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Non-Tariff Measures Trickling through Global Value Chains

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Abstract

In the current globalization process geographical and local production processes are intertwined through global value chains (GVC). In the presence of GVCs import tariffs therefore do not only affect the direct trading partners but also have indirect impact through international industrial linkages. This is also the case for non-tariff measures (NTMs) which have gained importance in the last decades. The paper analyses these indirect effects of these trade policy instruments in the global economy. In a four-stage approach, the cumulative impacts of trade policy measures along GVCs using the world input-output database (WIOD) are quantified. In the first stage, bilateral import demand elasticities consistent with WIOD classification are estimated. In the second stage, bilateral ad-valorem equivalents (AVE) of nine types of NTMs notified to the WTO by the end of 2011 are quantified. Then, cumulative bilateral-trade restrictiveness indices (BRIs) using the AVEs of NTMs and tariffs taking into account backward linkages are calculated. Finally, in the fourth step the impact of trade policy measures on the average annual growth of labour productivity is assessed. Summarising, the paper offers detailed BRIs for the inputs of 35 WIOD industries to 41 economies from 2002 to 2011, thus providing insights on the path of NTMs to the downstream industries and the final absorption.

Keywords: non-tariff measures, global value chains, cumulative ad-valorem equivalents, labour productivity

JEL codes: F13, F14

Deliverable 3.1

Database and analysis linking NTMs in goods and services in global supply chains

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1 Introduction

There are certain legitimate motives for the imposition of non-tariff measures (NTMs). When a foreign imported product potentially harms the domestic consumers' health, safety, animal health, environmental quality, etc. countries are allowed to restrict the importation of these products. Specific standards are regulated within qualitative NTMs such as sanitary and phytosanitary measures (SPS), and technical barriers to trade (TBTs) to assure certain standards and characteristics of imported products. Such regulations affect trade flows and prices of products at different stages of production in various ways. For instance, chemicals used in the first stages of production can be the focus of a prohibitive TBT, which can influence the cost of production for downstream products where this product is used as intermediary. In contrast, some market efficiency regulations such as mandatory labelling set within TBTs can improve the transparent information to the consumers and producers who can utilize the intermediates to their production with lower transaction costs.

The ability of the exporters to comply with the NTMs is diverse across countries. It might be the case that certain countries which are already producing in line with the imposed regulations are not harmed or even can increase their exports (due to re-direction effects or a general increase in demand due to quality improvements caused by the NTM). In contrast, some other countries' exports that are not in line with the measures in the destination market might be restricted. The consequence of a specific qualitative NTM might even result in absolute prohibition until the product complies with the implemented standards. Domestic producers in need of intermediate inputs from abroad then alter their demand to those import sources who comply with the new regulations. Therefore, responses of the domestic producers to the NTMs affecting their inputs are heterogeneous across sourcing countries depending on the exporters' capabilities to cope with the standards.

Quantitative NTMs, such as safeguards (SG), special safeguards (SSG), countervailing measures (CV), anti-dumping (ADP), and quantitative restrictions (QR) are usually imposed against restrictive or discriminative policy measures imposed by the trade partners. While the motivations behind these NTMs are not purely qualitative issues, these measures might also have some quality impact on the imported product (see Ghodsi, Jokubauskaite and Stehrer, 2015). Besides, such implemented measure might – similar to qualitative NTMs - lead to a trade creation effect. Moreover, unlike TBTs, quantitative NTMs are usually imposed bilaterally against a specific trade partner on a certain product which might lead to a trade diversion effect increasing the import from a third country. Therefore, the impact of the aforementioned quantitative NTMs might again be diverse across trading partners and products.

In addition to these seven types of NTMs, countries can raise specific trade concerns (STCs) on the TBT and/or SPS imposed by other WTO members. These STCs are raised mainly due to the trade restrictiveness of special cases of TBT or SPS. Some parts of these STCs are already notified by the

imposing country to the WTO notifications. However, some STCs are not directly notified by the maintaining member. It is argued that governments sometimes are reluctant to notify their implemented NTMs to avoid trade conflicts, which reduces the transparency of trade policies. Therefore, WTO established TBT and SPS committees to allow member states to discuss the policy measures imposed by other countries. These STCs have certain impact on bilateral trade flows, which sometimes lead to Dispute Settlement cases within the WTO (Ghodsi and Michalek, 2014).

Firms and industries are affected by (trade policy) measures through three channels. The first channel can be identified as a protectionist measure imposed against the competitors of an industry within the domestic market which is imposed by the domestic government. The second channel can refer to measures levied against the inputs of production of an industry, which usually imposes extra costs on the intermediate inputs of production in previous stages of production. The third channel comprises those measures that the industry faces while exporting to the foreign destinations. Depending on the type of measures implemented within each channel industries are affected differently.

Considering global value chains (GVCs) one can track NTMs' traces on the second channel of trade policy (TP) using measures of backward and forward linkages. Diverse impacts of various types of NTMs need to be carefully taken into consideration while studying their role in GVCs. Usually, tariffs and NTMs levied on the first-stage inputs of production exhibit a direct impact on the cost of production. However, heterogeneous effects of NTMs at previous stages of production might impact on costs and trade patterns of downstream sectors.

Therefore, the paper aims at studying such measures and the way they trickle through GVCs by assessing their role in sectoral performance across forty economies in the world. The main goal of this paper is to study the direct and indirect effects of NTMs through backward and forward linkages within GVCs, and assess their role in the growth of labour productivity of services and non-services sectors.

In order to achieve this goal, the methodological approach is divided into four stages. In the first stage, the bilateral import demand elasticities are estimated as the first major contribution in the literature. At the second stage, the bilateral impacts of nine types of NTMs on the import flows are assessed by calculating ad-valorem equivalents (AVE) of the NTMs using the above elasticities as another major contribution within the literature. The third stage provides the calculation of bilateral-trade restrictiveness indices (BRIs) that are levied against the upstream sectors of production for each sector. The fourth stage then analyses the impact of three channels of such measures on the labour productivity growth during the period.

The rest of the paper is organized as follows. In the next section we shortly overview the literature on the topic. The third section discusses the four stages of methodological approach and the data applied in the analysis. The fourth section presents the findings and, finally, section five concludes.

2 Literature

There exist a large number of recent studies acknowledging the opaque nature of NTMs. Complexity of the NTMs is argued by the diversity of the motives of the governments in addition to their various consequences. Substitutability for tariffs (Moore and Zanardi, 2011; Ghodsi, 2015a), substitutability for other NTMs (Rosendorff, 1996), and policy retaliation (Vandenbussche and Zanardi, 2008; de Almeida et al., 2012; Sanjuán López et al., 2013) are political motives behind the imposition of NTMs that might lead to trade disturbances and prohibitions. In contrast, safety, health, and environmental issues (Otsuki et al., 2001; Ghodsi, 2015a) and technological advancement and innovation are the qualitative issues that might have short term hampering impact on trade but a positive long run effect due to positive externalities (Beghin et al., 2012). The various causes of NTMs left no solid consensus for the general impact of each type of NTM among scholars. Hence, it might be more appropriate to analyse the causes and effects of each measure separately instead of giving a general conclusion regarding the diverse effect of NTMs given their ambiguity and complexity.

The estimation of the ad-valorem equivalent (AVE) for NTMs was proposed by Kee et al. (2009) using cross sectional trade data at the 6-digit level of the Harmonized System (HS) for 2002. They constrained their results to only the positive AVEs pointing at hampering effect on trade. This approach was then applied by Beghin et al. (2014) and Bratt (2014), however allowing for negative AVEs representing promotive behaviour of the NTM. In these studies, all types of NTMs were included as a dummy variable indicating whether any type of NTM was in force on the bilateral trade flow. Moreover, the estimates at the product level provided only one estimator of the impact of NTMs across all countries. The unilateral elasticities used in those studies were borrowed from Kee et al. (2008), which by construction vary across countries only through variations of import-GDP share of the given product across countries. Hence, in those studies, the variation of the AVE of all NTMs for a single product across countries only comes from the variation of import-GDP share. The shortcoming of those approaches is that the impact of the imposed NTMs by various countries on a single product is assumed to be uniform and is captured by a single estimator. Ghodsi, Grübler, and Stehrer (2015) extend the approach to have the NTMs impact varying by the importing countries using bilateral trade flows. In this study, we extend that empirical strategy differentiating the impact of NTMs by types, by products, by the imposing country, and by the exporting country facing them.

The concept of global value chains (GVC) stems from the first concepts of classical economics' *theory of value* by Piero Sraffa on his book titled 'Production of commodities by means of commodities' (Sraffa, 1975). During 1980s in a research proposal on *the modern world system*, Hopkins and Wallerstein (1977) elaborated the concept of *commodity chains* in a macro and holistic perspective as whatsoever inputs that a final consumable good needs to reach the final consumer. The process in which any types of raw materials, services, transportation mechanisms, etc., or even a food inputs into the labour at any stages of production of all those inputs used for an ultimate consumable

item was termed as *commodity chains*. Later on, Gereffi (1994) established a study framework on *global commodity chains* (GCC) in a meso or micro perspective. Industrial organization and structural governance in the economic literature of international business discussed in various studies such as Porter (1985) shifted the concept towards the GVC, which is not conceptually far from GCC. Studies such as Gereffi et al. (2005), and Gereffi and Sturgeon (2013) however, use GVC in explaining the industrial characteristics and performances through inter-firm and inter-industry relations.¹

Trade liberalization, decreasing tariffs, and other trade barriers by international and multilateral agreements lead to a dominant role of GVC in the world economy. Moreover, existing offshoring strategies, outsourcing of activities and global fragmentation of production of goods and services are emerging due to the reduced transaction costs by technological development in recent decades, such as the improvement in the information and telecommunication (ICT) services. In fact, ICT services advancement replaced the traditional transport costs, which are also parts of the GVC as major services sectors (Backer and Miroudot, 2013).

