# How the Reduction of Regulatory Barriers to Trade in Services may Affect the Architecture of Global Value Chains: The Case of TISA

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## 1. Introduction

Significant reductions in tariff and nontariff barriers as well as advances in information technology over the last decades have allowed countries to expand their production process beyond national borders, reflecting the increasing relevance of trade in intermediates. Nowadays, over two-thirds of global exports correspond to trade in intermediate goods and services, allowing firms to specialize in stages of production and reap the benefits of extra gains in productivity through connection into global/regional value chains (Baldwin and Lopez- Gonzales 2013, Baldwin 2016).

A main feature of current global/regional value chains is the strategic role played by the services sector. According to OECD (2016), services contribute to global exports in their own right, but also as inputs into the production process of commodities and manufacturing exporters in particular. Measuring trade in value-added terms reveals the underlying importance of competitive services for exports of extractive and manufacturing goods, two key sectors in global/regional value chains. In Brazil, for instance, services contribute only to about a quarter of total exports when measured in gross terms. However, taking into account the indirect contribution of services inputs to industrial value addition paints a different picture. In 2011, the total service content of gross exports was just under a half (49%), above the same figure recorded in most of the larger Latin American countries and most of the BRICS, but slightly below the OECD average (54%). Therefore, more than ever, country's availability of competitive services is a key factor for the well functioning of the international supply chains it belongs to as well as to burst national exports and GDP growth in general.

In this paper we investigate how the reduction in regulatory barriers for trade in services may change the architecture of global/regional value chains through its indirect effect on the exports of industrial goods. As a case study, we choose TISA (Trade in Services Agreement), a plurilateral agreement on trade in services currently under negotiation by 50 economies (including EU-28, USA and Japan) and comprising over 70% of global trade in services. Given the extraordinary volume of trade in services represented by the countries involved in the negotiations as well as their significant participation in international supply chains, we believe TISA can potentially impact the current unbundling of production, not only for member countries but also for outsiders.

A set of CGE simulations using the most recent static version of the GTAP model (GTAP 9) is carried out where the results are evaluated according to the logic of integration into international supply chains as well as trade in value added, instead of the usual 'gross" trade analysis. In this sense, we explore a rather innovative approach to evaluate the economic impacts of service reforms in an increasingly interconnected global economy. We draw extensively on the recent input-output framework developed by Johnson and Noguera (2012)

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and extended by Koopman (2014) to evaluate trade in value added and how integrated into global value chains a given economy may be. Service reforms are estimated as a horizontal 25% reduction in the estimated ad valorem equivalents of pre-existing regulatory barriers, for all 50 negotiating members (including the European Union). Based on the evolution of a set o value chain indicators, such as backward (VS) and forward linkages (VS1), it is possible to trace out the impact of service reforms on trade in value added for all TISA members as well as for other regions in the rest of the world. A positive impact on the VS indicator due to intra-bloc trade liberalization in services may be a sign that a given economy has increased its assembling role in a given supply chain. By the same token, an increase in VS1 suggests that a given economy has increased its role of supplier of intermediate goods to third countries' exports in a given chain. The sum of VS and VS1 is usually taken as a measure of how integrated into global value chains a given economy may be. Therefore, simulation results may reveal how TISA can potentially create price/cost incentives for GVC integration/disintegration for both member countries and outsiders.

Regulatory barriers for trade in services are estimated based on their *ad valorem* equivalents. These *ad valorem* equivalents are estimated, for each country and each service sector considered in the dataset, based on panel data analysis. The great challenge involved in the estimation of service barriers is that there is no specific data on tariffs for services sectors to use as controls, as there is for the most commonly studied sectors involving regular merchandise trade (Francois and Hoekman, 2010).

In order to overcome this issue we used state of the art econometric techniques, which are the most modern methodologies stemimg from the empirical literature that tries to properly identify the specific NTB (non-tariff barrier) channel for services in gravity models (Fontagné et al, 2011). In a preliminary analysis, we opted for using identification via fixed effects, using Ordinary Least Squares and, alternatively, the Heckman selection model. We then began an analysis based on a Poisson model, built on different premises to identify the effect of "crossing-the-border" on the trade for services (Yotov et al, 2016).

Data used for both analyses come from the same sources. The main variables referring to bilateral trade flows are from GTAP, for the years 2004, 2007 and 2011. We use data for bilateral imports and exports for all services sectors classified according to GTAP criteria, for all 50 TISA members and the 5 BRICS countries (Brazil, Russia, India, China and South Africa, the largest economies in their respective regions). We also used traditional variables included as controls in gravity equations: country-pair GDPs, distance measures, cultural ties (common colonial roots and language).

## 2. Related Literature

- **The Trade in Services Agreement (TISA)**

As the Doha talks dragged on without a deal materializing, a group of 23 countries/regions decided in 2013 to discuss services trade liberalization amongst them. The Trade in Services Agreement (TISA, for short) is currently a plurilateral negotiation comprising 70% of global trade in services.

Before the advent of TISA, services negotiations were conducted under the umbrella of GATS (General Agreement of Trade in Services), a multilateral agreement in services created in 1994 at the end of the Uruguay round.

Due to its compatibility with the GATS regulatory framework, TISA can be seen as a way to advance negotiations in services among the so called "Really Good Friends of Services", a group of countries including the largest services exporters in the world. Therefore, after negotiations are finished, it is expected that TISA can serve as a new template for negotiations under the GATS, in such a way to facilitate the entrance of new members, particularly in the developing world.

TISA negotiations include the main points from GATS such as scope, market access, national regulations and exemptions. Additional norms will define how each member country will comply with its assumed compromises. When it comes to national issues, assumed compromises will follow closely the GATT (General Agreement on Tariff and Trade) model, i.e., they will be applied horizontally to all services sectors and modes of supply[4]. For instance, it is expected that TISA negotiations will result in more trade liberalization in financial services, transportation, telecommunications, e- commerce and the temporary movement of workers (mode 4). Given its plurilateral nature, TISA members are not expected to compromise in the same way in every negotiated term. Moreover, unlike GATT negotiations, it will not be necessary to achieve consensus among members for negotiations to move forward.

The idea of moving forward with services liberalization has had the worldwide support of several interest groups (Hufbauer, Jensen & Stephenson, 2012). Both international institutions as well as business associations located in the largest services exporting countries in the world have declared their support to TISA negotiations. On the other hand, the majority of developing countries so far have demonstrated little interest in joining TISA negotiations. From the perspective of the BRICS countries, only China and Brazil have manifested their interest in joining TISA talks[5].

After more than a decade of diminishing expectations with the likely results of multilateral trade negotiations at the Doha round, plurilateral agreements such as TISA may signal an alternative way for advancing the free-trade agenda under the WTO surveillance in the years to come.

[4] See European Commission (2013).

[5] According to some public authorities in the BRICS economies, the support of plurilateral negotiations such as TISA would be against the fundamental principles of transparency, inclusion and multilateralism (see Hufbauer et al., 2012).

- **Estimating the Ad Valorem Equivalents of Regulatory Barriers**

The services sector currently responds to over 70% of global value added and for more than half of total labor employment in the world. For a fact, its share on world gross trade figures of over 20% does not reflect its real dynamism and importance for the global economy: when evaluated in value-added terms, services exports corresponds to more then 50% of global exports.

In general, due to the intangibility of the services sector, barriers to trade in services are mostly regulatory in nature (Whalley, 2004; Dee, 2005). Therefore, in order to properly access the likely gains from trade liberalization in services, it is necessary to somehow estimate the ad-valorem equivalents of pre-existing regulatory barriers imposed at country's borders.

Despite the fact that the empirical literature of trade in services is still relatively scarcer in comparison to the traditional literature of trade in goods, there is a growing number of empirical works particularly concentrated on the identification as well as estimation of the regulatory barriers to trade in services. The work by Deardoff and Stern (1998) classify the existing methodologies for estimating the ad valorem equivalents of regulatory barriers in services trade in three categories: (i) qualitative methods based on coverage indices and frequencies; (ii) methods based o price differences; (iii) quantitative methods based on gravity equations. Due to inherent high level of arbitrariness imbedded in qualitative methods, they have been frequently criticized and have progressively lost space in the empirical literature[6]. Price based methods[7], however, compare pre-existing differences between domestic *vis à vis* foreign prices in services, in order to access potential regulatory border barriers, being responsible for a substantial contribution in the empirical literature.

