable is *D_Econ_Dev*, which refers to the level of economic development of countries (i.e. GDP *per capita*, according to the classification of the World Bank). It takes the following values: 0 = low-income countries; 1 = lower-middle income countries; 2 = upper-middle income countries; 3 = high-income countries. The dummy *D_Econ_Dev* is used in the analysis as part of an interaction term, together with $\ln(1 + Tariff_{i,n})$. The reason the interacted variables were also not included separately is that the effects of these variables are captured by country dummies. By creating the interaction term, it allows the capture of the particular correlation between tariffs and NTMs of each country group. By estimating the coefficients of the 4 groups, differentiated correlations reinforce the hypothesis that the less developed the countries are, the more likely that NTMs are served in order to substitute for tariff protection.

Additional dummy variables are *D_Non_Agri*, which is a binary dummy which takes a value of 1 if the tariff line is associated with a non-agriculture product, and equals 0 if the tariff line refers to agriculture products. *D_EU* is also a binary dummy that takes a value of 1 if the country is a member state of the European Union, and equals 0 otherwise. Although at the time that the research was conducted there were 28 member states, since the data refer to earlier years (i.e. 2003 is the latest), and some data on NTMs were missing for some member states, only 10 member states are included in the sample. *D_OECD* is a binary dummy that takes a value of 1 when the country is a member of the Organization for Economic Cooperation and Development (OECD), and 0 otherwise. The sample used in the analysis is comprised of 15 OECD members, and the source of the information is the OECD website. Both EU member states and countries belong to the OECD are the more advanced economies, and as such it is likely that they are strongly committed to the WTO's objectives to facilitate trade, hence they impose relatively lower NTMs.

5 Estimation results

5.1 General regressions results

The results of the regression analysis for the entire sample of countries are presented in Table 3.

The first two columns report the findings of the basic specification, which include simply the main explanatory variables *Tariffs* and *OverHang*, while both country and product fixed effects are controlled simultaneously. Country fixed effects allow to control for the fact that some countries may have higher levels of both tariffs and NTMs than others due to their stronger participation in multilateral and bilateral trade agreements. Controlling for tariff line fixed effects indicates that some products may differ by their levels of both tariffs and NTMs due to domestic political economy strengths. From the third column onwards, additional plausible control variables which potentially determine

the prevalence of NTMs, are included. This was designed in order to test for the sensitivity of the results to the inclusion of additional explanatory variables, such as trade openness and customs revenues. As a caveat, while these correlations are relatively robust, econometrics alone cannot exclude the possibility of reverse causality between particular variables (i.e. trade openness) and the dependent variable. Therefore, an additional analysis of the partial correlation has been performed in order to prove the strength and direction of the correlation between the variables employed in the analysis. It shows that whilst controlling for the effect of other variables, the correlation is sufficiently significant and robust (the results are shown in tables 5 and 6). In column 4, the evidence is provided for the coefficients of tariffs and binding overhang for non-agricultural products relative to agriculture products. Column 5 presents an interaction term of tariffs and *D_Econ_Dev*, which shows the distinction between different country groups according to the level of economic development (i.e. GDP *per capita*). The goodness of fit of the model is satisfactory as approximately 35.6–38.0% of the variations in the NTMs are explained by the regressors specified.

Since the primary focus of this paper is to unveil evidence of a substitution effect between the applied tariffs and restrictiveness of NTMs, attention should first be drawn to the two control variables *Tariff* and *OverHang*. The findings are consistent with the expectations by most of the literature of trade protection theory. It shows that from an overall perspective which covers all countries in the sample the predetermined tariffs have a statistically significant and negative correlation with the import policy to impose NTMs. The result reinforces the idea that although countries agreed to lower tariffs during the Uruguay Round negotiations, they subsequently replaced some of this liberalization with a stringent NTM regime. The coefficient for the model estimating this correlation to the whole sample of countries implies that a 1% tariff decrease, leads to a 4.7% higher AVE of NTMs. In terms of economic magnitudes, it suggests that an increase in tariffs from 1% to their mean level of 9.3% (an 830% increase) decreases the AVE of NTMs by 39%, which is a considerable impact.

