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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

Trade restriction rationale for food safety implementation: Evidence from Southeast Asian Countries

Wuthiya Saraithong^{1*}

Abstract: In response to the widespread use of food safety standards as a tool for restricting international trade, this study attempts to answer whether Southeast Asian countries follow this protectionist trend or not. It employs the political economy framework and focuses on the case of the implementation of maximum residue limits (MRLs) on 113 food products which these countries import from their trading partners. The study utilizes the logit model and marginal effects to find the determinants of MRLs implementation. The estimation includes both the seven-countries and the single-country models. As for the former, the result indicates that Southeast Asian countries simultaneously use MRLs both to raise people's quality of life via food safety implementation and to protect import-competing producers. On the other hand, each single-country model provides a clearer picture of the reasons for its enforcement of MRLs; one is with trade restriction motive, while the others are with welfare improving purpose.

Subjects: Economics and Development; International Trade; Incl; Trade Agreements & Tariffs; Political Economy

ABOUT THE AUTHOR

Wuthiya Saraithong currently works at the Department of Economics, Faculty of Economics, Kasetsart University, Bangkok, Thailand. She received her Ph.D. in Economics from the School of Oriental and African Studies, University of London, in 1999. Before starting her academic career, she joined Thailand's diplomatic service and worked on EU issues. During 2004–2006 when Thailand and the United States negotiated on their FTA, she was part of the Thai negotiating team. Because of her long experience on international economic relations, when she entered the academic career, she continues to pursue her interest on this issue and expands it to cover such a new trade-related topic as standards. As Kasetsart University, her current work-place, is considered as the country's authority on agricultural matters, Wuthiya expands her horizon to include various topics relating to international trade in food and agriculture.

PUBLIC INTEREST STATEMENT

In spite of their legitimate purpose of improving consumer welfare, food safety standards, especially maximum residue limits (MRLs) for chemical substances, have been used as trade protection measures. This paper examines the determining factors of the use of MRLs in Southeast Asian countries. Being able to identify their determinants could pave the way for an interpretation of the rationale for the MRLs implementation. This will show if it is to enhance consumer welfare through food safety enforcement or to create import barriers. The paper finds inconclusive reasons for the MRLs implementation in the region as a whole. These countries use MRLs both to improve people's well-being and to protect import-competing producers. In contrast, each nation seems to have its different reasons for the implementation of MRLs. The results of both the region and the each country should allow domestic and foreign stakeholders to respond more appropriately and minimize possibly unfavorable consequences.

Keywords: international trade; protectionism; NTMs; MRLs; food safety; political economy; Southeast Asian countries

JEL classification: F14; F13; Q17

1. Introduction

The liberalization of international trade taking place over the last few decades has not only brought about a wider choice for consumers but also raised intense competition for domestic and foreign manufacturers as well. Facing this situation, agricultural producers need to increase their competitiveness by improving both the quantity and the quality of their products. This is usually achieved by using chemicals and fertilizers in the production process. At the same time, current trends, such as environmental preservation and food safety, also encourage people to demand higher quality products. Consequently, governments often set safety standards for food products to protect consumers from the misuse or excessive use of chemicals and fertilizers. Governments frequently refer to quality improvement and food safety as a reason to enforce product standards.

At present, however, there are no international rules strictly regulating the use of food safety standards. Therefore, these standards can be freely determined by implementing countries, resulting in a variety of enforcement details. In addition, having an unclear international obligation on this matter allows countries to set standards exceeding the level deemed appropriate for consumer protection. And these unnecessarily stringent safety standards may become a hidden trade barrier and restrict the flow of imports. This can be reaffirmed by the United Nations Conference on Trade and Development's classification of sanitary measures especially safety standards as non-tariff measures (NTMs) (Herghelegiu, 2018). The World Trade Organization (WTO) Agreement on the Application of Sanitary and Phyto-Sanitary (SPS) measures authorizes member countries to use their own standards to protect the health of human, animal, or plant, on condition that these standards are based on a risk assessment, not discriminatory, and are minimally trade distorting (Grant, Peterson, & Ramniceanu, 2015). Although there is no universal food product standard that all countries must strictly adhere to, the WTO has stated that importing countries should establish their SPS measures, including food safety standards, based on international standards, recommendations, or guidelines as suggested by the Codex (Beghin, 2014).