Since the work by Tinbergen (1962), the gravity equation has been used intensively in the international merchandise trade literature due to its outstanding adherence to trade flows in goods. For its theoretical underpinnings, a relatively recent literature has shown that the gravity equation can be derived from a diversity of theoretical trade models based on different assumptions[8].

The empirical literature of gravity models applied to trade in services is still on its early stages. However, the works of Francois (2001, 2005), Kimura & Lee (2006) and Walsh (2006) have already shown the significant explicative power of the gravity equation when it comes to trade in services. For the estimation of the ad valorem equivalents of regulatory barriers to trade in services using relatively mild OLS approaches, the paper by Fontagné et al., 2011 discusses several methodological aspects and key limitations in the existing literature, starting with the lack of trustable estimations for trade in services elasticities[9].

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[6] See for instance Hoekman (1995) and Hardin & Holmes (1997) for examples of qualitative approaches. The Australian Productivity Commission (APC) also makes available several sector-specific studies: Kalijaran (2000) for the distribuition sector; McGuire e Schuele (2000) for the maritime transportation sector and Warren (2000) for telecommunications; Mattoo et al. (2006) evaluate both telecommunications and financial services sectors.

[7] See Francois and Hoekman (1999), Dihel and Sheperd (2007) and several sector-specific studies from APC: Nguyen-Hong (2000) for engineering services, Trewin (2001) for telecommunications and Kalijaran et al. (2001) for the banking sector.

[8] See Anderson (1979), Helpman & Krugman (1985), Bergstrand (1990), Deardorff (1998), Feenstra (2002, 2004), Anderson & van Wincoop (2003), Helpman et al. (2008), Melitz & Ottaviano (2008) and Costinot and Rodríguez-Clare (2014).

[9] Other negative aspects are: lack of a clear consensus on the correct approach for gravity estimations (residuals x fixed effects) and the usually low quality of data for trade in services.

Park (2002) estimates the ad valorem equivalents of border barriers for seven services sectors in 62 countries, using the GTAP database for 1997. Bilateral trade flows in services were explained by country's GDP, distance, importer and exporter price indexes and a set of dummy variables including common language and contiguity. He shows that Asian countries tend to be the ones imposing the least restrictive regulatory barriers in services. Fontagné et al (2011) extend the work by Park (2002) including a new set of variables in their gravity equations such as dummies for RTAs (whether or not both countries are members of a regional trade agreement) and colonial ties. Using a more recent GTAP database (base year 2004), they calculated ad valorem equivalents based on the estimated importer fixed effects for seven services sectors in 65 countries. They show that developed countries are the ones imposing less restrictive regulatory barriers in services. When it comes to sector level regulatory barriers, they show that the transport sector – with an average ad valorem equivalent of 26% - is the least restrictive in the sample. On the other hand, the construction sector presents the highest barriers, with a sample average ad-valorem equivalent of 75%. In general, the ad valorem equivalents estimated by Fontagné et al (2011) are higher then the ones estimated by Park (2002). The authors conclude that ad valorem equivalent estimations based on gravity residuals may be downward biased. Both studies use balance of payments services data steming from different sources.

In the current paper we follow closely the fixed effects methodology developed in Fontagné et al (2011). However, based on the recent advances in the literature of gravity models, we decided to work with panel data using Poisson estimations (see Silva and Tenreyro, 2006)

- **Measuring the General Equilibrium Impact of Regulatory Measures**

A relatively new trend in the empirical literature of RTAs is to estimate the general equilibrium effects of preferential trade and regulatory agreements using the pre-estimated ad valorem equivalents of regulatory barriers as inputs into computable general equilibrium models (see, for example Harrison and Pearson; 1994; Andriamananjara et al.; 2003, 2004; Francois et al.; 2005; Fugazza and Maur; 2008). In most of the cases, the idea is to estimate the effects of trade agreements involving regulatory clauses related to mutual recognition and/or harmonization of standards, such as existing TBT/SPS measures. For instance, Harrison and Pearson (1994) simulated the effects of regulations harmonizations in the EU in the post-Maastricht era. Their results suggested that the impact of harmonization of standards among EU countries could reach an impressive 2.4% of EU's GDP.

An importat *caveat* in regard to this empirical literature is raised in the work by Baldwin et al. (2000), where they argued that notifications of TBTs and SPSs by importing countries are likely to generate extra fixed as well as variable costs for exporting firms. Therefore, when working in conjunction with the ad valorem equivalents of those notifications, CGE models should somehow accommodate an imperfect competition market structure able to represent export-specific fixed costs due to the existence of NTM (Non-tariff measures), which is hardly the case in most of the previous empirical studies in the field. To our knowledge, the first attempt to represent those fixed costs can be found in Zhai (2008) and more recently in Akgul et al. (2014).

In our case, fixed effects seems to be less of a problem, given the low share of zero trade flows in our sample due to the relatively high aggregation level corresponding to GTAP sectors (See

Melitz, 2003). Moreover, due to its very nature, our guess is that regulatory barriers to trade in services are less prone to represent fixed costs for exporting firms in comparison to both technical and phytosanitary barriers to trade in goods.

- **Measuring the General Equilibrium impacts on trade in value added**

Interregional CGE models - such as GTAP - are generally based on sufficiently detailed global input-output databases, where trade in value added as well as trade in intermediates can be traced out through the use of appropriate input-output techniques. In the current paper we explore an innovative approach to evaluate the economic impacts of TISA in an increasingly interconnected global economy through the marriage between CGE and Input-output models. We draw extensively on the recent input-output framework developed by Johnson and Noguera (2012a,b) and extended by Koopman (2014) to evaluate trade in value added in order to evaluate the potential connection between the implementation of TISA and the formation of Global/Regional Value chains involving intra/extra block members.

The analysis will be based on a dynamic view of the scheme proposed by Johnson and Noguera (2012) as a measure of how integrated to international supply chains a country may be, based on measures of backward (VS) and forward linkages (VS1) related to country's exports. The analysis will be concentrated on how these indicators may deviate from their baseline values as a consequence of long-term relative price changes induced by TISA.

The remainder of the paper is structured as follows. Section 3 provides detailed information on the database and how our panel estimations for the ad valorem equivalents were built. It also describes how the value added indicators can be obtained from the global input-output database used in the current work. Last, it summarizes the main modules from the GTAP model. Section 4 discusses our main findings from the simulation exercises and section 5 concludes.

## 3. Database and Methodology

- **Estimating the Advalorem Equivalent of Services Barriers for TISA members**

In this section we estimate the country-specific regulatory barriers for trade in services for a sample comprising all TISA members and the BRICS economies. The resulting estimations correspond to ad-valorem equivalents obtained from importer's fixed-effects and converted using the structural definition of trade costs.

Compared to the estimation of non-tariff barriers for merchandise trade, the quantitative assessment of regulatory barriers for trade in services poses some new challenges. First of all, there is no global services database that can convey reliable information over all existing modes of services flows. Therefore, most of the previous empirical works are based on services flow information stemming from country's balance-of-payments accounts, which excludes mode 3. Moreover, unlike trade in goods, there are no tariffs for trade in services, meaning less availability of controls to include in a gravity equation exercises.

Indirect methods have thus been proposed in the literature in order to overcome the issue. The general idea is to predict trade flows from a gravity equation and compare actual and predicted trade flows relatively to a "benchmark" most-open country.

Here we follow more closely the methodology applied by Fontagné et al (2011), but using a rather different set of controls and countries/sectors. Furthermore, we estimate Poisson regressions using panel data analysis (along the lines of Silva and Tenreyro, 2006), rather than mild OLS cross-sectional estimations as usual in the empirical literature.

We use data from two main sources. Data on services exports per country-pair comes from GTAP and refers to the periods 2004, 2007 and 2011. GTAP data refers to trade in services from modes 1, 2 and 4, i.e., excluding FDI. Data on gravity variables comes from CEPII. The variables used in the estimation are distance (in logs, weighted by population), contiguity, common language and colony, besides exporter and importers' GDP. Our database is therefore composed of trade flows between all countries that are members of the TISA with the addition of the BRICs, which includes a total of 55 exporters and importers. Services are divided into 14 sectors and data is available for 3 years, providing a total number of around 130.000 observations. In appendix we show the names of the sectors and the activities included in each definition.

