Impact of Non-Tariff Measures on ASEAN Trade: A Panel Data Approach

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Abstract

The research focuses on the role of Non-Tariff Measures (NTMs) in shaping trade within the Association of Southeast Asian Nations (ASEAN) **post the establishment** of the ASEAN Economic Community (AEC) in 2015. NTMs, **encompassing** a range of policy measures like sanitary and phytosanitary regulations and technical barriers to trade, have gained prominence in the wake of tariff reductions **facilitated by the AEC**. Their growing variety and complexity present both opportunities and challenges for ASEAN's trade dynamics.

This study is motivated by the need to understand the nuanced impacts of NTMs in ASEAN's diverse economic landscape. Prior literature, while acknowledging the significant role of NTMs in trade, has often been limited by cross-sectional data and a lack of focus on sector-specific effects. **There's a gap in understanding** the differential impacts of NTMs on various sectors, especially considering the varying roles of ASEAN countries as exporters and importers.

The research employs panel data from 2015 to 2020, covering all ten ASEAN member countries, to conduct a comprehensive sectoral analysis using a gravity model. This approach, leveraging the GTAP 11 database, aims to provide a detailed economic quantification of NTMs' impact across 65 sectors. The use of panel data enhances the robustness of the study, allowing for control of time-invariant variables and addressing potential endogeneity issues.

This sectoral analysis is crucial for understanding the asymmetric influence of NTMs and contributes to policy dialogue in ASEAN, focusing on managing NTMs effectively in line with regional economic integration goals. The study aims to provide insights into the diverse impacts of NTMs, enhancing the understanding of their role in international trade within the ASEAN context.

Research Questions

This study aims to explore pivotal research questions to enhance the understanding of Non-Tariff Measures (NTMs) within the ASEAN Economic Community framework:

1. **Impact of NTMs on Sectoral Trade Flows:** How do different types of NTMs affect import patterns across various sectors such as food and agriculture versus non-agriculture within ASEAN countries? This question focuses on identifying the sectors most impacted by trade expansion or distortion due to NTMs.

2. **Sector-Specific Influence of NTMs:** In what ways do specific NTMs uniquely impact each economic sector, leading to diverse outcomes for ASEAN countries based on their roles as exporters and importers? The emphasis here is on understanding the differential impact of NTMs across sectors, given the varied economic structures and trade roles of ASEAN member countries.

3. **Evaluating the Efficacy of Panel Data in NTM Estimation:** This research adopts a novel approach by utilizing panel data for NTM estimation in ASEAN trade. The question delves into the methodological robustness and accuracy of this approach, particularly in addressing potential data inconsistencies at the HS-6 level. It explores the advantages of panel data in capturing dynamic trade effects over time and discusses strategies for managing data variability and ensuring reliability in estimating the true impact of NTMs. This aspect is critical in assessing the study's methodological innovation and its capability to provide nuanced insights into NTM effects.

These questions are central to the study, guiding the comprehensive analysis of NTMs through a robust sectoral approach and employing advanced econometric models. The findings are expected to significantly contribute to our comprehension of the role of NTMs in shaping trade dynamics within the ASEAN region, aiding in the development of effective trade policies aligned with the goals of economic integration.

Background

In the global trade landscape, Non-Tariff Measures (NTMs) have become influential determinants of trade flows, particularly within the Association of Southeast Asian Nations (ASEAN). The establishment of the ASEAN Economic Community (AEC) in 2015 brought about significant changes in the deployment of NTMs in the region. While the AEC facilitated tariff reductions, it also led to a rise in the variety and complexity of NTMs, as member countries navigated economic integration while safeguarding their domestic industries.

NTMs encompass diverse policy measures beyond tariffs, including sanitary and phytosanitary (SPS) regulations, technical barriers to trade (TBT) regulations, and interventions affecting trade flows and prices, such as rules of origin, licensing, price-control measures, and distribution restrictions Webb et al. 2020. Although NTMs are often motivated by non-trade-related goals like food safety and environmental protection, they can also serve as instruments of commercial policy. Even when pursuing legitimate non-trade objectives, NTMs may impose restrictions or distortions on international trade.

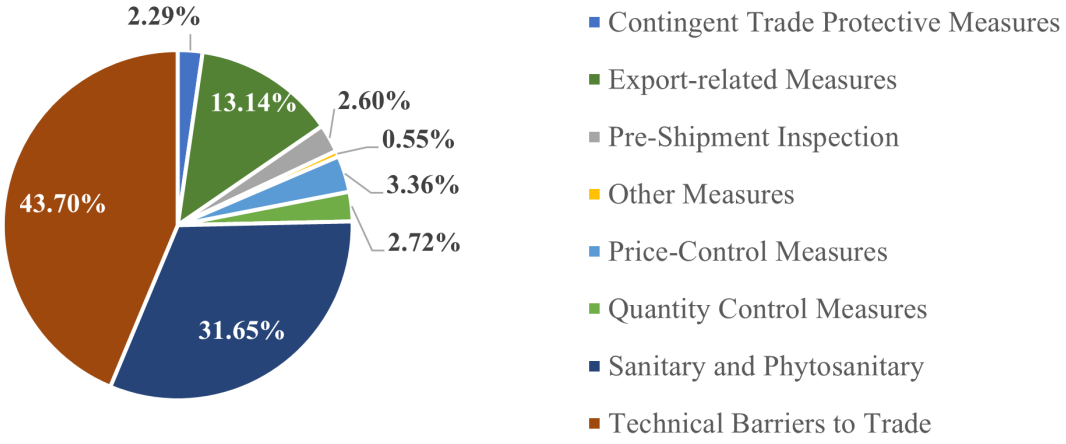
While ASEAN has successfully reduced most of its tariff barriers, non-tariff measures (NTMs) have seen less uniformity and coherence across member states (Pensupar, Mahathanaseth, and Nurancha 2013). As of 2019, ASEAN countries had a total of 5,886 measures, marking a significant increase from 1,634 in 2010 (Table 1). Thailand leads the ASEAN member countries with approximately 1,600 active NTMs, almost twice as many as the next country, the Philippines, and nearly eight times more than Vietnam. Figure 1 illustrates the types and shares of currently active NTMs in the ASEAN community.