The Codex is a science-based international organization responsible for determining a series of standards, codes of practice, guidelines, and other recommendations. They have been accepted as a global reference for international trade and related activities. The Codex's primary objective is to protect public health by providing acceptable standards for both food safety and fair practices in food trade. Although the Codex is not an integral part of the WTO, it has become relevant in global food trade. As the WTO SPS agreement encourages the international harmonization and coordination of food standards, the Codex serves as a benchmark against which food standards from individual members are measured, and regulations can be assessed within the WTO agreements (Martinez & Thornsbury, 2010). This WTO code of conduct aims to increase the chance that product safety standards will be used to promote consumer welfare and not to deter imported products. However, it should be noted that this principle does not have any binding effect on the members of the WTO; instead, it is merely voluntary.

There are a wide range and several types of standards and regulations applied in the food production and market, for example, hygienic measures, SPS standards, or maximum levels related to the content of pesticides, and so on. Also, standards can be classified based on other possible criteria, for example, whether they are private or public, voluntary or mandatory, product or processing standards (Frohberg, Grote, and Winter, 2006). Among them, one of the most commonly used standards, yet, most controversial, is the maximum residue limits (MRLs) for pesticides or veterinary drugs or chemical substances. According to Martinez and Thornsbury (2010), every nation has the right to determine its own MRLs. As a result, there are international differences in the types of chemicals and their quantities that are allowed to be used and left in food products. Due to the

complex nature of defining and implementing MRLs, they can create a negative impact on international trade in food products. When MRLs are too stringent, they may behave as disguised technical barriers to trade because governments may use MRLs to restrict imports and protect the domestic food industry (Choi & Yue, 2017). Food exporting countries can find themselves worsened by trying to respond to different MRLs for different products of different importing countries.

Since MRLs can be easily transformed from a welfare-promoting measure to a barrier to imports, this study focuses on analyzing factors influencing the implementation of MRLs. Finding these factors should reveal countries' true purpose of adopting MRLs. It applies the political economy framework, as suggested by Baldwin (1985, 1989) to identify determining variables. This study concentrates on the case of Southeast Asian countries which most of them, since 1967, have formed an economic integration called the Association of Southeast Asian Nations (ASEAN). These countries have remarkable records of economic performance in terms of both economic growth and stability. Regarding food products, there is a variety of both their production and their consumption. Additionally, ASEAN countries can generally be considered as an important player in world food trade with their food trade accounts for about 7% of total world food trade.

This paper fits within the literature on the political economy of trade policy because it draws variables from as well as applies the political economy concept to examine the determinants of MRLs implementation. This study's hypothesis is to test whether various variables derived from the political economy framework can explain the determination and enforcement of MRLs in ASEAN countries. It is also tested if these MRLs are implemented by the ASEAN governments to improve people's welfare or to impede imported food products as well. All in all, this paper contributes to the literature on the political economy of trade policy, especially on the determinants of MRLs, in two aspects. First, it provides empirical findings on the political economy-based factors that determine the implementation of MRLs on imported food products in Southeast Asian countries. This paper follows the steps introduced by Li and Beghin (2013) in calculating an index to measure the intensity of protection generated by MRLs. Second, with the interpretation based on the theoretical concept of the political economy framework, this paper presents the reasons leading to the implementation of MRLs, whether to improve people's welfare or to protect the domestic industry.

The next section reviews the related literature. The following section describes data and explains methodology employed. The subsequent section presents and discusses the study's empirical findings. And the last section concludes this study.

2. Literature review

This section reviews the literature on the determinants of trade policy and related issues. A number of works, for instance, Ferro, Wilson, and Otsuki (2013), Grant et al. (2015), and Ferraz, Ribeiro, and Monasterio (2017) find the decrease in the importance of traditional protectionist measures, such as tariffs and quantitative restrictions. Instead, the adoption of NTMs to protect the domestic market is climbing. Most NTMs are, in their nature, qualitative, thus, making it difficult to measure their impact on international trade (Disdier, Fontagne, and Mimouni, 2008; Drogue and DeMaria, 2010; Li & Beghin, 2012; Xiong & Beghin, 2012a). Because of this difficulty, economists tried to create methodologies for the evaluation of the NTMs' impact on trade. Among others, Li and Beghin (2013) develop an index to estimate the degree of protection of NTMs. They evaluate the level of trade protection concealed in MRLs administration of importing countries. Using Codex's internationally and scientifically acceptable MRLs as a reference, if countries' MRLs are stricter than the level proposed by the Codex, it may be the case that they pursue protectionist policy. Li and Beghin (2013) also indicate the advantage of their index, i.e., not varying with MRLs' unit of measurement. The index value will not change no matter what the unit is either part per million or part per billion. Moreover, as the calculation of the index uses the average of all residues and substances, consequently, the value of the index tends to be less biased.