The importance of GVC was emphasized more compiling the World Input-Output Databases (WIOD) by Timmer et al. (2012). Many scholars have proposed and used frameworks to track the GVC through WIOD. Antràs et al. (2012) establishes a framework to calculate upstreamness of sectors as the stages of production within GVC to the ultimate consumable item. Using the same methodology and considering the whole world as a single economy, Hagemejer and Ghodsi (2014) find that upstreamness within the European Union (EU) New Member States (NMS) has increased due to liberalization in trade with the old member states. Backer and Miroudot (2013) also show that number of stages within the GVC has increased during 1995-2008, which indicates a dominant role of trade liberalization in global fragmentation of production. This implicates that services and manufacturing are more intertwined, and their shares of value-added in each other's value added is becoming more dominant in the globalization process (OECD, 2013).

The intertwined sectors within GVC can be referred more as a network of industries, in which a simple shock in one reflects as a butterfly effect along GVC. Considering tariffs as a policy shock to a specific sector, all users of that sector are affected along the GVC. Rouzet and Miroudot (2013) proposed a framework to calculate the cumulative effect of such a shock. In fact, their approach calculates the cumulative costs of tariffs against the inputs of a given sector. Miroudot et al. (2013) use the same methodology to estimate the cumulative tariffs on the inputs of services sectors. In fact, they track the effects of tariffs against non-services industries on the production and exports of services and find a downward trend of cumulative tariffs on services sectors for majority of countries from 2000 to 2009 due to liberalization through WTO commitments.

The relationship between productivity growth and trade openness is also widely studied in the literature (e.g. Harrison, 1996; Edwards, 1998; Frankel and Romer, 1999; Rodriguez and Rodrik,

¹ For further study on the conceptual evolution of GVC, see Bair (2005).

2001). Grossman and Helpman (1993) argue that diffusion of knowledge through the inputs of production traded to a country increases the innovative capacities and consequently productivity. Coe, Helpman, and Hoffmaister (1997) identify channels through which R&D spillovers affect the productivity. Among those channels, imports of intermediate inputs and capital goods transfer the inner technology of products produced in a country to another affecting the productivity of the producers in the destination. In addition to this direct link, other scholars found such technology spillovers from a third country in the middle of the supply chain. Lumenga-Neso et al. (2005) find an evidence of such an indirect effect of technology spillover from a country to another country that have no trade relationship on the given sector. Thus, similar to tariff shocks discussed above, it would be possible to have the effects of technology shocks along the GVC. Nishioka and Ripoll (2012) tested the direct and indirect effects of technology spillovers through intermediate inputs using the input-output tables. Using WIOD, Foster-McGregor, Pöschl, and Stehrer (2014) find a positive relationship between the growth of the R&D contents of the intermediate inputs and labour productivity growth.

Going through the selected studies within the literature, we still find some gaps to fill in. Specifically, despite the existing studies on the cumulative tariffs using the backward linkages, the literature is still lacking the measurement of NTMs along the GVC. In order to have the role of NTMs trickling through GVC, we contribute to the literature in four-fold. First, we provide bilateral import demand elasticities as an extension to previous unilateral demand elasticities provided by Kee et al. (2008) for a more recent period from 2002 to 2011. Second, we provide new ad-valorem equivalents (AVE) for nine types of NTMs capturing the effects of these policy measures' intensity varying across sectors, importers, and exporters during the period. Third, taking positive externalities associated with some NTMs in addition to their trade restrictiveness, we provide cumulative AVEs and their summations as bilateral-trade restrictiveness indices (BRI) levied on the inputs of industrial production. Fourth, having these measures, we assess the impact of encompassing trade policy measures on the growth of labour productivity consistent with the WIOD classification.

3 Methodology

As discussed earlier, the methodological approach in this paper consists of 4 stages, which will be elaborated in the following sub-sections.

3.1 Bilateral import demand elasticities

In order to calculate AVEs characterising the impact of NTMs on the quantity of the imported products, one needs to estimate the respective import demand elasticities. These import demand elasticities determine how much a one percentage variation in the price of the imported product changes the quantity of the imported product in percentage. Such import demand elasticities were

estimated by Kee et al. (2008) for the period 1988-2002, however assumed to be unilateral across countries. In contrast, this analysis considers bilateral trade flows of the Harmonized System (HS) 6-digit products as provided in the World Input-Output Database (WIOD) over the period 2002-2011. In doing so, we extend the proposed approach by Kee et al. (2008) allowing for bilateral estimates following Ghodsi and Stehrer (2015). Starting from a flexible GDP function including prices of imported products differentiated by the country of origin j and factors of production one can extend the GDP function into a semi-flexible function including only one price indicator for the estimation. This price indicator is a ratio of the price of the imported good h to country i from country j , relative to the average price of all other goods demanded in the GDP of country i . Hence, the resulting benchmark equation is to be estimated by product-exporter hj as follows:

$$s_{hij}^t(p_{hij}^t, p_{-hi}^t, v_{hi}^t) = a_{0n} + a_{hij} + a_h^t + a_{hhj}^t \ln \frac{p_{hij}^t}{p_{-hi}^t} + \sum_{m \neq l, m=1}^M c_{hm}^t \ln \frac{v_{mi}^t}{v_{li}^t} + u_{hij}^t, \quad (1)$$

$$\forall h = 1, \dots, H, \quad \forall i = 1, \dots, I, \quad \forall j = 1, \dots, J,$$

$$\kappa_{hi}^t = a_{hi} + a_h^t + a_{hj} + u_{hi}^t$$

where s_{hij}^t is the share of import value of product h from country j to country i in the GDP of the country i at time t ; p_{hij}^t is the price (unit value) of the imported product; v_{mi}^t and v_{li}^t refer to the factors m and l in the production of GDP of country i ; and p_{-hi}^t is the Tornqvist price index (Caves et al., 1982) of all other goods constructed using the GDP deflator p^t as follows:

$$\ln p_{-h}^t = (\ln p^t - \bar{s}_h^t \ln p_h^t) / (1 - \bar{s}_h^t), \quad \bar{s}_h^t = (\bar{s}_h^t + \bar{s}_h^{t-1}) / 2 \quad (2)$$

However, estimating equation (1) by each product-exporter pair would reduce the consistency of the estimates due to small number of observations, which vary only across importing countries. In order to increase the efficiency of the estimates, following Ghodsi and Stehrer (2015), we run the estimation by each product. Moreover, in order to differentiate the countries of origins we interact the price indicator $\frac{p_{hij}^t}{p_{-hi}^t}$ by the exporter dummies. Thus, equation (1) is transformed into the following equation:

$$\begin{aligned}
s_{hij}^t(p_{hij}^t, p_{-hi}^t, v_{hi}^t) &= a_{0h} + a_{hij} + a_h^t + \sum_{j=1}^J a_{hhj} \ln \frac{p_{hij}^t}{p_{-hi}^t} a_{hj} + \sum_{m \neq l, m=1}^M c_{nm}^t \ln \frac{v_{mi}^t}{v_{li}^t} + u_{hij}^t, \\
\forall h &= 1, \dots, H, \quad \forall i = 1, \dots, I, \quad \forall j = 1, \dots, J, \\
\kappa_{hi}^t &= a_{hi} + a_h^t + a_{hj} + u_{hi}^t
\end{aligned} \tag{3}$$

Equation (3) is estimated for each individual 6-digit product with the number of parameters a_{hhj} being the number of exporters (J). Using a fixed effect estimator (FE) controlling for individual specific effects (κ_{hi}^t) provides a consistent estimate of the parameters indicating the elasticities through the changes of variables over time. By construction, the share of imports in GDP is negative, which gives the import demand elasticity of good hj derived from its GDP maximizing demand function as follows:

$$\hat{\varepsilon}_{hhij} \equiv \frac{\partial q_{hij}^t(p^t, v^t)}{\partial p_{hij}^t} \frac{p_{hij}^t}{q_{hij}^t} = \frac{\hat{a}_{hhj}}{\bar{s}_{hij}} + \bar{s}_{hij} - 1, \quad s_{hij}^t < 0; , \quad \varepsilon_{hhij}^t \begin{cases} < -1 \text{ if } a_{hhj}^t > 0 \\ = -1 \text{ if } a_{hhj}^t = 0 \\ > -1 \text{ if } a_{hhj}^t < 0 \end{cases} \tag{4}$$

For the purpose of the calculation of indirect AVEs, we are bound to use the WIOD classification in our analysis. Assuming homogeneous functional forms of parameters for the HS 6-digit products within each WIOD category, and controlling for their heterogeneity using the fixed effect estimators, we estimate equation (3) for each WIOD industry encompassing all 6-digit products via the relevant concordance tables. This firstly gives us a large number of observations with a larger number of statistically significant estimators. Secondly, capturing the across products variations it controls for cross-price elasticities within each WIOD category. Kee et al. (2008) suggested another method to calculate elasticities of sectorial levels using the elasticities at disaggregated levels².

3.2 AVE for NTMs

Following the approach proposed by Kee et al. (2009)³, we use a gravity framework to estimate the impact of nine types of NTMs on the bilateral import quantity.

$$\ln(m_{ijht}) = \alpha_{1h} + \sum_k \alpha_{1k} C_{ijt}^k + \alpha_{1ht} \ln(1 + T_{ijht}) + \sum_{ij=1}^{IJ} \sum_{n=1}^N \omega_{ij} \beta_{1nh} NTM_{ijht} + \omega_{1jh} + \omega_{1t} + \mu_{1ijht} \tag{5}$$

where $\ln(m_{ijht})$ is the natural log of the import quantity of product h to country i from country j at time t ; C_{ijt}^k is the country-pair characteristics and consists of classical gravity variables and factor

² Such sectorial aggregates of elasticities can be provided upon request.

