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Trade protection and the role of non-tariff barriers

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Abstract

A growing share of modern trade policy instruments is shaped by non-tariff barriers (NTBs). Based on a structural gravity equation and the recently updated Global Trade Alert database, we empirically investigate the effect of NTBs on imports. Our analysis reveals that the implementation of NTBs reduces imports of affected products by up to 12%. Their trade dampening effect is thus comparable to that of trade defence instruments such as anti-dumping duties. It is smaller for exporters that have a free trade agreement with the importing country. Different types of NTBs affect trade to a different extent. Finally, we investigate the effect of behind-the-border measures, showing that they significantly lower the importer's market access.

Keywords Non-tariff barriers · Trade protection · Gravity equation

JEL Classification F13 · F14

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1 Introduction

Applied tariffs have declined steadily over the past two decades, having decreased from almost ten percent in 2000 to less than seven percent in 2015.[1] Nevertheless, the International Monetary Fund warns that protectionism is increasing and poses a threat to global economic growth (International Monetary Fund 2017). In particular, governments increasingly resort to non-tariff barriers (NTBs),[2] with around 300 new measures implemented in 2014 alone. NTBs also play an increasing role in the design of trade agreements (Felbermayr 2016; Felbermayr et al. 2017), so that understanding their effects should be a key concern for policy makers.

Considering a broad range of government measures that lead to a discriminatory treatment of foreign competitors relative to domestic firms as an NTB, this paper exploits the recently updated Global Trade Alert (GTA) database, that collects information on protectionist policies.[3] We empirically quantify how bilateral trade flows change on average if at least one NTB is implemented. By estimating a structural gravity equation at the CPC[4] three-digit product level for 152 country pairs for the period 2010 to 2015, we find that bilateral import values of a particular product fall by 4–12% if at least one NTB is implemented by the importing country. This trade dampening effect is reduced if the importer and the exporter are engaged in a free trade agreement (FTA). Additionally, our estimations account for trade defence instruments (TDIs) such as anti-dumping duties. This enables us to compare the trade dampening effects of NTBs and TDIs, showing that they are on average of similar size.

As NTBs can be very diverse, we distinguish four groups of NTBs: (1) import controls, (2) state aid and subsidy measures, (3) public procurement and localisation policies and (4) other NTBs, which include Sanitary and Phytosanitary Standards (SPS), Technical Barriers to Trade (TBT) and capital controls. While we provide robust evidence that import controls reduce trade on average by 2–11%, the effect of the remaining NTBs is less pronounced.

Methodologically, our analysis contributes to the ongoing discussion on how to correctly identify the effect of NTBs that affect all trading partners equally. Most of the NTBs identified in the GTA database are so-called behind-the-border (BTB) measures. This means they are not targeted against specific trading partners but affect all trading partners equally. As soon as one accounts for importer-product-time fixed effects in a gravity equation, all variation within the BTB policy variable is absorbed. Hence, the effect of BTB measures on trade cannot be identified in a gravity equation with directional fixed effects. We apply a two-step estimation

[1] Simple averages across all products and countries. Tariff data used in this paper is accessible via the World Integrated Trade Solution database provided by the World Bank and based on UNCTAD's TRAINS database as well as the WTO's IDB and CTS database.

[2] See for example studies by Datt et al. (2011), Evenett (2014) or Kee et al. (2013).

[3] The Global Trade Alert (GTA) database was launched in 2009 following the global financial crisis. The following analysis is based on the recent update published in July 2017.

[4] Central Product Classification.

procedure following Head and Ries (2008) to identify the effect of BTB measures on trade and illustrate that such measures significantly reduce market access.

Our analysis relates to several strands of the trade literature. Regarding studies that examine how the overall level of NTBs affects trade, Kee et al. (2009) construct an overall restrictiveness index for over 70 developed and developing countries. The authors estimate ad valorem tariff equivalents to facilitate a direct comparison between the restrictiveness of NTBs and tariffs. They find that on average, NTBs contribute almost as much to trade restrictions as tariffs. According to Niu et al. (2017), even though tariffs have generally fallen between 1997 and 2015, the increase in the use of NTBs has meant that the overall level of protection for countries and products has not decreased. Hoekman and Nicita (2011) find that on average trade decreases more strongly if NTBs are implemented rather than tariffs. More specifically, trade decreases on average by 1.7% if the level of NTBs increases by 10%. Similar ad valorem tariff equivalents are calculated by Bouët et al. (2008) and Bratt (2017). We contribute to the literature by showing that the trade dampening impact of NTBs is mitigated by FTAs. Methodologically, we apply an extensive fixed effects setup to capture most sources of omitted variable bias.

With regard to the studies examining the effects of specific types of NTBs, a large strand of literature investigates the effects of TBT as well as SPS on trade.[5] Crivelli and Gröschl (2016) use a gravity model in order to investigate the intensive as well as extensive margin effects of SPS on agricultural and food trade. They find that SPS reduce the probability of exporting to a protected market but increase exports of incumbents, indicating that they serve as a barrier to market entry. Beestermöller et al. (2017) look at food safety border inspections, examining how the risk of rejection at European borders on safety grounds affects Chinese agri-food exporters. The authors find that inspections affect both entry to and exit from the European market as well as the value of incumbent exports.

Ghodsi et al. (2017) study different types of NTBs. Covering the period from 1995 to 2014, the authors estimate average trade reducing effects that vary between 5 and 30% depending on the type of NTB. They conclude that the trade reducing effects of NTBs can be similar to those of traditional TDIs. However, 82% of NTBs investigated are SPS or TBT measures.[6] NTBs such as subsidies, state aid or public procurement measures are not included as their database is limited to direct trade policies.[7] Furthermore, the authors are unable to distinguish whether non-tariff measures are likely to have a trade liberalising or a protectionist impact, a distinction we are able to make with the GTA data. This paper adds to the literature by comparing the protectionist impact of several different types of NTBs beyond those used in previous studies, showing that some measures affect trade more strongly than others.

NTBs can be measured directly or indirectly (Chen and Novy 2012). If NTBs are directly measured, information about the actual incidence of an NTB is used

[5] A comprehensive overview of studies that focus on specific non-tariff measures is provided by Ederington and Ruta (2016).

[6] In this analysis less than 1% of all measures have been SPS or TBT measures.

[7] Ghodsi et al. (2017) use the WTO's I-TIP database.

to construct counts, coverage or frequency ratios. This allows to distinguish different types of NTBs (Henn and McDonald 2014; Ghodsi et al. 2017). The indirect approach exploits information from market anomalies, such as price gaps or unexpectedly large or small trade flows to estimate the effects of NTBs (Andriamananjara et al. 2004; Bradford 2003; Ferrantino 2006). However, the identification of a single type of NTB is not feasible (Ederington and Ruta 2016). Since we aim to disentangle different trade effects for varying types of NTBs, we use the direct approach.

The greatest disadvantage of using the direct measurement approach is that data on NTBs is still relatively scarce. We use the recently updated GTA database, which collects protectionist policies that were implemented worldwide since 2009. One reason for using the database is that it covers a broad range of policy measures, identifying those that discriminate against non-domestic firms. Disadvantages include its reliance on government transparency as well as the absence of detailed information on the number of product lines (HS8 or HS10) covered within a product category. The merits and drawbacks of the database are discussed in detail in Sect. 3. Due to such data limitations, the results of this paper should thus be seen as complementing existing studies that rely on different databases.

Most studies that use data on NTBs from the GTA database either focus on determinants of protectionism (Georgiadis and Graeb 2016) or restrict their study to a specific protectionist measure or region (Shingal 2009; Evenett 2014). To the best of our knowledge, Henn and McDonald (2014) are the only ones who use the GTA database to assess the impact of different types of NTBs on bilateral trade. The authors find that border controls (defined as non-tariff and tariff measures) reduce trade by about 8%. We build on their analysis by relying on an updated version of the database which allows us to extend their estimation strategy substantially.[8] Specifically, we cover a broader period of time and more countries (6 years from 2010 to 2015 for 152 countries compared to 3 years (2008–2010) for G20 countries). Our analysis thus overcomes the potential caveat of Henn and McDonald (2014), who look at trade flows that were still largely affected by the world economic crisis.

In addition, it is reasonable to assume that trade flows do not immediately react to newly implemented trade barriers. Therefore, having the possibility to analyse yearly and not monthly trade flows as done by Henn and McDonald (2014) might capture the impact of NTBs on trade more accurately. The information on the types of products targeted by each measure is now available at the CPC three-digit level instead of the CPC two-digit level.[9]

A further strand of related literature is concerned with effects of BTB measures on trade. BTB measures do not vary by exporter and hence, they are absorbed in a gravity setting by importer-product-time fixed effects. Henn and McDonald (2014) address this problem by constructing dyads and tetrads of trade flows, which represent changes in imports relative to a reference importer and exporter. They argue that variation among exporters would be preserved particularly in cases where the

[8] Section 2 provides details on the estimation strategy.

[9] Data is also available at the HS six-digit product level. However, the affected HS six-digit product code is systematically missing for a subset of observations. See Sect. 3 for details.

reference exporter is not affected by protectionism in a certain import market, while most other exporters are subject to such protectionism. However, even if not all exporters are affected equally, it is difficult to anticipate which exporter is affected least and to assign treatment to different exporters accordingly.

Three alternative solutions have been suggested in the recent related literature: First, instead of including the full set of fixed effects into the regression, one could use proxies to account for multilateral resistance (Baier and Bergstrand 2009). However, Yotov et al. (2016) do not recommend relying on remoteness indices, as they cannot account for all multilateral resistances and therefore still lead to biased estimates.

A second solution is to extend international trade data with intra-national trade data. This is done by Heid et al. (2015) to identify the effect of non-discriminatory trade policies on trade. By adding intra-national trade, BTB measures become bilateral by definition and thus can be identified. The major issue here is that intra-national trade data is not yet available for all years and all countries considered in this analysis. The databases available to construct intra-national trade (i.e. databases that include bilateral trade and production data) do only cover data until 2004 (the World Bank's Trade Production and Protection database) or 2006 (CEPII's Trade-Prod database).

The third alternative suggested by Head and Mayer (2014), Egger and Nigai (2015) and Yotov et al. (2016) is to estimate the effect of BTB measures in two steps. In the first step the gravity equation is estimated with the full set of fixed effects. In the second step the predicted importer-product-time fixed effects from the first stage are regressed on importer-specific determinants to assess their impact on the importer's market access.[10] Head and Mayer 's derivation neglects the time dimension, as the model is assumed to hold in all time periods. In addition, the two-step estimator is only derived at the importer–exporter dimension. We extend the model by Head and Mayer (2014) model to the product level. In doing so, we are close to Anderson and Yotov (2016), who also use a two-step procedure, regressing estimates of importer–exporter-product fixed effects on BTB measures.