The degree of flexibility provided by the tariff binding schedules is considerably different across countries. It is generally lower in developed countries and in the manufacturing sector but reaches high levels in developing economies or in specific agricultural products. In column 2 the control variable *OverHang* is introduced and while the coefficient of tariffs (first row) does not change, the estimator for the binding overhang is found to be high and inversely associated with the use of NTMs. This clearly reinforces the notion that a bigger overhang gap allows countries to legally raise tariffs without breaking their WTO commitments. Without such a necessity, countries with a bigger binding overhang are less likely to substitute tariffs with NTMs.

From column 3 onwards, an additional set of variables is revealed in order to account for other determinants of the use of NTMs. These control variables include ln(*Openness*), which denotes the level of participation in world trade; ln(*Cus_Rev*), which is the share of revenues from imports, expressed as a percent of total tax revenues. Moreover, the specification of these models includes an interaction term between the country's GDP and a dummy for each sector (HS section classification). This interaction term allows to control for similar political economy influences of same size economies at the sectoral level. As political economy theory suggests, specific interest groups may push governments to impose higher NTMs compared to other industries which are less organized. Adding this term increases the goodness of the whole model, from R-squared of 35.6% to 37.5%. Notice that the tariff coefficient remains relatively unchanged and significant at the one percent level, while it slightly increases the negativeness of the second control variable *OverHang*.

Countries differ by their degree of reliance on international trade, and more specifically developed countries, which depend more on trade, generally impose on average fewer NTMs. By reducing their overall barriers to trade in their own borders, these countries gain better market access and enhance their ability to penetrate easily to their counterpart markets. Moreover, the fear of retaliatory measures on the foreign demand for their exports similarly results in fewer NTMs. Other countries, typically the less developed ones, demonstrate a more self-reliant trade policy based on domestic production, and therefore these countries prefer to increase their barriers to protect sensitive industries from foreign competition. Consequently, as predicted, the estimators of the control variable *Openness* are found to be negatively correlated and statistically significant with AVE of NTMs, at the 1% level. The coefficient is found to be 0.3%, meaning that an increase of 1% in the share of trade in goods and services (as a percentage of GDP) will result in an 0.3–0.4% decrease in the use of distortive NTM restrictions. The results are in line with Mansfield and Busch (1995), who use a different control variable, i.e. the ratio of a country's imports to world imports, for measuring countries participation in world trade. The findings are also consistent with Michalopoulos (1999), who notes that frequency ratios of quantity and price control measures tend to be higher in countries with lower levels of *per capita* income and lower degrees of openness.

When explaining the restrictiveness of NTM restrictions, the coefficient on the share of revenues from imports (percent of total tax revenues) is found to be statistically significant, negative and relatively small. The negative sign of the coefficient indicates that an improvement in the country's revenue from tariffs induces a fall in NTM protection. The coefficient shows that the AVE of NTMs are inversely associated with changes in the share of revenues from imports and that a 1% rise in this variable induces a 1.1% fall in NTM protection. The higher the import revenue as a share of total tax revenues, the less likely a country is to apply NTMs (and vice versa: a lower share of revenues from customs is associated with a higher prevalence of NTMs). Since NTMs differ from tariffs by the fact that these measures are not designed to generate revenues to countries, it seems worrisome that losses of revenues are in fact a source of concern for countries and a motivation for an increase in the imposition of NTMs.

Naturally, a considerable diversity among countries consists in the sensitivity towards local producers' interests. Some may favour protecting import-competing industries at the expense of the exporting sectors. This is particularly predominant when protection of agricultural products is involved. Evidence shows that tariffs on agricultural products are on average much higher than those on non--agricultural products, although there is considerable divergence between countries. Countries with a special interest in agricultural products would most probably pair their high level of applied tariffs with a more regulated trade regime. This way, countries may keep all options on the table, meaning that when global pressure rises to remove one form of protection, they could still keep the other measure active. An empirical validation is given in column 4 displaying a comparison between the correlation of tariffs and the AVE of NTMs for non-agriculture products relative to agriculture products. This comparison yields the result that a 1% reduction of tariffs on non-agri-products generates a rise of 5.7% in the restrictiveness of NTMs, and this coefficient is statistically significant. The conclusion is that while the two import instruments are found to be paired in the two cases, the substitutability is stronger for non-agriculture products compared to agriculture products.

