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Chinese Exports and Non-Tariff Measures: Testing for Heterogeneous Effects at the Product Level

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Abstract With international trade tariffs at historically low levels today, non-tariff measures (NTMs) play an important—and growing—role in global trade policy. Concerns about shifts in global trade policy agendas are on the rise. In this paper, we rely on a gravity model and focus on Chinese exports with two aims: the first is to test for heterogeneous effects of technical NTMs versus non-technical NTMs; the second is to verify whether the NTM's effect is influenced by the type of good (final good vs. intermediate or capital good). We find that: 1) technical NTMs tend to have positive effects on trade flows, potentially driven by improvements in consumers' confidence and by the technical capacities of Chinese exporters and 2) non-technical NTMs are particularly stringent for final goods, possibly due to political economy reasons or substitution effects.

Keywords: International trade, Trade policy, Non-tariff measures, Gravity model

JEL Classifications: F13, F14

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I. Introduction

The World Bank (WB), the International Monetary Fund and the World Trade Organization (WTO) recently released a joint report (2017) warning against a turn of the global trade policy agenda. Indeed, in a context of erratic global trade developments, policy issues have returned to the spotlight, both in politics and academia (Feng *et al*. 2017, Murina and Nicita 2017, Baccini *et al*. 2018, Blanchard *et al*. 2016, Conconi *et al*. 2016, Haaland and Venables 2016, Baldwin 2011, Antras and Yeaple 2013, Vandenbussche and Zanardi 2010). Even as tariffs are at historically low levels, non-tariff measures (NTMs) play an important—and growing—role

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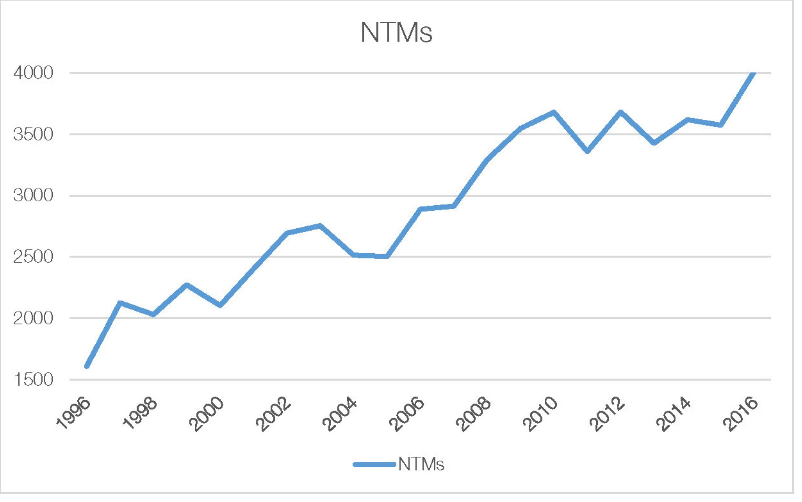
in global trade policy, exemplified by the burgeoning interest of international governmental and non-governmental bodies (i.a., Cadot and Malouche 2012, UN 2013, WTO 2012, GTA 2018). NTMs' impacts on trade are potentially more complex than those of tariffs.

Figure 1. NTMs, 1996~2016



(Note) "NTMs" represents the sum of all different NTMs initiated and in force in a specific year, using a flow approach.
(Source) Authors' elaboration on i-tip.wto.org.

Theoretical and empirical work on NTMs provides mixed results. As brilliantly summarized by Fugazza (2013), from a theoretical perspective it is ambiguous how certain type of NTMs (e.g., technical regulations) may affect exporters' and importers' behavior, and therefore trade (also Bertola and Faini 1990, with special emphasis on quotas). On the empirical side, the recent literature has largely concentrated on the effect of sanitary and phytosanitary standards (SPS, a subset of technical measures) on trade, with overwhelming attention being paid to agricultural products (e.g., Murina and Nicita 2017, Ferro *et al*. 2015, Melo *et al*. 2015, whereas Fontagné *et al*. 2015, cover the entire spectrum of HS-4 sectors, Gibson and Wang 2018).