The remainder of the paper is structured as follows: Sect. 2 presents the empirical strategy. An overview of the data used is given in Sect. 3. Section 4 presents the main findings, followed by some robustness checks. Section 5 concludes.

[10] Eaton and Kortum (2002) apply the two-step procedure as they are interested in the determinants of exporters' competitiveness. They use exporter fixed effects derived from a gravity equation and show that technology and human capital are important exporter-specific determinants. Head and Ries (2008) adopt Eaton and Kortum 's approach to assess country-specific determinants of foreign direct investments. In a very recent approach Agnosteva et al. (2019) use the two-step procedure to estimate systematic unobserved trade barriers based on standard gravity variables and predict pair-fixed effects from a first stage gravity estimation.

2 Estimation strategy

We estimate a structural gravity equation based on Yotov et al. (2016) and extend it to the product level as proposed by Larch and Wanner (2017). Modelling the gravity equation explicitly with tariffs allows the estimates to be interpreted as trade elasticities. This enables a direct comparison of the trade effect caused by NTBs and by tariffs. For each trade policy parameter tariff equivalents can be estimated (Yotov et al. 2016).

Extending the gravity model to the product level avoids potential underestimation of the effects of NTBs. NTBs are mostly targeted at specific products and do not target all imported or exported goods. The sectoral gravity equation captures all inter-sectoral linkages (Yotov et al. 2016) so that it accounts for substitution effects across different goods. The gravity equation derived by Larch and Wanner (2017) is given by

$$X_{ij}^k = \frac{Y_i^k \gamma_j^k Y_j}{Y^W} \left(\frac{t_{ij}^k}{\pi_i^k P_j^k} \right)^{(1-\sigma^k)} (\tau_{ij}^k)^{-\sigma^k}, \tag{1}$$

where X_{ij}^k are exports of product k from country i to country j. The equation can be decomposed into two terms that determine trade flows: The size effect and the trade costs effect. $\frac{Y_i^k \gamma_j^k Y_j}{Y^W}$ represents the size of the respective economies. It includes production value of product k in country i Y_i^k, the fraction of country j's expenditure spent on good k γ_j^k, country j's expenditure Y_j and global expenditure Y^W. The size effect determines the level of trade if there are no trade costs. It can be interpreted as follows: Firstly, without any trade costs large producers will export more to all destinations. Secondly, bigger or richer markets will import more from all origins. And thirdly, bilateral trade flows will be larger, the more similar two countries are in size.

The remaining term $\left(\left(\frac{t_{ij}^k}{\pi_i^k P_j^k} \right)^{(1-\sigma^k)} (\tau_{ij}^k)^{-\sigma^k} \right)$ reflects the effect of trade costs on bilateral trade flows. t_{ij}^k contains all bilateral trade costs at the product level. These are factors like distance, a common language or a shared border, but also NTBs. P_j^k is defined as the inward multilateral resistance. It reflects importer j's market access, which depends on economic size and bilateral trade costs. π_i^k is defined as the outward multilateral resistance and thus reflects the exporter i's market access. Similar to the inward multilateral resistance, outward multilateral resistance also depends on domestic production and bilateral trade costs. It is assumed that both, inward and outward multilateral resistance terms are product specific. Finally, τ_{ij}^k are product specific trade costs induced by tariffs. All trade costs are assumed to have negative effects on trade. σ^k is the elasticity of substitution between varieties of good k (assumed > 1).[11]

[11] For more detailed information on the individual components of the gravity equation the reader is referred to Yotov et al. (2016) and Larch and Wanner (2017).

2.1 Identification of the trade effects of non-tariff barriers

To empirically identify the effects of NTBs, we exploit the fact that for each implemented NTB, the GTA database contains the following information: Trading partners that are most likely affected, products that are affected (at CPC three-digit product level) and the date of implementation of any measure. We use this information to construct a dummy variable which equals one if at least one NTB is implemented between a destination country j and an origin country i that affects a product k at time t. Similar, a count variable is constructed, which counts how many NTBs are implemented between a country pair that affect product k at time t. For a more detailed analysis we split NTBs into four groups: (1) import controls, (2) state aid and subsidy measures, (3) public procurement and localisation policies and (4) other NTBs, which include SPS, TBT and capital controls. We estimate how imports change in response to NTBs from 2010 to 2015 using the following equation:

$$\begin{aligned} X_{ijkt} = exp[\beta_1 NTB_{ijkt-1} + \beta_2 TDI_{ijkt-1} + \sigma ln(1 + t_{ijkt-1}) + \lambda_{ikt} \\ + \gamma_{jkt} + \theta_{ijk} + \mu_{ijt}]\epsilon_{ijkt}, \end{aligned} \tag{2}$$

where X_{ijkt} are bilateral trade flows in thousand USD from country i to country j at product level k and time t. NTB_{ijkt-1} identifies NTBs imposed by the importing country j against exporting country i and either consists of a dummy or count variable.[12] TDI_{ijkt-1} does the same for TDIs. Tariffs are included in logarithmic form ($ln(1 + t_{ijkt-1})$), so that σ provides a direct estimate of the trade elasticity of tariffs.[13] λ_{ikt}, γ_{jkt}, θ_{ijk} and μ_{ijt} are exporter-product-time, importer-product-time, exporter–importer-product and exporter–importer-time fixed effects respectively. ϵ_{ijkt} is the stochastic error term.

All trade policy variables are lagged by 1 year for two reasons: Firstly, NTBs and TDIs are often implemented in reaction to an unexpected or rapid increase in imports. As we use annual trade data, our analysis cannot control for the exact date of implementation of each policy. Therefore, without lagging, the estimates might be biased towards zero, leading to an underestimation of the potentially negative treatment effect. Secondly, as argued by Ghodsi et al. (2017), it is reasonable to assume that intermediate goods do not react immediately to changes in trade costs. Using lags ensures that we account for changes in trade, which do not follow immediately, but only after some time of adaptation. As this practice is not standard in the literature, contemporaneous trade policy variables are used in a robustness check, yielding similar results.

One major concern when estimating the gravity equation is to consistently account for multilateral resistance terms. We do so by including importer-product-time and exporter-product-time fixed effects (Feenstra 2015; Head and Mayer 2014;

[12] We use the year of implementation as the starting period and the year of removal as the end period. If the policy was still in place at the beginning of 2015, we set the end date to 2014, the last year covered in our dataset. Only measures that last for at least 1 year are included.

[13] Henn and McDonald (2014) estimate a gravity equation, which does not explicitly model tariffs.

Yotov et al. 2016). Exporter–importer-product fixed effects are included in order to absorb all time invariant bilateral trade costs at the product level such as distance, a shared border or specific industry linkages. Exporter–importer-time fixed effects control for unobserved variables such as FTAs and exchange rate movements. By controlling for all trade costs that vary across the same dimensions as NTBs, we can identify their causal effect on trade. Given this identification, the estimated coefficient of the protectionist dummy can be interpreted as the average change in bilateral yearly-imports at the product level caused by the implementation of at least one protectionist policy by the importer. If counts of protectionist policies are used, this interpretation changes to the average change in imports following the implementation of one additional protectionist policy.

Regarding the estimation method used it is important to address zero and missing trade flows correctly. The gravity model does not explain the occurrence of zero trade flows. It assumes that trade flows are positive. However, in the trade data one observes several missing and zero trade flows. A missing trade flow can occur either because two countries do not trade with each other or because trade is not correctly reported and thus missing. The problem of missing trade flows increases with the level of detail of the trade data. The more products are distinguished, the more likely it is that countries do not trade certain specific goods with each other.

If an OLS estimator is used, missing or zero trade flows are dropped from the estimation and are thus ignored. The Poisson pseudo maximum likelihood (PPML) estimator constitutes an alternative method which treats all missing trade flows as zeros and assumes that these are statistical zeros, i.e. that the zeros occur randomly (Head and Mayer 2014). As Santos Silva and Tenreyro (2006) show, applying the PPML estimator has the additional advantage that it accounts for heteroscedasticity in trade data.[14] PPML is hence our preferred estimation method. It is estimated in Stata using the command “ppmlhdfe” (Correia et al. 2018a; Correia et al. 2018b). OLS estimates are provided for comparison and are generated using the command “reghdfe” by Correia (2014, 2016).[15]

2.2 Identification of the trade effects of behind-the-border measures

The bilateral structure in the dataset is constructed.[16] Identifying which trading partners are likely to be affected from an NTB based on past trade flows might cause substantial endogeneity. In addition, many of the NTBs identified in the GTA database are typical BTB measures. This means that they are not targeted against specific

[14] Another solution to the problem of zero trade flows would be to estimate a Heckman selection model, which is a two-step model. It first estimates the likelihood that two economies trade with each other at a product line (extensive margin). Then it assesses the impact of trade policies in a second step conditional on the fact that two economies trade with each other. Alternatively, Tobit models could be estimated, which assume that trade flows are not randomly missing (Head and Mayer 2014). However, these models are biased if trade costs are heteroscedastic. A third alternative would be a two-part PPML model which specifically deals with non-random selection into positive exports (Egger et al. 2011).

[15] For the OLS estimation Eq. 2 is log-linearised, so that it takes an additive form.

[16] See Sect. 3 below.

trading partners, but affect all trading partners equally. As soon as one accounts for importer-product-time fixed effects in the gravity equation, all variation within the BTB policy variable is absorbed by the fixed effects.

We follow the two-step procedure suggested by Head and Mayer (2014), Egger and Nigai (2015) and Yotov et al. (2016) to correctly identify the effect of BTB measures on trade, extending Head and Mayer's model to the product level. In the first stage, import values are regressed on TDIs, tariffs, an FTA dummy, exporter–importer-product, exporter-product-time and importer-product-time fixed effects, but without a dummy identifying NTBs. In order to store importer-product-time fixed effects, we rely on the command "ppml_panel_sg" by Larch et al. (2017).[17] All NTBs are treated as BTB measures and are thus absorbed by the importer-product-time fixed effects. TDIs and tariffs, which vary across all four dimensions, remain in the estimation equation. The first stage is estimated using the PPML estimator and takes the following form:

$$X_{ijkt} = exp\left[\beta_1 TDI_{ijkt-1} + \sigma ln(1 + t_{ijkt-1}) + \beta_2 FTA_{ijt} + \lambda_{ikt} + \gamma_{jkt} + \theta_{ijk}\right]\epsilon_{ijkt}. \tag{3}$$

In the second stage the predicted importer-product-time fixed effects from the first stage are regressed on BTB measures to assess their impact on the importer's market access. We hence assess how importer-specific trade costs on average change, if at least one BTB measure is implemented. The second stage is a linear estimation. The importer-product-time fixed effect can be split into unobserved and observed country-product-time specific determinants ($\gamma_{jkt} = \alpha_{jkt} + \beta BTB_{jkt}$). In this study BTB measures are the observed determinants (BTB_{jkt}).