Ferro et al. (2013) also develop a restrictiveness index to measure the level of protection of MRLs enforced by several countries on imported food products and use this index to analyze how MRLs affect food exports of developing countries. In conducting this study, they use MRLs data from 61 countries to assess the restrictiveness of standards for each country-product-year. The benefit of the restrictiveness index is that it combines the number of pesticides restricted as well as the amount with which they are set into one measure. Besides, this index includes, for every product, all pesticides regulated in the world, different from Li and Beghin (2013)'s index, which covers only those product-pesticide pairs regulated by Codex. By employing a gravity model, this study finds that the stricter food safety standards, the less likely international trade will occur. Furthermore, the marginal effect, which shows the impact of standards on the probability of international trade, is higher in the case of BRICS countries (Brazil, Russia, India, China, and South Africa) than the others. Also, it finds that restricted food safety standards are expected to have more negative effects on exporters from lower-income countries than on other groups. Considering more advanced countries, the restrictiveness of MRLs of the United States and Canada compared with that of international standards and its impact on their international trade are analyzed by employing Li and Beghin (2013)'s index. It is found that Canada tends to enforce more stringent food safety standards than the United States does. On the other hand, most United States' MRLs on vegetable and animal products are not different from those of Codex (Xiong & Beghin, 2012b).

Apart from the two indexes developed by Li and Beghin (2013) and Ferro et al. (2013), there are also other indexes designed to capture the level of protection of NTMs. For example, Vigani, Raimondi, and Olper (2010) construct a composite index of the complexity of Genetically Modified Organism (GMO) regulations for 60 countries. Theoretically, this index is similar to a correlation coefficient. This study uses a gravity model to show how bilateral similarities in GMO regulations affect trade flows. Results show that bilateral proximity in GMO regulations positively affects trade flows, primarily as an effect of labeling policies, approval process, and traceability systems.

The study on MRLs and their rationale, undertaken by Farnsworth (2012), finds that they are an example of trade regulations that can be considered both as necessary and as protectionist. This study utilizes agricultural trade and MRL data from various sources. It constructs a strictness index to measure the link between MRLs and trade protectionism. This index converts the actual MRLs into percentages reflecting how strict a particular country's MRL is with respect to the average MRL for that pesticide on a commodity. Hypotheses regarding protectionist behavior are tested in different econometric scenarios, using ordered logit and probit regressions. The results indicate that high-income, food-importing nations with fewer people working in agriculture and spending a larger share of their gross domestic product (GDP) on public health are in favor of stricter regulations.

DeMaria and Drogue (2017) explore the effect of European Union (EU)'s food safety regulations on the trade of baby food products. In order to quantify the impact of European regulation concerning the MRLs of pesticides on the trade of baby food products, a severity index is constructed based on the methodology described in Li and Beghin (2013). This index indicates if the EU regulation on MRL of pesticides in infant and baby foods is more or less stringent compared to that of its major trading partners. The European legislation is considered as protectionist if the values of the MRLs set by the EU are lower than the corresponding MRLs of its trading partners. Results indicate that this EU regulation may be considered as a tool protecting the vulnerable population.

Another index used to measure the inconsistency of MRL standards among countries is a similarity index. The advantage of the index is that it can capture the ratio between a country's MRL standard and the highest MRL standards. Choi and Yue (2017) adopt the similarity index to understand the extent to which the MRL standards are different between Japan and other nations. The gravity model is then used to analyze how MRL standards influence the Japanese imports of different categories of vegetables. The results reveal that the trade impacts of MRL

standards are varied for different kinds of vegetables, with the most substantial effect on imports of leafy plants.

Apart from many studies focusing on quantifying NTMs, especially MRLs, and their impact on international trade, as described above, there is a literature examining the determinants of tariffs and NTMs by employing the political economy framework. This concept has been introduced in the late 1950s and become well-known since the 1970s. This framework suggests that not only economic but political factors also determine the process of policy formulation. It considers the determination of a nation's trade policy in terms of demand and supply (Baldwin, 1985). Following this framework, a number of studies are undertaken to analyze trade policy measures, both tariffs and NTMs. Among them are widely recognized works carried out by Pincus (1975), Caves (1976), Ray (1981), Lavergne (1983), Baldwin (1985, 1989), Anderson and Baldwin (1987), Li, Xiong, and Beghin (2014), and Herghelegiu (2018).

According to Baldwin (1985, 1989), the political economy framework can be categorized into two main approaches, namely, the economic self-interest approach and the social concern approach. The economic self-interest approach generally argues that the differences in the ability to seek import protection result in the gaps in protection among industries. This approach is further classified into two models: the pressure group model and the adding machine model. The former argues that interest groups with the small number of members would receive high levels of protection. The adding machine model is formulated based on the idea that the government would do its best to maximize the chance of its reelection (Caves, 1976). He suggests that "labor has the votes," and therefore labor-intensive businesses are likely to gain the highest protection from the government.

