

Measuring Agricultural Trade Integration in Southeast Asia

Antoine Bouët^{1*}, Aziz Elbehri², Duc Bao Nguyen³, and Fousseini Traoré⁴

¹*IFPRI and Bordeaux School of Economics, USA*

²*Food and Agriculture Organization of the United Nation(FAO), Bangkok*

³*VNU University of Economics and Business, Vietnam National University, Hanoi, Viet Nam*

⁴*IFPRI-Dakar, USA*

Abstract This paper offers an evaluation of agricultural trade integration in Southeast Asia. Since the ultimate objective is to provide policy recommendations, the indicators presented include those obtained from a measurement based on trade barriers: tariffs applied on imports, tariffs faced by exports, customs procedures and trade facilitation measures, and nontariff measures. A new estimation of the trade impact of nontariff measures in the agrifood sector is provided, based on refinements to the methodology of Kee, Nicita, and Olarreaga (2009) and Ghodsi, Grübler, and Stehrer (2016a). Globally, the Southeast Asian region appears to be relatively open to the world, but regional integration could be strengthened, particularly in the agriculture and food sectors. Specifically, a convergence of Sanitary and Phytosanitary measures and Technical Barriers to Trade measures could achieve more integration.

Keywords: Trade integration, Trade indicators, Southeast Asia, Non-Tariff measures

JEL Classifications: F14, F15

Received 22 January 2021, Revised 28 October, 2021, Accepted 4 March 2022

I. Introduction

This paper offers an evaluation of agricultural trade integration in Southeast Asia. Strengthening regional agricultural trade integration is widely seen as a lever for accelerating a region's growth, fighting poverty and improving food security and the resilience of food system: while the

+Corresponding Author: Antoine Bouët

Senior Research Fellow, IFPRI and Bordeaux School of Economics, France, Email: a.bouet@cgiar.org

Co-Author: Aziz Elbehri

Senior Economist and Group Leader, Socio-Economic Development & Policy Support Group, Food and Agriculture Organization of the United Nations (FAO), Regional Office for Asia and the Pacific, Bangkok. Email: aziz.elbehri@fao.org

Co-Author: Duc Bao Nguyen

Lecturer-Research Fellow, VNU University of Economics and Business, Vietnam National University, Hanoi.
Email: baond@vnu.edu.vn

Co-Author: Fousseini Traoré

Research Fellow, IFPRI-Dakar, IFPRI 1201 Eye Street NW Washington DC, USA 20005-3915 USA.
Email: Fousseini.Traore@cgiar.org

Acknowledgment: This work was undertaken as part of a research project funded by FAO, undertaken in collaboration with IFPRI. This paper has not gone through FAO and IFPRI's standard peer-review procedures. The opinions expressed here belong to the authors, and do not necessarily reflect those of FAO or IFPRI.

prevalence of undernourishment in Southeast Asia declined significantly between 2000 and 2013 from 20.5 percent to 9.7 percent, it is stable since that date and is still at 9.8 percent in 2019.¹⁾ The current health situation associated with the COVID-19 pandemic will likely contribute to further deterioration of this indicator and puts the issue of resilience of food systems at the center of the international political agenda.

Three categories of barriers to international trade are generally considered in assessments of the degree of trade integration of a region (Bouët, Cosnard, and Laborde, 2017): tariffs, non-tariff measures (NTMs) and trade facilitation measures.

- Customs duties have been declining for the past 60 years, although agricultural products are still significantly taxed when imported in some countries (Bouët et al., 2008; Bureau, Guimbard, and Jean, 2016).
- NTMs have been considered an essential element of a new protectionism for the past 40 years (Greenaway, 1982). According to international standard definitions, NTMs are defined as "policy measures other than ordinary customs tariffs that can potentially have an economic effect on international trade in goods" (UNCTAD, 2021). NTMs may arise in very different regulations - e.g., in the pre-shipment inspection of cargoes, in a Sanitary and Phyto-Sanitary (SPS) measure, or in rules of origin related to implementation of a free trade agreement. Among the most important are: SPS measures - i.e., those related to food safety and to animal and plant health (such as restrictions on substances), those preventing dissemination of diseases, and those assessing product conformity (like certification, testing, inspections, and quarantine); and Technical Barriers to Trade (TBTs) - i.e., the technical characteristics of a product, the conditions of its fabrication, and the requirement of these characteristics and conditions of production. Numerous empirical studies have highlighted their importance and their restrictive impact on trade, particularly on agricultural trade (Disdier, Fontagné, and Mimouni, 2008; Kee, Nicita, and Olarreaga 2009; Beghin, Disdier, and Marette, 2015; Ghodsi, Grübler, and Stehrer, 2016a). As we show below, these assessments are unfortunately old or flawed.
- Finally, trade facilitation measures (efficiency of customs procedures, transport and communication infrastructures) are now subject to recurrent evaluation and specific negotiation at international level (Wilson, Mann, and Otsuki, 2005; Portugal-Perez, and Wilson, 2012).

To assess the degree of trade integration in Southeast Asia at the agricultural level, we evaluate the intensity of barriers to international trade in this sector: tariffs, non-tariff measures, and trade facilitation measures. We use data on tariffs and on NTMs, and results from the World Bank's *Doing Business* (World Bank, 2020) and *Enabling the Business in Agriculture*

1) These statistics were obtained from the FAO website: <http://www.fao.org/sustainable-development-goals/indicators/211/en/>, accessed on January 6, 2021.

(World Bank, 2019) reports to identify the main trading costs impeding the international movement of agricultural commodities in the region. Because existing estimations of the trade impact of NTMs are either old or flawed or both, we provide a new estimation of NTMs in the region, using a methodological improvement over previous studies. Indeed, previous estimates of the trade impact of NTMs were based on old statistics or old trade elasticities (Kee, Nicita, and Olarreaga 2009), or were misleading: all these estimations of Ad Valorem Equivalents (AVEs) of NTMs, even the one conducted by Ghodsi, Grübler, and Stehrer (2016a), did not consider Jensen's inequality. This clearly leads to an underestimation of the restrictive impact of NTMs. The main contribution of this paper is thus to offer a synthetic measure of agricultural trade integration in South-East Asia, with a more accurate assessment of non-tariff measures and to show that these measures have a more restrictive impact on regional agricultural trade than previous studies concluded. This allows us to propose that the easing of non-tariff measures affecting the agricultural sector in Southeast Asia be placed at the center of the region's policy agenda.

Section 2 gives the institutional and political of this study. Section 3 presents data on tariffs and trade facilitation measures, and previous estimates of the trade impact of NTMs in Southeast Asia. Section 4 presents our methodology concerning estimation of the trade impact of NTMs. Section 5 provides a statistical analysis of NTMs on agricultural and food products in the ASEAN region, while Section 6 estimates the trade impact of NTMs in ASEAN countries. Section 7 concludes with policy recommendations.

II. Background

From an economic and trade point of view, the ASEAN region is interesting. First, significant heterogeneity exists between member countries. For example, in terms of economic size, Brunei Darussalam is 77 times smaller than Indonesia. Cambodia's gross domestic product (GDP) per capita is 23 times smaller than that of Singapore. In terms of surface area, Singapore is 2,658 times smaller than Indonesia. While about one-quarter of domestic value added is produced in the agriculture, forestry, and fishing sector in Myanmar, in Singapore that figure is only 0.02 percent (World Development Indicators, 2020). Indeed, Brunei Darussalam and Singapore are classified as high-income economies by the World Bank. Cambodia, Lao PDR, and Myanmar are Least Developed Countries.

Second, each of the following countries has a relatively high ratio of trade over GDP; one-half of them have a ratio greater than one: (in decreasing order) Singapore, Vietnam, Malaysia, Cambodia, and Thailand. Singapore was recognized as the most competitive and open economy in 2018 at the World Economic Forum.

Third, another feature of ASEAN countries is their relatively strong economic growth in

the long term. Data show that the average long-term economic growth of ASEAN countries since 2001²⁾ has been between 5.5 and 6.5 percent (in real terms). Economic growth has been low in Brunei Darussalam since 2012, with negative performance in 2013, 2014, 2015, and 2016, while very high in Cambodia and Lao PDR.

As shown in this article, many barriers still hinder the international exchange of agricultural products in Southeast Asia, despite the efforts made by governments to promote regional trade. The Association of Southeast Asian Nations (ASEAN) is a regional intergovernmental organization including Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The organization promotes intergovernmental cooperation and is supposed to facilitate economic integration among its members and other countries in Asia. ASEAN countries ratified the ASEAN Trade in Goods Agreement (ATIGA) in February 2009, an agreement subsequently entered into force in May 2010. The agreement aimed to achieve free trade in goods, with fewer trade barriers, lower business costs, and a larger market to enable firms to operate with more economies of scale. Since then, ASEAN countries have eliminated almost all intra-ASEAN import duties. They focus today on addressing NTMs that could have a substantial negative impact on regional trade, and particularly on agricultural products.