As noted by Yotov et al. (2016), directional fixed effects do not only absorb all multilateral resistances, but also all economic size terms, like production and expenditures. Importer-fixed effects for example also control for differences across countries in the expenditure of domestic consumers. Therefore, we have to eliminate as many confounding factors as possible to capture a pure trade cost effect. We do so by including importer-product, importer-time and product-time fixed effects. Importer-time fixed effects control for differences in economic size, which is an important determinant of importers' market access. The product-time fixed effects absorb changes in productivity which are product specific and vary over time. For example, this could be a new production technology that is adopted across all countries. Finally, importer-product fixed effects control for time invariant importer-product characteristics.

As Head and Mayer (2014) note, the importer-product-time fixed effects from the first stage are estimated with error (denoted as v_{jkt}). This error is included in the error term of the second stage estimation. As the importer-product-time fixed effects are estimated with varying precision, the error term of the second stage can

[17] This command does not permit the additional inclusion of importer–exporter-time fixed effects. However, as shown in Table 7 in the "Appendix", regression results from using this slightly more relaxed specification are very similar to those of the baseline regression presented in Table 1.

be heteroscedastic (Head and Mayer 2014). Therefore, we choose to estimate bootstrapped standard errors to get consistent estimates.[18] This gives the following second stage estimation equation:

$$ln\widehat{\gamma_{jkt}} = \beta BTB_{jkt} + \eta_{jt} + \kappa_{kt} + \zeta_{jk} + (\psi_{jkt} + \nu_{jkt}). \tag{4}$$

In the specific context of multilateral resistance, there may, however, be a drawback to using the two-step procedure. As noted by Fally (2015), if a gravity equation is estimated using PPML, the estimated importer(-product-time) fixed effects can be represented as a function of the power transform of the corresponding inward multilateral resistance and national expenditure. Thus, in combination, the importer-product-time inward multilateral resistances and the importer-product-time expenditure will explain 100% of the importer-product-time fixed effects in specification (4). Therefore, in order to be able to identify the impact of country-specific BTB NTBs, we proceed with three alternative reduced-form specifications.

First, the multilateral resistance terms have an exact theoretical correspondence to the sum of trade costs, which include NTBs (as illustrated in Eq. 1). The reduced form regression in Eq. (4) hence offers some insights on how BTB barriers contribute to multilateral resistance and hence trade. In particular, the coefficients of the different types of NTBs inform about their relative importance in affecting market access. Second, building on Specification (4), we regress total imports directly on BTB barriers. Third, bilateral imports are regressed on BTB barriers, keeping in mind that we are unable to control for inward multilateral resistance in this specification. Taken together, the results provide additional evidence for the negative effect of BTB barriers on trade.

3 Data

3.1 The GTA database

All data on NTBs and TDIs comes from the GTA database. It collects all national policies that are imposed unilaterally and likely to change the treatment of domestic commercial interest relative to foreign commercial interests. International commercial flows are defined as trade in goods and services, as well as labour migration and foreign direct investments. We only focus on policies that affect trade in goods. The GTA database collects protectionist policies that were implemented worldwide since 2009, covering NTBs imposed by 152 countries.[19] In July 2017, a comprehensive update of the database was released. It covers an outstanding range of NTBs, which makes a detailed and up-to-date assessment of implemented NTBs possible.

[18] This is in line with Agnosteva et al. (2019) who also use the OLS estimator with bootstrapped standard errors. Head and Ries (2008) use weighted-least squares to account for heteroscedasticity in the error term, while Eaton and Kortum (2002) use the OLS estimator without adjusting for heteroscedasticity.

[19] A full list of countries is provided in Tables 15 in the "Appendix".

In our estimation, we rely on measures that were implemented between January 2009 and December 2014.[20] Products are identified according to the CPC product classification scheme at three digit level (version 2.1) and the HS six-digit product level. Since information about affected products at HS six-digit level is incomplete, we estimate the trade impact at CPC three-digit product level (177 product categories) to avoid any sample selection bias caused by omitting observations with missing information.[21]

The dataset covers both measures that are likely to harm and likely to benefit trade in goods. As we are interested in the role of NTBs as protectionist instruments, only protectionist measures are included in the analysis. We further restrict our study to "inward" measures, focusing on trade barriers that are likely to restrict imports into the implementing country.[22] The database distinguishes 44 different protectionist measures that can affect trade in goods. These could either be standard trade policies such as tariff increases and TDIs or NTBs. For each policy intervention, the GTA database provides information on (a) which trading partners are likely to be affected, (b) which products are targeted and (c) the date of implementation. Typical examples of NTBs included in the database are state aid measures, changes in public procurement rules, trading quotas, licensing requirements or trade finance instruments.

The GTA database offers several advantages over alternative data sources.[23] First, in contrast to data collection efforts of the WTO, UNCTAD, ITC and the World Bank, GTA data does not rely on official government notifications. Instead the GTA researchers systematically monitor government's websites and other official sources to depict all policy changes that potentially affect trade. This renders under-reporting of the actual degree of protectionism less likely. On the other hand, over-reporting is also unlikely as only measures that are either "implemented or whose future implementation is enacted" (Evenett and Fritz 2018) are included in the dataset. To avoid downward bias resulting from the inclusion of measures that are not implemented in the end, this paper only considers measures for which the date of implementation is available. The set of policies covered is not predefined. Therefore, it can be expected that the GTA database covers a broader range of policies than other sources.

Second, the database clearly distinguishes between discriminatory and non discriminatory NTBs. The TRAINS database, which is one of the largest databases

[20] Note that we use lagged dummies of NTBs.

[21] If an official policy document states that a measure is targeted at the agricultural sector and no more detailed information on which types of products are affected could be gained, no affected products at the HS six-digit were identified. However, information about affected products at the CPC three-digit level is complete.

[22] The large majority of NTBs are inward measures. In a robustness check we control for outward measures, which are implemented by the exporting country.

[23] Data on NTBs is still relatively scarce. Most often, researchers rely on data from the TRAINS database, which is collectively published by the WTO, UNCTAD, ITC and the World Bank. It contains information about implemented NTBs at detailed HS six-digit product level, classified according to the UN MAST classification of NTBs. Another common source is the I-TIP database provided by the WTO in cooperation with UNCTAD. It also collects trade policies classified according to the UN MAST classification.

on non-tariff measures, does not make this distinction. In the TRAINS database this leads to multiple entries of SPS and TBT measures, which are not necessarily protectionist, but could also be trade enhancing. In contrast, each policy intervention that is included in the GTA database has to pass a six-step evaluation process. During this process it is evaluated whether the policy discriminates against foreign exporters to the benefit of domestic producers.[24] However, the GTA database does not include NTBs that primarily serve the “protection of human, animal or plant health or life” (Evenett and Fritz 2018) “unless there is [...] evidence that the rationale [...] is false”. This means that many SPS and TBT measures are not reported, explaining why these are not recorded as often as in other databases such as I-TIP. If different kinds of NTBs affect trade differently, the composition of NTBs in a database can have implications for the estimated average treatment effect. This constitutes an additional motivation to estimate trade effects of different types of NTBs separately.

Third, the definition of NTBs according to the GTA is not restricted to merely trade policies. The TRAINS database, as well as I-TIP restrict their collection of non-tariff measures to explicit trade policies. According to I-TIP, non-tariff measures are “defined as the measures subject to monitoring through notification under GATT-WTO agreements. Measures that are not subject to monitoring are not considered”.[25] As a consequence, these databases do not include state aid or bailout measures. However, especially this kind of hidden protectionism might play an increasingly important role for developed economies, as WTO regulations have reduced the scope to use standard trade policies to restrict trade. Lastly, the GTA database is superior to the Non-Tariff-Measure business surveys, which are published by the ITC. These surveys provide very detailed information on how specific non-tariff measures affect businesses. However, they are only conducted country-wide and are therefore not suitable for a cross-country comparison.

One major drawback of the GTA database, however, is that it only contains information on NTBs from 2009 onwards, so that no comparison with pre-crisis levels of protectionism is possible. In addition, its data collection method strongly relies on the transparency of governments publishing their policies online. For example, Saudi-Arabia was listed as the least protectionist country among the G20 economies in 2015. Only after its state development fund made information about all loans and financial grants given to domestic companies publicly available, it jumped to the seventh rank in 2016 (Evenett and Fritz 2016). Similarly, governments differ in how they announce policies. As noted by the GTA initiative, the US government tends to announce each policy separately, while European governments tend to announce policies in bundles.

Furthermore, it is important to keep in mind that the GTA database only provides indicators of whether a certain measure is implemented or not. Indicators of NTBs do not reflect the degree of protectionism. The introduction of a protective

[24] See Evenett and Fritz (2018) for details.

[25] http://i-tip.wto.org/goods/Default.aspx. For a comprehensive list of measures subject to notification, see: https://www.wto.org/english/docs_e/legal_e/33-dnotf_e.htm, last accessed: 25. September 2017.

NTB is treated equivalently to a less protective barrier. Nevertheless, only measures which are likely to impose a significant relative change on the treatment of domestic relative to foreign agents pass the six-step evaluation process and are included in the database.

We group the 31 intervention types listed in the GTA database into four groups of NTBs: (1) import controls, (2) state aid and subsidy measures, (3) public procurement and localisation requirements and (4) other NTBs, which include SPS measures, TBT and capital controls. We also use the GTA database to identify the existence of TDIs including anti-dumping, anti-subsidy, safeguard and anti-circumvention policies. One shortcoming is that TDIs are often implemented at a more disaggregated (HS6 or HS8 digit) level than the one observed in the data. If not all HS6 products within a CPC three digit product category are treated, this results in an underestimation of the treatment effect. The same can be true for NTBs. Hence, the estimated coefficients of NTBs and TDIs reflect both their average effectiveness at their respective implementation level (e.g. HS8) as well as the average degree of coverage of the instrument within a CPC three-digit product category. The results thus show how NTBs and TDIs on average affect trade flows at the CPC three-digit level, allowing for a comparison of their overall protectionist impact. The results do not, however, predict which of the two instruments would reduce imports of a targeted product by more.