5.2 Correlation across country groups

The most important results of the model are presented in column 5 of Table 3. The specification of this estimation introduces a supplementary interaction term between ln(1 + $Tariff_{i,n}$) and the dummy variable *D_Econ_Dev*. The objective of this exercise is to allow to differentiate between country groups while controlling for the heterogeneity driven by the extent of economic development. The data is disaggregated into four groups; based on the World Bank classification each group represents a relatively homogenous cluster of countries, grounded on their level of GDP *per capita*. The results of the estimation suggest that controlling for the applied tariffs jointly with the level of economic development plays a substantial role in determining the correlation between tariffs and the AVE of NTMs across country groups. From a broad perspective, the model provides evidence which reinforces the substitutability between NTMs and tariffs for the majority of countries. However, a deeper examination renders some additional conclusions about the trajectory of this correlation in the light of the country variation.

The results of the estimation validate the main proposition of the paper. They confirm that although the correlation between tariffs and NTMs is negative, the scale of substitutability diminishes gradually the more developed a country is. This trend continues until the negative correlation changes to positive for the group of high-income countries. Despite the fact that part of the estimators may be affected by the sample size, the trend seems to be evident, and the estimations are statistically significant in all groups. The estimators indicate that a 1% decrease in the tariff rate leads to approximately a 13.4% increase in the AVE of NTMs in low-income countries. In lower-middle income and in upper-middle income countries, a 1% decrease in tariff rate is associated with an 11.4% and 9.4% increase in the restrictiveness of NTMs respectively. While in all country groups mentioned above, the estimators are found to be negatively correlated and statistically significant, the correlation between the two import measures is found to be significantly positive in the high-income countries. A similar decrease in tariffs is associated with a dramatic fall of 23.8% in the restrictiveness of NTMs. These last results confirm that in high-income countries, NTMs are more likely to be restrictive, the higher the tariff on a product is, and *vice versa*.

The applied tariffs are relatively high in the least developed countries; thus, the estimations imply that the restrictiveness of NTMs in these countries is typically low. Although the correlation is found to be negative, the interpretation is fairly counter-intuitive. The cost of operating an administration system which deals with NTMs is usually high and it is naturally complex. Moreover, these countries rely on revenues generated from import taxes. Consequently, low-income countries use NTM restrictions less extensively, and therefore the correlation is negative. Nevertheless, the correlation also implies that for specific products where tariffs are low, the imposition of some restrictions on imports still exists, mainly in order to preserve domestic protection.

Since most of the middle-income countries have undergone the deepest process of tariff liberalization, there is no wonder that they practice NTMs more excessively. As supported by the political economy theory, this negative correlation is mainly a subsequent reaction to tariff liberalization. Governments that are subject to pressures from domestic interests, adversely affected by the dismantling of tariff barriers, are often impelled to increase alternative channels of protectionism. That, in turn, is demonstrated in the strong substitution correlation between the two import policy instruments. Claims against these countries for using NTMs excessively are being rejected by

the increasing awareness of health and environmental causes. However, the negative and significant correlation demonstrates the compensative effect between the two import measures.

As for the case of the richest countries, it is evident that the correlation is strongly positive, meaning that if a country belongs to the high-income country group, it will most likely pair the two trade measures. Since the average applied tariffs in high-income countries are relatively low, it implies a low restrictiveness of NTMs as well. Several reasons could support these findings. Firstly, these countries are at the frontline of the WTO negotiations on TBT and SPS measures, and are generally more involved in designing large parts the world trade regime. This multilateral arena aims to achieve the goal of facilitating trade obstacles, as well as simplifying market access to the developing world. Therefore, the most developed countries take upon themselves these objectives genuinely, which naturally means removing trade barriers more extensively than elsewhere. Moreover, since high--income countries tend to rely more profoundly on international trade, it leads them to seek better conditions, both for domestic importers, as well as for their local exporters in foreign markets. Lastly, these interests coexist with the necessity to attract imports at the lowest costs possible for the benefit of domestic consumers as well as for importers of intermediate products.

5.3 Robustness checks and additional specification

Several robustness checks were performed in this last part of the paper. These checks were designed to test the validity of the results obtained in the general model when estimating different country groups according to geographical or organizational clusters. The results of these checks are robust and they reinforce the proposition of the paper. The developing countries demonstrate a strong substitution correlation in comparison to the rest of the world, while the richest countries such as the EU member states complement tariffs with an NTM regime. The results of the regression analysis are presented in Table 4.