There are some important issues about the GTAP database that might influence the results of estimations when it comes to its external validity. First, the way services sectors are classified by GTAP does not allow a direct comparison to other classifications presented in previous studies using OECD data. In fact, one has to do an approximate correspondence between GTAP and EBOPS classifications by means of ISIC codes, what leaves some categories incomparable due to the aggregation choice. For external validity of our results, we compare the sectors with the same or almost exact match[10]. Second, even trade flows data for rather specific comparable categories may vary to a great extent from one database to another. Third, the sample of trade partners considered in the estimation are another important dimension that makes results not directly comparable: the coefficients of interest for each country/sector are an average across trade-partners and hence it can make a large difference to consider only a subset of these partners in the estimation. More precisely, previous empirical studies using OECD data usually have trade flows in services sectors for around thirty country-pairs, while our estimation takes into account trade flows for more than fifty countries, including a set of non-developed ones.

The estimation strategy pursued in the current work is based on a Poisson regression, assuming conditional mean of trade flows is given by an exponential form, addressing both a possible large presence of zero flows in the data and possible heteroskedascity in the error terms, which might generate bias in a simple OLS regression using logs (see Silva and Tenreyro, 2006).

We estimate the following equation:

$$X_{ij,t}^{k} = \exp\left[\beta_1^k lnGDP_{i,t} + \beta_2^k lnGDP_{j,t} + \sum_{m=3}^{4} \beta_m^k \ln DIST_{ij,m} + \beta_5^k CNTG_{ij} + \beta_6^k LANG_{ij} + \beta_7^k CLNY_{ij} + \eta_i + \theta_j + \delta_t\right] + \varepsilon_{ij,t} \quad (1)$$

[10] In the appendix we display the correspondence between EBOPS and GTAP services sectors classification.

Where $X_{ij,t}^{k}$ are services export flows in sector *k*, from country *i* to country *j* in year *t*. The variables in parentheses are traditional gravity measures from the empirical literature: log-GDPs from exporter and importer, DIST (in log, weighted by population) is the distance between the country-pair, divided between the distance below and above the median of the sample, to allow for non-linear effects; CNTG is a dummy for contiguity; LANG is common language dummy and CLNY is a dummy for colonial relationship. We also control for year and country fixed effects, both for exporter and importer. Residuals are clustered by country-pair.

In order to calculate the ad-valorem equivalents, we follow the literature and use the importer fixed-effects as a starting point to calculate non-tariff barriers that generate resistance to trade. We need to define for each sector the benchmark ("open" country), i.e., the importer with the highest fixed-effect, meaning that it is on average more prone to import. Relatively to the benchmark, we calculate the tariff-equivalents for each country-sector, as in the formula:

$$\ln\left(1 + t_j^k\right)^{1-\sigma} = FE_j^k - FE_{benchmark}^k \qquad (2)$$

Where $t_j^k$ is the ad-valorem equivalent, FE are the importer/benchmark fixed-effects for each sector and σ is the elasticity of substitution, set to 5.6 following the literature (Park, 2002, Fontagné et al, 2011).

The estimated ad-valorem equivalents are displayed in Table 3 in the appendix. We show the non-tariff barriers in percentage terms for each sector, along with the corresponding benchmarks.

As mentioned above, the benchmark per sector is the country with the higher importer fixed-effect, which indicates that controlling for the observables and other fixed-effects, this country receives the highest value of imports, meaning that it is more open to trade in the specific sector. The most common benchmarks are the United Kingdom (Air Transport, Communication, Recreation and Water), the USA (Insurance, Public Administration and Other Transport), Luxembourg (Gas and Financial) and Germany (Construction and Business). Brazil (Electricity), China (Trade) and Greece (Water Transport) complete the list. A weighted average taking into account the relative share of each sector in total services imports displays the USA as the overall benchmark, followed by Germany, the UK and Japan. The most "closed" countries in this measure are Paraguay, Costa Rica and Mauritius.

The highest non-tariff barriers are by far found for the sector of gas distribution, with a value of 75%, followed by electricity and insurance, with 46% and 44% respectively. On the other side of the distribution, we have Recreation and Water supply and distribution with 18% on average. This is shown in Table 1, which presents simple and weighted averages per sector. Weighted averages are taken from the share of each country's imports for each sector multiplied by the respective Ad-valorem equivalent.

**Table 1- Average AVE per sector**

| Sector | Simple Average | Weighted Average |
|---|---|---|
| atp | 59,7% | 19,0% |
| cmn | 79,2% | 26,4% |
| cns | 120,1% | 25,1% |
| ely | 225,2% | 45,8% |
| gdt | 227,6% | 75,0% |
| isr | 141,0% | 43,7% |
| obs | 74,4% | 20,4% |
| ofi | 134,7% | 36,1% |
| osg | 62,9% | 23,4% |
| otp | 87,4% | 31,9% |
| ros | 53,9% | 18,0% |
| trd | 91,7% | 22,8% |
| wtp | 111,7% | 23,0% |
| wtr | 54,0% | 18,1% |

- **Estimating the general equilibrium effects of TISA over trade in value added**

The global input-output database used in the current work (GTAP 9) stems from the estimation of trade flows among industries located in a broad set of different countries and regions. More precisely, these tables trace out the interrelations among producers and consumers located in either the same country/region or in different countries/regions (OECD-WTO 2011).

The two basic accounting relations contained in global input-output tables are the following:

$$x_i(s) = \sum_{j=1}^{N}\sum_{t=1}^{S} z_{ij}(s,t) + \sum_{j=1}^{N} f_{ij}(s), \forall i = 1,\dots,N;\ \forall s = 1,\dots,S; \quad (1)$$

$$x_j(t) = \sum_{i=1}^{N}\sum_{s=1}^{S} z_{ij}(s,t) + v_j(t), \forall j = 1,\dots,N;\ \forall t = 1,\dots,S; \quad (2)$$

where:

$x_i(s)$ is the output of sector $s$ in country $i$;
$z_{ij}(s,t)$ is the quantity of intermediates from sector $s$ in country $i$ used to produce output in sector $t$ in country $j$;

$f_{ij}\ (s)$ is the quantity of final goods from sector $s$ in country $i$ absorbed in destination $j$;
$v_j\ (t)$ is the value added by sector in country $j$;
$S$ is the number of productive sectors considered;
$N$ is the number of countries considered;

Equation (1) guarantees that total output in a given sector of a given country is allocated between intermediate consumption and final consumption. Equation (2) shows that total output in a given sector reflects expenses with intermediate products and primary factors.

The system of equations (1) and (2) can be written in matrix form as:

$$\boldsymbol{x = Zi + f} \tag{3}$$

$$\boldsymbol{x = i'Z + v} \tag{4}$$

where $\boldsymbol{i}$ is a unitary row vector of a convenient dimension.

The first indicator to be described in this section calculates the domestic value added embedded in a country's exports and is based on the concept of "Vax ratio" developed by Johnson and Noguera (2012). As usual in input-output models, we define the technical coefficient $\mathrm{a_{ij}}(s,t)$ as:

$$\mathrm{a_{ij}}(s,t) = \frac{z_{ij}(s,t)}{x_{ij}\ (s)} \tag{5}$$

If $A$ is a matrix of technical coefficients, then:

$$\boldsymbol{x = (I - A)^{-1}.f = B.f} \tag{6}$$

$$\cdot\begin{bmatrix} \boldsymbol{x_1} \\ \boldsymbol{x_2} \\ \vdots \\ \boldsymbol{x_N} \end{bmatrix} = \begin{bmatrix} \boldsymbol{B_{11}} & \boldsymbol{B_{12}} & \cdots & \boldsymbol{B_{1N}} \\ \boldsymbol{B_{21}} & \boldsymbol{B_{22}} & & \boldsymbol{B_{2N}} \\ \vdots & & \ddots & \vdots \\ \boldsymbol{B_{N1}} & \boldsymbol{B_{N2}} & \cdots & \boldsymbol{B_{NN}} \end{bmatrix} \cdot \begin{bmatrix} \sum_{j=1}^{N} \boldsymbol{f_{1j}} \\ \sum_{j=1}^{N} \boldsymbol{f_{2j}} \\ \vdots \\ \sum_{j=1}^{N} \boldsymbol{f_{Nj}} \end{bmatrix} = \begin{bmatrix} \boldsymbol{B_{11}} & \boldsymbol{B_{12}} & \cdots & \boldsymbol{B_{1N}} \\ \boldsymbol{B_{21}} & \boldsymbol{B_{22}} & & \boldsymbol{B_{2N}} \\ \vdots & & \ddots & \vdots \\ \boldsymbol{B_{N1}} & \boldsymbol{B_{N2}} & \cdots & \boldsymbol{B_{NN}} \end{bmatrix} \begin{bmatrix} \boldsymbol{f_1} \\ \boldsymbol{f_2} \\ \vdots \\ \boldsymbol{f_N} \end{bmatrix} \tag{7}$$