There are no clear-cut results: at the aggregated level (using panel data including different exporting countries), the effect of NTMs on trade is mixed at best (Ghodsi *et al*. 2017, Hayakawa *et al*. 2016). To further this area of study, this paper focuses on China, the world biggest exporter. The growing competition from China has been identified as one of the causes that reinvigorated the recent revival of trade policy measures; some researchers accuse this of driving increases in unemployment (Autor *et al*. 2013), of lower wages (Ashournia *et al*. 2014), and of affecting political and electoral patterns (Colantone and Stanig 2018a, Colantone and Stanig 2018b, Che *et al*. 2016, Autor *et al*. 2016).[1)]

In this paper, using a new measure of NTMs (Murina and Nicita 2017), a recently released database (UNCTAD 2017), and relying on gravity models (Baier and Bergstrand 2007, Head and Mayer 2014, Glick and Rose 2016, UNCTAD-WTO 2016), we focus on Chinese exports with two aims. The first is to disentangle the effects of a destination country's NTMs on Chinese exports. Due to possible heterogeneous effects of different NTMs on trade flows, we separate NTMs measures by category, namely, technical NTMs (mainly product regulations to promote certain standards) and non-technical NTMs (i.e., anti-dumping and other measures inclined to shelter domestic producers from import competition) (UNCTAD 2015). Second, we aim to measure empirically whether NTMs have heterogeneous effects on specific sets of goods. Indeed, focusing trade policy on intermediate goods would cause input costs to rise and possibly disrupt global value chains. Oppositely, following political economy arguments (Baccini *et al*. 2018), we would expect final goods to be the focus of more restrictive NTMs, as they induce tougher import competition (Amiti and Konings 2007). Final goods may also report larger effects because of a higher degree of substitutability (Jones 2011). In addition, we estimate the elasticity of Chinese exports to tariffs.

We find that—at least in the case of measures related to Chinese exports—it is misleading to measure NTMs as a uniform aggregate because they have heterogeneous effects on trade. These effects also depend on the type of good. Technical NTMs tend to have positive effects on trade flows, potentially driven by improvements in consumers' confidence and by the technical capacities of Chinese exporters. Non-technical NTMs are particularly stringent for final goods, possibly due to political economy reasons or substitution effects.

The rest of the paper is organized as follows: Section II revises the relevant literature on gravity models, NTMs, and the political economy of trade policies. Section III explains the methodological choices and provides relevant details. Section IV briefly describes the data used. Section V analyzes the main results and their robustness. Section VI concludes.

II. Literature Review

The prominence of trade costs within international trade theory has served as a natural attraction for many applied economists investigating its influences on trade flows (and economic growth). With the changing trend in the relative importance of tariffs versus NTMs during the last decades, there is an indisputable need to explicitly account for the latter in models and estimations. However, NTMs are heterogeneous and complex in nature; they often having legal origins, and their measurement is inherently difficult. Anderson and Neary (2003) provide one of the few comprehensive attempts to estimate NTMs, through a "mercantilist trade

1) A parallel strand of literature estimate welfare effects related to "China's trade shock," finding aggregate welfare gains (Feenstra and Weinstein 2017), however with considerable within-state variance (Caliendo *et al*. 2015).

restrictiveness index" which represents "the uniform tariff which yields the same volume of imports as a given tariff structure" (p.27).[2] Using Anderson and Neary's (2003) theoretical approach as a reference, Kee *et al*. (2009) elaborated an "overall trade restrictiveness index" (OTRI) (also i.a., Nicita and Olarreaga 2008, Irwin 2010). The OTRI combines tariffs with anti-dumping (AD) duties data (which only represents a fraction of the types of NTMs), to calculate a weighted average *ad-valorem* correspondent for tariffs and AD duties at country level, where the weights depend on imported-product level characteristics, such as volume composition and demand elasticities.[3] The high level of data requirements limits the ability to replicate OTRI, and currently, comparable data exist for 2008 and 2009 only. Using these data, Kee *et al*. (2014) argue that trade policy faced no dramatic change between 2008 and 2009. They reached this conclusion plotting against each other the OTRI level in the two available years. At that time, AD duties were available for 13 countries.

Since then, data collection efforts have increased exponentially,[4] opening a wide set of opportunities for researchers. So, far, results estimating the effects of NTMs on trade have been mixed (Ghodsi *et al*. 2017). Moreover, very few examples provide internationally comparable results, and most of them focus on agriculture. For example, Ferro *et al*. (2015) use "maximum residue level of pesticides" as a proxy for restrictiveness dictated by NTMs, finding a negative relation with exports in more regulated markets. Melo *et al*. (2014) find heterogeneous effects of regulation on Chilean fresh fruit exports. Fontagné *et al*. (2015) use French firm level data to detect a negative impact of trade barriers (sample restricted to SPS) on both margins of exports. Kirpichev and Moral-Benito (2018), using a panel of Spanish firms, found that newly introduced NTMs do not only have negative effects on export growth, but also on other firm dimensions (such as productivity). In parallel, another strand of literature points toward a positive effect of specific certification measures and other standards, mainly on imports from developing