A detailed overview of the types of NTBs included in this study is provided in Table 5 in the "Appendix". For each implemented trade barrier the database includes the date of implementation and the date of removal for any measure. About 20% of the measures implemented after 2009 have been removed before the end of 2015. For each NTB that is implemented by a country, information is available about which trading partner(s) will most likely be affected by the respective measures based on past trade flows.[26] This bilateralisation of unilateral policies may trigger a potential endogeneity bias. We address this concern by applying the two-step estimation, eliminating the bilateral structure of NTBs and treating all measures as if they affect all trading partners equally. NTBs can vary across EU member states so that each member state is included separately, even though trade policy is set at the supranational level.

3.2 Other data sources

Data on applied tariffs at HS six-digit product level originates from TRAINS and the WTO's Integrated Database. As it is incomplete we use interpolated tariffs as provided by Felbermayr et al. (2018) to cover all product lines. The MFN tariff is used as the applied tariff if there is neither a preferential trade agreement between two countries nor a tariff according to the Generalized System of Preferences. In all other cases, the preferential tariff is used as the applied tariff. Like imports, tariffs

[26] For trade in goods a country is identified as being affected, if in the year prior to the implementation of the policy, exports of the respective product to the implementing country exceeded one million US-Dollars.

are aggregated to the CPC three-digit product classification by calculating simple averages and trade weighted averages.[27] We use simple averages across all specifications and provide estimation results using weighted tariff averages as robustness checks. An indicator of whether an FTA is in place is retrieved from CEPII, which builds on FTAs notified to the WTO. Data on FTA depth is taken from the World Bank's "Content Of Deep Trade Agreements" database (Hofmann et al. 2017, 2018).

Data on bilateral imports is retrieved from BACI, which reports trade flows at the HS6 digit product level using the HS-92 classification. Trade flows are aggregated to the CPC three-digit product classification to fit the data on NTBs. Since all policy variables (NTBs, TDIs and tariffs) are lagged by 1 year, we use imports from 2010 to 2015 and merge those with trade policy data from 2009 to 2014.

3.3 Development of non-tariff barriers

Figure 1 plots newly implemented NTBs by year. The number of NTBs remains relatively stable over the sample period, averaging around 280 per year.[28] State aid and subsidy measures constitute the largest share of NTBs, followed by public procurement and localisation policies. Discriminatory SPS and TBT measures (included in "other NTBs") make up for only a very small group of NTBs.

The world map in Fig. 2 shows the number of newly implemented NTBs by country between 2009 and 2014. It is eye-catching that the United States implemented by far the most NTBs (662). Saudi-Arabia and India, as the second and third largest users, only implemented 130 and 128 NTBs respectively. Germany and Brazil follow with 76 and 71 implemented measures.[29] Each implemented NTB on average targets imports of 24 products and affects 40 countries. Products of electrical energy, domestic appliances and parts thereof as well as products of iron and steel are most often targeted.

The world map in Fig. 3 shows how often exporters from each country were likely to be affected by an NTB imposed by another country between 2009 and 2014. Canada, Germany and China are the three economies that were most often likely to be affected by an implemented NTB. Accumulated, Canadian exporters were affected

[27] Both aggregation methods have their disadvantages: The problem with trade-weighted averages is that extremely high tariffs with nearly no trade contribute to the weighted average in the same way as zero-tariffs with high volumes of trade. The problem of using the simple averages of tariffs is that tariffs of products with a small import share and a large import share have the same weight.

[28] In contrast to that, usage of TDIs declined over the period of analysis. While 204 TDIs were implemented in 2009, this number dropped to 140 in 2014. Among the different types of TDIs, anti-dumping is by far the most often applied instrument.

[29] Most of the implemented NTBs from the United States are concentrated in the group of public procurement and localisation policies. They account for about 50% of all implemented measures worldwide. Similar, the United States is responsible for close to 40% of all state aid and subsidies measures. To a certain degree this extreme outlier might be driven by the fact that the US government tends to announce each policy separately, while for example European governments tend to announce policies in bundles. We provide a robustness check, excluding the United States from the estimation sample. Results are not driven by this outlier (see Tables 3 and 8 in the "Appendix").

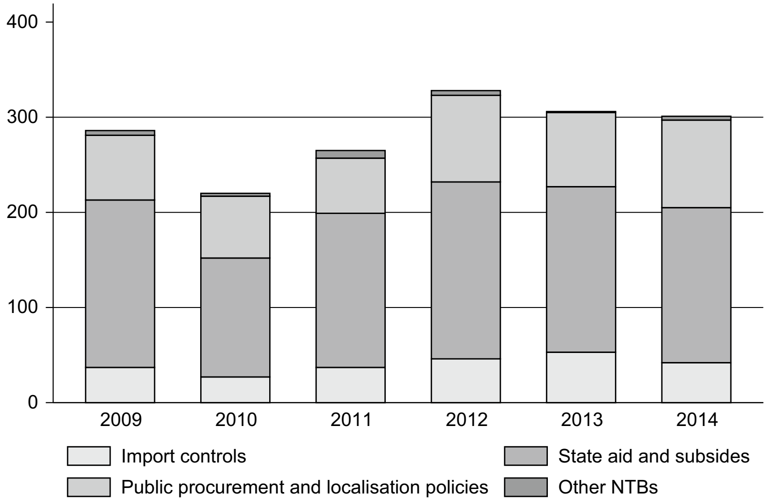

Fig. 1 Number of newly implemented NTBs, by type (2009–2014). *Source*: Global Trade Alert Database

by 1101, German exporters by 989 and Chinese exporters by 948 NTBs between 2009 and 2014.[30] In the majority of cases import flows are only distorted by one NTB. There are a few outliers, where certain country-product pairs are affected by more than 10 NTBs simultaneously. Overall, 2.6% of all importer–exporter-product-time combinations in the sample faced at least one NTB (Table 6 in the "Appendix"). TDIs, including anti-dumping, countervailing duties and safeguards, were implemented in 0.3% of all observations.

4 Estimation results

4.1 Gravity estimation results

Baseline estimation results are reported in Table 1. Columns (1) to (3) present results using the OLS estimator. According to the most general specification in Column (1), imports decrease on average by 11.8% following the implementation of at least one NTB.[31] This effect is significant at the 1% level. TDIs have a similarly large effect on bilateral trade flows. On average, imports of a particular product from a targeted country fall by 7.6% if at least one TDI is implemented against this product. The coefficients are significantly different from each other (5%), indicating that NTBs have on average a larger trade dampening effect than traditional TDIs. As discussed

[30] Table 15 in the "Appendix" provide a list with the number of times a country implemented NTBs and the number of times it has been affected by an NTB.

[31] Percentage change = $(e^{\beta_{NTB}} - 1) * 100$.

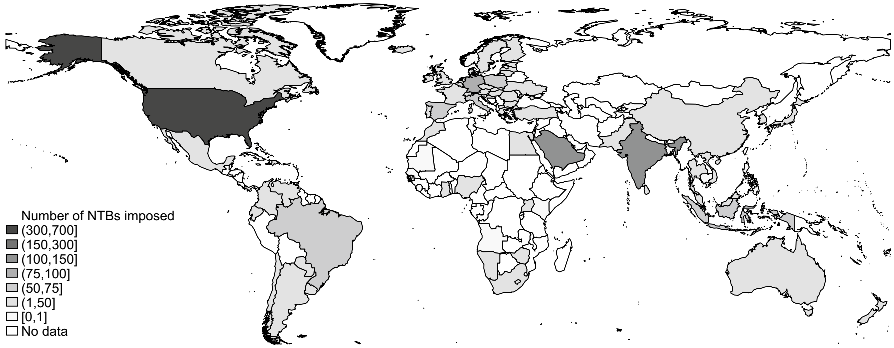

Fig. 2 Number of newly implemented NTBs by country (2009–2014). *Source*: Global Trade Alert Database

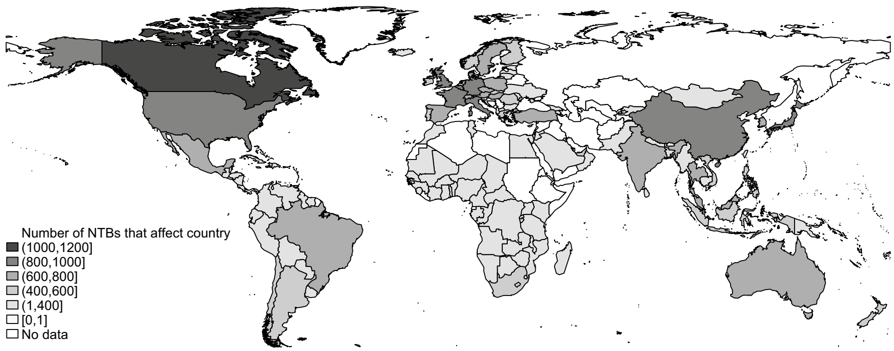

Fig. 3 Number of times a country is affected by implemented NTBs (2009–2014). *Source*: Global Trade Alert Database

in Sect. 3, this can be either due to differences in the effectiveness of the two measures or due to differences in coverage.

The estimated coefficient for tariffs is small and not statistically significant. This is not surprising since the extensive fixed effects strategy absorbs most variation in tariffs. Not controlling for exporter–importer-time fixed effects (Table 7 in the "Appendix") yields a significant coefficient for tariffs and also increases the magnitude of the TDI coefficients, while the coefficient for NTBs remains unchanged. In addition, the aggregation method (simple average) gives every tariff the same weight, disregarding the trade volume of the related product. Using a weighted average yields a larger estimated coefficient, while those of the other variables remain unchanged (see Sect. 4.2).

It is reasonable to assume that NTBs have a smaller impact on imports from countries that have an FTA with the importer. For example, common SPS of two countries that have an FTA would mean that such NTBs only affect countries outside the FTA. To investigate whether common FTA membership reduces the trade dampening effect of NTBs, the NTB dummy is interacted with a dummy identifying

Table 1 Gravity estimation results using OLS and PPML with dummies of NTBs

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	OLS	PPML	PPML	PPML
Dependent variable	ln imports	ln imports	ln imports	Imports	Imports	Imports
ln(1+tariff)	− 0.014	− 0.013	− 0.013	− 0.477***	− 0.477***	− 0.478***
	(0.076)	(0.076)	(0.076)	(0.179)	(0.179)	(0.180)
TDI	− 0.079***	− 0.078***	− 0.078***	− 0.040***	− 0.039***	− 0.039***
	(0.018)	(0.018)	(0.018)	(0.014)	(0.014)	(0.014)
NTB	− 0.125***	− 0.151***		− 0.036***	− 0.045***	
	(0.008)	(0.010)		(0.010)	(0.012)	
NTB × FTA		0.062***			0.019	
		(0.012)			(0.012)	
Import controls			− 0.112***			− 0.025*
			(0.013)			(0.014)
State aid and subsidies			− 0.059***			− 0.020
			(0.011)			(0.015)
Procurement/localisation			− 0.169***			− 0.084***
			(0.015)			(0.019)
Other NTBs			− 0.187***			− 0.069
			(0.030)			(0.049)
Observations	4,393,589	4,393,589	4,393,589	6,681,527	6,681,525	6,681,523
R^2	0.916	0.916	0.916			

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered at exporter–importer-product level. Variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies. Imports in thousand USD. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

common FTA membership of the importer and the exporter. The results are reported in Column (2) of Table 1. The NTB coefficient now identifies the effect of NTBs on imports from non FTA exporters while the coefficient of the interaction term identifies the difference in the trade effect of NTBs between non-FTA and FTA members. It is positive and statistically significant, indicating that imports from FTA members fall by less following the implementation of an NTB than imports from non-FTA countries.