The RCEP (for "Regional Comprehensive Economic Partnership") agreement was signed on November 15, 2020, during the ASEAN summit. It includes all ASEAN countries and five emerging (China) or high-income countries (Australia, Japan, New Zealand, South Korea). Nevertheless, it implies a limited trade liberalization. On one hand, tariffs will be eliminated for 92 percent of tariff lines on average, as the agreement contains a sensitive products clause. A significant share of agriculture is thus exempted from liberalization in many countries. On the other hand, the regulatory provisions negotiated are often not very restrictive, the most significant in practice being the establishment of common rules of origin. No attempt to impose truly binding commitments has yet been made on Sanitary and Phytosanitary (SPS) issues and on Technical Barriers to Trade (TBTs) (Guimbard and Jean 2020).

III. Tariffs, NTMs, and other Trading Costs in Agriculture in Southeast Asia

This section measures the intensity of trading costs in agricultural trade in ASEAN countries. We use data from the MAcMaps-HS6 database to construct indicators of integration based on trade barriers.³⁾ Indicators on customs procedures are from the World Bank.

2) These data also come from the World Development Indicators.

3) "Market Access Map (MAcMap) provides a disaggregated, exhaustive and bilateral measurement of *applied* tariff duties. It takes regional agreements and trade preferences exhaustively into account. The source data is from ITC (UNCTAD-WTO)." Extracted from the CEPII website on July 21, 2020.

Table 1 indicates the average tariff on imports given by MAcMAP-HS6 for 2016 for the 10 ASEAN countries for all products⁴⁾ and for only agricultural and food products, together with estimations of the AVEs of NTMs by Kee, Nicita, and Olarreaga (2009) and by Ghodsi, Grübler, and Stehrer (2016a). AVEs of NTMs are not available for Cambodia, Lao PDR, Myanmar, and Vietnam; AVEs of NTMs in agriculture and food from Ghodsi, Grübler, and Stehrer (2016a) are not available. The tariffs are weighted averages, based on a methodology designed to avoid the traditional endogeneity bias faced when using bilateral trade weights (Bouët et al., 2008).

Table 1. Average Tariff on Imports (2016) and AVE of NTMs (Around 2000* and 2011**) - ASEAN Countries - All Sectors and Agriculture and Food Sector

Country	All goods			Agriculture and food	
	Average tariff (%)	AVE of NTMs* (%)	AVE of NTMs** (%)	Average tariff (%)	AVE of NTMs* (%)
Brunei Darussalam	1.9	7.8	na	2.3	19.9
Cambodia	5.7	na	na	7.9	na
Indonesia	4.9	5.7	68.5	9.5	26.0
Lao PDR	4.2	na	na	5.5	na
Malaysia	5.5	31.8	5.9	13.9	47.7
Myanmar	3.8	na	na	6.1	na
Philippines	3.9	39.8	15.4	9.0	40.0
Singapore	0.1	33.8	35.2	1.4	46.3
Thailand	8.7	4.0	-14.5	36.7	39.8
Vietnam	4.6	na	-11.7	12.3	na

(Source) MAcMAP-HS6 2016 for tariffs and Kee, Nicita, and Olarreaga for NTBs (2009).

Note. na for "not available"; * for estimations from Kee, Nicita, and Olarreaga (2009); ** for estimations from Ghodsi, Grübler, and Stehrer (2016a).

In the MAcMAP-HS6 for 2016, the simple average of average tariffs on imports among 195 countries is 7.2 percent and the median is 6.2 percent, which reflects a right-skewed distribution (a few relatively high tariffs). In terms of import duties, all ASEAN countries are relatively open, except Thailand, where the average tariff is 8.7 percent. Tariff protection is 0.1 percent in Singapore.

However, the relatively low import tariffs in Malaysia, the Philippines, and Singapore are offset by very high AVEs of NTMs, as estimated by Kee, Nicita, and Olarreaga (2009): the simple average of their country estimates is 11.2 percent, while the AVE of NTMs is estimated at 31.8 percent in Malaysia (but 5.9 percent by Ghodsi, Grübler, and Stehrer 2016a), 33.8 percent in Singapore (35.2 percent by Ghodsi, Grübler, and Stehrer 2016a), and 39.8 percent in the Philippines (15.4 percent by Ghodsi, Grübler, and Stehrer 2016a). AVEs of NTMs are relatively low in Brunei Darussalam, Indonesia, and Thailand. Furthermore, the AVEs figures are likely underestimated as we will

4) Even if the focus of this study is on agricultural and food products, it is important to present the average tariff on all products to judge the importance of the average tariff on agricultural and food products alone.

show in section 3 due to the failure of the above-mentioned studies to consider Jensen Inequality in their econometric estimations.

In the agriculture sector, the same conclusions apply. However, the worldwide average of protection is higher. The simple average of average tariffs on agricultural imports is 14.9 percent and the median is 12.7 percent: the agriculture sector of all ASEAN countries is relatively less protected, except in Thailand, which applies an average tariff of 36.6 percent. Agricultural tariff protection is 0.1 percent in Singapore. However, the relatively low agricultural import tariffs in Malaysia, the Philippines, and Singapore are offset by a very high AVE of NTMs, as estimated by Kee, Nicita, and Olarreaga (2009): the world simple average of these estimates is 27.3 percent, while the AVE of NTMs is estimated at 47.7 percent in Malaysia, 46.3 percent in Singapore, and 40.0 percent in the Philippines. Thailand not only imposes high tariff protection in agriculture, but also imposes restrictive NTMs: its AVE is 39.8 percent for a total protection estimated at 76.5 percent in the agriculture and food sector.

The insertion of an economy in world trade can also be evaluated through the access it gets to foreign markets. With the MAcMAP-HS6 database, calculation of the average duty faced by a country's exports when entering foreign countries is possible. Table 2 presents the average duty faced by ASEAN countries' exports in 2016 on all products and on agricultural and food products.

Table 2. *Average Custom Duty Faced by Exports - 2016*

Country	All goods (%)	Agriculture and food (%)
Brunei Darussalam	0.6	8.9
Cambodia	4.1	15.4
Indonesia	4.1	9.1
Lao PDR	4.8	17.5
Malaysia	2.5	10.9
Myanmar	4.2	14.9
Philippines	1.4	7.3
Singapore	2.4	18.7
Thailand	6.1	20.7
Vietnam	3.8	9.0

(Source) MAcMAP-HS6 2016 and Bouët, Estrades, and Laborde (2013).

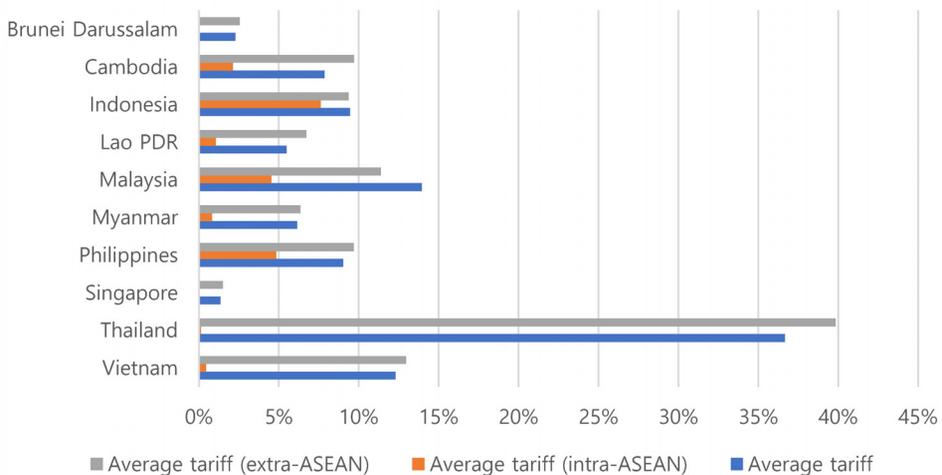
In 2016, the simple average of all countries' average duties faced on exports stands at 5.2 percent for all products and at 13.7 percent for agricultural products. All ASEAN countries benefit from better access on average for all products, except Thailand, where exports face an average tariff of 6.1 percent. In agriculture, five ASEAN countries (Cambodia, Lao PDR, Myanmar, Singapore, Thailand) are penalized by relatively high duties applied by trading partners on their exports. This is especially the case in Thailand, for which agricultural exports face an average

import duty of 20.7 percent when they enter foreign markets.

Why does a country face a higher or lower duty on its exports? Two elements can explain this situation. First, a country may have obtained more or less preferential arrangements from trading partners. Second, a country may be specialized in the export of products more or less taxed worldwide: countries specialized in agricultural exports are often penalized by high duties on their exports, especially when they export cereals, milk and dairy products, meat and meat products, or fruit and vegetables.⁵⁾

Figure 1 presents ASEAN countries' average tariffs on intra-ASEAN imports and on extra-ASEAN imports on agrifood imports. Anderson and van Wincoop (2003) demonstrated that what matters is not the absolute level of an import tariff (or of any barrier to trade), but its relative level. In other words, a low level of tariffs between ASEAN countries will cause more trade between ASEAN countries if the level of their tariffs on imports coming from non-ASEAN countries is higher.

Figure 1. Average tariff on agrifood imports, intra-ASEAN imports, and extra-ASEAN imports (2016) - ASEAN countries



(Source) MAcMAP-HS6 2016 and authors' calculation.