2) In parallel, in a quest for coherent variables available for properly identifying a reduction in trade costs, a part of the literature focused on free trade agreements (FTAs) and currency unions (CUs), as they are expected to reduce trade costs. Concretely, FTAs are supposed to influence tariffs and NTMs. Most of the studies find a clear positive relation with FTAs and bilateral trade flows, but do not differentiate its drivers, including a dummy variable that identifies dichotomously the existence of an agreement and the eventual membership of the two countries involved in bilateral trade (e.g., Baier and Bergstrand 2007, Philippidis and Sanjuán 2007, Hayakawa and Kimura 2015, Caporale *et al*. 2009, Kawasaki 2015, Thorbecke 2015a, Freeman and Pienknagura 2016). CUs instead, are expected to reduce transaction costs, favoring trade. Rose's seminal contribution (2000) together with Glick and Rose (2002) calculating the effects of the use of a common currency on bilateral trade flows started a buoyant discussion on methods and techniques for minimizing the potential estimation errors. Baldwin and Taglioni (2006) provide a detailed survey, highlighting the famous "gold, silver and bronze" errors and how to avoid them, while still applying gravity models. Rose (2017) and Glick and Rose (2016) recently summarized the results and provides new estimates for the entry and exit effects. For historical evidence on currency unions and trade see, i.a., Flandreau (2000), López-Córdova and Meissner (2003) and Timini (2018).

3) A precursor of this index was the TRI elaborated by the IMF in its review for the "Trade Liberalization in IMF-Supported Programs (EBS/97/163). Used mainly for managerial purposes, it has not been exempted by critics as some biases arose in the way tariffs and NTMs were rated.

4) See the data section for more details.

countries (e.g., Henson and Humprey 2009, Henson *et al*. 2011, Murina and Nicita 2017). Trimarchi (2018), focusing on AD measures, and Leonardi and Meschi (2016) extend these positive effects to the labor market. Among these, Murina and Nicita (2017) exploit the rich UNCTAD TRAINS database in a disaggregated fashion, using a cross-section perspective, focusing on the effect of SPS measures on agricultural imports in the EU market and how the level of development in the country of origin may affect the capacities for compliance (the higher the income, the lower the difficulty in meeting the required standards).

Nevertheless, despite its role in the world economy, there is no work focusing on the whole set of NTMs for the specific case of Chinese exports. Imbruno (2016) examines its imports and assesses the effectiveness of a group of trade policy instruments since the Chinese accession to the WTO. Caporale *et al*. (2016) instead, analyses exports to the main destinations, and its relationship with the Chinese industrial structure, using aggregate data, and not including in the gravity model any proxies for NTMs. Chandra (2016) offers a view on the effect of US imposed temporary trade barriers, finding negative spillovers for Chinese exports (including those to third countries).[5] Finally, using data for Chinese exports of fruit and vegetables, Gibson and Wang (2018) focus on SPS measures and trade intermediaries, finding a positive association between NTMs and exports.

Our contribution is to consider the entire spectrum of exports and NTMs at the finest (internationally comparable) level of detail while, at the same time, allowing for possible heterogeneous effects at the NTM and product type level. Indeed, the diversity within NTMs (technical and non-technical measures) and product (final vs. intermediate and capital) types emphasize the need to empirically take heterogeneity into account.

In other words, we aim to estimate the effects of NTMs on Chinese exports, at the product-country level, differentiating by NTMs (specifically between technical and non-technical measures) and by product classification (i.e., final and non-final good). The reasons for doing so are threefold: first, we aim to estimate the effects of the NTMs imposed by destination countries on Chinese exports. Second, we aim to take into account and disentangle the possible heterogeneous effects of different types of NTMs. Indeed, in some cases, the demand side effects may be positive: for example consumers may buy more products with higher regulatory requirements because they think they represent more sophisticated health, safety, and possibly also environmental protection standards (e.g., Murina and Nicita 2017). The supply side effects may not be necessarily negative if regulation does not directly aim to shield producers from import competition (as, for example the case of SPS measures and other "technical" measures, as defined by UNCTAD 2015). Nevertheless, if the final aim of NTMs is to shelter domestic producers, they are highly likely to have negative effects on the supply side (e.g., those NTMs classified by UNCTAD[2015] as non-technical, i.e., AD and other measures inclined to shelter