Table 1: Non-tariff Measures Imposed by ASEAN Countries - 2019

Country	SPS	TBT	CTP	ERM	PSI	PCM	QCM	Other	Total
Brunei Darussalam	161	288	-	46	1	18	2	-	516
Cambodia	36	120	-	70	1	12	3	-	242
Indonesia	125	318	48	74	52	5	8	4	634
Laos	82	82	82	14	1	26	38	48	291
Malaysia	260	331	34	72	5	12	9	-	723
Myanmar	75	41	-	35	2	13	5	1	172
Philippines	233	360	1	146	24	23	56	12	855
Singapore	127	300	-	49	2	35	1	-	514
Thailand	762	562	45	128	44	21	40	3	1605
Viet Nam	11	122	4	57	5	7	7	11	224
Plus Six Non-ASEAN Countries									
Australia	279	943	75	424	4	69	13	1	1808
China	1643	4309	101	1025	113	51	57	58	7357
India	72	46	347	37	2	11	30	7	552
Japan	264	722	6	193	32	43	16	5	1281
Republic of Korea	706	809	-	307	27	71	8	1	1929
New Zealand	1569	1422	9	61	29	5	-	3	3098

Source: ASEAN Secretariat (2019); Author's calculation.

Figure 1: ASEAN's Non-tariff Measures Percentage



Source: ASEAN Secretariat (2019); Author's calculation.

ASEAN's strategy toward NTMs, as per the AEC Blueprint 2025, involves improving transparency, streamlining and harmonizing NTMs, and eliminating unnecessary NTMs. However, the complex and diverse nature of NTMs, combined with the varying economic structures and policies of member states, has made their regulation challenging. For instance, Ing, Cadot, and Walz 2017 highlight that the absence of a standardized regional framework to monitor and evaluate NTMs could lead to trade-distorting practices. Moreover, the effects of NTMs can differ between countries, depending on whether they are acting as exporters or importers in specific sectors. Therefore, it is essential to conduct a sectoral analysis that highlights and specifies the impact of NTMs on both exporters and importers.

The escalating prevalence of NTMs has sparked interest in gauging their effects on international trade. However, unlike tariffs, the diverse objectives of NTMs make their direct quantification challenging (M. Ferrantino 2006; M. J. Ferrantino 2010; Fugazza 2013). Despite this, literature on the subject has expanded due to advancements in alternate frameworks, data accessibility, and econometric modeling, fostering the creation of new methodologies (J. C. Beghin and Bureau 2001; M. J. Ferrantino 2010; Arita, Mitchell, and Beckman 2015).[1] Prior research has utilized the gravity model to evaluate trade policy implications on trade flows, including tariff and non-tariff measures (NTMs) (Urata and Okabe 2010; Ing, Cadot, and Walz 2017). However, a distinct focus on NTMs' disparate impacts across different ASEAN sectors is yet to be explored. This investigation seeks to fill this gap, providing a quantitative analysis of NTMs' effect on sectoral trade flows in the ASEAN community, deploying a panel data gravity model.

A significant investigation by Urata and Okabe 2010 confirmed the substantial influence of NTMs on ASEAN trade flows using the Gravity Model. Their findings underscored the importance of sectoral analysis, with the effects of NTMs varying across sectors. Further, Mahmood 2022 explored the feasibility of Free Trade Agreements (FTAs) in mitigating NTMs' restrictiveness. They noted that despite the ASEAN Economic Community's (AEC) successes in tariff barrier reduction, NTMs' addressing progress has lagged, posing a vital inquiry for this study.

Webb et al. 2020 utilized the ppml gravity model to examine NTMs effects on the economies

[1]Notably, a majority of studies focus on technical regulations, particularly TBT and SPS, due to their dual trade-cost and demand-enhancing effects and the gradual phasing out of other NTMs, such as quantitative restrictions, under the WTO.

of key ASEAN nations and their trade relations. Their work introduced a novel approach, attributing diverse impacts to various types of NTMs, depending on their application to intermediate production, final consumption, or specific goods sectors in addition to differentiating between NTMs that create expenses for the importer and those that create expenses for the exporter. However, their results, rooted in cross-sectional NTM data, suffered from limited statistical power, as indicated by the minor proportion of coefficients achieving 5% statistical significance. Moreover, their study overlooked the inception of the AEC, a potential influencing factor on NTMs within their research timeframe.