Column (3) of Table 1 reports effects for the four disaggregated measures for NTBs. Estimated coefficients are negative and statistically significant for all types of NTBs. Other NTBs (SPS, TBT and capital controls) have the strongest negative impact on bilateral imports (− 0.187). On average, bilateral imports of a particular product decrease by 17.1%, following the implementation of at least one SPS, TBT or capital control. In contrast, state aid and subsidies (− 0.059) have the smallest negative impact on imports (– 5.7%). Direct import controls and public procurement and localisation policies reduce trade by 10.6% and 15.5% respectively.

Columns (4)–(6) of Table 1 show estimation results using the PPML estimator. While the effect of tariffs on imports increases compared to the OLS estimates and becomes statistically significant, the estimated coefficients of TDIs and NTBs reported in Column (4) decrease in magnitude compared to the OLS estimates in Column (1). According to the PPML estimation results, bilateral imports on average decrease by 3.5% if at least one NTB is implemented. For TDIs, the estimated coefficient decreases from – 0.079 in the OLS estimation to – 0.040 in the PPML estimation, predicting an average decrease in imports of 3.9% if at least one TDI is implemented. Both coefficients remain significant at the 1% level and are not significantly different from each other.

The larger NTB coefficient in Column (5) relative to Column (4) once again indicates that the effect of NTBs is stronger for imports from countries not sharing an FTA. However, the (positive) coefficient of the interaction term ceases to be statistically significant. Looking at the disaggregate measures of NTBs (Column 6), it is evident that only public procurement and localisation policies as well as import controls significantly affect imports, with reported coefficients of – 0.084 and – 0.025, respectively. There is no evidence that state aid, subsidies and other NTBs affect trade flows.

In light of the literature on the determinants of the global trade slowdown (Constantinescu et al. 2018), the coefficients can be used in a back-of-the-envelope calculation to provide a rough estimate of how much NTBs have reduced overall trade. Given that 32.8% of export value in our sample was affected by at least one NTB in 2015, using the baseline coefficients of – 0.125 (equivalent to a reduction of 11.8%, OLS) and – 0.036 (3.5% reduction, PPML) yields a trade reduction of 1.1–3.9% that can be attributed to NTBs.

Estimation results using counts instead of dummies are provided in Table 2. Qualitatively, the results are similar to those provided in Table 1. Column (1) of Table 2 shows that TDIs as well as NTBs both reduce imports. However, the coefficient for TDIs is now significantly larger than that for NTBs, indicating that each individual TDI reduces trade four times more than an NTB. This is also true in the PPML estimation (Column (4) of Table 2). However, as shown in Table 6 in the "Appendix", NTBs (113,725 cases) were applied about nine times as often as TDIs (12,432), explaining the difference in the aggregate effect. The coefficient of the interaction term (Columns 3 and 5) remains positive but is not statistically significant.

The results change when looking at the individual groups of NTBs (Column (3) of Table 2). The estimated coefficients for import controls, state aid and subsidies and other NTBs are significantly larger than the one for TDIs. The small aggregate effect is driven primarily by the small and insignificant coefficient of public procurement. The PPML estimates of the individual NTBs (Column 6) all become smaller in magnitude and lose significance relative to the OLS estimates.

4.2 Robustness of the baseline results

To test whether results depend on the aggregation method for tariffs from the HS six-digit to the CPC three-digit product level, a robustness check carries out the baseline regressions with tariff rates weighted by trade value. The results for the OLS estimation are reported in Columns (1) and (2) of Table 3.[32] Estimated coefficients for NTBs and TDIs do not change if trade-weighted averages of tariffs instead of simple averages are used. However, as expected, the estimated trade elasticity increases substantially if weighted averages of tariffs are used.

Second, NTBs imposed by the exporting country might affect both its exports as well as the importing country's decision to impose NTBs. To avoid any omitted variable bias that may result from this relationship, we use an additional dummy to control for the existence of NTBs imposed by the exporter, targeting exports to the importing country. The results are provided in Columns (3) and (4) of Table 3.[33] NTBs imposed by the exporter significantly reduce imports into the importing country. However, they do not seem to simultaneously affect any other estimates. The estimated coefficients of NTBs implemented by the importing country remain robust to including this additional control variable.

Third, the United States are responsible for more than half of global public procurement and localisation policies. To ensure that our results are not driven by the US, we thus run our baseline estimation excluding the United States. Regression results are reported in Columns (5) and (6) of Table 3. All coefficients remain robust, indicating that the US is not driving the results.[34]

One explanation for the smaller coefficients when using PPML might be the fact that one adds a substantial amount of zero trade flows to the reference group (Anderson and Yotov 2016). We hence perform an additional robustness check, excluding all missing trade flows from the sample (rather than treating them as zeros). The results are reported in Columns (7) and (8) of Table 8 in the "Appendix". The estimated coefficients are very similar in magnitude and significance to the Baseline results reported in Columns (4) and (6) of Table 1, indicating that differences in coefficients are not driven by adding zero trade flows.

It was shown in the baseline regression that NTBs have a smaller effect on exporters that are engaged in an FTA with the importer. Going further, it is possible that deep FTAs which include a lot of provisions have a stronger impact on the effectiveness of NTBs than shallow FTAs, which only have very few provisions. This hypotheses is tested using the "Content Of Deep Trade Agreements" database provided by the World Bank (Hofmann et al. 2017, 2018). The database provides different indices to construct a measure of depth of trade agreements. One is a simple count measure, which counts the number of provisions in an FTA, ranging from 1 to 52. This paper defines all agreements with 26 or fewer provisions as shallow

[32] Results for the PPML estimation are reported in Columns (1) and (2) of Table 8.

[33] PPML results in Columns (3) and (4) of Table 8 in the "Appendix".

[34] Using the PPML estimator, the estimated coefficient of TDIs remains similar in magnitude but turns insignificant. Coefficients for NTBs remain robust (Columns (5) and (6) of Table 8 in the "Appendix").

Table 2 Gravity estimation results using OLS and PPML with counts of NTBs

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	OLS	PPML	PPML	PPML
Dependent variable	ln imports	ln imports	ln imports	Imports	Imports	Imports
ln(1+tariff)	− 0.015	− 0.015	− 0.014	− 0.478***	− 0.479***	− 0.477***
	(0.077)	(0.077)	(0.077)	(0.180)	(0.180)	(0.180)
TDI	− 0.023**	− 0.023**	− 0.020**	− 0.008**	− 0.008**	− 0.008**
	(0.010)	(0.010)	(0.010)	(0.004)	(0.004)	(0.004)
NTB	− 0.005***	− 0.006***		− 0.002*	− 0.002*	
	(0.001)	(0.001)		(0.001)	(0.001)	
NTB × FTA		0.001			0.000	
		(0.002)			(0.001)	
Import controls			− 0.083***			− 0.025**
			(0.009)			(0.010)
State aid and subsidies			− 0.045***			− 0.020*
			(0.008)			(0.012)
Procurement/localisation			− 0.002			− 0.000
			(0.001)			(0.001)
Other NTBs			− 0.180***			− 0.068
			(0.030)			(0.048)
Observations	4,393,589	4,393,589	4,393,589	6,681,521	6,681,521	6,681,536
R^2	0.916	0.916	0.916			

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered at exporter–importer-product level. Variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as counts. Imports in thousand USD

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

and the remaining ones as deep. The NTB dummy is now interacted with the two constructed dummies.

The OLS regression results are reported in Column (1) of Table 9 in the "Appendix". The coefficients of the interaction terms are both positive and significant, indicating that FTAs reduce the trade dampening effect of NTBs. In addition, the coefficient of deep FTAs is significantly larger than the one for shallow FTAs. This implies that NTBs have a smaller impact on countries with whom the importer has deep FTAs. Results of the PPML regression (Column 2) are qualitatively similar, even though the shallow FTA coefficient ceases to be significantly different from zero.

In addition, the basic FTA dummy is interacted with each of the disaggregated NTB measures. The results are reported in Columns (3)–(6) of Table 9 in the "Appendix". All coefficients of NTBs remain robust and "Other NTBs" even turns significant in the PPML regressions. The interaction terms are all positive and are thus in line with the baseline result that trade effects of NTBs are smaller if the importer and the exporter are members of an FTA. The only outlier is the

Table 3 Robustness checks: Baseline using OLS

Specification	(1) Weighted Tariffs	(2) Weighted Tariffs	(3) Exporter NTBs	(4) Exporter NTBs	(5) w/o US	(6) w/o US
ln(1+tariff)	– 0.910	– 0.857	– 0.015	– 0.014	– 0.023	– 0.022
	(4.812)	(4.811)	(0.076)	(0.076)	(0.077)	(0.077)
TDI	– 0.079***	– 0.078***	– 0.078***	– 0.076***	– 0.079***	– 0.077***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
NTB	– 0.125***		– 0.125***		– 0.125***	
	(0.008)		(0.008)		(0.008)	
Import controls		– 0.112***		– 0.111***		– 0.114***
		(0.013)		(0.013)		(0.014)
State aid and subsidies		– 0.059***		– 0.059***		– 0.051***
		(0.011)		(0.011)		(0.012)
Procurement/localisation		– 0.169***		– 0.168***		– 0.184***
		(0.015)		(0.015)		(0.018)
Other NTBs		– 0.187***		– 0.186***		– 0.187***
		(0.030)		(0.030)		(0.030)
Exporter NTB			– 0.168***	– 0.167***		
			(0.024)	(0.024)		
Observations	4,393,589	4,393,589	4,393,589	4,393,589	4,312,008	4,312,008
R^2	0.916	0.916	0.916	0.916	0.915	0.915

OLS regression with ln(imports in thousand USD) as dependent variable. All estimations include importer-product-time, exporter-product-time exporter–importer-time and exporter–importer-product fixed effects. Standard errors are clustered at exporter–importer-product level. All variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

negative coefficient of the interaction between state aid and subsidies and FTAs reported in Column (4).