³ This approach has been extended by Ghodsi, Gr bler, and Stehrer (2015) for total imports.

endowments. It includes traditional market potential of trade partners that is the summation of both countries' GDP:

$$Y_{ijt} = \ln(GDP_{it} + GDP_{jt}) \quad (6)$$

and the economic development distance similarly used by Baltagi et al. (2003):

$$y_{ijt} = \left(\frac{GDPpc_{it}^2}{(GDPpc_{it} + GDPpc_{jt})^2} + \frac{GDPpc_{jt}^2}{(GDPpc_{it} + GDPpc_{jt})^2} \right) - \frac{1}{2}, y_{ijt} \in (0, 0.5) \quad (7)$$

In addition, C_{ijt}^k includes distance between the trading partners with respect to three relative factor endowments: labour force L , the capital stock K , and agricultural land area A_l as follows:

$$f_{mijt} = \ln\left(\frac{F_{mjt}}{GDP_{jt}}\right) - \ln\left(\frac{F_{mit}}{GDP_{it}}\right), F_m \in \{L, K, A_l\} \quad (8)$$

Further gravity variables that enter our regressions are dummy variables indicating whether both trade partners are EU and WTO members, share the same border, common languages, common colonial history, same countries, and having Preferential Trade Agreement (PTA), and also log of capital city distances from each other. Of course, using country-pair FE drops out the time-invariant variables from the regressions. In fact, ω_{1ijh} and ω_{1t} are respectively country-pair-product and time fixed effects capturing multi-resistances. Similar to the estimation of elasticities, the estimations are run by WIOD categories encompassing all corresponded 6-digit products of the HS. Thus, in order to achieve unbiased estimators robust to heteroscedasticity, we cluster the variance-covariance vectors of the error terms μ_{1ijht} by the country-pair-products.

Equation (5) incorporates the coefficients capturing the impacts of tariffs α_{1ht} and non-tariff measures on imports $\omega_{ij}\beta_{1nh}$, which in a final step are transformed to AVEs. For tariffs T_{ijht} we prioritize the data on AVEs (using UNCTAD 1 methodology⁴) on preferential tariff rates (PRF), then AVEs on most favoured nation rates (MFN), then effectively applied rates (AHS). NTM_{nijht} are count variables for $\forall n \in \{ADP, CV, SG, SSG, QR, SPS, TBT, TBT\ STC, SPS\ STC\}$ different groups of NTMs discussed earlier. For instance, $NTM_{TBTijht}$ shows the number of TBTs in force at time t (since beginning) maintained by country i on product h against trade partner j . This in fact is one of the major contributions of this paper capturing the intensity of each type of NTM. In order to obtain bilateral-product-specific AVEs of NTMs, we interact NTM variables with country-pair dummies ω_{ij} . However, including all country-pair interactions with all NTMs would exhaust all degrees of freedom. Therefore, we run the regression nine times (for each NTM type) for each product. Each time one of the NTMs is interacted with the bilateral dummy whereas the rest of the NTMs are kept as control variables.

⁴ UNCTAD/WTO (2012)

In a last step, we consider all coefficients of NTMs ($\omega_{ij}\beta_{2nh}$) to derive their corresponding AVEs. For this purpose, bilateral import demand elasticities ε_{ijh} from previous stage are used. AVEs are obtained by differentiating import equation (5) with respect to each of the count variables for NTMs:

$$ave_{nijh} = \frac{1}{\varepsilon_{ijh}} \frac{\partial \ln(m_{ijh})}{\partial NTM_{ijh}} = \frac{e^{\omega_{ij}\beta_{1nh}} - 1}{\varepsilon_{ijh}} \quad (9)$$

Summarising, as discussed earlier, this approach improves the estimates of the impact of NTMs and the calculations of AVEs compared to previous studies by additional information on the intensity of various types of NTMs. The reason for this is that variations in ave_{nijh} are not only due to the variations in the imports share to GDP across countries within the estimated bilateral-import demand elasticities, but also by the variations in the diverse effect of each NTM imposed against a specific trade partner. After estimation of AVEs for each type of NTM, we calculate the bilateral restrictiveness index (BRI_{ijh}) as the summation of all AVEs and weighted average tariff during 2002-2011 imposed by country i against h imported from country j .

3.3 Cumulative AVEs in GVCs

Following Miroudot et al. (2013) the AVEs of NTMs and tariffs using the concept of cumulative tariffs along the GVC can then be tracked. For notational convenience, denote the various types of AVEs calculated in the previous stage for the period 2002-2011 by BRI . Each industry h in a given country j is influenced by three channels of trade policy measures TP_{jht} .

The first channel of trade policy is comprised of the direct protectionism trade policies (DBRI) that the government imposes in order to support the domestic industries. In fact, these measures protect the domestic industry by reducing the fierce competition. The second channel affects the intermediate inputs of the given industry, which as elaborated above is captured by indirect trade policy measures (IBRI). Depending on the type of trade policy tool in this channel, technological progress of a given industry can be affected diversely because of some quality improvement of the inputs along backward linkages of GVC. Finally, the third channel includes the trade policy measures that the industry is facing while exporting to other destinations (BRI). According to the new trade theories, the relatively more productive firms can be able to afford higher costs of exports incurred by tariffs or qualitative regulations.

When country i imposes a BRI on a specific sector h imported from country j , as the price of the imported product increases by BRI_{ijht} , domestic production of the sector benefits from the direct BRI (DBRI), while consumers lose. However, the downstream domestic sectors utilizing the importing sector's products with higher prices also bear costs from the BRI. Thus, the impact of the indirect cumulative BRI (IBRI) is reflected as costs along later stages of production utilizing the affected sectors' output as inputs.

In order to calculate IBRI similar to Miroudot et al. (2013) assume that the imported product from country j is produced proportionally from the intermediate inputs used in the sector h that are imported from all other countries (including i) with levied BRI. The BRI paid for the production of one unit h in country j is thus $\sum_{ks} a_{ksjh} BRI_{jks}$, where $a_{ks,jh}$ is the technical coefficient of the sector s from country k that is used in the production of sector h in country j as input, and BRI_{jks} is the imposed BRI on the import of industry s to country j . Going one stage further backward, one needs to take into consideration the BRI imposed on the inputs of the above calculated stage as $\sum_{xz} \sum_{ks} a_{ksjh} BRI_{jks} a_{xzks} BRI_{kxz}$, where a_{xzks} is the amount of sector z from country x used in the production of sector s in country k . Adding up all other imposed BRI at previous stages of production, one obtains IBRI. For simplicity, instead of denoting country-sector pairs separately (i.e. as ih), denote each pair by a unique subscript (e.g. as i); there are J country-sector pairs. Thereby, BRI_{ij} is the BRI imposed on the import of country-sector i to country-sector j . Using matrix algebra, this approach can be summarised as follows:

$$IBRI = \left[e \times B \times \sum_{n=0}^{\infty} A^n \right]' = [e \times B \times [I - A]^{-1}]' \quad (10)$$

where A^n is a J by J matrix of technical coefficients, e is a row vector of ones, B is a J by J matrix of element-by-element multiplication of technical coefficients and tariffs $B = A \times T$. At the end, IBRI is a column vector indicating the IBRI for the inputs of production of each country-sector. Technical coefficients are calculated using the Leontief inverse of the WIOD.

The AVEs calculated in the previous stage are for the period 2002-2011, which indicate the impact of NTMs over time. Therefore, in order to have IBRI over the whole period, the average of technical coefficients over the period, i.e. $A = \frac{1}{10} \times \sum_{t=2002}^{2011} A_t$ is used. For bilateral tariffs we use the import weighted average bilateral tariffs during the period. Moreover, indirect AVEs of all nine types of NTMs are referred to as INTMs.

3.4 Data

At the heart of the dataset is the WTO I-TIP notifications database on NTMs as documented in Ghodsi, Reiter, and Stehrer (2015). Import data for all WIOD economies (except Taiwan as the importing country) were taken from the UN COMTRADE database and complemented by the TRAINS database. The data for the rest of the world (ROW) is the aggregation of all other economies in the world. We consider AVEs of tariffs at the HS 6-digit level from TRAINS. Wherever AVEs for tariffs are not available, preferential tariff rates (PRF), most-favoured nation tariff rates (MFN), and effectively applied rates (AHS) are included in respective orders. These data are corresponded to

WIOD classification for the first and second stages of analysis using relevant concordance tables. It is important to note that for the intra-EU trade, tariffs and NTMs are set to zero for the common trade policy within the EU and in order to keep the trade observations between the EU members.

Data on factor endowments (labour force, capital stock) as well as GDP are retrieved from the Penn World Tables (PWT 8.1); see Feenstra et al. (2013 and 2015). The latest update of the PWT includes data for 2011, which constrains the AVEs for NTMs to the period 2002 to 2011. Output-side real GDP per capita at chained PPP in 2005 USD are used for the computation of the similarity index, while expenditure-side real GDP at chained PPP in 2005 USD was considered for representing the traditional market (demand) potential. Information on agricultural land was taken from the WDI of the World Bank and wherever not available is obtained from Food and Agriculture Organization of the United Nations Statistics (FAOSTAT)⁵. CEPII provides data on commonly used gravity variables as mentioned above. As stated above, technical coefficients are calculated using the inverse Leontief of the WIOD.