To extend the findings of Webb et al. 2020, this research employs panel data from 2015 to 2020 of all ten ASEAN member countries, to offer a comprehensive and dynamic analysis in the ASEAN context.[2] Additionally, by leveraging the GTAP 11 database, it strives to provide a thorough economic quantification of NTMs' impact across 65 sectors. This research also aims to identify the magnitude of impacts that differ by exporting and importing countries, thereby capturing the asymmetric influence of NTMs, enabling the future research to examine the potential to mitigate or decrease their effects (*Chapter 2*).

The use of panel data will enable us to control for time-invariant variables and address the potential endogeneity issues that could otherwise bias the estimations. Moreover, this methodology will enhance our study's statistical power, overcoming the limitations in Webb et al. 2020 and allowing for more robust conclusions to be drawn. In doing so, the research aims to contribute to the policy dialogue in ASEAN about managing NTMs effectively, aligning with the region's economic integration goals, and ultimately fostering a conducive environment for international trade.

Non-tariff Measures Database

The NTMs database, updated and expanded to incorporate a broader spectrum of countries, is utilized for this research. This rich resource, a result of a joint project initiated by UNCTAD and the World Bank, contains meticulous NTM data gathered by dedicated research teams.[3] These researchers have systematically gone through every law, regulation, and rule that could potentially impact merchandise trade in a given country. Once gathered, these measures are placed within a standardized classification framework, linked to the World Customs Organization's Harmonized System (HS) tariff lines. This classification scheme, the outcome of a cooperative endeavor by UNCTAD and the Multi-Agency Support Team (MAST), consists of 16 chapters that serve as the bedrock of the NTM database. The details of this system are summarized in Table 3.

For this study, the NTMs data is collected at a granular level, corresponding to the HS6 digit product level. This ensures a detailed understanding of how specific product trades are affected by these measures. The study aim to estimate the tariff equivalent of the price effects associated with an NTM, or more specifically, the ad valorem equivalent (AVE).[4] The data used in the analysis covers all NTMs enforced between 2015 and 2020 among pairs of countries, thereby providing a recent and relevant perspective on trade restrictions. Furthermore, the database

[2]The ASEAN consists of the fllowing ten countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam

[3]https://trainsonline.unctad.org/home

[4]The AVE, serving as a measurement unit, converts the impact of NTMs into a singular metric, thus facilitating straightforward comparisons with tariff rates.

characterizes NTMs at a disaggregated division level, enhancing the resolution of our analysis.[5]

Table 3: Classification of Non-Tariff Measures

Technical Measures	Description
A	Sanitary and phytosanitary measures
B	Technical barriers to trade
C	Pre-shipment inspection and other formalities
Non-Technical Measures	**Description**
D	Contingent trade-protective measures
E	Non-automatic licensing, quotas, prohibitions and quantity-control measures other than for SPS or TBT reasons
F	Price-control measures, including additional taxes and charges
G	Finance measures
H	Measures affecting competition
I	Trade-related investment measures
J	Distribution restrictions
K	Restrictions on post-sales services
L	Subsidies (excluding export subsidies under P7)
M	Government procurement restrictions
N	Intellectual property
O	Rules of origin
P	Export-related measures

Theoretical Framework

In my analysis of the impact of NTMs on ASEAN trade and its interactions with partner nations, I utilize a theoretical approach inspired by Bratt 2017. This approach reveals the asymmetric effects of NTMs on trade, suggesting that a country's ability to meet its trading partners' NTMs is influenced by its specific circumstances. In particular, an exporting country with domestic regulations closely matching those of the importing country tends to have a competitive advantage over other exporters.

This alignment of NTMs is a crucial component of deep regional integration initiatives, such as harmonization of technical measures and mutual recognition agreements (MRAs). These concerted efforts help bridge the regulatory gap between trading partners, especially between developed and developing countries, leading to potential reduction or even elimination of compliance costs. Hence, an exporter that is part of the same Regional Trade Agreement (RTA) as the importer generally has an edge over those outside the RTA, a concept validated by Cadot, Asprilla, et al. 2015.

NTMs can also play a critical role in addressing market inefficiencies, such as externalities and information asymmetries, thus altering their impact on trade. As Marette and J. Beghin

[5]For instance, $a100$ corresponds to general prohibitions or restrictions, while $a110$ denotes temporary geographic prohibitions. This detailed classification facilitates a nuanced exploration of the varied impacts of different NTM types.

2007 showcased, pro-trade NTMs that correct consumption-related externalities are beneficial when foreign producers are more efficient in managing these externalities than their domestic counterparts. Furthermore, an NTM that sets a quality standard for a specific good can reduce information asymmetries, thus lowering transaction costs for producers and potentially boosting consumer trust. These effects can potentially increase exports from countries that adhere to the importing country's standards. This is further supported by Cadot, Gourdon, and Tongeren 2018, who found that while Sanitary and Phytosanitary (SPS) measures might increase trade costs, they also augment trade volume.

Overall, this theoretical framework suggests that the effects of NTMs vary across trading partners and underscores the importance of relative cost increases among exporters. This is particularly relevant for ASEAN member economies, considering their diverse domestic laws, regulations, and varying capacities to meet each other's NTMs. The deep regional integration efforts within ASEAN through the AEC serve as a gauge of the "standards divide" in the region.