5) For more information on temporary trade barriers and the relative database, see e.g., Bown and Crowley (2016)

domestic producers from import competition, which translates in measures ranges from “contingent trade-protective” to “non-automatic licensing, quotas, prohibitions and quantity control,” and from “trade-related investment” to “government procurement restrictions”). Moreover, we want to test for the possible existence of “political economy” arguments or heterogeneous substitution effects: are NTMs more restrictive in some cases (i.e., have larger negative/positive effects for a specific set of goods)? Indeed, trade policies focusing on intermediate goods should increase input costs and possibly disrupt global value chains. Oppositely, following political economy arguments (Baccini *et al.* 2018), we would expect final goods to be the focus of non-technical NTMs because they induce tougher import competition (Amiti and Konings 2007). However, the same effects may be derived from a different degree of substitutability across product types; this would explain that the same number of NTMs may have, for example, more detrimental effects on final goods if they are more easily substitutable than intermediate goods. Due to the nature of the data in our possession, we cannot disentangle the two theories.

III. Methodology

In our methodological approach, we follow Head and Mayer (2014) and UNCTAD-WTO (2012) using an augmented gravity model that is inclusive of multilateral trade resistances (MTRs) that was theorized by Anderson and Van Wincoop (2003). Some studies on NTMs failed to properly take MTRs into account. To properly address the “zeros of trade,” as standard in the literature, we implemented a pseudo-Poisson maximum likelihood estimating procedure (Santos Silva and Tenreyro 2006). We use disaggregated bilateral trade flows data.[6] Therefore, the main specification can be written as follow:

$$Tr_{jkt} = exp\left(\beta_0 + \beta X'_{jkt} + \lambda W'_{jkt} + \omega Z_{jt} + \delta_j + \gamma_{\text{sector}} + \eta_t\right) + \epsilon_{jkt} \tag{1}$$

where Tr_{jk} denotes nominal Chinese exports of product k to country *j*. X' is a vector that contains trade policy related variables as follows: 1) $Tariff_{jk}$, which is the effectively applied tariff reported by each destination country *j* for a specific product *k* (in logarithm); 2) RI_{jk}, which is a proxy for NTMs, as implemented first by in Murina and Nicita (2017), reflecting the “regulatory intensity” for product *k* in country *j*. The regulatory intensity index is calculated by simply considering the number of NTMs that are applied to imports of a particular product coming from China. For example, if the product corresponding to the Harmonized System (HS)

6) French (2014) highlights sub-optimal estimation performances of aggregated models with respect to trade barriers, as composition of trade flows matters.

6-digit category 611019 ("jerseys, pullovers, cardigans, waist-coats & similar articles, knitted/ crocheted, of fine animal hair other than of Kashmir [cashmere] goats") faces nine different measures in country A, the corresponding $RI_{A611019}$ is equal to nine. Following Murina and Nicita (2017), in the main specification, we include the regulatory index (RI) in log, but we run a series of robustness tests using alternative functional forms. Following the same methodology and to account for eventual contrasting effects, we also calculate the RI_{jk} separately for technical (RI-tech) and non-technical measures (RI-nontech).[7] In addition, we include a vector W', which contains other relevant variables: 1) $final_k$, defined as in Martínez-Zarzoso and Johannsen (2016), that has a dummy variable that equals 1 if product *k* is neither an intermediate nor a capital good following Broad Economic Categories (BEC) classification. In addition, we include two interaction terms in the regressions, between the $final\ good_k$ dummy and the RI-tech and RI-nontech, respectively, to test for the possible existence of heterogeneous effects for different product categories. Z' is a vector containing additional control variables: $lnGDP_{jt}$ and MRI_{jt}. $lnGDP_{jt}$ is the logarithm of the destination country's nominal GDP. MRI_{jt} is a multilateral resistance index[8]. Indeed, to control for MTRs (as suggested by, *inter alia*, Head and Mayer 2014, Feenstra 2016, Shepherd 2016, Anderson 2011, and UNCTAD-WTO 2016), we follow the method proposed by Carrère *et al*. (2010), widely used in the literature, e.g., Cirera *et al*. (2016).[9] As a further control for endogeneity issues, we included pseudo-pair fixed effects, δ_j,[10] the use of which automatically excludes the possibility of obtaining separate estimates for the standard "gravity-related" variables. However, this would have only been a second-best strategy to (partly) control for trade costs. Next, γ_{sector} represents two-digit sector fixed effects and η_t are time fixed effects (note that in our database China is the only exporter, therefore time fixed effects also absorb the variation of all China-level time varying characteristics, e.g., GDP, GDP per capita, etc.). Finally, ϵ_{jkt} is the error term.