Our preferred specification uses lagged policy variables. As a robustness check, we perform the baseline regression using contemporaneous values for tariffs, NTBs and TDIs rather than lags. The results, reported in Table 10 in the "Appendix", remain similar to the baseline in both magnitude and significance. However, estimates for TDIs increase in magnitude while those for NTBs become smaller. This indicates that NTBs take longer than TDIs to unveil their full effect on trade.

In order to see effects over time, we regress trade on contemporaneous and lagged policy measures simultaneously. The results, reported in Table 11 in the "Appendix", reveal an interesting difference between TDIs and NTBs. Columns (1) and (3) show that the contemporaneous coefficient of TDIs is larger in magnitude than lagged TDIs (which are even insignificant in the PPML specification), providing further evidence that the main impact of TDIs on trade is realised in the year of implementation. In contrast, the coefficient for lagged NTBs is larger in magnitude than that of contemporaneous NTBs, indicating that their trade effects increases over time. The same is true for individual NTBs (Columns (2) and (4) of Table 11).

Following Egger and Tarlea (2015), we re-run our baseline regression, clustering standard errors by exporter, importer, product and year, rather than by exporter–importer-product. The results are presented in Table 12 in the "Appendix". Standard errors of NTBs increase but overall results remain robust. In particular, the estimated coefficients for NTBs remain strongly significant in all specifications. Their standard errors remain almost unchanged in the PPML specifications, while they even fall for the interaction between NTBs and FTA (Column 5), so that the coefficient becomes significant at the 5% level. Estimated coefficients for TDIs as well as import controls, however, turn insignificant in the PPML specifications.

Last but not least, we conduct a placebo test, regressing bilateral imports on future changes in NTBs, using 2-year leads (Baier and Bergstrand 2007).[35] The placebo test yields insignificant coefficients for tariffs and TDIs (Columns (1) and (2) of Table 13 in the "Appendix"). However, estimated coefficients for NTBs are positive and significant. This is reasonable, as it underlines the argument that NTBs are implemented in response to increasing imports. Consequently, the estimated baseline coefficients are likely to be biased towards zero, hence constituting a lower bound of the true treatment effect. PPML results (reported in Columns (3) and (4) of Table 13 in the "Appendix") are insignificant for the aggregate NTB measures. This can be taken as evidence that the PPML estimation suffers less from endogeneity between NTBs and imports and should therefore be the preferred specification. Finally we also conduct the placebo test using multi-way clustering of standard errors. Overall, this reduces the significance of coefficients further (Columns (5)–(8) of Table 13 in the "Appendix").

4.3 Unilateral estimation results

The constructed bilateral structure might bias estimation results for those NTBs that classify as BTB measures and affect all exporters equally. Keeping in mind the caveats discussed in Sect. 2, we address this issue by applying a two-step estimation procedure. In the first step, we estimate a standard gravity equation which omits any NTBs. In the second step, we regress the predicted importer-product-time fixed effects from the first stage on importer-product specific NTBs to assess their contribution to importer-specific trade costs.

Results for the first stage are shown in Column (1) of Table 4. The coefficients for tariffs and TDIs remain similar to the baseline results in magnitude and significance.[36] In the second stage, importer-product-time fixed effects are regressed on a

[35] Since the GTA database only provides information on NTBs until 2014, the years 2013–2015 are dropped from the sample.

[36] Importer-product-time fixed effects are predicted using the gen(M) option of the ppml_panel_sg command from stata. The gen(M) option produces exponentiated importer-product-time fixed effects (Larch et al. 2017). Therefore, we use the logarithm of the predicted fixed effects in the second stage as the dependent variable. Taking the logarithm excludes all fixed effects that are zero. This is not problematic since fixed effects of the value zero do only occur, if an importer did not import any goods of a respective product at time t. After taking the logarithm, the predicted fixed effects vary between – 22.9 and 15.53. The average predicted fixed effect is – 0.97. 147,667 non-zero fixed effects are predicted.

Table 4 2 Stage estimation results

	1st stage	2nd stage			
	(1)	(2)	(3)	(4)	(5)
ln(1+tariff)	− 0.4147**				
	(0.1788)				
TDI	− 0.0549***				
	(0.0178)				
FTA	0.0616***				
	(0.0173)				
Behind-the-border measures		− 0.0232**	− 0.0232**		
		(0.0112)	(0.0101)		
BTB: Import controls				− 0.0299*	− 0.0299**
				(0.0159)	(0.0137)
BTB: State aid and subsidies				0.0063	0.0063
				(0.0140)	(0.0134)
BTB: Procurement/localisation				− 0.0184	− 0.0184
				(0.0234)	(0.0191)
BTB: Other NTBs				0.0357	0.0357
				(0.0627)	(0.0654)
R^2	0.9899	0.9495	0.9495	0.9495	0.9495
Standard errors	Cluster: ijk	Cluster: jk	Bootstrapped	Cluster: jk	Boot-strapped

Dependent variable: Import value in thousand USD (1st Stage) and importer-product-time fixed effects (2nd stage). The 1st stage PPML estimation includes importer-product-time, exporter-product-time and exporter–importer-product fixed effects. Standard errors are clustered at exporter–importer-product level. The 2nd stage OLS estimations include importer-time, product-time and importer-product fixed effects. Standard errors are either clustered at country-product level or bootstrapped. All explanatory variables except for the FTA dummy are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

dummy indicating the existence of at least one NTB, controlling for importer-product, importer-time and product-time fixed effects. We assume that any implemented NTB affects all exporters equally and therefore we refer to it as BTB barrier.[37] The estimated coefficient can be interpreted as the average change in importer market access caused by at least one implemented NTB. Due to the potential heterogeneity contained in the error term from the predicted fixed effects from the first stage we report standard errors once clustered at the importer-product level and once bootstrapped.[38]

[37] By making this assumption the constructed bilateral structure of the GTA dataset becomes irrelevant. The sample size naturally is much smaller than in the first stage, as the exporter-dimension is dropped. In total 147,667 observations are included.

[38] If the bootstrapping method is used, the estimation is repeated 100 times for different draws from the estimation sample. Each time a sample of the same size of the estimation sample is drawn. Observations

Results of the second stage regression are reported in Columns (2)–(5) of Table 4. Importer-product market access on average decreases by 2.3% following the implementation of at least one BTB measure (Columns 2 and 3). This effect is significant at the 5% level regardless of whether standard errors are clustered at importer-product level or bootstrapped. Looking at the disaggregated measures of NTBs (Columns 4 and 5) it becomes clear that the aggregate effect is driven by import controls. While these findings confirm the baseline result that NTBs in general and import controls in particular negatively affect trade, they do not offer evidence that all types of NTBs are effective in reducing imports.

Following the discussion in Sect. 2, we use the two-step structure to conduct additional robustness checks. First, rather than running the regression in two steps, Eq. (4) can be plugged in directly into Eq. (3). κ_{kt} and ζ_{jk} drop out because they are already nested in λ_{ikt}, and θ_{ijk}. Only η_{jt} remains. Recall that the variable BTB_{jkt} does not vary at the exporter dimension any longer, as NTBs are assumed to affect all exporters equally. TDIs and tariffs enter as before. The results are reported in Columns (1) and (2) of Table 14 in the "Appendix". The estimated coefficient for BTB NTBs is smaller than in the baseline, but has a similar magnitude to that of the 2nd stage results. The difference with respect to the baseline is not surprising. If not all countries are affected by NTBs, treating all exporters as treated leads to an underestimation of the treatment effect.

In a further step, importer-time fixed effects are replaced by importer-exporter-time fixed effects. Columns (3) and (4) of Table 14 show that estimated coefficients remain robust to this more restrictive specification. Finally, rather than investigating how BTB NTBs affect the importer's market access, it is possible to check directly how BTB NTBs affect aggregate imports of affected products across all exporters. To do so, the exporter dimension is dropped and imports at the importer-product-time dimension are regressed on average tariffs and a BTB NTB dummy.[39] Regression results are presented in Columns (5) and (6) of Table 14. The estimated coefficient of BTB NTBs is negative and significant in the PPML specification, providing further evidence that BTB measures negatively impact trade.

5 Conclusion

Our empirical analysis provides evidence that NTBs significantly decrease the level of trade. For the period from 2010 to 2015, our baseline results show that NTBs implemented by a country reduce imports of affected products from targeted exporters by 4–12%, depending on the estimation method used. This effect is partly offset by FTAs between the imposing country and the exporter. While an individual NTB

Footnote 38 (continued)

can be included more than once in the drawn sample. Bootstrapping ensures that standard errors are estimated consistently.

[39] The estimation equation is thus similar to Eq. (4), but with imports rather than estimated fixed effects as dependent variable and average tariffs as additional control. TDIs are dropped as they cannot be aggregated across exporters.

does not reduce trade as much as a traditional TDI, taking into account the number of implemented NTBs, their effect on trade is comparable to that of traditional TDIs such as anti-dumping, countervailing duties or safeguards.

When looking at individual NTBs, it is demonstrated that import controls significantly reduce imports across all specifications. Specifically, the implementation of one additional import control reduces trade by 2–8%, so that imports fall on average by 2–11% if at least one import control is implemented. Public procurement and localisation policies have an even larger average effect (8–16%), although evidence is less robust when it comes to marginal effects of one additional such policy. State aid and subsidies as well as other NTBs (SPS, TBT and capital controls) also reduce imports by up to 6 and 17% respectively, even though their effect is less robust to changes in the estimation method.

Methodologically, this study applies a two-step estimation procedure to identify trade effects caused by BTB measures. The two-step estimation confirms that non-standard trade policies are important determinants of the trade costs faced by the importer. Implementing at least one BTB measure that discriminates all exporters equally on average reduces market access of the importer by 2%.

Overall, the paper illustrates the importance of exploiting new data on NTBs to reveal the significant protectionist impact of non-standard trade policies, which can however be mitigated through FTAs. The results imply that the WTO should follow recent developments in bilateral trade agreements. More precisely, it should shift its focus towards multilateral agreements that aim at limiting the use of NTBs to avoid the increase in hidden protectionism that might otherwise result in lower levels of trade.

Appendix

See Tables 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15.