4 Descriptive results

This analysis results in several datasets for the period 2002-2011. First, we provide a dataset on bilateral import demand elasticities estimated for each WIOD industry, estimated at the level of HS 6-digit products aggregated to WIOD industry levels. Second, by estimating the AVE for NTMs, we have a dataset of direct bilateral AVE for nine types of NTMs imposed against 6-digit products within each WIOD industry level imported to a country. Moreover, the summation of all AVEs and average tariffs within each WIOD industry gives a dataset on BRI and DBRI. Third, using the input-output techniques, we construct a dataset of IBRI indicating the restrictiveness on trade of the inputs to a specific country-sector within WIOD classification. Besides, such a dataset is constructed on the AVE for each type of NTM affecting the trade of inputs of production during the period. The elasticity and direct AVE datasets are available for only manufacturing industries. Indirect restrictiveness indices dataset is compiled for both services and non-services WIOD sectors using the input-output linkages.

Only the estimation results that are statistically significant at 10% level are included in the analysis. Besides, AVEs are constrained to 100 in absolute terms. The intuition behind this restriction is that an NTM that works as a subsidy rather than a tariff cannot reduce the price of a given product import by more than 100%. It is important to note that the AVEs are not constrained to only positive ones indicating restrictiveness, and positive elasticities are not dropped out indicating luxurious or Giffen goods. This means that for some bilateral flows, some NTMs promoted trade resulting in negative AVE. Table 1 presents some summary statistics of direct AVEs. Both positive and negative AVEs are

⁵ See: <http://faostat.fao.org/site/377/DesktopDefault.aspx?PageID=377#ancor>

included. For instance, TBT in average work as a tariff of 0.20%, while there are 3526 positive AVEs for TBTs with the magnitude average of a 10.46% tariff; there are 3391 negative AVE for TBTs with the average subsidy-equivalent of 9.29%.⁶

Table 1 – Direct AVE statistics

NTM	Sample Mean	Mean AVE>0	No. AVE>0	Mean AVE<0	No. AVE<0
ADP	-0.00081	18.51141	593	-15.7574	698
CV	0.057959	20.9505	156	-11.1088	157
QR	0.286486	14.45192	871	-5.80876	870
SG	0.112203	19.84517	320	-9.57677	355
SPS	0.061192	11.63205	2653	-11.1261	2629
SPS STC	-0.05986	14.99955	399	-23.33	324
SSG	0.070455	19.48769	157	-7.44894	162
TBT	0.204682	10.46093	3526	-9.29003	3391
TBT STC	0.038552	11.91209	1033	-12.6585	892

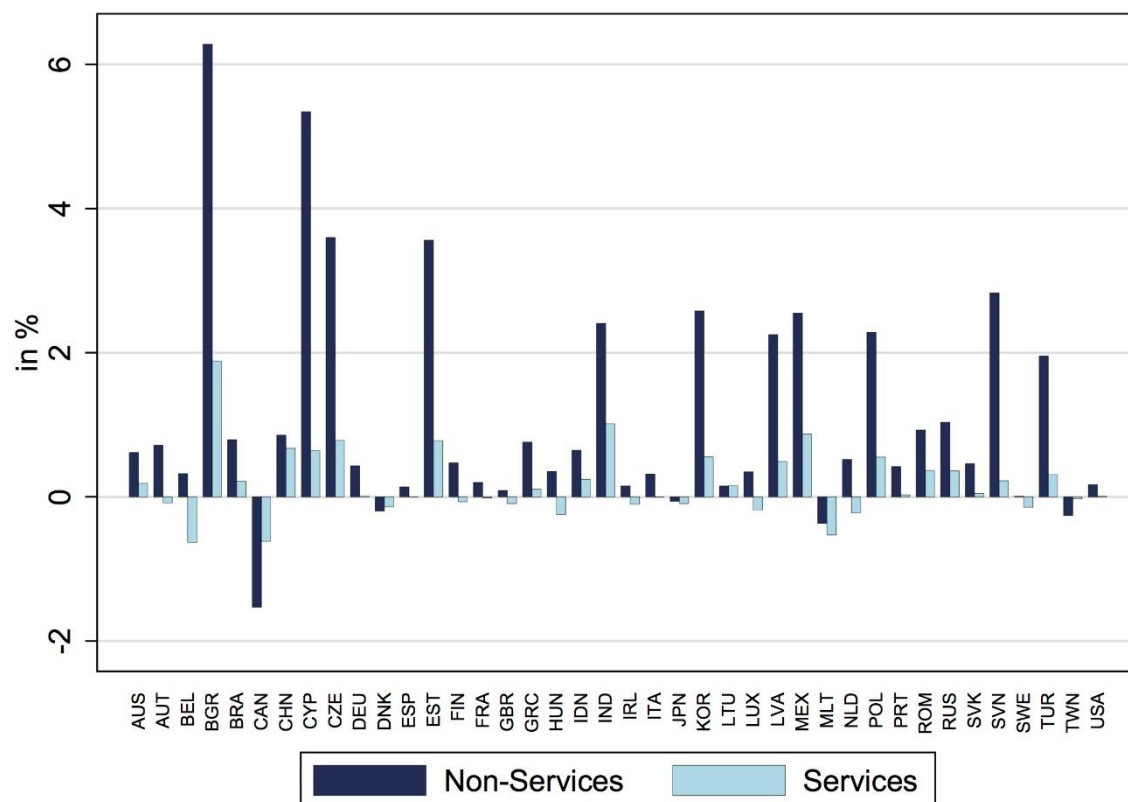
Source: Authors' calculations.

Next, we present the indirect bilateral restrictiveness indices (IBRI) that are tariff-equivalents (TE) levied against the inputs of production along the GVC. These results are aggregated using simple average that is equivalent to tariffs or subsidies in percentages. Thus, percentage shows ad-valorem restrictiveness of NTMs. Besides, in the appendix the indirect AVEs for each NTM on the inputs of production are presented by country.

Figure 1 indicates that these IBRIs range up to 6.28% as tariff-equivalents for most countries – not considering negatives now - and are generally larger for manufacturing industries as compared to services industries. In some countries these IBRIs for manufacturing are however much larger; these countries are Bulgaria, Cyprus, Czech Republic, India, Latvia, Mexico, Poland, Slovenia and Turkey.

⁶ For a detailed description of results with respect to AVEs see Grübler et al. (2016).

Figure 1 – Average IBRI – accumulated BRI on inputs by country



Source: wiiw calculations.

Despite positive indirect accumulative tariffs on inputs (see Figure 3 in the appendix) the average IBRIs are negative for some countries (Figure 1). For instance, Canada on average benefits from the global trade policy measures with average negative IBRIs including AVEs from both tariffs and NTMs. This suggests that Canadian providers benefit from trade policy measures that promote the trade of their inputs of production along the GVC. This happens for both Canadian services and non-services sectors. On the other hand, Bulgarian suppliers incur larger losses for more expensive inputs due to trade restrictive NTMs. While normal tariffs induce above 1% indirect tariffs (Figure 3 in the appendix) to the Bulgarian inputs for manufacturing sectors, NTMs induce around 5% in average, which in total make the average BRI on Bulgarian inputs to above 6%.

As mentioned above, no tariffs are levied against trade flows of services. However, service providers are indirectly affected by the policy measures imposed against the non-services inputs for their production. In general, services are less impacted due to no direct impacts and the lower linkages. For some countries - such as Belgium - service inputs are promoted on average by the global trade policy measures while the inputs for the manufacturing have become expensive due to such measures.