We define $\boldsymbol{f}$ as a matrix of final demand where a typical element $\boldsymbol{f}_{ij}$ é a vector $Sx1$ of country's $j$ final demand for goods sourced from country $i$. The vector $\boldsymbol{x}$ of total production can also be arranged in a more transparent way as:

$$\boldsymbol{X} = \begin{bmatrix} \boldsymbol{x_{11}} & \boldsymbol{x_{12}} & \cdots & \boldsymbol{x_{1N}} \\ \boldsymbol{x_{21}} & \boldsymbol{x_{22}} & & \boldsymbol{x_{2N}} \\ \vdots & & \ddots & \vdots \\ \boldsymbol{x_{N1}} & \boldsymbol{x_{N2}} & \cdots & \boldsymbol{x_{NN}} \end{bmatrix} = \begin{bmatrix} \boldsymbol{B_{11}} & \boldsymbol{B_{12}} & \cdots & \boldsymbol{B_{1N}} \\ \boldsymbol{B_{21}} & \boldsymbol{B_{22}} & & \boldsymbol{B_{2N}} \\ \vdots & & \ddots & \vdots \\ \boldsymbol{B_{N1}} & \boldsymbol{B_{N2}} & \cdots & \boldsymbol{B_{NN}} \end{bmatrix} \cdot \begin{bmatrix} \boldsymbol{f_{11}} & \boldsymbol{f_{12}} & \cdots & \boldsymbol{f_{1N}} \\ \boldsymbol{f_{21}} & \boldsymbol{f_{22}} & & \boldsymbol{f_{2N}} \\ \vdots & & \ddots & \vdots \\ \boldsymbol{f_{N1}} & \boldsymbol{f_{N2}} & \cdots & \boldsymbol{f_{NN}} \end{bmatrix} \tag{8}$$

The vector of valued added per unit of total output can be written as:

$$\boldsymbol{v} = (\boldsymbol{I_{NS}} - \boldsymbol{A})'.\boldsymbol{i} = \left( \begin{bmatrix} \boldsymbol{I_S} & \boldsymbol{0} & \cdots & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{I_S} & & \boldsymbol{0} \\ \vdots & & \ddots & \vdots \\ \boldsymbol{0} & \boldsymbol{0} & \cdots & \boldsymbol{I_S} \end{bmatrix} - \begin{bmatrix} \boldsymbol{A_{11}} & \boldsymbol{A_{12}} & \cdots & \boldsymbol{A_{1N}} \\ \boldsymbol{A_{21}} & \boldsymbol{A_{22}} & & \boldsymbol{A_{2N}} \\ & \vdots & \ddots & \vdots \\ \boldsymbol{A_{N1}} & \boldsymbol{A_{N2}} & \cdots & \boldsymbol{A_{NN}} \end{bmatrix} \right)' .\boldsymbol{i} = \begin{bmatrix} \boldsymbol{v_1} \\ \boldsymbol{v_2} \\ \vdots \\ \boldsymbol{v_N} \end{bmatrix} \tag{9}$$

Additionally, for the vector of bilateral exports we have:

$$\boldsymbol{e_{ij}} = \boldsymbol{A_{ij}}\boldsymbol{x_j} + \boldsymbol{f_{ij}} \tag{10}$$

$$\boldsymbol{e} = \boldsymbol{E}.\boldsymbol{i} = \begin{bmatrix} \boldsymbol{0} & \boldsymbol{e_{12}} & \cdots & \boldsymbol{e_{1N}} \\ \boldsymbol{e_{21}} & \boldsymbol{0} & & \boldsymbol{e_{2N}} \\ \vdots & & \ddots & \vdots \\ \boldsymbol{e_{N1}} & \boldsymbol{e_{N2}} & \cdots & \boldsymbol{0} \end{bmatrix} .\boldsymbol{i} = \begin{bmatrix} \boldsymbol{e_1} \\ \boldsymbol{e_2} \\ \vdots \\ \boldsymbol{e_N} \end{bmatrix} \tag{11}$$

Assuming "hat" variables for diagonal matrixes, we define value-added exported from country $i$ to country $j$ as:

$$\boldsymbol{vae_{ij}} = \widehat{\boldsymbol{v}}_{\boldsymbol{i}}.\boldsymbol{x_{ij}} \tag{12}$$

Therefore, the trade balance between country $i$ and $j$ can be written as:

$$\boldsymbol{vatb_{ij}} = \boldsymbol{vae_{ij}} - \boldsymbol{vae_{ji}} \tag{13}$$

Following Johnson and Noguera (2012), we define the "Vax ratio" as the value added exported over total exports in country $i$:

$$VAX_{\boldsymbol{i}} = \frac{\boldsymbol{i}'.\left(\sum_{\boldsymbol{j}}^{\boldsymbol{N}} \boldsymbol{vae_{ij}}\right)}{\boldsymbol{i}'.\left(\sum_{\boldsymbol{j}}^{\boldsymbol{N}} \boldsymbol{e_{ij}}\right)} \tag{14}$$

Moreover, total exports in country $i$ can be decomposed as:

$$\boldsymbol{i}'.\boldsymbol{e_{ij}} = \boldsymbol{i}'.\left(\boldsymbol{A_{ij}}.\boldsymbol{x_{jj}} + \boldsymbol{f_{ij}}\right) + \boldsymbol{i}'.\boldsymbol{A_{ij}}.\boldsymbol{x_{ji}} + \sum\nolimits_{\boldsymbol{k}\neq\boldsymbol{j},\boldsymbol{i}} \boldsymbol{i}'.\boldsymbol{A_{ij}}.\boldsymbol{x_{jk}} \tag{15}$$

The three terms on the right hand side of equation (15) have the following interpretation: 1) the first term is called "absorption" and captures the share of country's $i$ exports that are consumed in destination $j$ either as final or intermediate goods; 2) the second term is called "reflection" and captures the share of country's $i$ exports as intermediates to destination $j$, that are reprocessed in country $j$ and re-exported back to country $i$. 3) the third term is called "redirection" and captures the share of country's $i$ exports as intermediates to destination $j$ that are reprocessed and re-exported to the rest of the world.

Koopman et al (2014) extends the work by Johnson and Noguera (2012) demonstrating that it is possible to summarize several trade in value-added statistics (including the ones above) through the decomposition of a country's gross exports in an alternative way. Accordingly,

given the diagonal matrix $\hat{v}$, it is possible to write the production matrix in valued added terms $\hat{\boldsymbol{v}}\boldsymbol{B}\boldsymbol{f}$ as:

$$\begin{bmatrix} \hat{v}_1 & 0 & \cdots & 0 \\ 0 & \hat{v}_2 & & 0 \\ \vdots & & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{v}_N \end{bmatrix} \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1N} \\ x_{21} & x_{22} & & x_{2N} \\ \vdots & & \ddots & \vdots \\ x_{N1} & x_{N2} & \cdots & x_{NN} \end{bmatrix}$$

$$= \begin{bmatrix} \hat{v}_1 \sum_j^N B_{1j} f_{j1} & \hat{v}_1 \sum_j^N B_{1j} f_{j2} & \cdots & \hat{v}_1 \sum_j^N B_{1j} f_{jN} \\ \hat{v}_2 \sum_j^N B_{2j} f_{j1} & \hat{v}_2 \sum_j^N B_{2j} f_{j2} & & \hat{v}_2 \sum_j^N B_{2j} f_{jN} \\ & \vdots & \ddots & \vdots \\ \hat{v}_N \sum_j^N B_{Nj} f_{j1} & \hat{v}_N \sum_j^N B_{Nj} f_{j2} & \cdots & \hat{v}_N \sum_j^N B_{Nj} f_{jN} \end{bmatrix}$$

The diagonal elements above give how much of the local production in value added is absorbed domestically. It is straightforward to show that the total value added exported from country *i* to the world can be written as:

$$vt_{i^*} = \sum_{i \neq j}^{N} vx_{ij} = v_i \sum_{i \neq j}^{N} \sum_{n=1}^{N} B_{in} f_{nj}$$

The equation above can be re-written in a rather convenient way as a decomposition of three terms:

$$vt_{i^*} = v_i \sum_{i \neq j}^{N} B_{ii} f_{ij} + v_i \sum_{i \neq j}^{N} B_{ij} f_{jj} + v_i \sum_{i \neq j}^{N} \sum_{z \neq i,j}^{N} B_{ij} f_{jz}$$

According to Koopman et al (2014) the above decomposition shows the value added exported from country *i* in terms of all ultimate final demands faced by this country's exports. The first term corresponds to the total domestic value added exported directly through final goods to the rest of the world. The second term corresponds to the total domestic value added exported through intermediate goods that are consumed directly by the importers. Last, the third term corresponds to the total domestic value added exported through intermediate goods that are reprocessed in the importing country and re-exported to the rest of the world (indirect consumption).