7) NTMs technical and non-technical measures are classified following UNCTAD (2015), also called UN MAST classification. Technical measures include: chapters A to C, i.e., sanitary and phytosanitary measures; technical barriers to trade; pre-shipment inspection and other formalities. Non-technical measures include: chapters D to O, i.e., contingent trade-protective measures; non-automatic licensing, quotas, prohibitions and quantity-control measures other than for SPS or TBT reasons; price-control measures, including additional taxes and charges; finance measures; measures affecting competition; trade-related investment measures; distribution restrictions; restrictions on post-sales services; subsidies (excluding export subsidies); government procurement restrictions; intellectual property; rules of origin.

8) $MRI_{it} = \Sigma_{j=1}^{n}\frac{Y_{jt}}{Y_{wt}}ln(Dist_{ij})$, where Y_{wt} is the world output at time t (for an explanation of the variables included in the Equation, see text)

9) The procedure to estimate MTRs suggested by Baier and Bergstrand (2009), coherent with the Anderson and Van Wincoop (2003) theoretical framework, is highly data intensive (see i.a., Head *et al*. 2010, Melitz and Toubal 2014 for a practical application; and Baltagi *et al*. 2014 for a theoretical discussion).

10) Due to the lack in exporter variance, importer fixed effects correspond to pair-fixed effects in our database.

IV. Data

Our quantitative analysis exploits a new dataset generated by a variety of different sources. We follow Schindler and Beckett (2005) and Day (2015), using Chinese export data in the database mirroring import data from destination countries. Data on trade flows and tariffs come from UN COMTRADE (through the WB World Integrated Trade Solutions data platform–WITS).[11] On the NTMs side, there has been a recent explosion of interest. Data collection has to follow accordingly. Indeed, at least three major projects have delivered (public) databases containing internationally comparable information on NTMs. The first, the PRONTO project, is comprehensive in its scope: the authors created a diverse set of databases (ranging from Export Processing Zones to domestic environmental taxes), of which one is strictly dedicated to "measuring the incidence of NTMs" (NTM-MAP),[12] at the HS 2 digit level. The second, the Global Trade Alert database, contains rich information, devoting "particular attention to the policy choices of the G-20 economies,"[13] on NTMs "flows", in other words, changes in NTMs barriers. This information is collected by teams of international trade experts, i.e., it is not "official" *strictu sensu*. More importantly (at least from the perspective of this analysis), it does not provide information on the NTMs "stock" (i.e., how many NTMs were in place for each product at the beginning of the period). Finally, the third database, the UNCTAD TRAINS, considered the "global database on NTMs,"[14] provides information at the highest internationally comparable level of disaggregation (HS 6 digit) for a large number of countries. Therefore, for NTMs, we decided to capitalize on the third database, because it includes information on the NTMs "stock" (the number of NTMs imposed by each country at the product level) at the finest internationally comparable level of disaggregation (HS 6 digit). In addition, we classified each product by the basic classes of goods identified in the System of National Accounts. Each one of these is related to the BEC classification, which makes the equivalence with HS classification doable (Miroudot 2009). GDP and distance data (necessary to calculate the MRI) are from CEPII. Limitations in terms of countries are related to both the availability of data for NTMs and trade flows at the product level. There are approximately 5,000 product observations per country-time,[15] including the zeros level trade, for a total of more than three million observations, for the period 2001~2014. This study focuses on China from its accession in the WTO to the latest available data, because the Chinese integration into the world economy, as far as trade is concerned, increased dramatically and the potential for using tariffs is circumscribed into WTO rules.

11) https://wits.worldbank.org/
12) More information at: http://pronto.wti.org.
13) More information at: http://www.globaltradealert.org.
14) http://trains.unctad.org/.
15) The member states of the European Union are included in the database as a single country, as the EU trade policy is defined at the Union level. See Appendix I for the complete list of countries included in the database.