MENA. A special geographical group that was examined is the Middle East and North African group (MENA countries). Despite the geographical and regulatory proximity, alongside increasing trade relations with the EU, most of these countries are still considered developing by nature. These countries' GDP *per capita* is relatively low and the level of tariffs is rather high. Therefore, it is interesting to check whether the level of economic development influences more of the MENA countries' NTM policy, compared with the mentioned proximities to the EU. The model estimate that tariff is inversely correlated with the AVE of NTMs, suggesting that a MENA import line whose tariff is 1% higher than another MENA member's import line tariff has 6.7% lower AVEs for its imposed NTM. The estimator is found to be statistically significant; however, it is relatively smaller than that found for the low-income country case. The negative coefficient implies that the correlation between tariff and AVE of NTMs is substitutable and despite the low level of GDP *per capita*, the influence of the EU has a positive impact on the restrictiveness of NTMs. Meanwhile, a MENA country tariff line whose binding overhang is 1% higher than other MENA country tariff lines exhibits 2.5% higher AVEs of NTMs relative to the other tariff line.

OECD. The OECD organization is comprised of a heterogeneous group of countries. However, these developed countries typically have open economies and a relatively low level of applied tariffs. Despite some minor exceptions, this rule applies also to the low level of binding overhang.

The estimation for the tariff correlation with the AVE of NTMs suggests that an OECD import line whose tariff is 1% higher than other OECD members' import line tariffs has 15% higher AVEs for its imposed NTM. The estimator is found to be statistically significant, and the positive high coefficient implies that the correlation between tariff and AVE of NTMs is complementary, for the reasons mentioned in the previous sub-section.

EU. The most remarkable positive correlation between the two import policy measures is found in the group of countries that belong to the European Union. These countries are constrained to a single customs union regime, meaning that the MFN applied tariffs for all these countries are similar for each product. The similarity, however, does not apply to all NTMs, which vary to some extent according to each country's national regulations and domestic administration. The coefficient in the case of the EU demonstrates how an EU import line whose tariff is 1% higher than another EU member state's import line tariff has 25.3% higher AVEs for its imposed NTM. The estimator is found to be statistically significant, and the high positive coefficient implies a strong complementarity between the tariff and the restrictiveness of NTMs. The fact that the EU does not substitute between the two import measures is fairly reasonable. The EU is part of an extensive network of PTAs, and the elimination process of the restrictiveness of NTMs started as early as in 1973, the year in which all internal tariffs were abolished. Furthermore, the EU has been one of the promoters of trade facilitation issues within the WTO and has taken upon itself the role of eliminating distortive measures to trade mostly, in favour of the developing world. With respect to the binding overhang, it is found to be inversely correlated with the AVE of NTMs at the one-percent level. Since the binding overhang of the EU is relatively small, this suggests that a 1% change of the gap is associated with a 5.5% decrease in the restrictiveness of NTMs.

6 Conclusions

The main objective of this research is to reject the common hypothesis that non-tariff measures (NTMs) serve as protectionist instruments in light of the global obsolete use of tariffs in a similar manner across all country groups. Moreover, it seeks to establish that the commitment to lower all forms of trade barriers increases with the country's level of economic development. In order to realize these objectives, an econometric analysis has been undertaken, while exploiting a unique dataset of *ad valorem* tariff equivalents of NTMs at the 6-digit HS classification. The empirical results reaffirm that from a global perspective the correlation between tariffs and NTMs is negative and statistically significant. Yet, the study asserts that while taking into account the country variation, the substitutability effect diminishes with the rise in the country's level of economic development. This proves that the higher a country's GDP *per capita*, the less likely that it compensates for the adverse effects of tariff elimination with a growing restrictiveness of NTMs, while alternative considerations become relevant. Furthermore, the relationship between the two import policy measures changes its sign from negative to strongly positive in high-income countries at the lowest levels.

The paper argues that the most advanced economies have taken upon themselves stronger international commitments than less developed countries in order to achieve protectionist relief in a genuine manner. Such complementarity is also attributed to the fact that these countries are highly dependent on international trade, as well as to the response of policy makers to consumer's interests to freer trade. This outcome is shown in the regression estimation, which clearly demonstrates

the significant extent to which high-income countries tend to pair their low levels of tariffs with similarly less restrictive NTMs. The empirical results of the analysis are further confirmed by the robustness checks of the correlation between the two import policy instruments when different country clusters such as the MENA countries, OECD and EU member states are examined.