Table 5 Overview of types of non-tariff barriers and trade defence instruments

Non-tariff barriers	
(1) *Import controls*	(3) *Public procurement and localisation policy*
Import ban	Public procurement access
Import incentive	Public procurement localisation
Import licensing requirement	Public procurement preference margin
Import monitoring	Local operations
Import quota	Local sourcing
Import tariff quota	Localisation incentive
Import-related non-tariff measure, nes	
Internal taxation of imports	(4) *Other non-tariff barriers*
Trade balancing measure	Competitive depreciation
Trade payment measure	Price stabilisation
	Instrument unclear
(2) *State aid and subsidies*	Sanitary and phytosanitary measure
Bailout (capital injection or equity participation)	Technical barrier to trade
Financial assistance in foreign market	
Financial grant	
In-kind grant	
Interest payment subsidy	*Types of trade defence instruments*
Loan guarantee	*Trade defence instruments*
Production subsidy	Anti-circumvention
State aid, nes	Anti-dumping
State loan	Anti-subsidy
Tax or social insurance relief	Safeguard

Table 6 Summary statistics

Variable	Mean	SD	Min.	Max.	N
Imports in thousand USD	19725.189	317480.117	1	97142264	4,405,016
Tariff (simple average, in percent)	6.28	20.066	0	2314.286	4,405,016
		Count	Percent		
Trade defence instruments	0	4,392,584	99.7		
	1	12,432	0.3		
Non-tariff barriers	0	4,291,291	97.4		
	1	113,725	2.6		
Import controls	0	4,368,891	99.2		
	1	36,125	0.8		
State aid and subsidies	0	4,365,324	99.1		
	1	39,692	0.9		
Puplic procurement and localisation policies	0	4,367,799	99.2		
	1	37,217	0.8		
Other NTBs (SPS, TBT, capital controls)	0	4,390,576	99.7		
	1	14,440	0.3		

Table 7 Excluding exporter–importer-time fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	OLS	PPML	PPML	PPML
Dependent variable	ln imports	ln imports	ln imports	Imports	Imports	Imports
ln(1+tariff)	− 0.176***	− 0.174***	− 0.175***	− 0.414**	− 0.413**	− 0.414**
	(0.061)	(0.061)	(0.061)	(0.179)	(0.179)	(0.179)
TDI	− 0.114***	− 0.112***	− 0.111***	− 0.053***	− 0.052***	− 0.053***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
NTB	− 0.127***	− 0.157***		− 0.067***	− 0.078**	
	(0.008)	(0.010)		(0.026)	(0.031)	
FTA	0.015**	0.014**	0.015**	0.062***	0.056***	0.062***
	(0.007)	(0.007)	(0.007)	(0.017)	(0.018)	(0.017)
NTB × FTA		0.072***			0.024	
		(0.011)			(0.018)	
Import controls			− 0.117***			− 0.042**
			(0.013)			(0.021)
State aid and subsidies			− 0.056***			− 0.066
			(0.011)			(0.043)
Procurement/localisation			− 0.183***			− 0.075***
			(0.014)			(0.019)
Other NTBs			− 0.108***			− 0.026
			(0.025)			(0.045)
Observations	4,405,016	4,405,016	4,405,016	6,798,176	6,798,175	6,798,171
R^2	0.913	0.913	0.913			

All estimations include exporter–importer-product, importer-product-time and exporter-product-time fixed effects. Standard errors are clustered at exporter–importer-product level. Variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies. Imports in thousand USD

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 8 Robustness checks: Baseline using PPML

Specification	(1) Weighted Tariff	(2) Weighted Tariff	(3) Exporter NTBs	(4) Exporter NTBs	(5) w/o US	(6) w/o US	(7) w/o missing Trade	(8) w/o missing Trade
ln(tariff+1)	− 26.358**	− 26.402**	− 0.477***	− 0.477***	− 0.514***	− 0.515***	− 0.483***	− 0.483***
	(11.394)	(11.396)	(0.179)	(0.180)	(0.183)	(0.183)	(0.180)	(0.180)
TDI	− 0.040***	− 0.039***	− 0.039***	− 0.039***	− 0.027	− 0.027	− 0.041***	− 0.041***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.018)	(0.018)	(0.014)	(0.014)
NTB	− 0.036***		− 0.036***		− 0.030***		− 0.028***	
	(0.010)		(0.010)		(0.010)		(0.010)	
Import controls		− 0.025*		− 0.025*		− 0.028**		− 0.019
		(0.014)		(0.014)		(0.014)		(0.014)
State aid and subsidies		− 0.020		− 0.020		− 0.019		− 0.012
		(0.015)		(0.015)		(0.014)		(0.014)
Procurement/localisation		− 0.084***		− 0.084***		− 0.080***		− 0.084***
		(0.019)		(0.019)		(0.022)		(0.019)
Other NTBs		− 0.069		− 0.069		− 0.068		− 0.053
		(0.049)		(0.049)		(0.049)		(0.049)
Exporter NTB			− 0.028*	− 0.028*				
			(0.017)	(0.017)				
Observations	6,681,528	6,681,522	6,681,522	6,681,525	6,574,800	6,574,800	4,393,589	4,393,589

PPML regression with imports in thousand USD as dependent variable. All estimations include importer-product-time, exporter-product-time, exporter–importer-time and exporter–importer-product fixed effects. Standard errors are clustered at exporter–importer-product level. All variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 9 Non-tariff barriers and free trade agreements

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	PPML	OLS	PPML	OLS	PPML
Specification	Dummies	Dummies	Dummies	Dummies	Count	Count
Dependent variable	ln imports	Imports	ln imports	Imports	ln imports	Imports
ln(1+tariff)	− 0.013	− 0.475***	− 0.013	− 0.484***	− 0.013	− 0.478***
	(0.076)	(0.179)	(0.076)	(0.179)	(0.077)	(0.180)
Trade defense	− 0.078***	− 0.039***	− 0.077***	− 0.036***	− 0.020**	− 0.007**
	(0.018)	(0.014)	(0.018)	(0.014)	(0.010)	(0.004)
NTB	− 0.152***	− 0.048***				
	(0.010)	(0.012)				
NTB × deep FTA	0.089***	0.037**				
	(0.015)	(0.016)				
NTB × shallow FTA	0.037**	0.008				
	(0.017)	(0.016)				
Import controls			− 0.130***	− 0.034**	− 0.103***	− 0.037***
			(0.015)	(0.016)	(0.011)	(0.011)
State aid and subsidies			− 0.077***	− 0.004	− 0.056***	− 0.022*
			(0.015)	(0.017)	(0.010)	(0.012)
Procurement/localisation			− 0.169***	− 0.100***	− 0.002	− 0.000
			(0.017)	(0.020)	(0.001)	(0.001)
Other NTBs			− 0.195***	− 0.214***	− 0.187***	− 0.211***
			(0.036)	(0.059)	(0.036)	(0.059)
Import controls × FTA			0.058***	0.030*	0.053***	0.031**
			(0.022)	(0.017)	(0.014)	(0.013)
State aid and subsidies × FTA			0.035**	− 0.028*	0.022*	0.004
			(0.016)	(0.015)	(0.011)	(0.008)
Procurement/localisation × FTA			0.001	0.057**	0.001	0.000
			(0.024)	(0.025)	(0.001)	(0.001)
Other NTBs × FTA			0.023	0.263***	0.021	0.259***
			(0.054)	(0.071)	(0.054)	(0.069)
Observations	4,393,589	6,681,526	4,393,589	6,681,535	4,393,589	6,681,525
R^2	0.916		0.916		0.916	

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered at exporter–importer-product level. Variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies or counts. Imports in thousand USD

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 10 Contemporaneous NTBs

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	OLS	PPML	PPML	PPML
Dependent variable	ln imports	ln imports	ln imports	Imports	Imports	Imports
ln(1+tariff)	− 0.039	− 0.039	− 0.038	− 0.248	− 0.249	− 0.247
	(0.090)	(0.090)	(0.090)	(0.205)	(0.205)	(0.205)
TDI	− 0.112***	− 0.111***	− 0.111***	− 0.047***	− 0.046***	− 0.046***
	(0.021)	(0.021)	(0.021)	(0.016)	(0.016)	(0.016)
NTB	− 0.079***	− 0.098***		− 0.030***	− 0.039***	
	(0.009)	(0.011)		(0.011)	(0.012)	
NTB × FTA		0.045***			0.020	
		(0.014)			(0.013)	
Import controls			− 0.069***			− 0.027*
			(0.014)			(0.014)
State aid and subsidies			− 0.043***			− 0.023
			(0.012)			(0.015)
Procurement/localisation			− 0.132***			− 0.059***
			(0.016)			(0.020)
Other NTBs			0.038			0.057
			(0.056)			(0.066)
Observations	3,609,969	3,609,969	3,609,969	5,350,624	5,350,623	5,350,608
R^2	0.923	0.923	0.923			

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered at exporter–importer-product level. Except for tariffs all explanatory variables enter the regression as dummies. Sample period: 2010–2014 Imports in thousand USD

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 11 Contemporaneous and lagged NTBs

	(1)	(2)	(3)	(4)
Estimation method	OLS	OLS	PPML	PPML
Dependent variable	ln imports	ln imports	Imports	Imports
ln(1+tariff)	− 0.068	− 0.066	− 0.118	− 0.119
	(0.088)	(0.088)	(0.216)	(0.217)
TDI	− 0.089***	− 0.089***	− 0.038**	− 0.037**
	(0.021)	(0.021)	(0.015)	(0.015)
NTB	− 0.027***		− 0.018*	
	(0.009)		(0.011)	
ln(1+tariff) -1	0.109	0.109	− 0.387**	− 0.387**
	(0.077)	(0.077)	(0.194)	(0.194)
TDI -1	− 0.038**	− 0.037*	− 0.020	− 0.020
	(0.019)	(0.019)	(0.012)	(0.012)
NTB -1	− 0.121***		− 0.040***	
	(0.009)		(0.011)	
Import controls		− 0.020		− 0.019
		(0.015)		(0.015)
State aid and subsidies		− 0.017		− 0.018
		(0.012)		(0.015)
Other NTBs		0.102*		0.122**
		(0.056)		(0.058)
Procurement/localisation		− 0.062***		− 0.028
		(0.017)		(0.021)
Import controls -1		− 0.121***		− 0.040**
		(0.016)		(0.018)
State aid and subsidies -1		− 0.054***		− 0.012
		(0.013)		(0.016)
Other NTBs -1		− 0.184***		− 0.123***
		(0.031)		(0.040)
Procurement/localisation -1		− 0.138***		− 0.070***
		(0.017)		(0.019)
Observations	3,609,969	3,609,969	5,350,624	5,350,630
R^2	0.923	0.923		

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered at exporter–importer-product level. Except for tariffs all explanatory variables enter the regression as dummies. Imports in thousand USD