The total gross exports from country *i* can also be written as:

$$E_{i^*} = \sum_{i \neq j}^{N} E_{ij} = \sum_{i \neq j}^{N} (A_{ij} X_j + f_{ij})$$

The above equation can be rearranged and decomposed as:

$$uE_{i^*} = v_i B_{ii} E_{i^*} + \sum_{i \neq j}^{N} v_j B_{ji} E_{i^*}$$

$$= vt_{i^*} + \left\{ v_i \sum_{i \neq j}^{N} B_{ij} f_{j\square} + v_i \sum_{i \neq j}^{N} B_{ij} A_{ji} x_i \right\}$$

$$+ \left\{ \sum_{z \neq i}^{N} \sum_{i \neq j}^{N} v_z B_{zi} f_{ij} + \sum_{z \neq i}^{N} \sum_{i \neq j}^{N} v_z B_{zi} A_{ij} x_r \right\}$$

Considering the gross product identities for each country as well as the decomposition of value added exported, the above equation can be rewritten as a decomposition of nine terms:

$$uE_{i^*} = \left\{ v_i \sum_{i \neq j}^{N} B_{ii} f_{ij} + v_i \sum_{i \neq j}^{N} B_{ij} f_{jj} + v_i \sum_{i \neq j}^{N} \sum_{z \neq i}^{N} B_{ij} f_{jz} \right\}$$

$$+ \left\{ v_i \sum_{i \neq j}^{N} B_{ij} f_{ji} + v_i \sum_{i \neq j}^{N} B_{ij} A_{ji} (I - A_{ii})^{-1} f_{ii} \right\} + v_i \sum_{i \neq j}^{N} B_{ij} A_{ji} (I - A_{ii})^{-1} E_{i^*}$$

$$+ \left\{ \sum_{z \neq i}^{N} \sum_{i \neq j}^{N} v_z B_{zi} f_{ij} + \sum_{z \neq i}^{N} \sum_{i \neq j}^{N} v_z B_{zi} A_{ij} (I - A_{jj})^{-1} f_{jj} \right\}$$

$$+ \sum_{i \neq z}^{N} v_z B_{zi} A_{ij} \sum_{i \neq j}^{N} (I - A_{jj})^{-1} E_{j^*}$$

Each one of the nine terms on the right hand side of the equation above has a precise interpretation and, when conveniently combined, may express some of the most relevant indicators of the input-output literature applied to international trade, particularly to trade in value added. The interpretation for each of the nine terms above goes as follows: 1. domestic value added in the exports of final goods; 2. domestic value added embedded in intermediates exported to and consumed directly in importing countries; 3. domestic value added embedded in intermediates that are exported, reprocessed and re-exported to third countries; 4. domestic value added embedded in domestic intermediates that are imported embedded in final goods; 5. domestic value added embedded in domestic intermediates that are imported embedded in foreign intermediate goods; 6. double counting term related to the exports of intermediates; 7. foreign value added embedded in the exports of final goods; 8. foreign value added embedded in the exports of intermediates; 9. double counting term related to the imports of intermediates. In the current paper, the following combined statistics will be used:

- Value added exported = 1 + 2 + 3
- Domestic content embedded in total exports = 1 + 2 + 3 + 4 + 5
- VS: foreign content embedded in total exports = 7 + 8 + 9

- VS1: share of intermediates exported, reprocessed and consumed in third countries= 3 + 4 + 5 + 6

## 4. Results

### 4.1 Modeling Issues

The GTAP model is a global comparative static applied general equilibrium model that identifies 57 sectors in 140 countries of the world. Its system of equations provides detailed microeconomic specification of household and perfect competitive firm behavior as well as the characteristics of economic relations between the distinct countries/regions listed in the database, taking into consideration transportation costs. The solutions are obtained by solving a system of linearized equations of a Johansen-type model, generally exhibiting the percentage change in a set of endogenous variables after a policy shock is applied to the initial equilibrium. The GTAP 9 database (base year 2011) includes bilateral trade, transport and protection data pertaining to economic relations between regions or countries along with local nation input-output databases that account for inter-sectoral relations within each region.

In the current work we adopt a long-run closure where capital and labor are perfectly mobile among sectors and investment flows are expected to equalize rate of returns among regions. Land and natural resources are considered sluggish factors of production meaning they have imperfect mobility among sectors in the model.

We model the 25% reduction of regulatory barriers to trade in services among TISA members as efficiency shocks, following Hertel et al (2001). Accordingly, bilateral trade in the GTAP model is represented by a CES type demand equation for good "i", exported from country "r" to destination country "s" as:

$$qxs_{irs} = -ams_{irs} + qim_{is} - \sigma_m^i.[pms_{irs} - ams_{irs} - pim_{irs}]$$

A technical progress in trading activities due to reduction in regulatory costs in country "s" may be represented by a positive (efficiency) shock on the variable $ams_{irs}$. This corresponds to an upward shift in import demand in country "s" for product "i", exported by country "r";

### 4.2. The Broad Picture

#### 4.2.1. The Architecture of Global Value Chains for both TISA and Non-TISA regions

Table 4 represents the structure of VS (broken down by factors of productions) for a typical TISA member and for the rest of the world, divided in four remaining regions: Asia (Japan, Korea, Hong-Kong and Taiwan excluded), Latin-America (Mexico, Chile and Peru excluded), Africa and Rest of the world (including Russia and the Middle-east countries).

According to Table 4, it is fair enough to say that trade in intermediates is a reality in the five country groups presented. Moreover, a common pattern of offshoring/outsourcing stems from the data: global/regional value chains tend to be relatively more concentrated in manufacturing sectors (more capital intensive) and unskilled labor tasks tend to be offshored at a higher degree in comparison to skilled labor tasks. Table 4 also shows that both TISA and Asia regions are the most integrated in international supply chains, at least from the perspective of VS (share of foreign content embedded in regional exports). For the rest of the world, the VS indicator is expected to be lower for regions specialized in the exports of land/natural resource intensive commodities such as Latin-America, Africa, Middle-east and Russia (Row).

**Table 4. The Architecture of Global Value Chains from the Perspective of VS.**

| | Land | NatRes | Unskill | Skill | Capital | VS |
|---|---|---|---|---|---|---|
| TISA | 0.12 | 1.69 | 4.41 | 3.47 | 8.27 | 17.96 |
| Asia | 0.08 | 2.05 | 4.44 | 4.17 | 9.21 | 19.95 |
| Latin_America | 0.08 | 0.47 | 2.56 | 2.18 | 3.98 | 9.26 |
| Africa | 0.12 | 0.66 | 3.54 | 3.11 | 5.78 | 13.22 |
| Row | 0.06 | 0.21 | 2.51 | 2.20 | 3.56 | 8.54 |

Source: Author's elaboration from GTAP9 database.

Table 5 reports supply chain integration for all regions from the perspective of VS1, which measures the share of regional exports corresponding to local intermediates that are exported to and reprocessed in the importing country and then re-exported to third countries final consumption. In this case, a typical TISA member integrates in international supply chains as a supplier of both capital and relatively skill intensive goods. In the case of Asia, the region integrates as a supplier of both capital and unskill intensive goods. For the rest of the world (the commodity suppliers) a common pattern emerges from Table 5: all regions integrate in international supply chains as suppliers of both natural resource/land and relatively unskill intensive commodities. For the Latin America region, this pattern is slightly biased towards land and skill intensive commodities.