Moreover, the analysis allows for additional control variables to serve as determinants for the extent of the restrictiveness of NTMs. Among these variables, an imperative role is given to the binding overhang gap and its effect on the AVE of NTMs. The binding overhang, which represents the difference between countries binding commitments and their actual applied tariffs, is a significant policy measure practiced by WTO member states. The results of the estimations validate that the less developed a country and the bigger the overhang gap, the less likely that the country imposes restrictive NTMs. The negative estimators reinforce the notion that countries that enjoy a larger binding overhang gap may raise their tariff legally without breaking their WTO commitments, hence they do not need to resort to compensatory measures such as NTMs.

The empirical framework employed in this study was based on a broad dataset, although it was limited in years. Therefore, in future studies and based on the availability of the AVE of NTMs it would be useful to investigate whether the findings reported in this paper held over recent years.

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Acknowledgements

First and foremost, the author wishes to express his gratitude to Jan Jakub Michałek, as well as to Jan Hagemejer, both of the Faculty of Economic Sciences, University of Warsaw, for the inspiring discussions and productive feedbacks, ongoing interest and constant encouragement. Furthermore, the author thanks Paola Conconi, Université libre de Bruxelles and Maurizio Zanardi, Lancaster University, for their constructive and helpful suggestions, which significantly contributed to this paper. The research for this paper has been supported by the framework of the DISSETTLE project. Dissettle: Dispute Settlement in Trade: Training in Law and Economics, Marie Curie Initial Training Network (ITN), financed by the European Commission; IP: FP7-PEOPLE-2010-ITN.

Appendix

Table 1
Variables and sources

Variable	Definition	Source
AVE_NTM	*Ad valorem* equivalents of non-tariff measures	the World Bank (Kee, Nicita, Olarreaga 2009)
Tariff	Average applied tariffs (6-digit HS classification)	Tariff Download Facility (WTO)
OverHang	Gap between MFN applied tariff rate and bound rate (6-digit)	Tariff Download Facility (WTO)
Openness	Share of trade in goods and services, as % of GDP	Global Development Network Growth Database
Cus_Rev	Customs and other import duties, as % of tax revenue	the World Bank
GDP	Gross domestic product, current prices (USD billion)	International Monetary Fund
GDPpc	Gross domestic product *per capita*, in current prices (USD)	International Monetary Fund
D_Econ_Dev (dummy)	0 = low-income countries 1 = lower-middle income countries 2 = upper-middle income countries 3 = high-income countries	the World Bank
D_Non_Agri (dummy)	0 = agriculture products 1 = non-agriculture products	the World Bank
Tariff · Non_Agri	Interaction term of tariff and *D_Non_Agri*	
D_OECD (dummy)	0 = non OECD country 1 = OECD member country	OECD website
D_EU (dummy)	0 = non EU member states 1 = EU member states	European Commission
D_MENA (dummy)	0 = non MENA country 1 = MENA country	
Country FE	Fixed effects of country variables	
Product FE	Fixed effects of products lines (6-digit HS classification)	

Table 2
Statistical description

Country group	Variables	Mean	Standard deviation	Min	Max	Observations
Low-income countries	*Tariff*	0.1350	0.1089	0	3.21	57,742
	AVE_NTMs	0.0399	0.1711	0	2.99	57,742
	OverHang	0.6343	0.3596	0	1	16,202
	GDP	5.6480	8.091	0.4	30.5	53,221
	GDPpc	0.3099	0.1643	0.139	0.829	57,742
	Openness	0.5303	0.1993	0.288	0.945	57,742
	Tr_Non_OECD	0.3827	0.2157	0.759	0.826	48,827
	Cus_Rev	0.2630	0.1275	0.1577	0.535	40,174
Lower-middle income countries	*Tariff*	0.1534	0.3829	0	10	112,474
	AVE_NTMs	0.1475	0.3055	0	4.56	112,474
	OverHang	0.6513	0.3203	0	1	61,768
	GDP	31.620	66.04	0.3	323.5	112,474
	GDPpc	0.8140	0.483	0.306	2.31	112,474
	Openness	0.6906	0.2634	0.219	1.24	112,474
	Tr_Non_OECD	0.3414	0.1478	0.155	0.658	108,080
	Cus_Rev	0.1581	0.0864	0.030	0.355	99,041
Upper-middle income countries	*Tariff*	0.1296	0.1471	0	10	109,068
	AVE_NTMs	0.0988	0.2618	0	4.79	109,068
	OverHang	0.5439	0.3135	0	1	61,172
	GDP	87.420	126.87	2.09	465	104,522
	GDPpc	3.1670	1.777	1.04	7.42	109,068
	Openness	0.6917	0.4623	0	2.10	104,522
	Tr_Non_OECD	0.2575	0.1114	0.0596	0.457	109,068
	Cus_Rev	0.0942	0.075	0.0139	0.344	99,984
High-income countries	*Tariff*	0.0510	0.1437	0	10	145,135
	AVE_NTMs	0.0893	0.2636	0	4.61	145,135
	OverHang	0.2528	0.3742	0	1	94,852
	GDP	538.51	1,137.9	1.1	5,800.5	145,135
	GDPpc	18.200	9.956	2.096	37.82	145,135
	Openness	0.7390	0.325	0.197	1.62	145,135
	Tr_Non_OECD	0.2241	0.147	0.058	0.613	140,589
	Cus_Rev	0.0427	0.101	0	0.438	131,815