Figure 2 – Accumulated AVE on inputs by sectors (IBRIs), in TE %

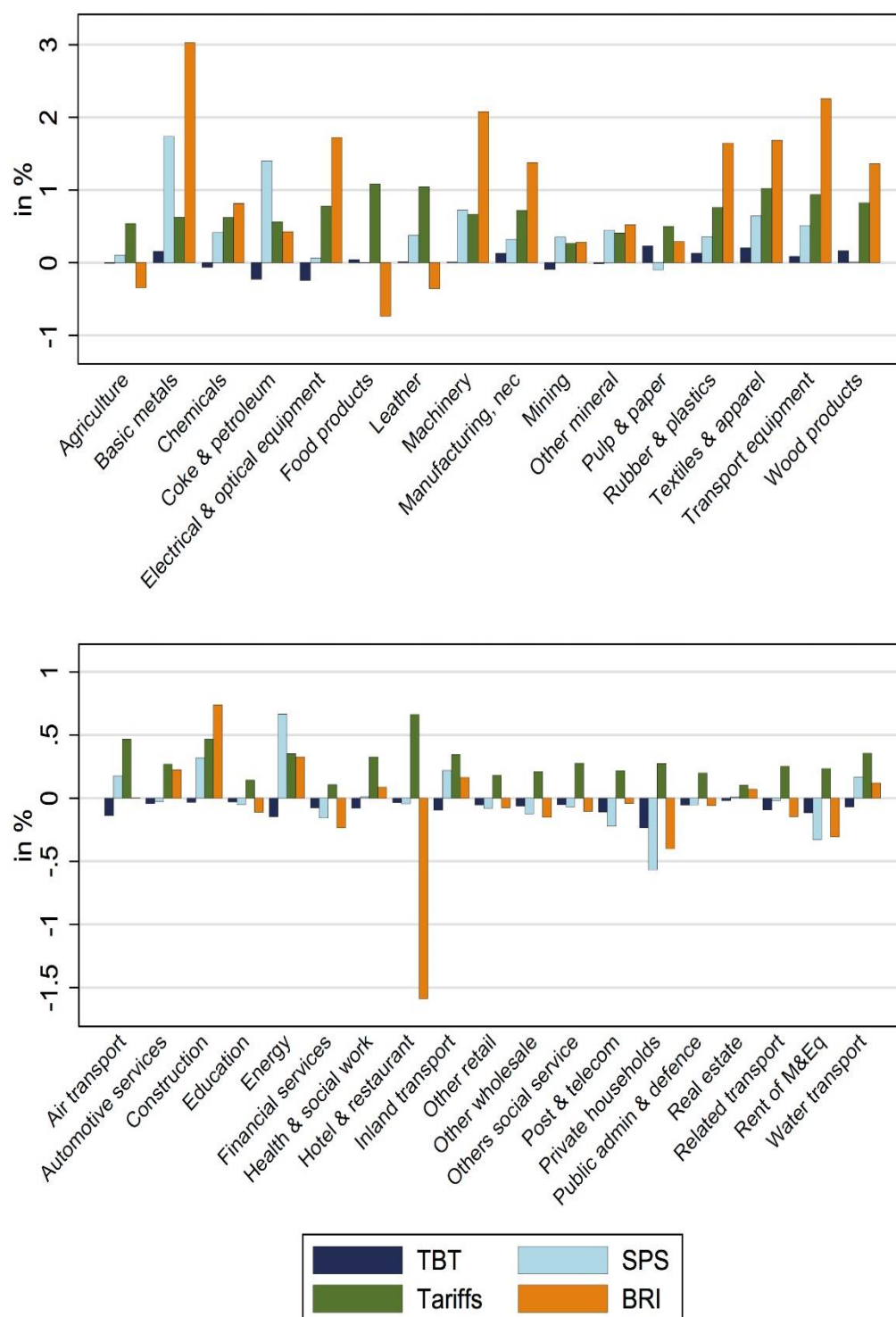


Figure 2 shows the effects of the respective trade policy measures by industry. For instance, TBTs improve the cost efficiency of the inputs for the production of electrical and optical equipment, while SPS, tariffs, and average BRIs increase the costs of inputs for these industries. An interesting pattern emerges for the services sectors, where the majority of BRIs and AVEs for NTMs show negative

signs (see figures in the appendix). In fact, while tariffs levied on manufacturing products increase the costs of inputs for service providers, regulated NTMs reduce these costs. Market efficiency regulations enhancing the information symmetries which are directed within TBTs are good examples that can act in opposite direction of tariffs.

5 Impact on performance measures

The bilateral AVEs of NTMs imply different cost structures for the direct but also indirect users of intermediate inputs.⁷ The higher cost of intermediate inputs does not necessarily harm production. For instance, as argued earlier, a higher quality induced by qualitative regulations embodied within NTMs along the GVC, could bring inputs of production with higher prices. However, such a higher quality can reflect in either higher quality of final product or better production procedure. Both will result in higher gross output, while the latter is caused by higher value-added, the former is caused by the higher price for higher quality of final goods. In this section the relation between BRIs and IBRIs on productivity growth is considered.

5.1 Methodological outline and data

As discussed above, IBRI indicates the extent to which intermediate inputs are affected by trade policy measures. From a simple Cobb-Douglas function $Y_{jht} = \Psi_{jht} K_{jht}^\alpha L_{jht}^{1-\alpha}$, $\Psi > 0$, $0 < \alpha < 1$ (where, Y, Ψ , K, and L are output, technology, capital, and labour, respectively), and then taking first differences of the logarithmic labour intensive form, we can obtain labour productivity growth as:

$$\Delta y_{jht} = \Delta \Psi_{jht} + \alpha \Delta k_{jht} \quad (11)$$

where y_{jht} and k_{jht} are respectively logarithmic forms of output to labour (productivity) and capital to labour ratios, and $\Delta \psi_{jht}$ is the technological progress of industry h in country j at time t, which we hypothesize to be a function of trade policy channels and the share of high-skill labour in the given industry $\Delta \psi_{jht} = \gamma_0 TP_{jht} + \gamma_1 HS_{jht}$.

Since the aforementioned AVE for an NTM on a given industry is a constant effect over the period, we will analyse its impact on the period-averaged annual productivity growth. Plugging the hypothesized technology growth function into equation (11), and using the initial productivity levels to account for convergence, we use the following growth model in our econometric analysis:

⁷ NTMs also impact on trade flows as such which are not considered here.

$$\begin{aligned}\overline{\Delta y_{jh}} = & \beta_0 + \beta_1 y_{jh,t0} + \beta_2 \overline{\Delta k_{jh}} + \beta_3 \overline{HS_{jh}} + \beta_4 \overline{DBRI_{ijh}} + \beta_5 \overline{IBRI_{jh}} + \beta_6 \overline{BRI_{jh}} + \gamma_h \\ & + \gamma_{ij} + \mu_{ijh}\end{aligned}\quad (12)$$

where $\overline{\Delta y_{jh}}$ is the average annual labour productivity growth of industry h in country j from 2002 to 2009, $y_{jh,t0}$ is the initial level of productivity in logarithmic form, $\overline{\Delta k_{jh}}$ is the average annual growth of capital to labour ratio, $\overline{DBRI_{ijh}}$ includes the AVEs for nine types of NTMs and period-averaged tariffs imposed by country i against sector h from country j ; $\overline{IBRI_{jh}}$ refers to the indirect tariff equivalents of nine types of NTMs and tariffs on the inputs of industry h in country j ; $\overline{BRI_{jh}}$ includes import-weighted AVEs and tariffs imposed by country j on sector h ; γ_h and γ_{ij} are respectively industry and country-pair specific effects, and μ_{ijh} is the error term. Since we have a cross section data, we use normal OLS for the estimation of equation (12) with robust standard errors to correct for possible heteroscedasticity.

Data on gross output (GO), value added (VA), employment (l), and sectorial deflator for the fourth stage of analysis are obtained from the WIOD SEA data. Finally, we borrow a data compilation for Preferential Trade Agreements (PTAs) as reported by the WTO.

5.2 Results

Let us summarize the results of this investigation. The estimation of equation (12) is separated into two categories, services and non-services sectors. This separation is mainly done because no tariff data are available for services. Intuitively, IBRI affect the intermediate inputs of production of services sectors as well as non-services sectors.

For labour productivity, we use two measurements to study the issue. One is the real gross output divided by employment, and the other is the real value added divided by employment. Sectorial value added deflators and exchange rates are used to calculate the real values from the national currency units. This constrains the period of analysis to 2009.

The results indicate that there is no impact of any trade policy measures of the aforementioned first channel (i.e. DBRI) on productivity growth of domestic industries, thus, we present the estimation results excluding them including the two other channels. Table 2 presents the estimation results of the impact of BRI and IBRI on the average annual labour productivity growth. As discussed earlier, we separate the estimations on services and non-services sectors, because there are no tariffs levied on services sectors.

Table 2 – Direct and Indirect BRI Impact on Productivity Growth

Dep. Var:	Non-services		Services	
	$\overline{\Delta y_{jh}^{VA}}$	$\overline{\Delta y_{jh}^{GO}}$	$\overline{\Delta y_{jh}^{VA}}$	$\overline{\Delta y_{jh}^{GO}}$
$y_{jh,2002}$	-0.80*** (0.11)	-2.95*** (0.23)	-1.18*** (0.11)	-1.15*** (0.11)
\overline{HS}_{jh}	20.4*** (1.09)	20.4*** (1.32)	0.12 (0.35)	-0.094 (0.35)
$\overline{\Delta k}_{jh}$	9.38*** (0.49)	4.97*** (0.69)	19.3*** (0.87)	9.78*** (0.70)
BRI	0.00026 (0.0010)	0.00074 (0.0012)		
IBRI	0.29*** (0.024)	0.32*** (0.035)	-0.55*** (0.046)	-0.37*** (0.045)
Constant	2.75*** (0.34)	0.78 (0.55)	2.80*** (0.18)	6.13*** (0.15)
N	25707	25707	29069	29069
R-sq	0.401	0.317	0.451	0.424
adj. R-sq	0.360	0.269	0.418	0.389
Sector FE	Yes	Yes	Yes	Yes
Bilateral FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

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

Source: wiiw calculations.

Control variables show the expected effects on productivity growth. It is important to note that the dependent variable is the average annual growth rate in percentages to make them comparable with the BRI and IBRI that are also in percentages. Thus, we observe large coefficients of human physical capital. Negative statistically significant coefficients of initial productivities indicate the convergence of growth, meaning that sectors with lower initial productivity have larger average annual growth during the period. Non-services sectors with larger average share of high-skill labour (HS) enjoy larger productivity growth. Statistically positive significant coefficients of physical capital to labour ratio growth indicate how labour productivity is enhanced by capital.

Results do not show a statistically significant impact of the BRIIs imposed against the sector's exports on the average annual growth of labour productivity. This is consistent for both types of productivity measures. We mentioned earlier that DBRI had also statistically insignificant coefficients, which indicate that neither BRI faced by the exporting sector nor DBRI faced by the foreign competitors of the given sector influences the growth of productivity.

However, coefficients are statistically significant for IBRI and are positive for commodities (non-services) and for services. Thus, labour productivity growth is affected positively by the trade policy measures imposed against the inputs of a given non-service sector. This effect is larger for the productivity calculated using the real gross output (GO). While value-added is net of the inputs, we still observe positive influence of input trade policy measures on the productivity. Concerning

services, results suggest that services sectors with larger average annual productivity growth are those with smaller costs of inputs. Global trade policy measures reducing the price of inputs for service providers lead them to be more productive during years.

As discussed earlier, different types of policy measures have diverse impact on trade flows for various reasons and consequently affect the productivity differently. In Table 3, we present the estimation results of labour productivity growth over various types of policy measures. Many of these policy measures against the exporting sectors do not have any statistically significant impact on productivity growth of the sectors. Not even bilateral tariffs influence the growth of productivity. Non-services sectors whose export flows are hindered by ADP and SPS STC measures to a larger extent are the ones with larger average annual labour productivity growth. In contrast, smaller productivity growth is related to the non-services sectors whose exports are largely hampered by the CV and TBT STC measures.