**Table 5. The Architecture of Global Value Chains from the Perspective of VS1.**

| | Land | NatRes | Unskill | Skill | Capital | VS1 |
|---|---|---|---|---|---|---|
| TISA | 0.07 | 0.45 | 5.13 | 5.26 | 6.58 | 17.49 |
| Asia | 0.29 | 0.58 | 5.63 | 1.95 | 7.05 | 15.50 |
| Latin_America | 0.32 | 2.13 | 3.78 | 4.02 | 8.73 | 18.98 |
| Africa | 0.09 | 4.67 | 3.90 | 3.18 | 12.54 | 24.37 |
| Row | 0.03 | 7.18 | 2.92 | 2.60 | 17.19 | 29.92 |

Source: Author's elaboration from GTAP9 database.

### 4.2.2. The Macro Effects of TISA on Gross Trade Patterns

Table 6 shows the aggregated impacts of trade liberalization in services among TISA members for a set of regions in the world, comprising the whole global economy. Trade liberalization in services is likely to stimulate investment, GDP, exports and imports for TISA members, with less pronounced (or even negative) effects for non-TISA countries.

Hecksher-Ohlin theory allows one to take conclusions regarding the likely effects of TISA on worldwide trade patterns, based on the behavior of factor returns. From Table 5, TISA members are likely to become more specialized in the exports of both capital and (skilled) labor intensive goods and services, whereas non-TISA regions are more prone to become specialized in the exports of land/natural resource based goods that are relatively intensive in (unskilled) labor. Given that TISA members are basically developed economies and that tradable services are generally more sophisticated in comparison to non-tradables ones, this result may be considered hardly unexpected. However, given the relevance of sophisticated services as inputs to capital-intensive manufacturing exports, it is also possible that manufacturing exports (and not direct services) is driving this result.

**Table 6. Impacts of TISA for a set of regions and macro variables.**

| (%) | TISA | Asia | L-America | Africa | Row |
|---|---|---|---|---|---|
| Real GDP | 0.17 | 0.00 | -0.01 | -0.01 | 0.00 |
| Exports Volume | 0.41 | 0.26 | 0.38 | 0.02 | 0.04 |
| Imports Volume | 0.69 | -0.13 | -0.48 | -0.26 | -0.36 |
| Investment | 0.24 | -0.25 | -0.59 | -0.32 | -0.48 |
| Wage-Skill | 0.23 | -0.14 | -0.08 | -0.16 | -0.22 |
| Wage-Unskill | 0.21 | -0.05 | -0.09 | -0.07 | -0.12 |
| Returns on Capital | 0.22 | -0.06 | -0.05 | -0.07 | -0.11 |
| Returns on Land | -0.31 | 0.28 | 0.96 | 0.39 | 0.52 |
| Returns on NatRes | -0.75 | 0.66 | 1.08 | 0.69 | 0.91 |

Source: Author's elaboration from GTAP simulations.

Table 7 gives a more transparent picture over the effects of TISA on global trade flows and suggests that TISA members tend to become relatively more specialized in the direct exports of services, whereas the opposite picture emerges for non-TISA regions.

**Table 7. The Impacts of TISA on Regional Exports by sector.**

| (%) | TISA | Asia | L-America | Africa | Row |
|---|---|---|---|---|---|
| Agriculture | -0.43 | 0.44 | 0.65 | 0.84 | 0.67 |
| Agribusiness | -0.53 | 0.45 | 0.79 | 0.68 | 0.74 |
| Extraction | 0.13 | -0.05 | 0.01 | 0.09 | 0.06 |
| Manufacturing | -0.68 | 0.77 | 1.50 | 1.01 | 1.03 |
| Services | 4.10 | -2.59 | -2.58 | -2.68 | -2.37 |

Source: Author's elaboration from GTAP simulations.

When it comes to the impacts of TISA over import flows broken down by sectors, Table 8 suggests that TISA members also tend to become more specialized on the direct import of services. The opposite emerges again for non-TISA regions.

**Table 8. The Impacts of TISA on Regional Imports**

| (%) | TISA | Asia | L-America | Africa | Row |
|---|---|---|---|---|---|
| Agriculture | 0.23 | -0.12 | -0.25 | -0.35 | -0.3 |
| Agribusiness | 0.44 | -0.16 | -0.41 | -0.23 | -0.32 |
| Extraction | -0.23 | 0.28 | 0.29 | 0.26 | 0.15 |
| Manufacturing | 0.38 | -0.21 | -0.54 | -0.26 | -0.34 |
| Services | 3.20 | -0.45 | -0.58 | -0.49 | -0.61 |

Source: Author's elaboration from GTAP simulations.

### 4.2.3. The Macro Effects of TISA on Regional Bilateral Trade Flows

Table 9 shows the impacts of TISA over regional bilateral trade flows and suggest that intra-block trade tend to gain prominence over extra-block trade as a consequence of the agreement. For instance, intra-TISA exports tend to increase by 0.85%, whereas TISA exports to Asia are likely to drop by -0.7% (-1.15% for Latin-America). When it comes to the likely impacts of TISA over regional supply chain integration, it is therefore very likely that TISA members will become relatively less integrated in supply-chain trade in comparison to non-TISA regions, as the former become more specialized in direct services exports and imports. As trade in services is less prone to fragmentation in comparison to trade in manufacturing goods, the VS and VS1 indicators are expected to decrease for TISA members, as will be become clear in the next section.

**Table 9. The Impacts of TISA over Regional Bilateral Trade Flows.**

| (%) | TISA | Asia | L-America | Africa | Row |
|---|---|---|---|---|---|
| TISA | 0.844 | **-0.699** | **-1.147** | **-0.814** | **-0.879** |
| Asia | **-0.003** | 0.239 | -0.043 | -0.106 | -0.164 |
| Latin_America | **-0.149** | 0.445 | 0.442 | 0.163 | 0.100 |
| Africa | **-0.536** | 0.398 | 0.214 | 0.215 | 0.099 |
| Row | **-0.475** | 0.297 | 0.200 | 0.251 | 0.176 |

Source: Author's elaboration from GTAP simulations.

### 4.2.4. The Effects of TISA over Regional Supply-chain trade.

Given that TISA members are likely to increase intra-block trade in services as a consequence of the agreement, supply chain indicators are expected to decrease. Table 10 corroborates this expectation and shows that while a typical country in TISA becomes relatively less integrated in both forward (VS1) and backward linkages (VS), non-TISA members (where trade in services loses ground) tend to become relatively more integrated.

**Table 10. The impacts of TISA over Regional Supply Chain Trade.**

| (%) | TISA | Asia | L-America | Africa | Row |
|---|---|---|---|---|---|
| VS | -0.45 | 0.15 | 0.22 | 0.08 | -0.23 |
| VS1 | -0.46 | 0.19 | 0.00 | 0.21 | 0.37 |
| **VS+VS1** | **-0.45** | **0.17** | **0.07** | **0.16** | **0.23** |

Source: Author's elaboration from GTAP simulations.

The results presented in Table 10 do not allow one to take conclusions regarding the impacts of TISA over the structure of inter-regional value chains, since the indicators reported are not inter-regional in nature. A possible way to have a glance on how TISA may change the architecture of inter-regional supply chains is through the decomposition of VS according to source regions/countries. For instance, Table 11 reports the decomposition of VS for a typical TISA member both before and after trade liberalization in services takes place. As can be seen, intra-block supply chain trade seem to be reinforced as the share of TISA intermediates in the foreign content of a typical TISA member's exports increases 0.54%, to the detriment of the other regions. For instance, the share of intermediates sourced from Asia over a typical TISA member's exports decreases from 20.75% to 20.7% as a consequence of the agreement, suggesting a potential for TISA to slightly change the current landscape of international supply chain trade among regions.

**Table 11. Decompostion of VS for a Typical TISA member by Region of Origin.**

| | TISA | Asia | L-America | Africa | Row |
|---|---|---|---|---|---|
| Before | 47.73 | 20.75 | 4.52 | 6.97 | 20.03 |
| After | 47.99 | 20.70 | 4.50 | 6.91 | 19.90 |
| (%) | **0.54** | **-0.24** | **-0.44** | **-0.86** | **-0.65** |

Source: Author's elaboration from GTAP simulations.

## 5. Final Remarks

The services sector has gained prominence over the last decades following the explosion of regional/global value chains. The TISA initiative is an attempt to give new momentum to trade in services among a group of countries comprising over 70% of global services exports.