V. Results

The results from the gravity model, with pseudo-Poisson maximum likelihood estimates, are presented in Table 1. Column 1 represents a standard specification for panel gravity models focused on understanding the effects of trade policy tools. Beyond the time, sector and (pseudo) country-pair fixed effects, we include the effectively applied tariff variable, which reports a negative and significant coefficient. This means that, as expected, a tariff increase in country *j* reduces Chinese exports to country *j*. Specifically, a 10% change in tariffs in country *j* produces a 1.5% change in Chinese exports to country *j* (with the opposite sign, e.g., a tariff increase produces a reduction in exports). Moreover, it also includes the logarithm of the destination country's GDP and the MRI. Column 2 contains—in addition to the previous regression—the RI (we test the robustness of a logarithmic specification in the robustness section), including all type of NTMs. The coefficient is positive and significant, meaning that there is an association between higher NTMs and higher trade flows. The average result may be driven by positive effects on the demand side. Consumers may be more willing to buy products with higher regulatory requirements, in terms of technical standards. However, it is difficult to imagine that non-technical barriers would have any positive effects. Therefore, in Column 3, we allow for heterogeneous effects of technical and non-technical NTMs, *via* two different variables. Indeed, we confirm our suspects that the NTMs positive and significant coefficient in Column 2 was driven by technical NTMs, such as SPS measures. The coefficient of non-technical NTMs is not significant. Finally, in Column 4 we introduce a dummy ("final") and its interaction with both subsets of NTMs (RI-tech and RI-nontech). In this way we can test for the possible existence of heterogeneous effects for different product subsets: NTMs may be more restrictive in some cases (i.e., have larger negative effects for a specific set of goods). Indeed, trade policies focusing on intermediate goods may cause input costs to rise and possibly disrupt global value chains. Oppositely, following political economy arguments (Baccini *et al*. 2018), we would expect final goods to be the focus of non-technical NTMs because they induce tougher import competition (Amiti and Konings 2007). However, final goods may report larger effects of NTMs because of a higher degree of substitutability (Jones 2011). The negative coefficient of the interaction term final*RI-nontech confirms that the negative effects of non-technical NTMs are concentrated on final goods.

To frame our results, on one hand we find that technical NTMs have a positive effect on Chinese exports. On the other hand, we see that non-technical NTMs have an opposite (i.e., negative) effects on Chinese exports, concentrated on exports of final goods. Technical NTMs are composed mainly by SPS measures and technical barriers to trade (TBTs). While SPS are rules that are mainly oriented to issues of food safety and animal and plant health standards, TBTs are technical regulations, standards, and conformity assessment procedures. The economic impacts of SPS and TBTs are a matter of discussion in the literature, and often have been found to be of opposite directions (i.a., WTO 2012). The positive effect of technical NTMs on Chinese export can be rationalized as follows: the adoption of SPS and other technical standards (e.g., Bao and Chen 2012, Bao and Chen 2013) may cut transaction costs by ensuring quality standards for consumers. In other words, SPS and other technical standards reduce consumers' uncertainty regarding product quality and improve consumers' confidence. By the same channel, i.e., if SPS and other technical standards serve to signal quality, technical NTMs may additionally increase the elasticity of substitution among similar goods, favoring more efficient producers (Athukorala and Jayasuriya 2003). Additionally, the economic impact of technical NTMs has been described as dependent to the level of development of the exporter (and less often of the importer). Indeed, as SPS and TBTs costs are strictly related to the exporters' capacity to meet the standards imposed by the importing country (Disdier *et al.* 2008), exporters from developed and emerging countries are better equipped to comply with these measures. In other words, the costs of compliance (with SPS and TBTs rules) are mainly a matter of "technical know-how, production facilities and infrastructural base" (Murina and

Table 1. Chinese exports, regulatory intensity, and final goods

	(1)	(2)	(3)	(4)
lnGDP	0.888***	0.885***	0.892***	0.889***
	(0.091)	(0.091)	(0.090)	(0.090)
MRI	0.098	0.252**	0.255**	0.248**
	(0.128)	(0.124)	(0.122)	(0.122)
tariff [ln(1+tariff)]	−0.152***	−0.148***	−0.148***	−0.163***
	(0.014)	(0.014)	(0.014)	(0.014)
ln_RI [ln(1+RI)]		0.133***		
		(0.034)		
RI-tech [ln(1+RI-tech)]			0.136***	0.138***
			(0.037)	(0.048)
RI-nontech [ln(1+RI-nontech)]			0.031	0.147
			(0.098)	(0.117)
final				0.462***
				(0.028)
*final*RI-tech*				−0.0276
				(0.055)
*final*RI-nontech*				−0.517***
				(0.128)
Observations	3,176,012	3,176,012	3,176,012	3,176,012
Year FE	YES	YES	YES	YES
Sector 2-digit FE	YES	YES	YES	YES
Country-pair FE	YES	YES	YES	YES

(Note) Poisson regressions. Dependent variable: Chinese exports. Fixed effects and constants not reported for the sake of simplicity. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
(Source) Authors' elaboration.