The interesting results in Table 3 are the diverse impact of trade policy measures against the inputs of sectors on productivity growth. Statistically significant positive coefficients of ITBT and ISPS in non-services sectors point at the positive influence of quality regulations embodied in these measures further up the value chains. Large AVEs for TBT and SPS indicate trade restrictiveness of these measures increasing the price of inputs for production. In spite of higher costs of inputs induced by these measures, VA productivity growth is improved. While ISPS increases also GO productivity growth, ITBT does not influence GO productivity growth significantly. Robustness checks⁸ indicate that excluding the initial GO productivity result in statistically significant positive coefficients for ITBT. In fact, ITBT is negatively related with the initial GO productivity. These results point towards the fact that TBTs hit the inputs of the least productive sectors at the beginning of the period much more effectively, and induce them to be more productive in VA terms. Nevertheless, ITBT and ISPS are negatively linked with the labour productivity growth of services sectors. This might point at the shortcoming of these regulations in favour of services. Indirect cumulative AVEs for ADPs against the inputs of non-services sectors have also positive impact on the productivity growth. While the increased prices of inputs by ADP are linked with larger VA productivity growth of services, they are related to lower growth of labour productivity calculated using GO.⁹

⁸ Robustness checks can be provided up on request.

⁹ This puzzling role of ADP was also highlighted in other studies such as Ghodsi, Jokubauskaite, and Stehrer (2015)

Table 3 – Direct and Indirect Policy Measures Impact on Productivity Growth

Dep. Var:	Non-services		Services	
	$\overline{\Delta y_{jh}^{VA}}$	$\overline{\Delta y_{jh}^{GO}}$	$\overline{\Delta y_{jh}^{VA}}$	$\overline{\Delta y_{jh}^{GO}}$
$y_{jh,2002}$	-0.85*** (0.11)	-2.98*** (0.23)	-1.14*** (0.11)	-1.21*** (0.12)
\overline{HS}_{jh}	20.8*** (1.12)	20.8*** (1.35)	0.10 (0.36)	-0.29 (0.36)
$\overline{\Delta k_{jh}}$	9.68*** (0.49)	5.46*** (0.70)	19.7*** (0.89)	10.0*** (0.71)
ADP	0.0076** (0.0031)	0.0062* (0.0034)		
CV	-0.029*** (0.0088)	-0.012 (0.0083)		
QR	-0.0055 (0.0039)	-0.0044 (0.0044)		
SG	0.0012 (0.0047)	0.0030 (0.0049)		
SPS	-0.00087 (0.0022)	0.00034 (0.0025)		
SSG	0.0022 (0.0067)	-0.0038 (0.0082)		
TBT	0.00029 (0.0025)	-0.00092 (0.0034)		
TBTSTC	-0.0054* (0.0033)	-0.0031 (0.0035)		
SPS STC	0.015*** (0.0030)	0.017*** (0.0033)		
Tariffs	0.0035 (0.0047)	0.0032 (0.0061)		
IADP	0.64*** (0.061)	0.29*** (0.071)	0.91*** (0.17)	-1.47*** (0.17)
ICV	-0.099 (0.093)	-0.023 (0.100)	-1.33*** (0.36)	-0.011 (0.30)
IQR	0.15 (0.22)	-0.53** (0.21)	-0.35* (0.19)	-0.91*** (0.25)
ISG	-0.086 (0.093)	-0.18 (0.14)	0.61 (0.57)	-1.23** (0.54)
ISPS	0.58*** (0.048)	0.70*** (0.078)	-1.31*** (0.068)	-0.89*** (0.071)
ISSG	-0.57 (0.36)	0.056 (0.51)	-3.09*** (0.23)	-1.41*** (0.25)
ITBT	0.31*** (0.047)	-0.020 (0.044)	-1.88*** (0.18)	-1.93*** (0.19)
ITBT STC	-0.27*** (0.063)	-0.42*** (0.10)	2.02*** (0.29)	2.87*** (0.32)
ISPS STC	0.80*** (0.12)	1.66*** (0.18)	-1.81*** (0.57)	1.14* (0.62)
ITariffs	-0.092*** (0.034)	0.44*** (0.071)	0.45*** (0.072)	1.16*** (0.076)
Constant	2.66*** (0.35)	0.56 (0.54)	3.19*** (0.20)	4.93*** (0.21)
N	25707	25707	29069	29069
R-sq	0.407	0.322	0.456	0.432
adj. R-sq	0.365	0.275	0.423	0.397
Sector FE	Yes	Yes	Yes	Yes
Bilateral FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

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

High costs of inputs induced by QR do not significantly affect the VA productivity growth of non-services sectors. IQR mainly influence the GO productivity growth, which shows no relevant role of these measures in qualitative performance of industries. Despite no influence of SG and SSG on the productivity growth of non-services sectors, the results indicate a negative relationship between these measures and services labour productivity growth.

Governments raise STCs on TBTs that are more trade restrictive harming their domestic industries (Ghodsi, 2015a). ITBT STC coefficients point at a similar intuition that higher costs of inputs induced

by trade restrictive TBT STCs are linked with smaller annual productivity growth of non-services sectors. However, the TBT STC-induced higher prices of inputs increase the productivity growth of services. Cumulative AVEs of SPS STCs incurring higher costs of inputs are linked with larger productivity growth of non-services sectors. However, they are linked with lower VA productivity growth of services sectors.

Another interesting result concerns the impact of indirect tariffs on inputs. Despite the small magnitude of tariffs incurred along the GVCs due to liberalization process, manufacturers are affected by them statistically significantly. Positive coefficient for the GO productivity growth and negative coefficient for the VA productivity growth mainly indicate that producers increase their price of products and services due to higher costs of inputs. However, this is a burden on non-services industries leading to lower VA productivity growth.

6 Conclusions

In this paper we track the non-tariff measures (NTMs) and study how they trickle through the global value chains (GVCs). The importance of the NTMs as complex trade policy measures is highlighted in various studies of the international trade policy literature. The opaque nature of NTMs distinguishes them from normal tariffs since they have qualitative impact on products flows in addition to price effects. While price effects incurred further up the value chains can be easily tracked along GVC, impact of NTMs on quality of upper stream sectors influence the production processes along GVC. In this paper, we present a framework to quantify such impacts.

In a four-stage approach we estimate the trickling down effect of NTMs and tariffs on labour productivity growth. The first stage estimates the bilateral import demand elasticities applying a semi-flexible translog GDP function using detailed 6-digit bilateral trade flows. The second stage quantifies the bilateral ad-valorem equivalents (AVE) of nine types of NTMs notified to the World Trade Organization (WTO) until 2011 applying a structural gravity model on traded quantities and using the elasticities calculated in previous stage for the period 2002-2011. The third stage uses these estimated AVEs of the various types of NTMs and the average tariffs for the period to calculate the cumulative indirect bilateral-trade restrictiveness indices (IBRI) for the inputs of production applying the Leontief technical coefficients consistent with WIOD. Three channels of trade policy measures are discussed as possible channels affecting the performance of industries. The first channel affects the foreign competitors of a given industry through direct trade protectionism measures (DBRI). Second channels are considered to be IBRI. Third channel is discussed as trade policy measures faced by the exports of a given sector (BRI). The final stage of the paper analyses the impact of these three channels of trade policy measures on the average annual labour productivity growth.

The contribution of this paper is two-fold. We firstly provide a database for bilateral AVEs of NTMs. This contributes to the existing literature in different ways: a dataset on bilateral AVEs for nine types

of NTM notified to the WTO during a period based on their intensity is a major contribution of this paper. Secondly, we explain labour productivity growth by various types of global trade policy measures incorporated along the GVC. The results point towards a positive influence of regulations embodied within TBTs and SPS further up the value chains on the performance of non-services industries. Moreover, diverse effects of different types of NTMs are in line with the existing argument within the literature on complexity of these trade policy tools.