In terms of value-added, services exports currently represent more than 50% of global exports. Therefore, a more dynamic and competitive service sector is considered a key factor for international competitiveness, as more and more services go embedded in country's exports.

Given the strategic role for services in supply chain trade, this paper has taken a preliminary step in order to evaluate the likely implications of trade in services liberalization among TISA countries, with a special focus on its likely impacts on the current architecture of global/regional value chains. We found evidence that TISA can lead to higher supply chain integration among its members while they tend to become more specialized in direct services exports. By the same token, other regions in the world – such as commodity exporters like Latin America and Africa – tend to weaken their connection into supply chain trade with the more developed economies belonging to TISA, as they also tend to do more trade with non-TISA regions. In general, trade liberalization in services has consequences for relative prices of tradable goods and, therefore, for inter-regional supply chain trade.

A natural extension of this work is to evaluate trade liberalization in services at the sectorial level in order to identify the potential for each sector to reinforce/weaken supply chain trade linkages among countries/regions. Moreover, given the inherent uncertainty over the content of TISA negotiations and its potential for trade liberalization in services, the robustness of our results may be tested through a sensitive analysis using several distinct levels of reductions in the estimated ad-valorem equivalents.

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## APPENDIX

**Table 2 - Correspondence between GTAP and ISIC sectors**

| Sector | GTAP # | GTAP code | ISIC |
|---|---|---|---|
| Air Transport | 50 | atp | 62 |
| Communications: post and telecommunications | 51 | cmn | 64 |
| Construction: building houses factories offices and roads | 46 | cns | 45 |
| Electricity: production, collection and distribution | 43 | ely | 401 |
| Gas Distribution: distribution of gaseous fuels through mains; steam and hot water supply | 44 | gdt | 402, 403 |
| Insurance: includes pension funding, except compulsory social security | 53 | isr | 66 |
| Other Business Services: real estate, renting and business activities | 54 | obs | 70, 71, 72, 73, 74 |
| Other Financial Intermediation: includes auxiliary activities but not insurance and pension funding (see next) | 52 | ofi | 65, 671 |
| Other Services (Government): public administration and defense; compulsory social security, education, health and social work, sewage and refuse disposal, sanitation and similar activities, activities of membership organizations n.e.c., extra-territorial organizations and bodies | 56 | osg | 75, 80, 85, 90, 91, 99 |
| Other Transport: road, rail ; pipelines, auxiliary transport activities; travel agencies | 48 | otp | 60, 63 |
| Recreation & Other Services: recreational, cultural and sporting activities, other service activities; private households with employed persons (servants) | 55 | ros | 92, 93, 95 |
| Trade: all retail sales; wholesale trade and commission trade; hotels and restaurants; repairs of motor vehicles and personal and household goods; retail sale of automotive fuel | 47 | trd | 50, 51, 521, 522, 523, 524, 525, 526, 55 |
| Water: collection, purification and distribution | 45 | wtr | 41 |
| Water Transport | 49 | wtp | 61 |

## Table 3 - Ad-Valorem Equivalents per Sector, by country

| Sector | atp | cmn | cns | ely | gdt | isr | obs | ofi |
|---|---|---|---|---|---|---|---|---|
| **Benchmark** | **gbr** | **gbr** | **deu** | **bra** | **lux** | **usa** | **deu** | **lux** |
| arg | 53,6% | 74,0% | 182,2% | 80,2% | 132,3% | 156,5% | 99,5% | 169,1% |
| aut | 35,4% | 46,2% | 38,6% | 74,7% | 23,1% | 95,8% | 39,0% | 105,7% |
| bel | 38,6% | 29,7% | 46,8% | 110,5% | 169,9% | 100,9% | 19,0% | 54,2% |
| bgr | 84,7% | 121,0% | 53,2% | 125,5% | 11,2% | 187,8% | 97,8% | 184,2% |
| bra | 41,4% | 96,1% | 189,1% | 0,0% | 180,7% | 102,3% | 39,4% | 82,7% |
| can | 29,9% | 35,1% | 110,0% | 26,9% | 227,6% | 59,8% | 37,0% | 63,3% |
| che | 51,9% | 57,4% | 170,3% | 82,8% | 265,2% | 117,5% | 39,9% | 70,0% |
| chl | 67,5% | 99,1% | 257,7% | 107,7% | 80,1% | 139,8% | 115,8% | 126,7% |
| chn | 39,9% | 42,4% | 29,8% | 48,7% | 338,3% | 33,0% | 42,2% | 81,6% |
| col | 62,8% | 99,1% | 281,8% | 349,9% | 907,9% | 156,5% | 119,1% | 181,1% |
| cri | 104,2% | 129,8% | 330,3% | 203,6% | 494,3% | 223,7% | 174,7% | 326,7% |
| cyp | 80,0% | 109,3% | 152,7% | 641,5% | 188,1% | 216,7% | 125,4% | 184,2% |
| cze | 73,4% | 67,7% | 85,0% | 79,8% | 293,2% | 141,4% | 52,6% | 88,4% |
| deu | 4,5% | 7,4% | 0,0% | 26,3% | 72,3% | 46,2% | 0,0% | 23,6% |
| dnk | 23,6% | 26,0% | 13,3% | 61,9% | 294,0% | 53,1% | 26,7% | 44,0% |
| esp | 16,7% | 23,4% | 34,1% | 51,3% | 140,0% | 62,5% | 10,6% | 32,3% |
| est | 110,0% | 123,4% | 98,7% | 160,4% | 136,4% | 376,6% | 102,2% | 226,6% |
| europe | 18,4% | 24,0% | 26,7% | 51,3% | 63,6% | 64,8% | 15,8% | 32,6% |
| fin | 78,4% | 74,0% | 64,4% | 72,0% | 247,4% | 151,5% | 32,5% | 149,9% |
| fra | 16,5% | 28,3% | 36,1% | 62,9% | 116,7% | 68,2% | 17,8% | 57,8% |
| gbr | 0,0% | 0,0% | 42,5% | 22,1% | 158,5% | 61,0% | 6,6% | 13,3% |
| grc | 73,8% | 65,5% | 103,0% | 58,1% | 303,6% | 95,6% | 77,8% | 121,8% |
| hkg | 19,4% | 36,6% | 70,9% | 62,0% | 31,1% | 122,9% | 55,6% | 65,8% |
| hrv | 109,1% | 111,1% | 95,8% | 56,9% | 154,0% | 219,5% | 83,3% | 200,7% |
| hun | 55,6% | 68,8% | 69,6% | 55,0% | 258,9% | 153,2% | 44,4% | 127,6% |
| irl | 70,1% | 49,1% | 128,7% | 141,4% | 134,4% | 30,9% | 8,0% | 47,0% |
| isr | 47,7% | 80,2% | 210,6% | 620,8% | 174,7% | 148,3% | 54,1% | 262,5% |
| ita | 16,2% | 14,2% | 16,3% | 6,8% | 79,7% | 56,0% | 12,1% | 60,7% |
| jpn | 9,4% | 33,3% | 5,1% | 277,0% | 186,3% | 48,2% | 16,4% | 29,5% |
| kor | 14,9% | 40,4% | 34,8% | 345,8% | 157,3% | 95,2% | 27,0% | 78,9% |
| latam | 55,9% | 98,1% | 181,2% | 20,1% | 142,9% | 110,5% | 67,2% | 123,5% |
| ltu | 141,4% | 133,4% | 115,7% | 102,8% | 165,3% | 235,9% | 155,1% | 289,4% |
| lux | 66,8% | 46,9% | 46,0% | 171,9% | 0,0% | 85,9% | 43,6% | 0,0% |
| lva | 92,9% | 129,8% | 91,7% | 106,6% | 148,0% | 256,9% | 124,9% | 247,1% |
| mex | 54,2% | 96,5% | 217,4% | 167,1% | 144,3% | 76,0% | 130,3% | 117,0% |
| mlt | 110,5% | 161,3% | 326,6% | 1422,7% | 465,3% | 238,8% | 89,0% | 173,3% |
| mus | 100,6% | 185,6% | 213,3% | 1274,8% | 311,6% | 290,2% | 136,9% | 365,4% |
| nld | 37,4% | 16,8% | 35,9% | 41,3% | 21,4% | 77,9% | 10,3% | 62,1% |
| nor | 54,9% | 64,4% | 126,2% | 46,9% | 527,5% | 122,1% | 36,7% | 71,3% |
| nzl | 56,6% | 84,5% | 125,3% | 651,2% | 613,3% | 194,1% | 89,0% | 191,7% |
| pak | 92,5% | 132,3% | 176,8% | 221,4% | 493,0% | 225,8% | 73,2% | 222,3% |
| pan | 83,9% | 163,6% | 351,4% | 373,8% | 157,9% | 235,9% | 189,4% | 166,2% |
| per | 85,9% | 122,5% | 122,9% | 552,2% | 520,7% | 169,1% | 120,1% | 266,5% |
| pol | 63,9% | 62,0% | 51,6% | 96,4% | 56,0% | 121,3% | 51,1% | 104,6% |
| prt | 43,6% | 61,3% | 93,5% | 43,1% | 128,3% | 150,4% | 80,6% | 140,9% |
| pry | 140,8% | 321,5% | 492,3% | 1767,9% | 668,1% | 291,1% | 380,2% | 421,2% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| rus | 39,9% | 37,5% | 5,1% | 60,4% | 113,5% | 93,4% | 36,1% | 66,6% |
| svk | 94,6% | 115,8% | 67,1% | 75,1% | 319,7% | 184,7% | 85,7% | 124,2% |
| svn | 117,4% | 108,4% | 80,0% | 85,2% | 269,2% | 270,4% | 86,1% | 216,8% |
| swe | 34,2% | 29,6% | 41,4% | 35,3% | 169,4% | 121,3% | 15,1% | 87,8% |
| tur | 60,0% | 87,8% | 140,0% | 132,1% | 23,9% | 92,6% | 124,4% | 107,3% |
| usa | 1,2% | 1,3% | 53,6% | 1,6% | 237,7% | 0,0% | 9,5% | 7,1% |
| zaf | 44,5% | 87,4% | 199,3% | 43,1% | 96,5% | 139,3% | 148,5% | 162,8% |