Empirical Strategy

This research examines the effect of NTMs on imports in ASEAN markets, including the following ten countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.[6] In order to properly capture the asymmetric impacts of NTMs, it's essential for the model specification to enable the calculation of the quantity effect for every pairing of importer-exporter, for each product, and for every type of NTM. I employ a gravity model specification, inspired by Santos Silva and Tenreyro 2006, the Poisson pseudo-maximum likelihood estimator (PPML).

The PPML estimator provides distinct advantages for the study on NTMs (i.e., theoretical development of the PPML is explained in this chapter *Appendix*). Firstly, PPML is robust to heteroscedasticity, ensuring reliable estimates despite possible variance inconsistencies across different sectoral trade values. Secondly, the estimator adeptly handles zero-trade values, a common occurrence when examining disaggregated trade data across various sectors. This ensures our analysis is comprehensive and not skewed by the absence of trade in certain sectors between particular countries. Moreover, the PPML estimator is scale invariant, providing reliability and versatility in different contexts (Shepherd 2013). Given these advantages, the PPML estimator emerges as the most suitable method for my study on NTMs within the ASEAN context.

To adequately capture the differential effects of each type of NTM, our model is designed to calculate the quantity impact of each NTM type for every importer-exporter pair and each product. The gravity model specification I employ, adapted from Bratt's (2017) approach, is as follows:

[6]It is important to acknowledge that certain countries, such as Myanmar, may have inconsistent data availability. Consequently, the final estimation may necessitate the exclusion of these countries from the analysis.

$$
\begin{aligned}
y_{i,m,e,t} = exp\Bigg(& \beta_0 + \beta_1 \ln(GDP_{m,t}) + \beta_2 \ln(GDP_{e,t}) + \beta_3 \ln(AgriLand_{m,t}) \\
& + \beta_4 \ln(AgriLand_{e,t}) + \beta_5 \ln(Employment_{m,t}) + \beta_6 \ln(Employment_{e,t}) \\
& + \beta_7 \ln(Dist_{m,e}) + \beta_8 \ln(AVETariff_{i,m,e,t}) + \beta_9 contig_{it} + \beta_{10} comlang_{it} \\
& + \beta_{11} RTA_{it} + \sum_k \beta_{NTM^k_{i,m,e,t}} D_{\mathrm{NTM}^k_{i,m,e,t}} + \epsilon_{i,m,e,t} \Bigg)
\end{aligned} \tag{1}
$$

The import value of product i by importing country m from exporting country e in year t is represented by $y_{i,m,e}$. Here, $D_{NTM_k,i,m}$ is a set of dummy variables corresponding to each distinct NTM type, being equal to one if the importing country m applies NTM k where k denotes each division under the NTM classification defined in Table 3, on imports of product i from any exporting country e. The import data of product i (at the HS6 digit level) by ASEAN countries from any one of a group of 135 exporting countries corresponding to the GTAP-11 database, including intra-ASEAN trade.

I incorporate Ad Valorem Equivalent (AVE) rates, denoted as *AVEtariff*. The model also includes other control variables typically used in gravity models, like distance, contiguity, a common legal system, and existence of a regional trade agreement. Finally, I account for fixed effects related to the importer, exporter, and sector by augmenting dummy variables for each FE into the estimation.

The regression is executed for each tariff line and iterated for all target NTM types. The ultimate outputs are multiple estimates for $\beta_{NTM^k_t}$, which are specific to each product i, chosen NTM type, and country pair for a particular year. After consolidation, the final outcome will be reported in terms of economic sectors, taking into account the GTAP sectors.[7]

Data Description

The scope of this study encompasses the analysis of product imports classified at the HS 6-digit level for each importer-exporter dyad over the period from 2015 to 2020. The focus is on the nine ASEAN countries, excluding Myanmar due to inconsistencies in data. These nine nations account for 135 exporting countries and collectively imported a total of 5,987 distinct products during the years 2015 through 2020, as per the available data. The GTAP-11 database, which this study employs, provides comprehensive coverage of 65 sectors. Consequently, the complete dataset encompassed by the study comprises approximately 3.1 million observations. The variables included in this study are described in Table 5.

[7]Plan products: PDR, WHT, GRO, V_F, OSD, C_B, OCR, VOL, PCR, SGR, OFD, B_T;
Animal products: CTL, OAP, RMK, FSH, CMT, OMT, MIL;
Wood products: FR, LUM, PPP; Textile: PFB, WOL, TEX, WAP, LEA, FRS, LUM, PPP;
Machinery and equipment: MVH, OTN, ELE, OME;
Others: COA, OIL, GAS, OMN, P_C, CRP, NMM, I_S, NFM, FMP, OMF, ELY, GDT, CHM, OXT, BPH, RPP, EEQ.