Table 3
Regression results; dependent variable: ln(1 + *AVE_NTMs*)

	1	**2**	**3**	**4**	**5**
ln(1 + *Tariff*)	-0.047*** (-11.06)	-0.047*** (-11.06)	-0.049*** (-11.56)		
ln(1 + *OverHang*)		-0.286*** (-7.00)	-0.369*** (-17.45)	-0.368*** (-17.42)	-0.312*** (-14.72)
ln(*Openness*)			-0.003*** (-3.60)	-0.003*** (-3.66)	-0.004* (-0.42)
ln(*Cus Rev*)			-0.011** (-3.83)	-0.011** (-3.94)	-0.004* (-1.36)
ln(1 + *Tariff*) · *D_Non_Agri*				-0.057*** (-13.68)	
ln(1 + *Tariff*) · low income					-0.134*** (-6.18)
ln(1 + *Tariff*) · lower-middle income					-0.114*** (-22.24)
ln(1 + *Tariff*) · upper-middle income					-0.094*** (-8.80)
ln(1 + *Tariff*) · high income					0.238*** (8.03)
Constant	-0.022*** (-3.64)	0.147*** (8.04)	0.851*** (13.20)	0.854*** (13.24)	0.724*** (11.10)
Country FE	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes
R2	0.356	0.356	0.375	0.375	0.379
Adjusted R2	0.342	0.342	0.360	0.360	0.365
F statistics	391.332	391.332	361.599	361.861	351.880
Observations	206,554	206,554	206,554	206,554	206,554

Notes:
t statistics in parentheses;
p-value: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4
Regression results, robustness checks; dependent variable: ln(1 + *AVE_NTMs*)

	MENA	**OECD**	**EU**
ln_(1 + *Tariff*)	-0.067*** (-6.56)	0.150*** (4.90)	0.253** (2.84)
ln_(1 + *OverHang*)	0.025*** (3.37)	0.006 (1.73)	-0.055*** (-7.49)
ln_*Openness*	-0.690*** (-31.51)	-0.007** (-2.79)	-0.004 (-1.22)
ln_*Cus_Rev*	-0.038*** (-18.79)	-0.001*** (-3.56)	-0.008*** (-10.17)
Country FE	Yes	Yes	Yes
Product FE	Yes	Yes	Yes
R2	0.359	0.338	0.457
Adjusted R2	0.359	0.338	0.456
F statistics	370.161	759.083	629.716
Observations	21,443	71,657	47,289

Notes: *t* statistics in parentheses;
p-value: * p < 0.05, ** p < 0.01, *** p < 0.001.