On all products, average tariffs are much lower, from 0.12% for Singapore to 8.71% for Thailand. Trade between ASEAN countries is not fully liberalized in terms of import duties: while these tariffs are zero or close to zero in Brunei Darussalam, Myanmar, Singapore, Thailand,

5) Countries can also impose taxes on their own exports to get public revenues, to decrease local prices, or to increase world prices of their exports (Bouët and Laborde 2010). However, accessible information is limited as World Trade Organization (WTO) members do not usually notify these export taxes. In the region, Indonesia has been identified as a country implementing significant export taxes, especially on a few products like untreated skin, white tanned leather, and coal (Bouët, Estrades, and Laborde, 2013). Information is so limited that we do not include it here.

and Vietnam, some significant agrifood import tariffs still exist in other ASEAN countries, especially Indonesia, Malaysia and Philippines. The level of ASEAN countries' agrifood protection vis-à-vis the rest of the world is heterogeneous, with almost complete free trade in Singapore and a relatively high level of tariff protection in Thailand (40 percent), and to a lesser extent in Vietnam (13 percent), Malaysia (11 percent) and Cambodia (10 percent).

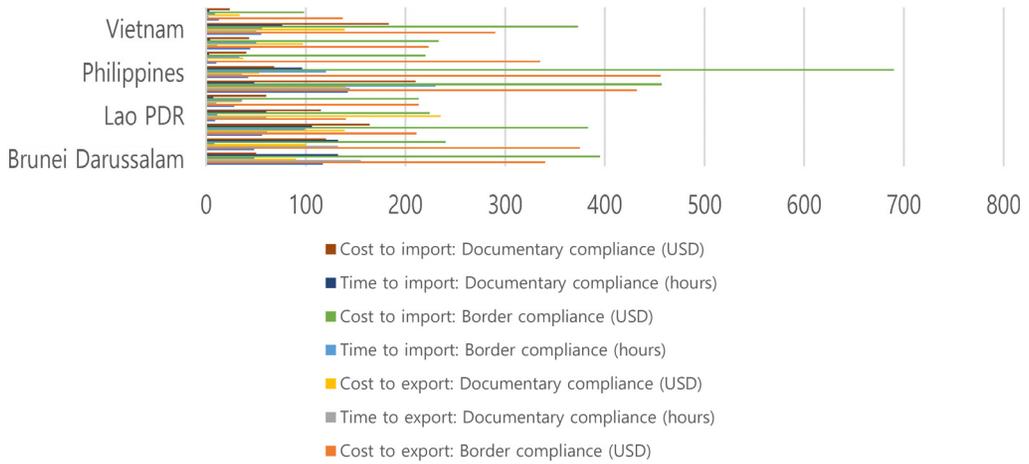
Comparing average tariffs on intraregional imports with those on extraregional imports leads to very heterogeneous conclusions. On one hand, the very low level of Singapore's tariff on intraregional trade (almost 0 percent) supports such trade, but Singapore gets approximately the same level of tariff on imports coming from non-ASEAN countries. On the other hand, Cambodia taxes intraregional imports at a relatively high level of average tariff compared to other countries (2.1 percent both). However, the relatively high level of average tariff on extra-ASEAN imports (9.7 percent, respectively) should encourage intra-ASEAN imports. Thailand has an interesting tariff structure, where the average tariff on intraregional trade (almost 0 percent) supports intraregional trade, a support amplified by the high level of average tariff on extra-ASEAN imports (39.8 percent).

Protection of the ASEAN agriculture and food sector is still higher than that of other sectors, both from a global perspective (all origins) and on extra-regional imports. On intra-regional imports, protection of the agriculture and food sector in Cambodia and Vietnam is lower than that of other goods sectors.

Border measures, either tariffs or NTMs, are not the only impediments to international trade. Other trading costs can slow down or even prevent trading across borders; these include high domestic transportation costs, lack of communication infrastructure, and insufficient access to credit and insurance markets.

Doing Business 2016 (World Bank 2020) constructed indicators to measure the cost in both time and money, excluding tariffs and border taxes, of exporting and importing a specific shipment of goods to and from an economy's main trading partners. For all countries, imports are shipments of containerized auto parts from that country's natural partner. For exports, a product that represents comparative advantage is identified; the country of destination is the largest purchaser of this product (the natural partner). Time to export and time to import include documentary compliance, border compliance, and domestic transport (all in hours). Cost to export and cost to import include documentary compliance, border compliance, and domestic transport (all in US dollars). The advantage of these indicators is that they include many trading costs associated with exporting and importing operations. Figure 2 indicates the level of these indicators in 2019 for the 10 ASEAN countries and on average for OECD (Organization for Economic Co-operation and Development) high-income countries as a benchmark.

Figure 2. Doing business 2020 indicators



(Source) Doing Business 2020.

These administrative trade barriers are especially high in Brunei Darussalam and Myanmar, and, albeit to a lesser extent, in Cambodia and Indonesia. In Cambodia, the main impediment to trade is the time for documentary compliance to both export and import. In Indonesia, the time for border compliance is also relevant. Malaysia, Thailand, and especially Singapore have procedures that are almost as efficient as those of high-income countries.

The World Bank has also facilitated estimation of the cost of business in agriculture with its "Enabling the Business in Agriculture" indicator. Concerning trade integration, the "Trading Food" indicator (a score and an index) "measures laws and regulations that help domestic farmers trade agricultural products."⁶ It includes the time and cost required to obtain mandatory documents for each shipment.

Table 3 gives the score of the seven ASEAN countries in the database, together with the score of three high-income countries as a benchmark.

6) Extracted from <https://eba.worldbank.org/en/methodology#a>, on July 27, 2020.

Table 3. *Enabling the Business of Agriculture Indicator, 2019*

Country	Trading Food Score*	Time to obtain agriculture-specific export documents (hours)	Cost to obtain agriculture-specific export documents (USD)	Trading Food Index (0-7)*
Cambodia	19.05	144	218	4
Lao PDR	38.19	96	148	4
Malaysia	77.08	60	25	6
Myanmar	47.62	96	65	3
Philippines	69.64	48	1	3
Thailand	25.40	96	195	3
Vietnam	58.30	72	35	3
France	85.69	36	7	6
Netherlands	100	0	0	7
United States	66.01	48	106	6

(Source) World Bank - 2020

Note. * A higher score or index reflects a better business-enabling environment.

Among ASEAN countries, only Malaysia gets an honorable score and has an environment that well enables the trade of agricultural commodities. Of the 101 countries in the Enabling the Business of Agriculture database, Cambodia scores last and Thailand 99th.

This section provides relatively precise estimates of tariffs and of the costs related to customs procedures concerning agricultural trade in the ASEAN region. Estimation of NTMs is significantly more imprecise as it is based on old information, misleading methodologies, or both. Therefore, the next section develops a specific methodology for NTMs in ASEAN countries.

IV. New Methodology to assess the Intensity of NTMs in the ASEAN Region

This section first presents the data used in this study, then the indicators used to assess the importance of adoption of NTMs in the ASEAN region, and finally the method used to estimate the AVEs of NTMs.

We designed a database on NTMs on agricultural products in the ASEAN region based on various existing databases, like the UNCTAD TRAINS Portal on the global database on Non-Tariff Measures, the WTO Integrated Trade Intelligence Portal (WTO I-TIP; see Ghodsi, Reiter, and Stehrer 2016c), and complemented by the World Bank's Temporary Trade Barriers database.

It is common to illustrate the intensity of NTMs in a sector and/or in a country by three indexes:

- The frequency index is the percentage of products subject to one or more NTMs.
- The coverage ratio is the percentage of imports subject to one or more NTMs.
- The prevalence score captures the average number of NTMs that apply to a product.

The disadvantages of the frequency index are numerous. First, it identically weights products that are only slightly imported and those that are massively imported. Second, it identically weights a very restrictive nontariff barrier (e.g., a prohibition) and one that is only slightly restrictive (e.g., a preshipment inspection). Third, it identically weights multilateral and bilateral trade barriers. Fourth, it identically weights a product exposed to only one NTM and a product exposed to many NTMs.

The coverage ratio only addresses the first and third previous criticisms. However, like any indicator based on an own-import weighting system, it underestimates the protectionist nature of a trade policy, since a very restrictive barrier will see its weight reduced, or even cancelled (prohibition): this is what economists used to call endogeneity of the weights. To address the fourth criticism (accounting for products exposed to several NTMs), construction of a prevalence score matters.

One objective of this article is to come up with the AVEs of a series of NTMs in Southeast Asia, with a focus on agriculture and food. The two main NTMs are: (i) SPS measures, since the focus is on agricultural products; and (ii) to a lesser extent, TBTs.

After a thorough literature review (Kee, Nicita, and Olarreaga 2009; Ghodsi, Grübler, and Stehrer 2016a), our approach builds upon a two-step econometric procedure. We first estimate a gravity-type model to assess the impact of NTMs on trade flows in volume. In the second step, we combine the quantitative impact of NTMs with import demand elasticities to compute the AVEs.