Table 5: Definition of Variables and Data Sources

Variable	Description	Data Source
Import	Annual data on bilateral import flows per product at the HS-6 digit level; measured in current USD	UN Comtrade Database
GDP	Annual data on each country's Gross Domestic Product; measured in current million USD	World Bank Database
Agricultural Land	Measures arable land in each country in square kilometers	World Bank Database
Employment	Measures the ratio of persons engaged in the labor force	World Bank Database
Distance	Measures geographical distance between a country pair's biggest cities, weighted by the share of those cities in those countries' total population	CEPII
Contiguity	Takes the value of 1 if a country-pair shares a border; 0 if otherwise	CEPII
Common Language	Takes the value of 1 if both countries speak a common language; 0 if otherwise	CEPII
Average Tariff	Average tariff rate imposed by an importer on a specific product	Integrated Database (IDB)
RTA	Takes the value of 1 if both countries have RTA; 0 if otherwise	Integrated Database (IDB)

Expected Findings

Our preliminary PPML estimations present a broad perspective on the distinct effects of various non-tariff measures (NTMs) across both agriculture (plant and animal products) and non-agriculture sectors (wood, machine, textile, and others) as reported in Table 7. The primary intention of presenting this result is to illustrate these differences; it must be noted that these are initial findings, and they should not be viewed as conclusive results.

Interestingly, the initial results in some cases align with the findings of Austria 2021. A key point to highlight is the significantly negative correlation between geographical distance and trade across all sectors, supporting the gravity model of trade. Additionally, sharing a common language seems to boost trade in plant products and machinery but reduces it in textiles and other non-agricultural goods. Moreover, we find interesting sector-specific impacts. For instance, an increase in the importer's agricultural land significantly boosts the trade in wood products but has a strong negative effect on animal products trade.

A crucial note is that these findings are based on an initial data cleaning stage, which implies a further refined and robust analysis could potentially alter some of these outcomes. These results

will serve as a basis for a more in-depth exploration, and the eventual final findings may provide a nuanced understanding of how different NTMs affect trade across various sectors.

Table 8 reports the preliminary PPML regression results, transformed into percentages for a more intuitive understanding and comparison, for each NTM division of SPS and TBT. This transformation allows for a direct interpretation of the coefficients in terms of percentage changes in trade flows, rather than the typical log-linear interpretation. The coefficients represent the estimated percentage change in the dependent variable (trade flows) for a one-unit change in the respective independent variable, holding all other variables constant.

In the food and agriculture sector, certain NTMs (e.g., those indicated by 'A11', 'A13', 'A21') demonstrate a strong negative impact, suggesting that these measures may be inhibiting trade expansion within this sector. On the other hand, some NTMs (such as 'A31', 'A32', 'A33') reveal a positive coefficient, indicating that they might be facilitating an increase in imports within this sector. Similarly, in the non-agriculture sector, NTMs like 'B14', 'B19', 'B41', and 'B81' seem to exert a significant negative influence, whereas others such as 'B31', 'B32', 'B7', and 'B83' display positive coefficients, suggesting a boost to import trade. Furthermore, the preliminary findings align with Webb et al. 2020's study, particularly with the observed positive impacts of 'a110' and 'a410' on the food and agriculture sector.

The findings of the study reveal not only the significant influence that NTMs exert on ASEAN imports, but also the considerable variance in their impacts across different sectors. This underlines the importance of viewing NTMs not as universally applicable policy instruments, but as sector-specific tools that may yield diverse outcomes depending on their context of application.

For instance, in the food and agriculture sector, NTMs such as 'A11', 'A13', and 'A21' show a negative influence, suggesting that these measures may be constraining trade in this sector. On the other hand, NTMs like 'A31', 'A32', and 'A33' demonstrate positive coefficients, suggesting a facilitative role in expanding imports within the sector. On the flip side, in the non-agriculture sector, we notice a similar discrepancy. NTMs like 'B14', 'B19', 'B41', and 'B81' appear to inhibit trade, while others such as 'B31', 'B32', 'B7', and 'B83' appear to stimulate it.

This sectoral variance in the impacts of NTMs presents significant implications for trade policy within the ASEAN region. These results reveal a complex landscape of trade influences following the AEC establishment, wherein certain NTMs appear to play a crucial role in shaping sectoral import patterns. The study underscores the importance of a nuanced understanding of these measures to maximize trade potential within ASEAN countries. Future policy considerations should take into account these specific NTM impacts when strategizing for further enhancement of the ASEAN trade landscape.