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Appendix

Figure 3 – Average Indirect Tariffs on Inputs by Country

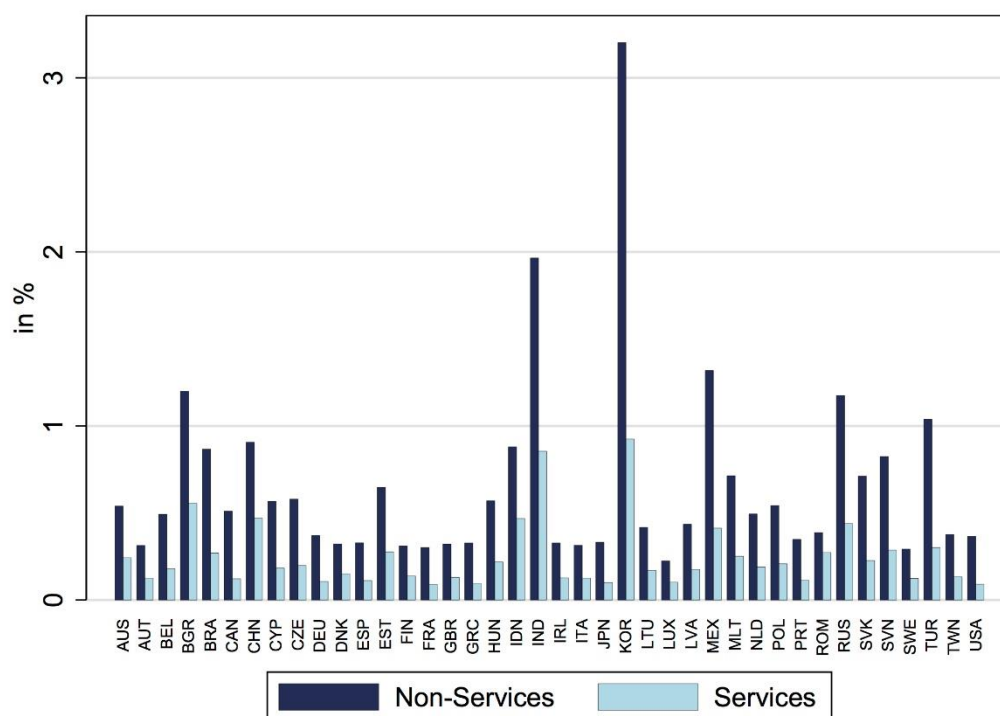


Figure 4 – Average tariff-equivalent (TE) for TBT on Inputs by Country

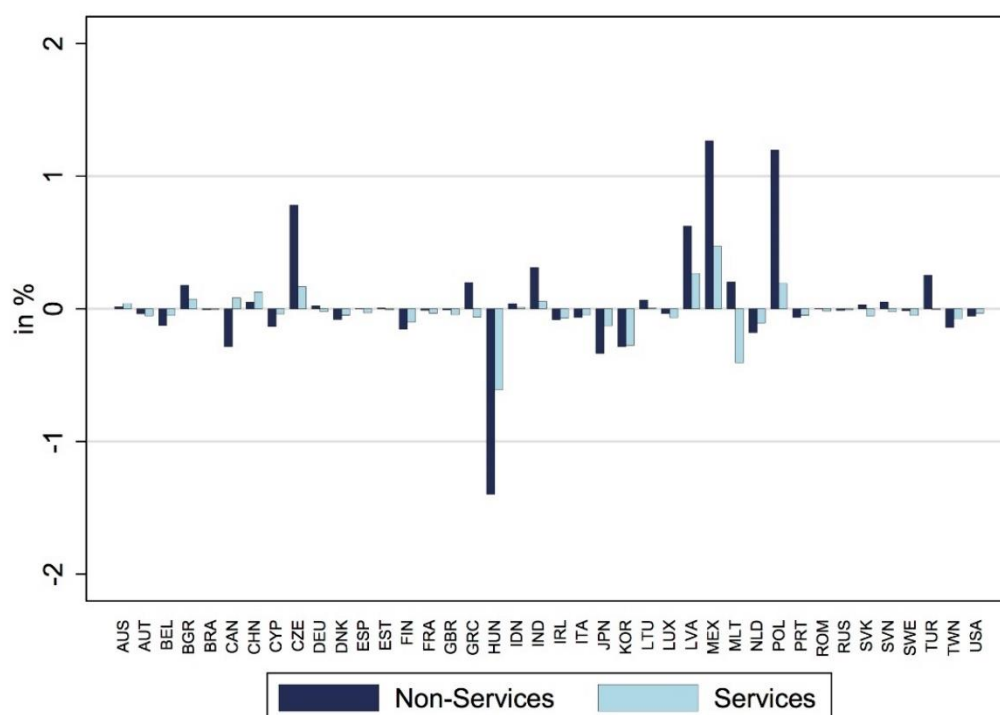


Figure 5 - Average TE for TBT on Inputs by Country

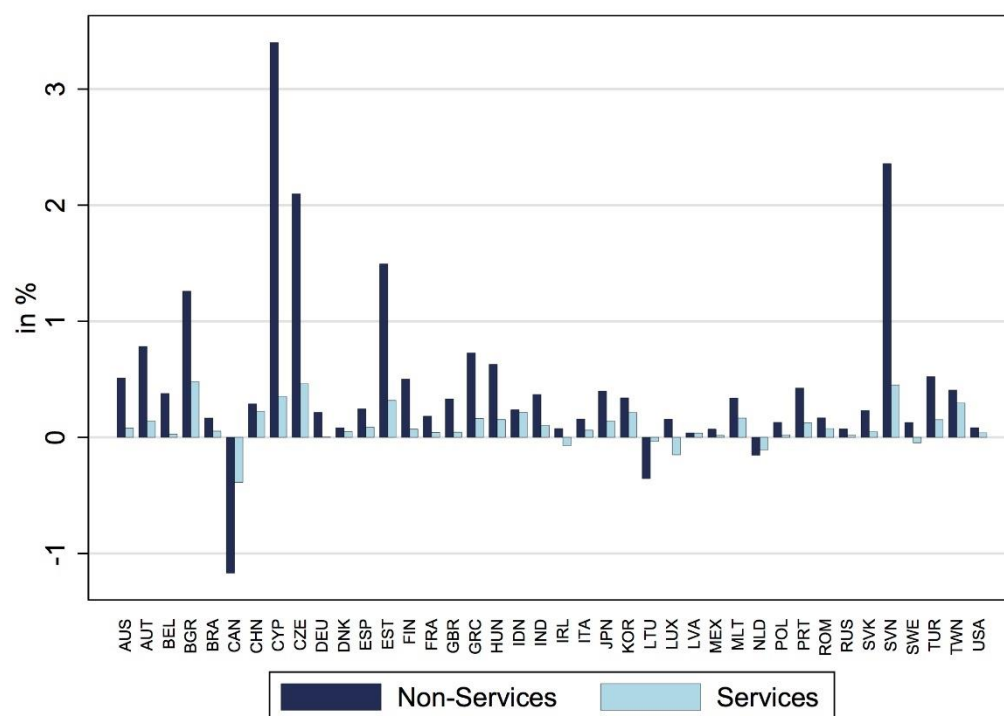


Figure 6 - Average TE for TBT STC on Inputs by Country

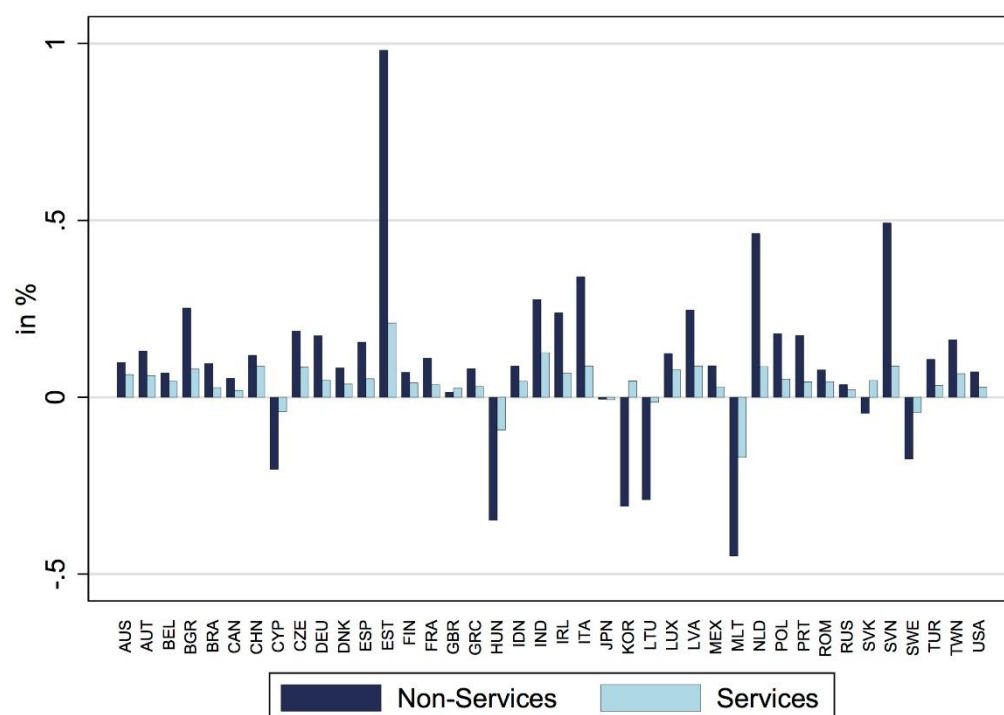


Figure 7 - Average TE for SPS STC on Inputs by Country