Nicita 2017), and while these elements are present in most developed and emerging markets, they are not presented in many developing (particularly low-income) countries. Chinese exporters seem to have the necessary technical capacities and/or access to an enabling environment.

In the case of Chinese exports, these positive effects seem to prevail on other potentially negative impacts deriving from compliance costs. Our results for technical NTMs are in line with (and expand) Gibson and Wang (2018), which show SPS standards imposed on Chinese fruit and vegetable exports have a positive effect on trade. Indeed, our results include the effects of the entire spectrum of NTMs on the universe of Chinese exports.

Finally, we find that non-technical NTMs (e.g., AD measures, etc.) imposed on Chinese exports are particularly stringent for final goods.

A. Robustness analysis

To ensure the robustness of the results, we considered a set of alternative specifications. The results are included in Table 2.

In the first set of robustness tests, we focus on the functional form of the NTMs. In the main regression we included NTMs in logarithm, however there is no agreement yet in the literature on this. Therefore, we tested the incorporation of NTMs as a dummy as shown in Column 1 (RI-tech is equal to 1 and RI-nontech are ≥1), and in levels (Column 2). Changing the NTMs functional form does not produce any relevant change to the main results.

In the second set of robustness test, we consider possible geographical and institutional peculiarities that may introduce biases in the results. In Column 3, we address the legitimate concern that "Honk Kong traders distribute a large fraction of China's exports" (Feenstra and Hanson 2004), resulting in biases when counting Chinese exports. Consequently, we combined Chinese with Honk Kong exports for a product k to a country j. In Column 4, we take into account the prominence and peculiarities of the China-US trade relationship (Thorbecke 2015b), running a regression without China-US bilateral data to check whether overall results are driven by this subset. In both cases, the results hold, with a coefficient equal in sign and significance that is very similar in "size." In Column 5, in line with Column 4, we exclude trade with the European Union, to check whether results are driven by the specificities of this important trade relationship. In Column 6 we exclude agricultural products from the regression. Even if agricultural products constitute a minority of Chinese exports (Zhang 2006), we aim to prove that the NTMs-related effects in this analysis go beyond those typically related to SPS of agricultural products (e.g., Gibson and Wang 2018, Murina and Nicita 2017, Ferro *et al*. 2015, Melo *et al*. 2015).

In the third set of robustness tests, we address some general issues related to the equation specification choice. Therefore, in Column 7 we run a regression at 4-digit HS level, instead

Table 2. Robustness tests

	(1) NTMs dummy (=1 if NTM≥1)	(2) NTMs In level	(3) + Honk Kong	(4) without US	(5) without EU	(6) without agricultural goods	(7) 4-digit	(8) γ at 1 digit level	(9) GVCs
lnGDP	0.899***	0.897***	0.770***	0.844***	0.884***	0.885***	0.892***	0.907***	0.883***
	(0.090)	(0.091)	(0.088)	(0.090)	(0.095)	(0.093)	(0.121)	(0.091)	(0.088)
MRI	0.273**	0.168	0.290**	0.358**	0.303*	0.265*	0.480***	0.304**	0.214*
	(0.119)	(0.125)	(0.119)	(0.171)	(0.156)	(0.125)	(0.163)	(0.123)	(0.122)
tariff [ln(1+tariff)]	−0.164***	−0.164***	−0.168***	−0.112***	−0.169***	−0.170***	−0.140***	−0.116***	−0.160***
	(0.014)	(0.014)	(0.014)	(0.012)	(0.016)	(0.014)	(0.023)	(0.013)	(0.014)
RI-tech	0.266***	0.0210***	0.137***	0.140**	0.187***	0.139***	0.176***	0.199***	0.114**
	(0.071)	(0.007)	(0.048)	(0.056)	(0.048)	(0.049)	(0.034)	(0.048)	(0.051)
RI-nontech	0.078	0.061	0.148	0.110	0.128	0.149	0.094	0.186	0.118
	(0.115)	(0.047)	(0.114)	(0.085)	(0.118)	(0.118)	(0.071)	(0.115)	(0.111)
final	0.480***	0.453***	0.450**	0.315***	0.452***	0.460***	0.793***	0.826***	0.349***
	(0.029)	(0.027)	(0.028)	(0.028)	(0.031)	(0.029)	(0.035)	(0.021)	(0.032)
*final***RI-tech*	−0.122	−0.0054	−0.029	−0.050	0.015	−0.0175	−0.054	−0.058	−0.004
	(0.087)	(0.0091)	(0.055)	(0.065)	(0.065)	(0.057)	(0.042)	(0.06)	(0.058)
*final***RI-nontech*	−0.444***	−0.210***	−0.523***	−0.316***	−0.582***	−0.540***	−0.260***	−0.566***	−0.497***
	(0.124)	(0.059)	(0.125)	(0.101)	(0.135)	(0.131)	(0.082)	(0.127)	(0.056)
GVCs									−0.024***
									(0.002)
Observations	3,176,012	3,176,012	3,176,012	3,113,492	3,110,980	2,785,925	800,947	3,176,012	3,007,756
ear FE	ES	ES	ES	ES	ES	ES	ES	ES	ES
Sector 2-digit FE	YES	YES	YES	YES	YES	YES	YES	1 digit	YES
Country-pair FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