Table 7: Preliminary PPML Estimations of Control Variables

	Agriculture		Non-Agriculture			
	Plant	Animal Product	Wood	Machine	Textile	Other
GDP.Imp	-0.723*	1.771*	0.531	0.398	-0.603	0.636
	(0.419)	(0.969)	(0.602)	(0.721)	(0.591)	(0.438)
GDP.Exp	0.158	0.466	0.458	0.445	0.614	0.858**
	(0.389)	(0.654)	(0.444)	(0.557)	(0.394)	(0.349)
AgLand.Imp	-0.828	-8.410***	4.537*	-1.310	-0.093	-0.394
	(2.495)	(3.106)	(2.550)	(1.568)	(1.424)	(1.282)
AgLand.Exp	-1.472	-1.793	0.471	-1.039	1.433**	-0.443
	(1.707)	(1.903)	(1.390)	(1.021)	(0.679)	(0.919)
lnemp_imp	0.131	-2.454	1.233	1.045	-2.105	-0.786
	(1.440)	(1.863)	(1.220)	(1.289)	(1.716)	(0.946)
lnemp_exp	0.140	-1.295	-0.335	-1.096	-0.837	-1.512*
	(1.193)	(2.243)	(1.301)	(1.343)	(1.281)	(0.906)
Distance	-0.242***	-0.826***	-0.659***	-0.221***	-0.450***	-0.330***
	(0.058)	(0.107)	(0.083)	(0.056)	(0.055)	(0.054)
Average Tariff	0.016	-0.094	-0.023	-0.198	-0.047	-0.048
	(0.064)	(0.085)	(0.048)	(0.171)	(0.030)	(0.030)
Contiguity	-0.162***	0.323*	-0.077	0.358***	-0.069	0.204***
	(0.059)	(0.188)	(0.091)	(0.098)	(0.069)	(0.057)
Common Language	0.283***	-0.141	-0.114	0.422***	-0.390***	-0.250***
	(0.070)	(0.100)	(0.080)	(0.067)	(0.057)	(0.057)
RTA	0.112	0.051	0.090	0.546	0.240**	0.124
	(0.193)	(0.246)	(0.115)	(0.459)	(0.109)	(0.092)
Constant	64.432*	130.741***	-37.978	44.095**	24.631	29.687*
	(36.585)	(43.060)	(30.945)	(21.500)	(17.614)	(17.247)
Importer FE	YES	YES	YES	YES	YES	YES
Exporter FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	256215	48992	142141	736929	491309	1451754

Heteroskedasticity robust 95% CIs reported in brackets. * for p<0.1, ** for p<0.05, and *** for p<0.01.

Table 8: Preliminary PPML Estimations of NTMs

	Agriculture		Non-Agriculture			
NTMs	Plant	Animal Product	Wood	Machine	Textile	Other
Sanitary and Phytosanitary Measures						
A11	147.1%***	-12.5%	-	-	31.5%	-23.2%
A12	-61.7%**	171.7%*	-	-	1002.3%***	326.6%***
A13	-8.4%	23.5%	-19991.7%***	-	-35.1%	-898.9%***
A14	230.7%***	-58.6%*	22.8%	-4897.5%***	5390.2%***	-42.9%***
A15	-35.9%***	-40.7%***	4165.8%***	-18.2%	170.5%**	5.3%
A19	-75.7%***	-2615.3%***	-1833.9%***	9002.7%***	-2994.8%***	4.9%
A21	46.7%**	269.7%***	-	-	264.6%	-40.0%**

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Table 8 – Continued from previous page

	Agriculture		Non-Agriculture			
NTMs	Plant	Animal Product	Wood	Machine	Textile	Other
A22	23.8%**	-1810.3%***	-	-	778.0%	-2.8%
A31	-14.5%	-45.2%***	359.6%	-	2822.1%***	-13.9%*
A32	-77.6%**	27.4%	-	-	-	-
A33	-5.4%	-27.8%	-	-	-	-23.5%
A41	133.5%**	1178.8%***	-	-	-	161.8%***
A42	109.4%***	-67.2%*	-	-	-	-77.8%***
A49	317.7%***	-45.1%	-	-	-	-56.5%**
A51	-59.4%***	-75.2%**	-	-	-	-
A52	-40.3%**	-	-	-	-	-
A53	35.6%	-	-	-	-	-
A11	147.1%***	-12.5%	-	-	31.5%	-23.2%
A12	-61.7%**	171.7%*	-	-	1002.3%***	326.6%***
A13	-8.4%	23.5%	-19991.7%***	-	-35.1%	-898.9%***
A14	230.7%***	-58.6%*	22.8%	-4897.5%***	5390.2%***	-42.9%***
A15	-35.9%***	-40.7%***	4165.8%***	-18.2%	170.5%**	5.3%
A19	-75.7%***	-2615.3%***	-1833.9%***	9002.7%***	-2994.8%***	4.9%
A21	46.7%**	269.7%***	-	-	264.6%	-40.0%**
A22	23.8%**	-1810.3%***	-	-	778.0%	-2.8%
A31	-14.5%	-45.2%***	359.6%	-	2822.1%***	-13.9%*
A32	-77.6%**	27.4%	-	-	-	-
A33	-5.4%	-27.8%	-	-	-	-23.5%
A41	133.5%**	1178.8%***	-	-	-	161.8%***
A42	109.4%***	-67.2%*	-	-	-	-77.8%***
A49	317.7%***	-45.1%	-	-	-	-56.5%**
A51	-59.4%***	-75.2%**	-	-	-	-
A52	-40.3%**	-	-	-	-	-
A53	35.6%	-	-	-	-	-
A59	-9.8%	-	-	-	-	-
A61	51.8%*	-	-	-	-	-
A62	-28.1%	-	-	-	-	-
A63	30.7%	-	-	-	-	-
A64	11.9%	-	-	-	-	-
A65	17.6%	-	-	-	-	-
A71	41.6%	-	-	-	-	-
A72	-18.7%	-	-	-	-	-
A73	-8.3%	-	-	-	-	-
A74	15.5%	-	-	-	-	-
A81	20.3%	-	-	-	-	-
A82	-10.6%	-	-	-	-	-
A91	7.6%	-	-	-	-	-
A92	-12.4%	-	-	-	-	-
A93	4.9%	-	-	-	-	-
A94	-2.8%	-	-	-	-	-
A99	-	-	-	-	-	-