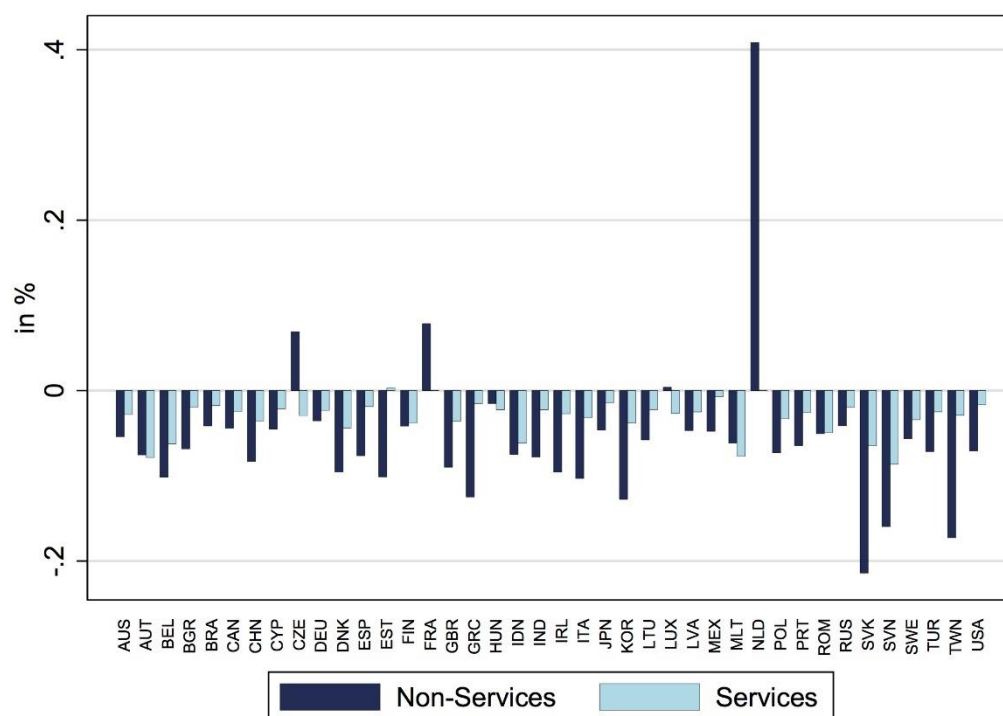


Figure 8 - Average Te for ADP on Inputs by Country

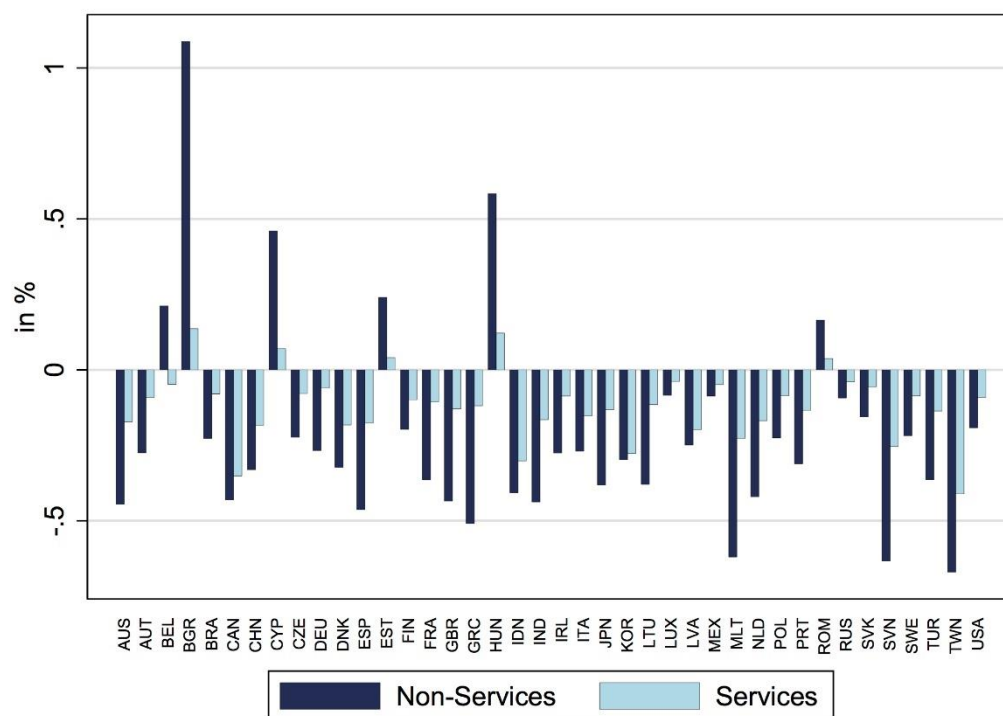


Figure 9 - Average TE for CV on Inputs by Country

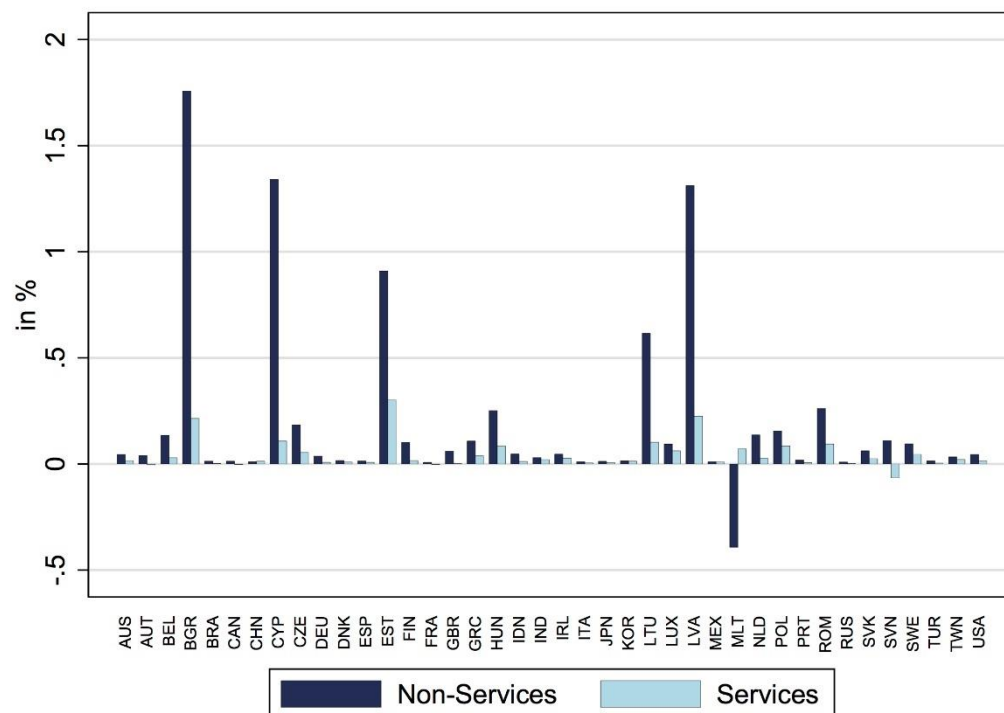


Figure 10 - Average TE for QR on Inputs by Country

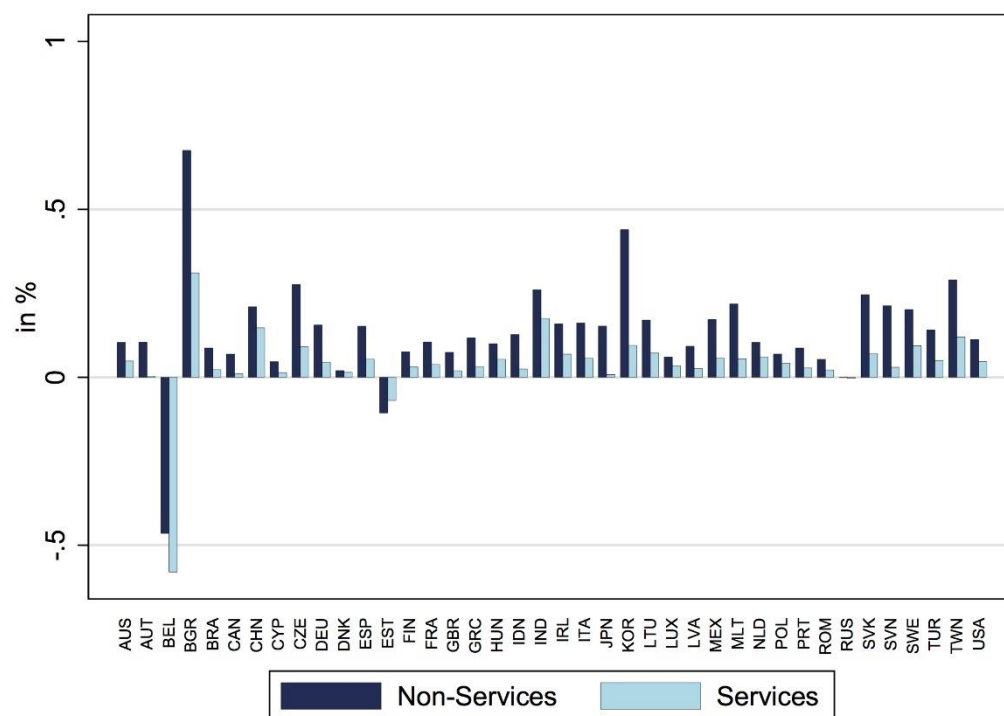


Figure 11 – Average TE for SG on Inputs by Country

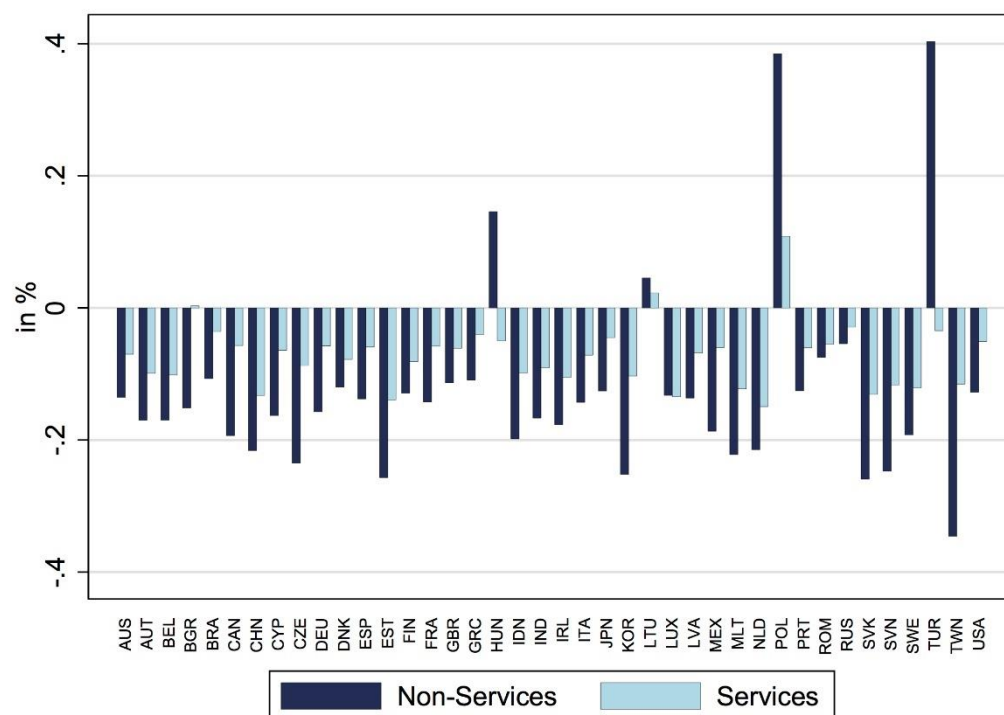


Figure 12 - Average TE for SSG on Inputs by Country