The equation to be estimated is:

$$\ln(M_{i,j,h,t}) = \beta_{0h} + \beta_{1h} \ln(1 + t_{i,j,h,t-1}) + \sum_{n=1}^{N-1} \beta_{2h} NTM_{i,j,h,t-1}^n + \sum_{i=1}^I \beta_{2i,h} \omega_i NTM_{i,j,h,t-1}^{n'} + \beta_{3h} X_{i,j,t-1} + \phi_{i,j,h} + \theta_{h,t} + \epsilon_{i,j,h,t} \quad (1)$$

where:

- $M_{i,j,h,t}$: import quantities of product h to country i from partner country j at time t
- $t_{i,j,h,t}$: ad valorem tariff rate applied by country i on product h from partner j at time t
- $NTM_{i,j,h,t}^n$: count variable that shows the total number of NTM regulations in force of type n applied by country i on product h from partner j at time t
- $NTM_{i,j,h,t}^{n'}$: count variable that shows the total number of NTM regulations in force of type n' applied by country i on product h from partner j at time t
- $X_{i,j,t}$: time-varying country-pair characteristics consisting of classical gravity variables and factor endowments⁷⁾

7) We use all the standard variables found in the literature including country pair product fixed effects to avoid any omitted variable bias such as the multilateral resistance terms, classical country pair gravity variables (which

- n and $n' \in \{1, 2, \dots, N\}$ where $n \neq n'$, the set of NTM types
- $\phi_{i,j,h}$ is a country-pair product fixed effect
- $\theta_{h,t}$ is a product time fixed effect
- $\epsilon_{i,j,h,t}$ is an error term.

The coefficient $\beta_{2ih}^{n'}$ measures the importer-specific impact of NTM of type n' under consideration, with the help of the dummy variable ω_i . In this article, we only consider SPS and TBT measures. β_{2ih}^n measures all other NTM types that we take into account. Explanatory variables are lagged by one period to avoid a potential endogeneity bias in cases where NTMs or tariffs are imposed in response to changes in imports.⁸⁾ The Poisson Pseudo-maximum likelihood (PPML) estimator suggested by Santos Silva and Tenreyro (2006) is used in the estimations to solve both the heteroskedasticity and zero trade flow issues.

AVEs are obtained by differentiating equation (1) with respect to the NTM type under consideration. More precisely, the impact of a specific NTM on import quantities can be decomposed into the impact of prices on import quantities (import elasticities) and the impact of the NTM on prices (AVEs).

$$\frac{\partial \ln(M_{i,h})}{\partial NTM_{i,h}^{n'}} = \frac{\partial \ln(M_{i,h})}{\partial \ln(p_{i,h})} \frac{\partial \ln(p_{i,h})}{\partial NTM_{i,h}^n} = \epsilon_{i,h} A VE_{i,h}^{n'} \tag{2}$$

$\epsilon_{i,h}$ represents the import demand elasticity for country i for product h and $p_{i,h}$ the price of product h in country i .

Since $\frac{\partial \ln(M_{i,h})}{\partial NTM_{i,h}^{n'}} = e^{\beta_{2i,h}^{n'}} - 1$ we have⁹⁾ $e^{\beta_{2i,h}^{n'}} - 1 = \epsilon_{i,h} A VE_{i,h}^{n'}$

Solving for a particular NTM n' and rearranging terms yields the AVE:

control for whether both countries are members of a regional trade agreement, or members of the WTO; for whether the trade agreement between these two countries include SPS provisions) and bilateral factor endowments (which indicate market potential by making use of the sum of the trading partners' GDP at PPP, the distance between countries in terms of three distinct endowments relative to GDP, i.e., labor, capital stock as well as agricultural land area, and show how different the economies in a country pair are with respect to real GDP per capita, as suggested by Baltagi et al., 2003).

8) This would indeed cause a simultaneity bias, one of the most important cause of endogeneity in this framework and require instrumental variables technics (see for instance Kee and Nicita, 2016). Lagging variables avoids the simultaneity bias.

9) Since NTMs are dummy and count variables, $\frac{\partial \ln(M_{i,h})}{\partial NTM_{i,h}^{n'}} = e^{\beta_{2i,h}^{n'}} - 1$ and not $\beta_{2i,h}^{n'}$ like in the continuous case (Wooldridge, 2002).

$$AVE_{i,h}^{n'} = \frac{e^{\beta_{2i,h}^{n'}} - 1}{\epsilon_{i,h}} \quad (3)$$

The formula in Equation (3) is used in previous studies like Kee, Nicita, and Olarreaga (2009) and Ghodsi, Grübler and Stehrer (2016a). However, we claim that this is a biased estimate of the true value. Indeed, the fact that the impact of NTMs on import quantities must be exponentiated (nonlinear transformation) automatically yields a biased estimate due to Jensen's inequality. Following Kennedy (1981) and Giles (1982), the true value is given by:

$$A\widehat{VE}_{i,h}^{n'} = \frac{e^{\left(\widehat{\beta}_{2i,h}^{n'} - \frac{1}{2}\widehat{\sigma}_{\beta_{2i,h}^{n'}}^2\right)} - 1}{\epsilon_{ih}} \quad (4)$$

where $\widehat{\sigma}_{\beta_{2i,h}^{n'}}^2$ is the variance of $\widehat{\beta}_{2i,h}^{n'}$.

For import demand elasticities, we rely on the extensive work of Ghodsi, Grübler, and Stehrer (2016b), which is more recent (estimations are from 1996 to 2014) than Kee, Nicita, and Olarreaga (2008), which stops in 2001. Ghodsi, Grübler, and Stehrer (2016b) provide import demand elasticities estimates for 167 countries and 5,124 products at the HS6 (Harmonized System 6) level.

V. Statistical Analysis of NTMs on Agricultural and Food Products in the ASEAN Region

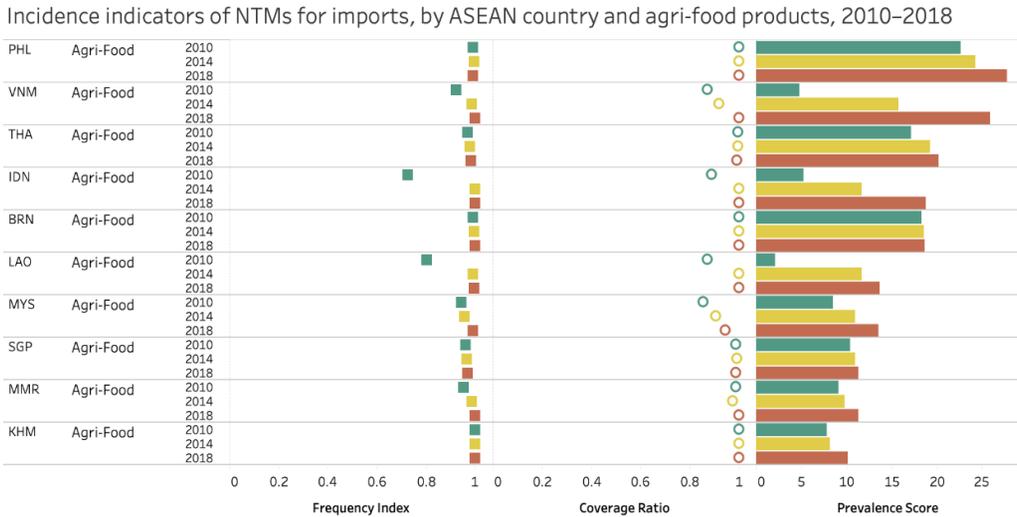
This section presents the statistical analysis of NTMs in ASEAN countries. It is based on the calculation of frequency indexes, coverage ratios, and prevalence scores for each of the 115 importing countries (including the 10 ASEAN countries) for which data on NTMs are available through the UNCTAD TRAINS portal. As countries declare these measures based on different versions of the Harmonized System (HS 1992, HS 1996, HS 2002, HS 2007, HS 2012, or HS 2017), harmonization is necessary. In the next section, AVEs are estimated with the help of import demand elasticities from Ghodsi, Grübler, and Stehrer (2016b). As these authors use the HS 1996 classification, all data on NTMs (UNCTAD TRAINS portal), on trade (BACI), and on protection (MacMAP-HS6) were converted into this classification.¹⁰⁾ We obtained 5,113 products at the HS6 (version HS 1996), of which 704 are agricultural products (chapters 1 to 24).

10) This conversion is based on the inter-HS-6 versions correspondence table of UN COMTRADE.

A. NTMs by importers

This first subsection presents frequency indexes, coverage ratios, and prevalence scores of NTMs for each ASEAN country in a way that facilitates intercountry comparison and time evolution, for agrifood products (Figure 3).

Figure 3. NTMs by importer: ASEAN countries, 2010-2014-2018, Agrifood products



(Source) UNCTAD and authors' calculation.

A significant increase in the number of NTMs in the ASEAN region occurred between 2010 and 2018. However, the agrifood sector was already characterized by at least one NTM in each product in 2010, except in Indonesia and Lao PDR, such that the augmentation between 2010 and 2018 mostly concerns the industrial sector. This is especially the case in Lao PDR and Myanmar between 2014 and 2018 in Lao PDR, in the agrifood sector the frequency index increased from 80.2 percent in 2010 to 99.8 percent in 2018. In agriculture, frequency indexes are between 96 percent and 100 percent; coverage indexes are greater than 99 percent, except in Malaysia; and prevalence scores are between 10 (Cambodia) and 27 (the Philippines). These prevalence scores in the agrifood sector substantially increased between 2010 and 2018 in Vietnam, the Philippines, Thailand, Indonesia, and Lao PDR.