Continued on next page

Table 8 – Continued from previous page

	Agriculture		Non-Agriculture			
NTMs	Plant	Animal Product	Wood	Machine	Textile	Other
Technical Barriers to Trade						
B14	-80.10***	-72.66*	465.33***	77.33***	313.99***	61.43***
B15	-37.66*	-73.12	0.00	-8.74	1091.59***	-8.64
B19	-47.62***	-47.21***	-26.82	-21.17	23.96	4.91
B21	-17.79	26.09	-2.48	-87.90***	2109.16***	-55.16***
B22	0.00	0.00	0.00	800.67***	-67.75	11.28
B31	52.77***	98.67	-92.71***	-30.73***	-73.96***	-15.08***
B32	1167.07***	0.00	0.00	0.00	0.00	225.29***
B33	21.33	-98.37***	0.00	-90.48***	49.38	-39.32***
B41	-80.33***	-86.33***	4439.02***	0.00	307.02	215.07***
B42	-12.77	4.79	2416.30***	-65.43**	1911.49*	-34.05***
B49	165.35**	406.66***	1.01	0.00	-94.66***	-32.41***
B6	-72.05***	1231.87***	0.00	-3.62	-99.99***	68.40**
B7	75.33***	131.04**	57.51	468.53***	315.39***	82.88***
B81	-64.10***	-34.05	0.00	-52.79***	778.02*	-42.23***
B82	58.29**	866.91***	-80.82***	-62.47***	-81.59***	12.83*
B83	281.67***	-94.77***	360.81***	142.97***	3.47	-19.12**
B84	-86.28***	0.00	-52.67	78.86**	-78.12***	-6.53
B85	-8.00	-46.37	0.00	18.18	-96.62***	20.91**
B851	-94.95***	0.00	-34.18	0.00	515.39***	-89.88***
B852	0.00	0.00	0.00	0.00	0.00	-75.41***
B853	-94.30***	2066.78***	0.00	16.05	0.00	111.53***
B859	51.03	-97.05***	-34.03	-51.78***	-78.12***	-46.32***
B89	8.08	-97.59***	9.19	25.35	-7.88	30.57**
B9	0.00	0.00	0.00	-39.90**	0.00	-29.27*

To reiterate, these preliminary results are intended to illuminate the disparate impacts of non-tariff measures (NTMs) across various economic sectors.[8] Derived from the initial data cleansing stage, the robustness of these findings may be constrained, particularly in the absence of statistical testing, which has been deferred due to time limitations. A deeper and more comprehensive understanding of the implications of NTMs necessitates further exploration, supported by rigorous data validation and analysis.

Goodness of Fit and Model Specification Test

To measure of the goodness-of-fit for each of the operational models in the study, I will perform the McFadden R^2. McFadden's R-squared (or pseudo R-squared) is often used in the context of logistic regression models or other generalized linear models (like Poisson regression), where the traditional R-squared measure is not applicable. It provides an estimate of the improvement of the fitted model over a null model, which simply predicts the mean value of the dependent

[8]The definition of NTM division can be found in the *International Classification* document available at: https://unctad.org/system/files/official-document/ditctab2019d5_en.pdf.

variable (Austria 2021). The formula for McFadden's R^2 is given as:

$$R^2_{McFadden} = 1 - \frac{\text{log likelihood of the full model}}{\text{log likelihood of the null model}}, \tag{2}$$

where the log likelihood of the full model is calculated with all predictor variables and the log likelihood of the null model is calculated with no predictor variables (only the intercept).

The value of $R^2_{McFadden}$ ranges from 0 to just under 1. A higher value signifies a better fit of the model to the data. However, unlike the traditional R^2 in ordinary least squares (OLS) regression which explains the proportion of variance in the dependent variable that is predictable from the independent variables, McFadden's R^2 is not a measure of explained variance, but rather measures the improvement of the log likelihood relative to a null model.

This measure is useful in PPML models because it provides a quantifiable metric to assess the goodness-of-fit in models where traditional R^2 cannot be used. It aids in understanding how much the addition of predictor variables improves the model's fit, offering critical insights into model utility and performance. This is especially important when comparing different models or testing the contribution of specific groups of variables.

Furthermore, I will employ the RESET (Regression Equation Specification Error Test) Ramsey test to evaluate the appropriateness of our model's functional form. This general specification test assists in detecting omitted variable bias or incorrect functional forms in our Poisson Pseudo Maximum Likelihood (PPML) model - *see Appendix B* (Ramsey 1969).

Conclusion

This paper will be beneficial to a number of stakeholders. Primarily, policymakers in the ASEAN region could use the insights from the research to design effective trade policies that take into account the effects of different NTMs on trade flows and sector-specific impacts. In particular, it will help them in understanding how to strike a balance between the necessary societal objectives (like health and environmental protection) that NTMs aim to address, and their potential negative impacts on trade. It could also be beneficial to international trade bodies and regional economic communities, offering them a nuanced understanding of NTMs and their impacts on sectoral trade flows.

Moreover, businesses and corporations operating within these regions could use the findings to predict and understand changes in trade flows due to these measures. This could potentially guide their strategic decisions related to supply chains, pricing, and market targeting. Lastly, academic researchers studying international trade, especially in the context of ASEAN, will also find the results useful as they can build upon these findings into a Computable General Equilibrium (CGE) model to assess shifts in NTMs restrictiveness (*see Chapter 2*).