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 12 Multi-way clustering

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	OLS	PPML	PPML	PPML
Dependent variable	ln imports	ln imports	ln imports	Imports	Imports	Imports
ln(1+tariff)	− 0.014	− 0.013	− 0.013	− 0.477*	− 0.477*	− 0.478*
	(0.126)	(0.126)	(0.126)	(0.260)	(0.261)	(0.260)
TDI	− 0.079**	− 0.078**	− 0.078**	− 0.040	− 0.039	− 0.039
	(0.029)	(0.029)	(0.029)	(0.025)	(0.025)	(0.026)
NTB	− 0.125***	− 0.151***		− 0.036***	− 0.045***	
	(0.025)	(0.027)		(0.013)	(0.015)	
NTB × FTA		0.062**			0.019**	
		(0.017)			(0.008)	
Import controls			− 0.112**			− 0.025
			(0.033)			(0.022)
State aid and subsidies			− 0.059			− 0.020
			(0.032)			(0.013)
Procurement/localisation			− 0.169***			− 0.084***
			(0.035)			(0.025)
Other NTBs			− 0.187***			− 0.069
			(0.018)			(0.079)
Observations	4,393,589	4,393,589	4,393,589	6,681,527	6,681,525	6,681,523
R^2	0.916	0.916	0.916			

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered by exporter, importer, product and year. Variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies. Imports in thousand USD

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 13 Placebo: 2 year leads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method	OLS	OLS	PPML	PPML	OLS	OLS	PPML	PPML
Dependent variable	ln imports	ln imports	Imports	Imports	ln imports	ln imports	Imports	Imports
ln(1+tariff)	− 0.075	− 0.074	0.154	0.156	− 0.075	− 0.074	0.154	0.156
	(0.121)	(0.121)	(0.205)	(0.205)	(0.125)	(0.125)	(0.270)	(0.268)
TDI	0.028	0.029	0.012	0.013	0.028	0.029	0.012	0.013
	(0.033)	(0.033)	(0.018)	(0.018)	(0.045)	(0.044)	(0.027)	(0.029)
NTB	0.153***		0.021		0.153		0.021*	
	(0.014)		(0.014)		(0.062)		(0.012)	
Import controls		0.115***		0.000		0.115		0.000
		(0.019)		(0.017)		(0.073)		(0.023)
State aid and subsidies		0.089***		0.041***		0.089		0.041
		(0.018)		(0.015)		(0.045)		(0.030)
Procurement/localisation		0.149***		0.028		0.149*		0.028
		(0.035)		(0.043)		(0.050)		(0.037)
Other NTBs		0.326***		0.343**		0.326**		0.343**
		(0.083)		(0.146)		(0.073)		(0.171)
Observations	2,049,411	2,049,411	2,856,744	2,856,744	2,049,411	2,049,411	2,856,744	2,856,744
R^2	0.942	0.942			0.942	0.942		

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered by exporter–importer-product (Columns 1–4) or exporter, importer, product and year (Columns 5–8). Variables for NTBs, TDIs and tariffs are leading 2 years. Except for tariffs all explanatory variables enter the regression as dummies. Imports in thousand USD

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 14 Measuring the effect of BTB NTBs

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	PPML	OLS	PPML	OLS	PPML
Data dimension	ijkt	ijkt	ijkt	ijkt	jkt	jkt
ln(1+tariff)	− 0.178***	− 0.368***	− 0.094**	− 0.248**	− 0.091	− 0.290
	(0.039)	(0.125)	(0.042)	(0.097)	(0.115)	(0.271)
TDI	− 0.121***	− 0.017	− 0.089***	− 0.016		
	(0.016)	(0.021)	(0.016)	(0.016)		
BTB NTB	− 0.011**	− 0.032***	− 0.011**	− 0.019***	− 0.013	− 0.041**
	(0.004)	(0.010)	(0.004)	(0.006)	(0.010)	(0.018)
Fixed effects	ikt,ijk,jt	ikt,ijk,jt	ikt,ijk,ijt	ikt,ijk,ijt	jt,kt,jk	jt,kt,jk
Observations	4,410,589	4,410,589	4,399,174	4,399,174	147,468	151,056
R^2	0.908		0.912		0.973	

All estimations include exporter–importer-product, importer-product-time, exporter-product-time and exporter–importer-time fixed effects. Standard errors are clustered by exporter–importer-product (Columns 1–4) or importer-product (Columns 5–6). Variables for NTBs, TDIs and tariffs are lagged by 1 year. Except for tariffs all explanatory variables enter the regression as dummies. Imports in thousand USD

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 15 NTBs by Country (2009–2014)

Country	Number of implemented NTB's	Number of times country is affected by NTB	Country	Number of implemented NTB's	Number of times country is affected by NTB
Afghanistan	0	0	Korea (DPR)	0	0
Albania	0	159	Congo (DR)	0	17
Algeria	0	0	Ecuador	9	125
American Samoa	0	0	Egypt	6	387
Andorra	0	0	El Salvador	0	40
Angola	1	22	Equatorial Guinea	0	0
Anguilla	0	0	Eritrea	0	0
Antigua and Barbuda	0	7	Estonia	21	318
Argentina	38	467	Ethiopia	0	0
Armenia	1	8	Fiji	0	14
Aruba	0	0	Finland	25	584
Australia	3	661	France	48	938
Austria	32	742	French Polynesia	0	0
Azerbaijan	0	0	Gabon	0	13
Bahamas	0	0	Gambia	1	4
Bahrain	0	212	Georgia	0	235
Bangladesh	1	138	Germany	76	989
Barbados	0	13	Ghana	3	34
Belarus	0	0	Greece	31	427
Belgium	34	823	Grenada	0	2
Belize	0	13	Guam	0	0
Benin	0	11	Guatemala	0	234
Bermuda	0	0	Guinea	0	7
Bhutan	0	0	Guinea-Bissau	0	2

Table 15 (continued)

Country	Number of implemented NTB's	Number of times country is affected by NTB	Country	Number of implemented NTB's	Number of times country is affected by NTB
Bolivia	0	34	Guyana	0	16
Bosnia and Herzegovina	0	0	Haiti	0	12
Botswana	0	17	Honduras	0	43
Brazil	71	674	Hong Kong	1	602
Brunei Darussalam	0	10	Hungary	23	608
Bulgaria	26	338	Iceland	2	143
Burkina Faso	0	10	India	128	683
Burundi	0	4	Indonesia	63	548
Cambodia	1	76	Iran	0	0
Cameroon	0	28	Iraq	0	0
Canada	17	1101	Ireland	32	581
Cape Verde	0	4	Israel	2	519
Cayman Islands	0	0	Italy	54	927
Central African Republic	0	3	Ivory Coast	0	30
Chad	0	7	Jamaica	0	25
Chile	2	431	Japan	29	802
China	42	948	Jordan	0	64
Taiwan, Province of China	0	47	Kazakhstan	0	0
Colombia	13	321	Kenya	1	42
Comoros	0	0	Kiribati	0	0
Congo	0	19	Kuwait	1	68
Costa Rica	0	297	Kyrgyzstan	1	6
Croatia	11	247	Laos	0	0

Table 15 (continued)

Country	Number of implemented NTB's	Number of times country is affected by NTB	Country	Number of implemented NTB's	Number of times country is affected by NTB
Cuba	0	26	Latvia	23	301
Cyprus	20	136	Lebanon	0	0
Czech Republic	28	634	Lesotho	0	10
Denmark	35	678	Liberia	0	0
Djibouti	0	1	Libya	0	0
Dominica	0	6	Liechtenstein	0	12
Dominican Republic	2	288	Lithuania	21	218
Luxembourg	11	435	Saint Lucia	0	5
Macao	0	1	Saint Pierre and Miquelon	0	0
Macedonia	2	175	Saint Vincent and Grenadines	0	3
Madagascar	0	32	Samoa	0	0
Malawi	0	10	San Marino	0	0
Malaysia	6	601	Sao Tome and Principe	0	0
Maldives	0	6	Saudi Arabia	130	349
Mali	0	7	Senegal	1	30
Malta	9	119	Serbia	0	0
Marshall Islands	0	0	Seychelles	0	0
Mauritania	1	11	Sierra Leone	0	8
Mauritius	0	31	Singapore	0	605
Mayotte	0	0	Slovakia	22	480
Mexico	8	632	Slovenia	30	393
Micronesia	0	0	Solomon Islands	0	7
Mongolia	0	8	Somalia	0	0

Table 15 (continued)

Country	Number of implemented NTB's	Number of times country is affected by NTB	Country	Number of implemented NTB's	Number of times country is affected by NTB
Montenegro	0	0	South Africa	16	526
Montserrat	0	0	South Sudan	0	0
Morocco	3	138	Spain	52	768
Mozambique	0	97	Sri Lanka	6	101
Myanmar	0	43	Palestine, State of	0	0
Namibia	4	26	Suriname	0	55
Nauru	0	0	Swaziland	0	42
Nepal	0	30	Sweden	28	784
Netherlands	34	765	Switzerland	2	724
Netherlands Antilles	0	0	Syrian Arab Republic	0	0
New Caledonia	0	0	Tajikistan	0	0
New Zealand	2	452	Tanzania, United Republic of	0	31
Nicaragua	0	37	Thailand	3	690
Niger	0	3	Timor-Leste	0	0
Nigeria	12	86	Togo	1	22
Niue	0	0	Tokelau	0	0
Norway	1	521	Tonga	0	1
Oman	0	280	Trinidad and Tobago	0	253
Pakistan	13	297	Tunisia	0	171
Palau	0	0	Turkey	7	644
Panama	1	114	Turkmenistan	0	0
Papua New Guinea	0	25	Turks and Caicos Islands	0	0
Paraguay	5	39	Tuvalu	0	0

Table 15 (continued)

Country	Number of implemented NTB's	Number of times country is affected by NTB	Country	Number of implemented NTB's	Number of times country is affected by NTB
Peru	0	170	Uganda	2	19
Philippines	1	480	Ukraine	17	395
Pitcairn	0	0	United Arab Emirates	0	511
Poland	60	626	United Kingdom	39	915
Portugal	31	553	United States of America	662	833
Qatar	0	78	Uruguay	2	159
Korea (Republic of)	10	746	Uzbekistan	0	0
Moldova (Republic of)	0	24	Vanuatu	0	0
Sudan	0	0	Venezuela	14	299
Romania	24	523	Vietnam	13	494
Russian Federation	0	0	Western Sahara	0	0
Rwanda	0	4	Yemen	0	0
Saint Helena	0	0	Zambia	0	52
Saint Kitts and Nevis	0	2	Zimbabwe	3	205

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