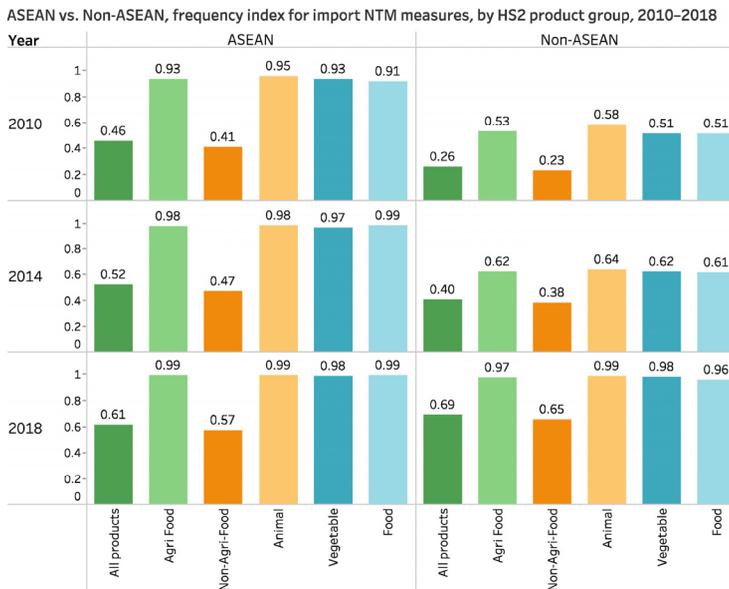
B. NTMs in ASEAN versus non-ASEAN countries

Figures 4, 5, and 6 compare, respectively, frequency indexes, coverage indexes, and prevalence scores of NTMs in ASEAN and non-ASEAN countries by year (2010-2014-2018), for all

products, for agrifood versus non-agrifood products, and for 3 large categories of products (Animal, Vegetable, and Food).

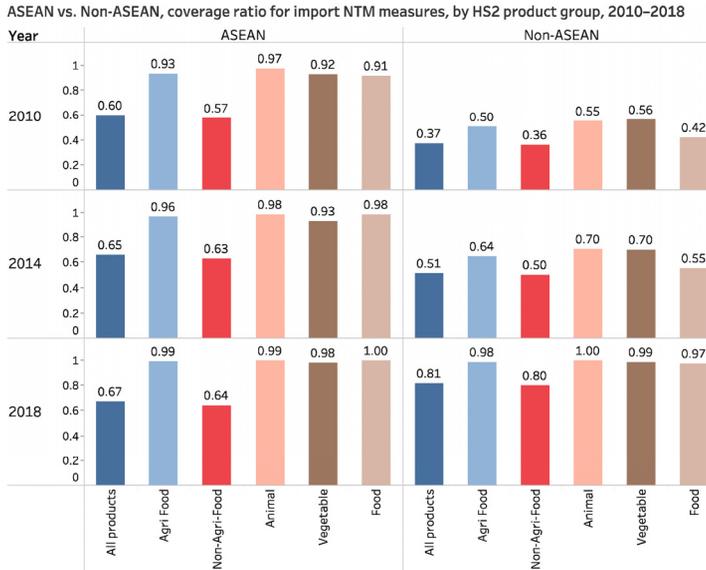
Whereas in 2010 frequency indexes and coverage ratios, but also prevalence scores, on all products were greater in ASEAN than in non-ASEAN countries, they were close in 2018. This is true for all products, but also for agrifood products. For example, while in 2010 frequency indexes for agrifood products were 93.1 percent in ASEAN and 52.8 percent in non-ASEAN countries, these indexes were 98.8 percent and 97.2 percent in 2018. Still for agrifood products in 2010, coverage indexes were 92.8 percent in ASEAN and 50.4 percent in non-ASEAN countries, but these indexes were 98.8 percent and 98.3 percent in 2018. Likewise, in 2010 prevalence scores for agrifood products were 11.4 percent in ASEAN and 6.4 percent in non-ASEAN countries, but 17.6 percent and 18.6 percent in 2018. In 2018, NTMs were adopted in almost all tariff agrifood lines and covered almost all agrifood products, both in ASEAN and non-ASEAN countries. However, animal products were characterized by more NTMs by product (Figure 6).

Figure 4. NTMs by importer: Frequency index, 2010-2014-2018, all products and by large categories of products, in ASEAN vs. non-ASEAN countries



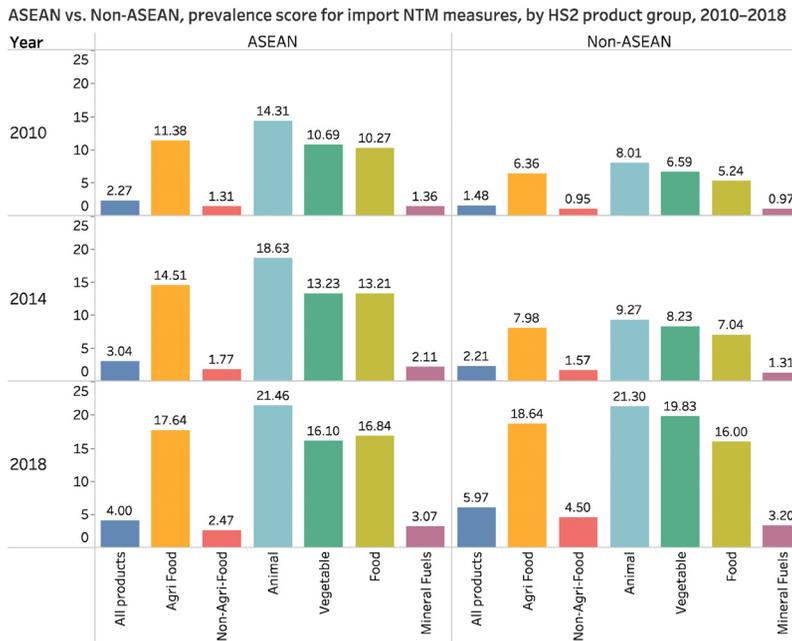
(Source) UNCTAD and authors' calculation.

Figure 5. NTMs by importer: Coverage ratio, 2010-2014-2018, all products and by large categories of products, in ASEAN vs. non-ASEAN countries



(Source) UNCTAD and authors' calculation.

Figure 6. NTMs by importer: Prevalence score, 2010-2014-2018, all products and by large categories of products, in ASEAN vs. non-ASEAN countries



(Source) UNCTAD and authors' calculation.

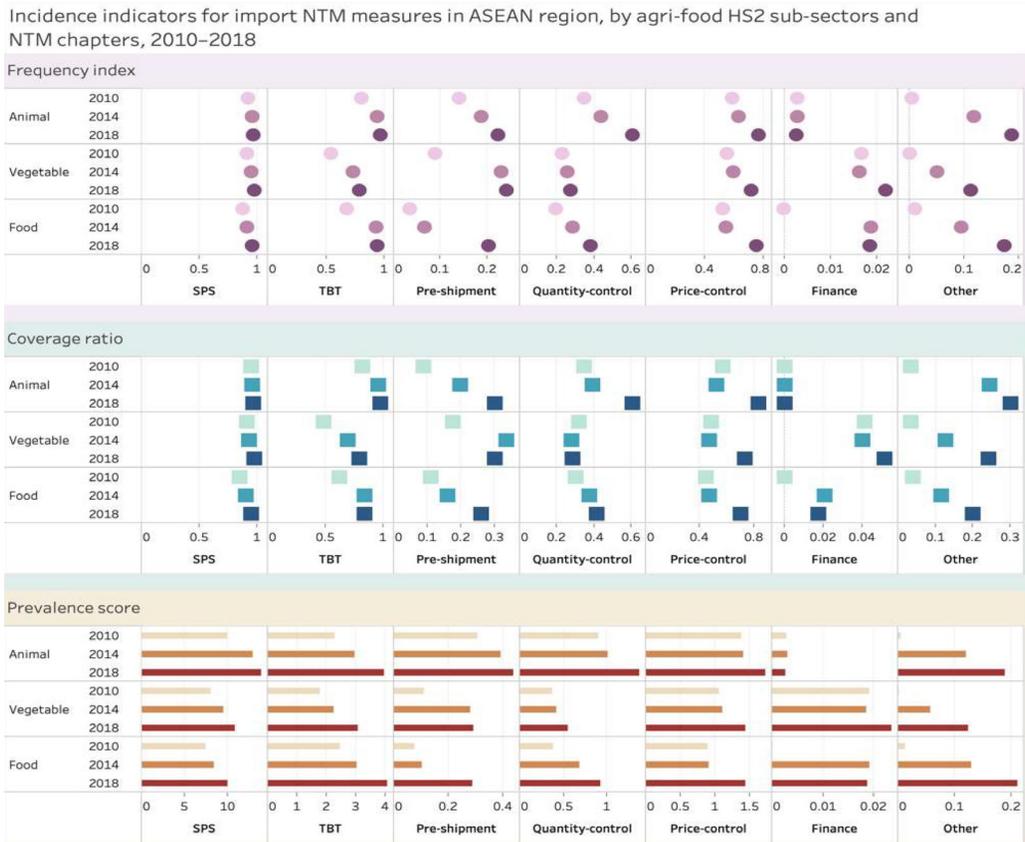
C. NTMs by type

This subsection examines the distribution of NTMs by type adopted by ASEAN countries. Indeed, NTMs include various types of measures: SPS, TBTs, and price and quantity control measures, among others.

Figure 7 presents frequency and coverage indexes and prevalence scores of NTMs adopted in ASEAN countries by type in 2010, 2014, and 2018 for three large categories of agricultural products (animal, HS2: 01-05; vegetable, HS2: 06-15; food, HS2: 16-24).