This paper significantly contributes to the literature gap in several ways. First, the study focuses on a sectoral analysis, which few studies have done before within the ASEAN context (Webb et al. 2020). It allows for a more granular understanding of the impact of NTMs on trade flows, providing insights into how different sectors are affected, including food and agriculture, and non-agriculture sectors. This approach helps to bring out the nuances in the trade policy impacts that may be masked in an aggregated analysis.

Secondly, the paper fills the gap in understanding the impact of NTMs post-AEC establishment, an area not covered by previous studies. It provides insights on the extent to which

AEC's objective of regional economic integration has been achieved and whether NTMs have potentially become non-tariff barriers in this process.

Lastly, it overcomes the limitations of previous studies by employing a panel data gravity model using the Poisson pseudo-maximum likelihood estimator (PPML), which adeptly handles zero-trade values and is robust to heteroscedasticity (Webb et al. 2020). This ensures reliable estimates and allows for a more comprehensive analysis. Moreover, this study uses more detailed data, such as the Ad Valorem Equivalent (AVE) rates and sector-specific data from the GTAP database, which provide a more accurate and nuanced analysis of the impacts of NTMs on trade flows.

Appendix

Appendix A: The PPML estimator

Santos Silva and Tenreyro 2006 introduced the Pseudo Poisson Maximum Likelihood (PPML) estimator to address pervasive issues in Gravity model estimation for trade: the presence of heteroskedasticity and zero trade flows between some nations. They highlighted the inadequacies of prevalent estimation methods in this context and recommended the PPML as an alternative.

Traditionally, the gravity model takes on a multiplicative form as shown:

$$T_{ijt} = G_{it} \times F_{jt} \times D_{ijt}^{1-\theta} \times \epsilon_{ijt}, \tag{3}$$

where T_{ijt} denotes the trade flows between countries i and j at time t. G_{it} and F_{jt} symbolize exporter-time and importer-time fixed effects, respectively. D_{ijt} is the time-dependent matrix of bilateral trade costs, while θ is indicative of the trade elasticity relative to the bilateral trade cost. ϵ_{ijt} is an error term with an assumption of log-normal distribution.

Trade researchers frequently logarithmize both sides of the gravity equation to address heteroskedasticity, thereby converting it into an additive form.[9] However, this introduces a new challenge: the management of zero trade flows (i.e., logarithm of zero is undefined). To resolve this, Santos Silva and Tenreyro 2006 proposed an enabling framework for the gravity model in its original multiplicative form:

$$ln(T_{ijt}) = ln(G_{it}) + ln(F_{jt}) + (1-\theta) \times ln(D_{ijt}) + ln(\epsilon_{ijt}) \tag{4}$$

This equation can be directly estimated using PPML, which presumes the dependent variable is distributed according to the Poisson distribution for estimation purposes, without restricting the conditional mean. Consequently, the model can be assessed by maximizing the following log-likelihood:

$$L(\beta) = \sum_{ijt} \left[-e^{X_{ijt}\beta} + Y_{ijt} X_{ijt} \beta \right] \tag{5}$$

The underlying intuition of the Poisson model is to optimize the chance of observing the Y_{ijt} given the input matrix X_{ijt} and the parameter β. The log-likelihood function comprises the expected likelihood $-e^{X_{ijt}\beta}$ and the observed likelihood $Y_{ijt}X_{ijt}\beta$, and the objective is to discover β that maximizes this likelihood.

[9] The conversion to the additive form using the logarithm not only solves the problem of heteroskedasticity but also helps linearize the equation, which makes it easier to handle in statistical analysis.

The strength of the PPML lies in its provision of reliable and efficient β estimates, even in the face of heteroskedastic error terms. Also, the log-likelihood becomes $-e^{X_{ijt}\beta}$ when trade flows are zero, thereby circumventing issues related to logging zeros. Santos Silva and Tenreyro 2006's study, supported by Monte Carlo simulations, showcased the impressive performance of the PPML estimator in situations of heteroskedasticity and zero trade flows, validating its effectiveness in gravity model estimation for trade.

Appendix B: The RESET Ramsey Test

The Ramsey RESET test provides a crucial means of validating the specification of our PPML model. It helps to ensure the validity of the Poisson assumption and the correctness of the multiplicative error structure. The steps of the test include:

1. Estimate the model and obtain the predicted values.
2. Create new variables that are powers of the predicted values.
3. Include these new variables in the model and re-estimate.
4. Perform an F-test on the coefficients of the new variables.

For instance, let's assume our original PPML model is:

$$y = \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n) \tag{6}$$

After obtaining the fitted values, $\hat{y}$, we create new variables $\hat{y}^2, \hat{y}^3, ..., \hat{y}^k$, and then include them into the model:

$$y = \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + \gamma_2 \hat{y}^2 + \gamma_3 \hat{y}^3 + \ldots + \gamma_k \hat{y}^k) \tag{7}$$

The null hypothesis for the RESET test is $H_0 : \gamma_2 = \gamma_3 = \ldots = \gamma_k = 0$. If we reject this null hypothesis, it suggests that the model is mis-specified.

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