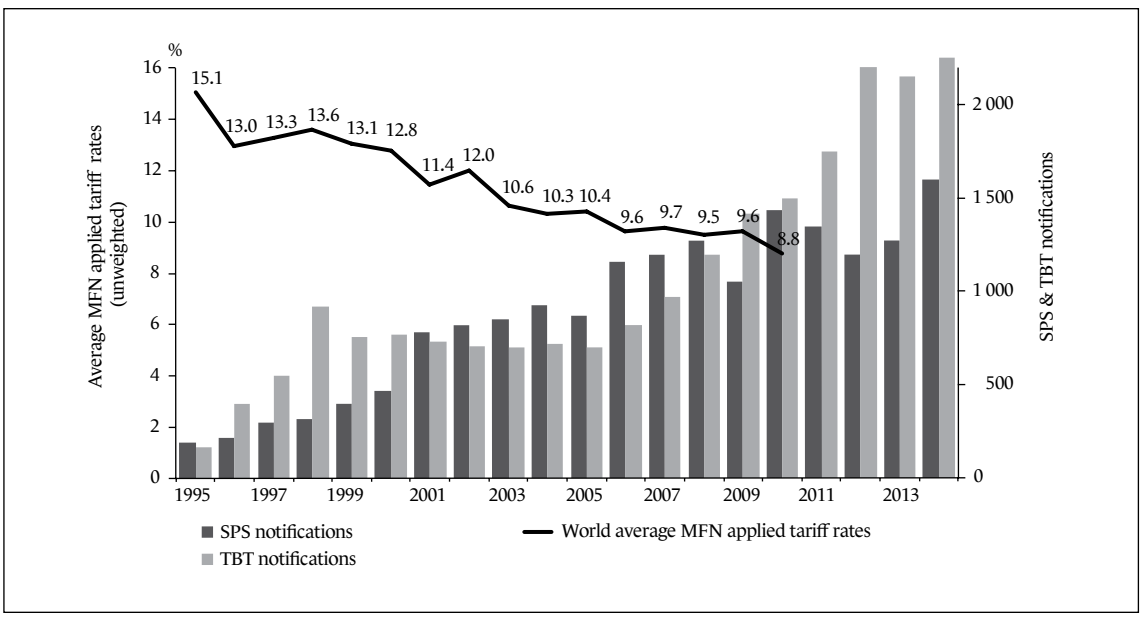
Table 5
Correlations between variables (observations = 206,554)

Variable	**ln(1 + *AVE_NTMs*)**	**ln(1 + *Tariff*)**	**ln(1 + *Over Hang*)**	**ln(*Openness*)**	**ln(*GDP*)**	**ln(*GDPpc*)**	**ln(*Cus_Rev*)**
ln(1 + *AVE_NTMs*)	1						
ln (1 + *Tariff*)	0.0778	1					
ln(1 + *OverHang*)	0.0052	0.0163	1				
ln(*Openness*)	0.0345	-0.1521	-0.0569	1			
ln(*GDP*)	0.0711	-0.0904	-0.4603	-0.2483	1		
ln(*GDPpc*)	0.0411	-0.2801	-0.4633	0.126	0.6445	1	
ln(*Cus_Rev*)	-0.0307	0.2974	0.5727	-0.1875	-0.5675	-0.749	1

Table 6
Partial and semipartial correlations of ln(1 + *AVE_NTMs*) with observations = 206,554