The most frequently adopted NTMs on agrifood products in ASEAN countries are SPS regulations. They cover almost all products and the totality of the value of agrifood imports. The average number of SPS regulations by product (prevalence score) significantly expanded between 2010 and 2018 and is especially large in the animal sector. TBTs are another type of NTM frequently adopted.

Figure 7. NTMs by HS2 and type: Frequency and coverage indexes and prevalence scores, 2010-2014-2018, for animal, vegetable, and food sectors, in ASEAN region



(Source) UNCTAD and authors' calculation.

VI. Estimation of the Trade Impact of NTMs in the ASEAN Region

NTMs may have very different impacts on trade: a simple preshipment inspection is certainly less restrictive than a prohibition. Therefore, it is important to assess the trade impact of NTMs, which can be achieved by an indirect method: a gravity equation. This section uses such a method to estimate the AVEs of NTMs in ASEAN countries.

To limit the size of the database and the time for executing regressions, we separately estimate 704 agricultural products (HS 01-24) with the PPML estimator and a set of fixed effects including importer, exporter, year, and importer-exporter fixed effects. Our regressions include the period ranging from 2009-2018 and cover 115 importing countries for which NTM data are available.¹¹⁾

Estimations of "import demand elasticities" come from Ghodsi, Grübler, and Stehrer (2016b), although they do not provide these for six importing countries (Afghanistan, Guyana, Lao PDR, Liberia, Papua New Guinea, Tajikistan). All these countries were excluded except Lao PDR, which is an ASEAN member. For Lao PDR, an average of "import demand elasticities" of the other ASEAN countries was used for each product.

As SPS and TBT measures are the predominant NTMs employed in food and agricultural commodities, we focus on an analysis of the trade impact of SPS measures on food and agricultural products in ASEAN countries and then provide the trade impact of TBTs on these products.

Extreme values and potential outliers of AVEs are excluded. To do this, we first determine the maximum and minimum values of the distribution of AVE values using the interquartile range rule (*i.e.*, the minimum AVE value equals the lower quartile minus three interquartile range, while the maximum AVE value equals the upper quartile plus three interquartile range). Then, we define the lower bound for negative AVEs at -100 as suggested by Ghodsi, Grübler, and Stehrer (2016a), since the domestic price of a commodity can only be decreased by a maximum of 100 percent.

A. Trade impact of SPS measures

Figure 8 shows the distribution of import-weighted average binding AVEs of SPS measures on food and agricultural products, by importing country and HS section. ASEAN countries are represented in red bars and non-ASEAN countries in blue bars. This analysis considered only binding AVE estimates for which the impact of NTMs on import quantities was statistically different from zero at the 10 percent level. Using import values as weights¹²⁾ for the AVEs

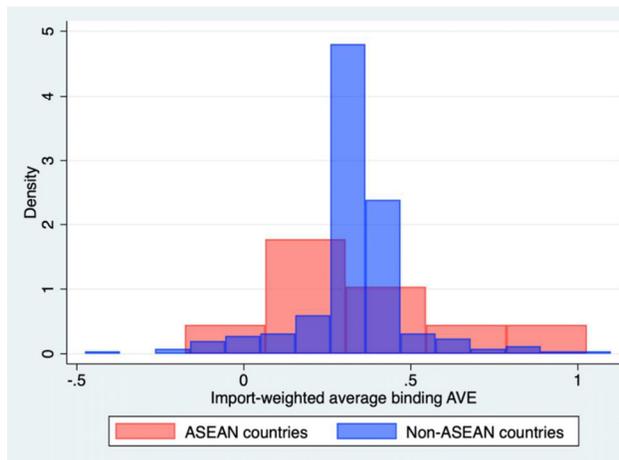
11) Therefore we do not present the results of the 704 individual estimations but they are available from the authors upon request.

12) Import-weighted average AVE = $\sum_h \frac{AVE_{ih} * Imports_{ih}}{Imports_i}$, where $Imports_{ih}$ constitutes imports of country i from other partners over all h products for which at least one AVE could be calculated.

of NTMs, we can account for the import structures of importing countries and emphasize the importance of AVEs for certain agricultural products. However, this technique likely underestimates the import-impeding impacts of NTMs on the overall value of imports.

The two distributions in Figure 8 are quite similar, suggesting that the trade impacts of SPS measures on agricultural products in ASEAN countries are not different than those in the rest of the world, even if the compliance costs of SPS measures in ASEAN countries are slightly lower than those in non-ASEAN countries. For ASEAN countries, at the importer-section level, the median and mean AVEs of SPS measures are 40.8 percent and 40.7 percent, respectively. The median and mean AVEs of SPS measures across all other countries are 48.5 percent and 47.7 percent, respectively.

Figure 8. Distribution of import-weighted average binding AVEs of SPS measures on agrifood HS sections



(Source) Authors' calculation.

Note. Density is on the vertical axis. AVEs are in algebraic form, which means 0.5 = 50%. Import-weighted (using import values) averages of AVEs are calculated by importing country and by agrifood HS sections (HS 01-04).

Table 4 displays averages of binding AVEs for SPS measures, by HS2 chapter and by ASEAN importer. These are simple averages of AVEs over all country-product-specific AVEs.¹³⁾ While all HS2 are the object of at least one SPS NTM, only 139 over a total of 240=24 chapters*10 countries (60 percent) are hurt by significantly trade-distorting SPS NTMs. This impact on trade is negative (positive AVE) in 94 percent of all cases (AVE significantly different from zero) and positive (negative AVE) in 6 percent of all (8) cases. In recent literature, negative AVEs of NTMs are described as trade-facilitating effects of NTMs (Beghin, Disdier, and Marette 2015; Bratt 2014; Grübler, Ghodsi and Stehrer 2016).

13) Trade-weighted averages of SPS measures are provided in the Annex.

Table 4. Average AVEs of SPS Measures, by HS2 Chapter and Importer (%)

	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Live animals	31.3%				93.9%	-5.0%	34.1%	76.8%	7.1%	-18.6%
Meat and edible meat offal			37.8%	28.0%	4.7%					22.0%
Fish and crustaceans, molluscs and other aquatic invertebrates	42.1%	88.8%	47.0%	32.9%	47.1%		48.6%	33.6%	51.6%	41.6%
Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included		34.8%	62.7%	49.2%	67.6%		70.1%	66.1%	36.7%	49.7%
Products of animal origin, not elsewhere specified or included		25.2%				86.2%				92.8%
Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage			-3.9%	17.1%			14.1%			20.9%
Edible vegetables and certain roots and tubers			75.9%	33.1%	48.8%		46.5%	46.5%	29.2%	22.3%
Edible fruit and nuts; peel of citrus fruit or melons		102.8%	51.2%	45.8%	46.7%		42.2%	56.8%	21.6%	43.2%
Coffee, tea, mate and spices			45.9%	39.6%	35.7%		54.3%	73.0%	37.9%	60.9%
Cereals		-10.6%		52.1%			74.1%	77.4%		42.5%
Products of the milling industry; malt; starches; inulin; wheat gluten			49.4%	46.9%	73.0%		44.3%		25.4%	42.3%
Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder		43.6%	64.8%	29.6%	26.6%		61.0%	50.2%	45.1%	50.6%
Lac; gums, resins and other vegetable saps and extracts			59.7%	48.5%	56.7%		60.7%		87.0%	43.3%

Table 4. *Continued*

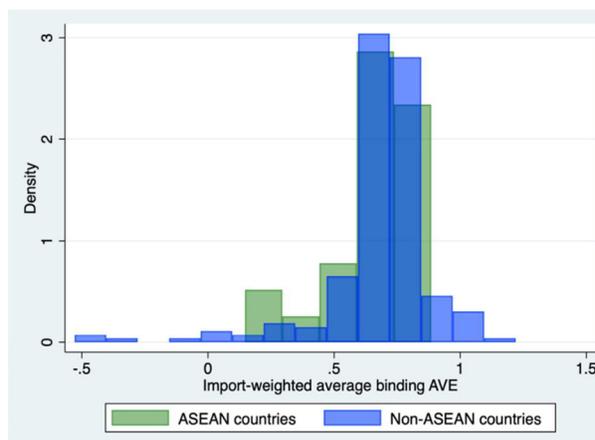
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Vegetable plaiting materials; vegetable products not elsewhere specified or included				64.0%						41.3%
Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes			45.6%	45.0%	40.5%	77.5%	45.9%	63.0%	66.7%	40.3%
Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates	60.2%			33.4%	48.4%	87.8%	-15.4%		35.2%	56.2%
Sugars and sugar confectionery			28.8%	26.1%	68.0%		44.1%	70.9%	-3.8%	31.5%
Cocoa and cocoa preparations			45.1%	60.7%			53.9%		70.8%	
Preparations of cereals, flour, starch or milk; pastrycooks' products				37.2%	61.0%		45.0%		66.3%	68.5%
Preparations of vegetables, fruit, nuts or other parts of plants			33.7%	31.8%	40.4%		55.5%	70.2%	28.3%	12.4%
Miscellaneous edible preparations	59.0%			50.6%	86.1%		52.2%	10.5%	38.1%	39.2%
Beverages, spirits and vinegar				30.2%	-0.5%		24.1%	20.2%	38.4%	46.2%
Residues and waste from the food industries; prepared animal fodder	61.3%		23.8%	29.2%			32.9%	44.1%	45.9%	39.5%
Tobacco and manufactured tobacco substitutes				22.8%			10.3%		-26.6%	