(Note) Poisson regressions. Dependent variable: Chinese exports. Fixed effects and constants not reported for the sake of simplicity. Robust standard errors in parentheses; $***p < 0.01$, $**p < 0.05$, $*p < 0.1$.

(Source) Authors' elaboration.

of our preferred choice of 6-digit HS level. In other words, we use trade flows at a more aggregated level. To do this we make some assumptions on tariffs (to have the applied tariff at the 4-digit level, we calculate the average effects among 6-digit products) and NTMs (we simply sum the number of NTMs across products, assuming there is no equal regulation across product). Finally, in Column 8, we relax the sector fixed effects with the introduction of 1-digit sector fixed effects.

Finally, we account for the central role of China in world trade, and particularly its role in global value chains (GVCs) (Manova 2014). Multifaceted GVCs, with their variety of interactions among domestic and foreign suppliers, however, are extremely difficult to quantify. We proxy GVCs by the share of China's import value in terms of world import with respect to the same product p. We acknowledge that this proxy captures GVCs only that occur within the same product category. Importantly, however, the main results do not change with the inclusion of the GVCs proxy (Column 9).

It is worth noting that across all specifications, there are no changes in the sign or significance of the main variables of interests and that the elasticity of Chinese exports to tariffs is remarkably stable, varying between −0.112 to −0.170.

VI. Conclusions

In this article we estimate the effects of trade policy on Chinese exports, using trade data at the highest internationally comparable level of disaggregation (HS 6 digit), with a particular focus on NTMs.

We show that—at least in the case of measures related to Chinese exports—it is misleading to measure NTMs as a uniform aggregate; the effects on trade are heterogeneous and also vary by the type of good. Technical NTMs tend to have positive effects on trade flows, potentially driven by improvements in consumers' confidence and by the technical capacities of Chinese exporters. Non-technical NTMs are particularly stringent for final goods, possibly due to political economy reasons or substitution effects. Additionally, we show that the elasticity of Chinese exports to tariffs is around −0.15, which means that about a 10% change in tariffs in country j produces a 1.5% change in Chinese exports to country j (with the opposite sign, e.g., a tariff increase produces a reduction in exports).

These conclusions have a twofold relevance for increasing our understanding of trade policy effects in general, and NTMs in particular. In the first case, we argue that it is necessary to disentangle NTMs by group (at least allowing the technical versus non-technical dichotomy to emerge) in order to fully grasp the diversity of demand- and supply side effects. In addition, we claim that in order to understand non-technical NTMs effects, is necessary to go beyond aggregate flows, as these seem to be more stringent for a particular set of products, namely final goods.

These results call for further research to find out whether NTMs have been used in substitution of traditional trade policy tools like tariffs and quotas to shelter domestic firms from the surge in international competition deriving from the decline in tariff rates(i.a., Blonigen and Prusa 2003, Konings and Vandenbussche 2005, Ketterer 2016), particularly focusing on final goods.

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Appendix I

Table A.I.1. Countries included in the database (ISO 3 digit code)

Countrie									
AFG	ARG	AUS	BEN	BFA	BOL	BRA	BRN	CAN	CHL
CIV	COL	CPV	CRI	CUB	ECU	ETH	EUN	GHA	GIN
GMB	GTM	HND	IDN	IND	JPN	KAZ	KHM	LAO	LBR
LKA	MEX	MLI	MMR	MYS	NER	NGA	NIC	NPL	NZL
PAK	PAN	PER	PHL	PRY	RUS	SEN	SGP	SLV	TGO
THA	TJK	URY	USA	VEN	VNM				

(Source) Authors' elaboration