| | **osg** | **otp** | **ros** | **trd** | **wtp** | **wtr** | **weighted average** |
|---|---|---|---|---|---|---|---|
| **Benchmark** | **usa** | **usa** | **gbr** | **chn** | **grc** | **gbr** | **usa** |
| arg | 66,1% | 92,4% | 46,9% | 94,4% | 147,2% | 50,3% | 85,6% |
| aut | 58,0% | 62,0% | 32,1% | 70,3% | 118,0% | 34,0% | 52,3% |
| bel | 41,6% | 37,8% | 28,4% | 48,1% | 42,6% | 30,8% | 35,5% |
| bgr | 81,2% | 106,2% | 70,0% | 131,3% | 148,3% | 67,9% | 103,9% |
| bra | 38,9% | 77,1% | 32,7% | 53,7% | 28,6% | 39,6% | 44,3% |
| can | 42,4% | 66,0% | 23,7% | 55,6% | 67,5% | 31,1% | 44,6% |
| che | 64,3% | 59,2% | 52,5% | 91,1% | 108,2% | 52,6% | 58,6% |
| chl | 82,8% | 108,1% | 74,8% | 85,7% | 26,0% | 72,4% | 80,1% |
| chn | 39,0% | 29,7% | 20,8% | 0,0% | 95,9% | 15,3% | 21,4% |
| col | 98,1% | 135,0% | 82,6% | 117,2% | 151,0% | 80,4% | 111,0% |
| cri | 112,3% | 168,9% | 102,7% | 157,9% | 283,6% | 94,3% | 156,4% |
| cyp | 61,5% | 131,4% | 63,8% | 155,1% | 86,0% | 68,7% | 115,2% |
| cze | 76,5% | 89,5% | 58,9% | 99,1% | 138,8% | 55,6% | 73,3% |
| deu | 16,3% | 6,3% | 0,8% | 5,7% | 4,7% | 0,3% | 7,0% |
| dnk | 24,2% | 54,1% | 23,2% | 44,3% | 38,7% | 42,7% | 33,3% |
| esp | 35,8% | 49,2% | 16,1% | 39,1% | 68,6% | 23,6% | 23,7% |
| est | 97,6% | 126,0% | 107,6% | 209,6% | 104,2% | 90,5% | 124,9% |
| europe | 25,6% | 34,1% | 16,1% | 25,4% | 24,7% | 17,9% | 24,6% |
| fin | 71,6% | 91,6% | 61,3% | 86,9% | 66,5% | 46,5% | 55,9% |
| fra | 31,7% | 29,3% | 14,1% | 19,4% | 22,4% | 19,2% | 24,8% |
| gbr | 2,6% | 16,7% | 0,0% | 16,4% | 21,5% | 0,0% | 9,2% |
| grc | 50,0% | 54,8% | 47,2% | 104,4% | 0,0% | 56,7% | 46,1% |
| hkg | 36,4% | 39,6% | 22,7% | 60,2% | 29,3% | 17,1% | 45,6% |
| hrv | 92,6% | 136,5% | 79,9% | 121,5% | 126,7% | 91,8% | 99,6% |
| hun | 66,5% | 79,1% | 29,5% | 95,7% | 143,0% | 66,5% | 61,3% |
| irl | 50,0% | 74,5% | 46,3% | 9,9% | 98,9% | 40,8% | 22,0% |
| isr | 67,2% | 100,1% | 65,6% | 67,7% | 27,2% | 58,4% | 60,4% |
| ita | 24,0% | 32,9% | 15,2% | 8,2% | 20,9% | 17,3% | 18,1% |
| jpn | 19,9% | 36,7% | 5,5% | 6,0% | 2,8% | 5,6% | 15,4% |
| kor | 21,4% | 22,9% | 8,0% | 16,5% | 7,2% | 8,1% | 23,1% |
| latam | 56,6% | 100,9% | 48,6% | 83,6% | 38,2% | 53,5% | 71,5% |
| ltu | 84,8% | 106,2% | 94,9% | 175,3% | 200,0% | 81,2% | 129,2% |
| lux | 63,6% | 91,1% | 37,7% | 74,4% | 95,1% | 56,7% | 20,1% |
| lva | 101,1% | 134,0% | 94,5% | 180,1% | 139,8% | 83,6% | 129,2% |
| mex | 55,6% | 94,1% | 45,0% | 77,8% | 157,1% | 46,8% | 76,3% |
| mlt | 118,4% | 229,1% | 119,2% | 247,4% | 321,2% | 128,7% | 134,4% |
| mus | 129,1% | 154,1% | 92,0% | 185,6% | 104,2% | 108,7% | 152,0% |
| nld | 29,1% | 39,0% | 19,3% | 19,9% | 46,7% | 20,4% | 22,9% |
| nor | 30,0% | 54,8% | 24,6% | 67,0% | 0,1% | 29,4% | 36,1% |
| nzl | 68,6% | 90,3% | 52,1% | 103,5% | 77,7% | 39,3% | 89,3% |
| pak | 80,4% | 129,9% | 94,1% | 184,4% | 206,6% | 86,4% | 102,0% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| pan | 111,9% | 209,7% | 130,9% | 128,8% | 314,8% | 124,3% | 147,2% |
| per | 95,5% | 155,8% | 96,2% | 179,5% | 180,5% | 92,6% | 128,4% |
| pol | 55,6% | 65,2% | 43,5% | 79,8% | 107,8% | 40,5% | 64,0% |
| prt | 60,8% | 100,1% | 46,3% | 70,3% | 130,1% | 57,3% | 72,4% |
| pry | 163,9% | 234,9% | 180,8% | 245,9% | 438,4% | 175,1% | 233,3% |
| rus | 30,8% | 37,6% | 22,1% | 69,2% | 70,5% | 19,2% | 37,5% |
| svk | 95,1% | 89,1% | 74,8% | 117,7% | 260,9% | 77,7% | 94,3% |
| svn | 113,3% | 110,3% | 87,8% | 159,0% | 178,6% | 77,7% | 106,9% |
| swe | 34,1% | 46,9% | 26,2% | 56,8% | 51,1% | 17,8% | 31,0% |
| tur | 50,3% | 88,3% | 69,2% | 122,0% | 223,7% | 62,6% | 80,5% |
| usa | 0,0% | 0,0% | 11,5% | 3,9% | 72,3% | 1,8% | 5,2% |
| zaf | 66,5% | 84,2% | 53,5% | 56,1% | 97,2% | 49,7% | 76,0% |

Note: weighted average per country calculated as the AVE per sector times the share of each sector in total imports.