The simple average of binding AVEs for SPS measures, by HS2 chapter and by ASEAN importer, is 44.1 percent, while worldwide it is 45.6 percent. In ASEAN countries, the highest AVE is observed in Cambodia for "Edible fruit and nuts" (102.8 percent). The most trade-facilitating SPS measures are found in Thailand for "Tobacco and manufactured tobacco substitutes." "Products of animal origin" is the sector with, on average, the highest AVE of SPS measures, but with only three countries with significantly trade-distorting measures. At the other extreme, "Tobacco and manufactured tobacco substitutes" is the HS2 chapter with, on average, the lowest AVE of SPS measures, with only three countries with significantly trade-distorting measures (in one country, it is trade-enhancing, as already stated). Myanmar (61.6 percent), Singapore (54.2 percent), and then Malaysia (49.7 percent) have the highest AVE of SPS measures, on average. Such high values of AVEs of SPS measures suggest high compliance costs due to bureaucratic friction and limited capabilities to implement and monitor NTMs in those countries. In Singapore, the high value of AVEs of SPS measures may reflect the fact that Singaporean consumers are likely to have more concerns for food safety and quality, especially for live animals, fish products, and edible vegetables and fruits. In the region, Thailand, Lao PDR, and Vietnam display the lowest average AVEs of SPS measures.

B. Trade impact of TBT measures

Figure 9 shows the distribution of import-weighted average binding AVEs of TBT measures on food and agricultural products (HS 01-04), by importing country. ASEAN countries are represented in green bars and other countries in blue bars. The distribution of AVEs of TBTs

Figure 9. Distribution of import-weighted average binding AVEs of TBT measures on agrifood HS sections



(Source) Authors' calculation.

Note. Density is on the vertical axis. AVEs are in algebraic form, which means 0.5 = 50%. Import-weighted (using import values) averages of AVEs are calculated by importing country and by agrifood HS sections (HS 01 - 04)

in ASEAN countries is in a close form with that of non-ASEAN countries. Across ASEAN countries, the median and mean AVEs of TBTs at the importer-section level are 66.2 percent and 67.2 percent, respectively. The median and mean AVEs of TBTs across all other countries are 71.7 percent and 69.8 percent, respectively.

Table 5 displays a breakdown of average binding AVEs for TBT measures, by HS2 and by ASEAN importers. These are a simple average of AVEs over all country-product-specific AVEs.¹⁴⁾ While all HS2 chapters are the object of TBT measures, only one-half (49.2 percent) of all these groups of products (over a total of 240=24 chapters*10 countries) are hurt by significantly trade-distorting TBTs. This impact on trade is negative (positive AVE) in all cases except one (-7 percent, “Beverages, spirits and vinegar” in Myanmar), another illustration of the trade-facilitating effects of NTMs.

The simple average of AVEs of TBTs in ASEAN countries, by importer and HS2, is 68.9 percent, versus 64.1 percent worldwide. The highest AVE is observed in Lao PDR for “Cocoa and cocoa preparations” (134.7 percent). “Cocoa and cocoa preparations” is the sector with, on average, the highest AVE of TBTs, but with only four countries with significantly trade-distorting measures. At the other extreme, “Beverages, spirits and vinegar” is the HS2 chapter with, on average, the lowest AVE of TBTs, but with eight countries with significantly trade-distorting measures (in one country, it is trade-enhancing, as already stated). Let us add that in the “Products of animal origin,” no country has adopted a TBT with a significant impact on trade. The Philippines (78.7 percent), Cambodia (77.0 percent), and then Singapore (72.0 percent) have the highest AVE of TBTs, on average. As with the SPS measures, such high AVE values suggest high compliance costs due to bureaucratic friction and limited capabilities to implement and monitor NTMs. Likewise, in Singapore, the high TBT AVEs may reflect Singaporean consumers’ concerns for food safety and quality, especially for live animals, fish products, and edible vegetables and fruits. In the ASEAN region, Myanmar, Indonesia, and Lao PDR display the lowest average AVEs of TBTs.

14) Trade-weighted averages of TBT regulations are provided in the Annex.

Table 5. *Continued*

	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes	100.9%			92.2%	62.1%	85.4%		79.9%		61.0%
Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates	29.4%			21.7%	67.4%	62.1%	56.0%		33.7%	88.7%
Sugars and sugar confectionery	73.9%		27.4%	43.0%	90.3%		54.4%			70.4%
Cocoa and cocoa preparations				134.6%	60.8%		109.2%	85.7%		
Preparations of cereals, flour, starch or milk; pastrycooks' products	69.9%			36.3%	68.9%		58.6%			101.7%
Preparations of vegetables, fruit, nuts or other parts of plants	57.0%			26.2%	49.4%		61.3%	99.9%		40.1%
Miscellaneous edible preparations	58.7%		66.6%	68.6%	75.8%		76.6%			68.4%
Beverages, spirits and vinegar	69.6%			41.4%	27.5%	-7.0%	73.6%	65.5%	59.8%	48.7%
Residues and waste from the food industries; prepared animal fodder	77.3%		79.1%	23.5%	59.8%			58.5%	53.9%	56.2%
Tobacco and manufactured tobacco substitutes	74.2%			77.4%						111.1%

(Source) Authors' calculation.

VII. Conclusion

This article aimed to evaluate trade integration in Southeast Asia with a focus on agriculture and food. Food security is a key policy issue in the region. We observed the level of import duties in the region and each country's access to global markets. We also examined the measurement of trading costs related to the business environment, especially those related to customs efficiency. We provided a new assessment of NTMs' importance in Southeast Asian countries and the impact of these measures on regional trade in agricultural and food products.

Tariffs on imports are low in Singapore and Brunei Darussalam, whereas they are relatively high in Thailand and Malaysia. They are especially high on agricultural and food products in Thailand. However, tariffs on intraregional imports are relatively low, which means that regional trade integration is deep and that the elevated level of tariffs on extra-regional imports amplifies the degree of regional integration. Concerning the business environment and efficiency of customs procedures, Southeast Asian countries are not performing as well as OECD countries. This is especially true for Cambodia, Lao PDR, and the Philippines. NTMs were already frequent in the region in 2010 and are imposed particularly frequently in the agriculture and food sectors. While in 2010 the countries of this region had adopted more of these measures than the rest of the world, by 2018 this was no longer the case—the frequency, import coverage, and average number of imports per product are no longer dissimilar—in other words, the rest of the world adopted new measures significantly over the period, thereby “catching up” with the countries of Southeast Asia.

The report also estimated the impact of these measures on trade, the impact of SPS and TBT measures on trade in agricultural products in particular. The SPS measures adopted by countries in the region are equivalent to an average tariff of 44.1% in terms of their impact on agricultural and food trade, while across the world these measures are equivalent to an average tariff of 45.6%. In the same sector, Indonesia, Myanmar, and Singapore have adopted relatively restrictive measures compared to the rest of the world. The vegetable and food sectors are subject to more restrictive measures in general. TBTs have an impact on agricultural and food trade that is equivalent to an average tariff of 68.9%, compared to 64.1% in the rest of the world. Indonesia, the Philippines, and Malaysia have adopted measures with a significantly more restrictive effect on trade in these products, while those adopted by Myanmar and Thailand are significantly less restrictive.

Overall, the countries of the Southeast Asian region appear to be relatively open to the world, but regional integration could be strengthened, particularly in the agriculture and food sectors. More integration could be achieved, on one hand, by improvements in customs procedures and, on the other hand, by convergence of SPS and TBT measures. This paper has clearly shown that previous estimations have underestimated the restrictiveness of the

negative trade impact of NTMs, especially in the agriculture and food sectors. To improve food security in the region, policymakers should prioritize reforming NTMs. The idea should be not to completely remove NTMs, but to make them less trade restrictive by means of the harmonization, mutual recognition, or adoption of international standards. Greater trade integration of these countries in the agriculture and food sectors would certainly significantly improve food security in the ASEAN region.