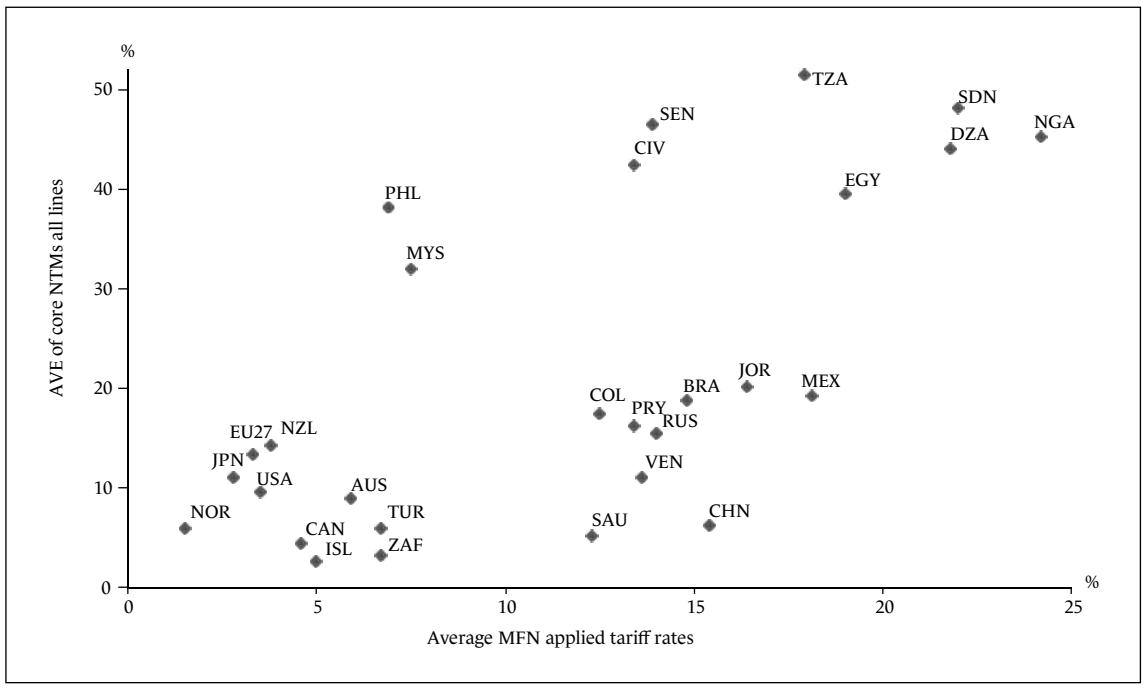
Variable	Partial correlation	Semipartial correlation	Partial correlation ^ 2	Semipartial correlation ^ 2	Significance value
ln(1 + *Tariff*)	0.0989	0.0983	0.0098	0.0097	0.0000
ln(1 + *OverHang*)	0.0615	0.0610	0.0038	0.0037	0.0000
ln(*Openness*)	0.0718	0.0712	0.0052	0.0052	0.0000
ln(*GDP*)	0.0820	0.0814	0.0067	0.0066	0.0000
ln(*GDPpc*)	0.0009	0.0009	0.0000	0.0000	0.0689
ln(*Cus_Rev)*	-0.0114	-0.0112	0.0001	0.0001	0.0000

Figure 1
World average MFN applied tariff rates vs. SPS and TBT notifications



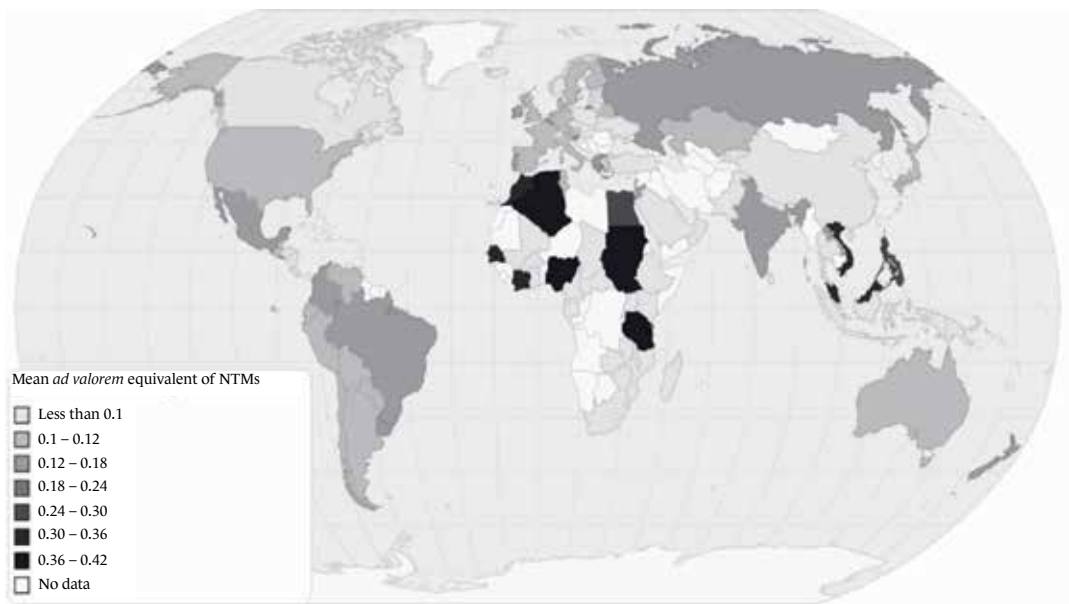
Source: calculations based on data of the World Bank and WTO I-TIP.

Figure 2
World average MFN applied tariff rates vs. SPS & TBT notifications



Source: calculations based on Kee, Nicita, Olarreaga (2009).

Figure 3
Mean of *ad valorem* equivalent of NTMs across countries



Source: calculations based on Kee, Nicita, Olarreaga (2009).