References

- Anderson, J. E., & van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, 93(1), 170-192.
- Baltagi, B. H., Egger, P., & Pfaffermayr, M. (2003). A generalized design for bilateral trade flow models. *Economics Letters*, 80(3), 391-397.
- Beghin, J.C., Disdier, A. C., & Marette, S. (2015). Trade restrictiveness indices in the presence of externalities: An Application to non-tariff measures. *Canadian Journal of Economics/Revue Canadienne D'économie*, 48(4), 1513-1536.
- Bouët, A., Cosnard, L., & Laborde, D. (2017). Measuring trade integration in Africa. *Journal of Economic Integration*, 32(4), 937-977.
- Bouët, A., & Laborde, D. (2010). The economics of export taxes in a context of food security. In *The Economic Impact of Export Restrictions on Raw Materials* (pp. 59-78). Paris: OECD Trade Policy Studies, Trade and Agriculture Division.
- Bouet, A., Estrades, C., & Laborde, D. (2013). A global assessment of the economic effects of export taxes. *The World Economy*, 36(10), 1333-1354.
- Bouet, A., Decreux Y., Fontagne L., Jean S., & Laborde D. (2008). Assessing applied protection across the world. *Review of International Economics*, 90(5), 850-863.
- Bratt, M. (2014). Estimating the Bilateral Impact of Non-Tariff Measures (NTMs). *Working Paper WPS*, No. 14-01-1, Université de Genève.
- Bureau, J. C., Guimbar, H., & Jean, S. (2016). Competing liberalizations: Tariffs and trade in the 21st century. *CESifo Working Paper Series No. 5962*, Available at <http://dx.doi.org/10.2139/ssrn.2814463>
- Disdier, A. C., Fontagne L., & Mimouni, M. (2008). The impact of regulations on agricultural trade: evidence from the SPS and TBT agreements. *American Journal of Agricultural Economics*, 90(2), 336-350.
- Ghods, M., Gruebler, J., & Stehrer, R. (2016a). *Estimating importer-specific ad valorem equivalents of nontariff measures* (wiiw Working Paper). Vienna: Vienna Institute for International Economic Studies, Mimeo.
- Ghods, M., Gruebler, J., & Stehrer, R. (2016b). *Estimating importer-specific ad valorem equivalents of nontariff measures* (wiiw Working Paper). Vienna: Vienna Institute for International Economic Studies, Mimeo.

- Ghods, M., Reiter O., & Stehrer R. (2016c). *Compilation of a Database for Non-Tariff Measures from the WTO Integrated Trade Intelligence Portal (WTO I-TIP)* (wiiw Working Paper). Vienna: Vienna Institute for International Economic Studies, Mimeo.
- Giles, D. E. (1982). The interpretation of dummy variables in semilogarithmic equations: Unbiased estimation. *Economics Letters*, 10(1-2), 77-79.
- Grübler, Julia, Mahdi Ghods, & Robert Stehrer (2016). *Assessing the impact of non-tariff measures on imports*. The Vienna Institute for International Economic Studies, Vienna.
- Guimbard, H., & Jean, S. (2020). *L'intégration commerciale en Asie met les Etats-Unis au Défi de Leurs ambitions*. Billet du CEPII, Retrieved January 18, 2021, from http://www.cepii.fr/BLOG/bi/post.asp?ID_communique=850
- Kee, H. L., & Nicita, A. (2016). *Trade fraud, trade elasticities and non-tariff measures* (Vol. 30), In 5th IMF-World Bank-WTO Trade Research Workshop, Washington, DC, November.
- Kee, H. L., Nicita, A., & Olarreaga, M. (2008). Import demand elasticities and trade distortions. *The Review of Economics and Statistics*, 90(4), 666-682.
- Kee, H. L., Nicita, A., & Olarreaga, M. (2009). Estimating trade restrictiveness indices. *The Economic Journal*, 119, 172-199.
- Kennedy, P.E. (1981). Estimation with correctly interpreted dummy variables in Semilogarithmic equations. *American Economic Review*, 71(4), 801.
- Nguyen, D. B., Bouet, A., & Traore, F. (2022). On the proper computation of Ad Valorem equivalent of non-tariff measures. *Applied Economics Letters*, 29(4), 298-302.
- Portugal-Perez, A., & Wilson, J. S. (2012). Export performance and trade facilitation reform: Hard and soft infrastructure. *World Development*, 40(7), 1295-1307.
- Santos Silva, J. M. C., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, 88(4), 641-658.
- UNCTAD. (2021). UNCTAD website. Retrieved January 20, 2021, from <https://unctad.org/topic/trade-analysis/non-tariff-measures/NTMs-classification>
- Wilson, J. S., Mann, C.L., & Otsuki, T. (2003). Trade facilitation and economic development: A new approach to quantifying the impact. *The World Bank Economic Review*, 17(3), 367-389.
- Wooldridge, J. (2002). *Introductory econometrics: A modern approach*. (2nd ed.). South-Western College Pub.
- World Bank. (2019). *Enabling the business of agriculture 2019*. Washington D.C.: The World Bank.
- World Bank. (2020). *Doing business 2020: Measuring regulatory quality and efficiency*. Washington D.C.: The World Bank.
- World Development Indicators. (2021). <https://databank.worldbank.org/source/world-development-indicators> (accessed on January 20, 2021.)

Annex

Table A1. Average AVEs for SPS Measures, by HS2 Chapter and Importer (%)

	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Live animals	31.3%				-2.5%		76.8%		-18.6%
Meat and edible meat offal			46.7%	21.8%		44.9%		21.8%	35.8%
Fish and crustaceans, molluscs and other aquatic invertebrates	-29.6%	88.8%	57.1%	41.2%		52.8%	63.7%	46.8%	40.8%
Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included		21.3%	56.4%	44.1%		67.9%	66.1%	64.4%	55.3%
Products of animal origin, not elsewhere specified or included		25.2%			86.2%				92.8%
Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage			-3.9%	7.1%		14.1%			26.5%
Edible vegetables and certain roots and tubers			64.4%	41.2%		61.6%	51.8%	25.3%	45.5%
Edible fruit and nuts; peel of citrus fruit or melons		102.8%	53.2%	43.5%		41.7%	56.3%	41.5%	41.8%
Coffee, tea, mate and spices				24.5%		67.4%	77.6%	15.8%	52.9%
Cereals		-10.6%	41.6%	38.4%		60.3%	77.4%		42.5%
Products of the milling industry; malt; starches; inulin; wheat gluten			56.9%	51.1%		52.0%		25.4%	46.4%
Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants ; straw and fodder		30.2%	31.0%	14.3%		52.0%	50.2%	66.1%	51.9%
Lac; gums, resins and other vegetable saps and extracts			59.7%	37.1%		60.7%		87.0%	41.9%
Vegetable plaiting materials; vegetable products not elsewhere specified or included				64.0%					41.3%

Table A1. *Continued*

	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes			45.6%	31.0%	77.5%	33.5%	55.6%	62.3%	56.6%
Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates	60.2%			20.4%	87.8%	-15.4%		-28.7%	45.3%
Sugars and sugar confectionery			34.0%	18.6%		41.4%	70.9%	-3.8%	48.0%
Cocoa and cocoa preparations			45.1%	69.3%		49.5%		57.4%	
Preparations of cereals, flour, starch or milk; pastrycooks' products				36.2%		44.9%		66.3%	53.7%
Preparations of vegetables, fruit, nuts or other parts of plants			33.7%	25.7%		46.8%	73.8%	41.3%	11.8%
Miscellaneous edible preparations	59.0%			54.0%		53.6%	21.7%	35.9%	40.5%
Beverages, spirits and vinegar				23.8%		28.9%	19.4%	57.8%	49.9%
Residues and waste from the food industries; prepared animal fodder		61.3%	24.4%	-12.7%		8.4%	44.1%	40.4%	36.1%
Tobacco and manufactured tobacco substitutes				21.1%		10.3%		-26.6%	

(Source) Authors' calculation.

Table A2. Average AVEs for TBT Measures, by HS2 Chapter and Importer (%)

	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Live animals				74.3%					83.2%
Meat and edible meat offal		15.1%	85.2%	61.4%		70.8%	84.6%		11.1%
Fish and crustaceans, molluscs and other aquatic invertebrates	83.7%	94.4%	15.7%	73.7%		57.3%	78.8%	28.7%	65.6%
Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included	47.9%	79.1%	96.0%	92.1%		79.3%			93.7%
Products of animal origin, not elsewhere specified or included					31.4%				67.7%
Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage	103.1%			88.5%		107.0%			76.0%
Edible vegetables and certain roots and tubers	104.1%	84.5%	68.8%	58.4%		57.0%		44.3%	65.9%
Edible fruit and nuts; peel of citrus fruit or melons			73.3%	72.5%	69.8%	131.2%			88.9%
Coffee, tea, mate and spices	112.8%	54.7%	116.1%						83.1%
Cereals	73.7%		45.2%	77.3%		128.0%			65.5%
Products of the milling industry; malt; starches; inulin; wheat gluten	73.0%		9.0%	80.8%	64.0%		73.4%	93.4%	62.5%
Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder				75.6%		114.4%			57.3%
Lac; gums, resins and other vegetable saps and extracts									63.9%
Vegetable plating materials; vegetable products not elsewhere specified or included	99.4%		115.6%	81.3%	85.4%		74.2%		80.0%
Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes	14.0%		15.6%	62.4%	53.8%	75.4%		27.3%	73.3%
Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates	101.8%	21.5%	42.1%	108.4%		56.3%			76.0%

Table A2. *Continued*

	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Sugars and sugar confectionery			158.0%	60.8%		109.2%	83.2%		
Cocoa and cocoa preparations	73.3%		46.4%	75.6%		69.0%			90.2%
Preparations of cereals, flour, starch or milk; pastrycooks' products	59.5%		40.2%	58.5%		65.1%	99.9%		22.5%
Preparations of vegetables, fruit, nuts or other parts of plants	42.3%	66.6%	75.0%	73.7%		90.9%			66.4%
Miscellaneous edible preparations	50.7%		55.4%	38.6%	-7.0%	65.6%	62.3%	85.2%	48.2%
Beverages, spirits and vinegar	74.7%	79.1%	39.3%	59.8%			58.5%	53.9%	52.9%
Residues and waste from the food industries; prepared animal fodder	74.2%		80.5%						112.2%

(Source) Authors' calculation.