According to the social concern approach's concept, trade policy is explained mainly by the government's wish to promote the welfare of its people. This approach can be subclassified into three models: the status quo model, the social change model, and the foreign policy model. The status quo model proposes a positive relationship between the current levels of protection and past levels. This model implies that income maintenance is the motivation of many protectionist policies (Lavergne, 1983). The social change model argues that trade policy is a tool of the government not just to keep the current status but also to enhance people's living standard. The foreign policy model views trade policy as an instrument of foreign policy to serve various international objectives of the government to secure the interests of the nation.

Under the political economy framework, some explanatory variables are identified as determining factors of trade policy. These variables have been analyzed in several empirical works to study the determinants of tariffs and NTMs. The results of these studies are quite varied. For instance, Ray (1981) investigates the determinants of tariff and nontariff trade restrictions in the United States. In addition to analyzing the relationship between average tariff levels and many explanatory variables such as the concentration ratio, and the import penetration ratio, he also studies the relationship between tariffs and nontariff barriers. He finds that tariffs positively and significantly affect nontariff trade restrictions, while nontariff trade restrictions have no significant impact on the determination of tariffs.

Three decades later, the pattern of trade policy determinants changes considerably. More recently, to examine a range of the economic and political determinants of MRLs, a political economy framework together with an econometric analysis is employed in Li et al. (2014). It is found that countries with higher income and larger population implement stricter MRLs. Also, nations set more stringent MRLs in their more competitive sectors. The results suggest that, for the government, MRLs and import tariffs are policy replacement. Herghelegiu (2018) also builds up on the political economy concept to explore the determinants of NTMs in different developing countries. For comparison purposes, a case study is also examined for two developed economies, the EU and Japan. This analysis is conducted at a disaggregated level, the six-digit level of the

Harmonized System (HS), and includes several types of measures, both technical and nontechnical categories. The results suggest that NTMs used by developing countries are driven by both political and economic factors. Sectors facing with tariffs cut, confronting import competition, and employing a large number of workers are the ones with a higher probability of receiving NTM protection. Transnational lobbying is also positively and significantly related to the adoption of NTMs at the national level.

This paper employs some of the methodologies reviewed above and applies it to analyze the determinants of MRLs implementation on imported food products in ASEAN countries. To the best of knowledge, this line of study with reference to this region has not been done before. The next section will explain and discuss in detail the application of methodology and the description of data used in this study.

3. Methodology and data

To investigate factors that could influence the implementation of MRLs by Southeast Asian countries, this study employs the logit model for the analysis. The estimation uses an index developed by Li and Beghin (2013) as a dependent variable. This index is constructed as follows:

$$Index_{j,k} = \left[\sum_{n(k)=1}^{N(k)} \exp \left(\frac{MRL_{codex,k,n(k)} - MRL_{j,k,n(k)}}{MRL_{codex,k,n(k)}} \right) \right] / N(k) \quad (1)$$

where $MRL_{j,k,n(k)}$ is MRLs of importing country j for goods k and pesticide or drug or substance $n(k)$, while $MRL_{codex,k,n(k)}$ is MRLs which are recommended by Codex for the same goods, pesticide, drug, or substance. $N(k)$ is the number of pesticide or drug or substance used for goods k .

Technically, the index developed by Li and Beghin (2013) is an appropriate proxy for this study's estimation due to three reasons. First, this index is less biased, as reviewed earlier. Second, it analyzes the trade protection effect of MRLs by comparing individual countries' MRLs with those of the Codex. By doing so, it can separate MRLs with protectionist intention from the ones with welfare-improving purpose. And last, this study aims to examine the political economy determinants of MRLs implementation and to show whether it is trade protection in disguise, not to investigate the impact of MRLs on international trade between countries. Therefore, it is not necessary to employ a similarity or a severity index which compares MRLs of trading partners.

Li and Beghin (2013)'s index can show whether MRLs imposed on imported products have an element of trade restrictions or not. If imposed MRLs are, on average, stricter than the Codex levels, the index will be higher than 1, and it will be coded as 1 in the logit estimation. Otherwise, it will be equal to or less than 1, and it will be coded as 0. The former means the MRLs implementation has the objectives of not only maintaining the safety and quality of food products but also protecting the domestic producers from external competition. The latter, on the other hand, indicates that MRLs are employed concentrating on promoting people's well-being.

In this study, among 791 calculated indexes, there are 665 indexes with values equal to or lower than 1, reflecting MRLs implementing with an objective of consumer protection. On the contrary, the remaining 16% of indexes have values higher than 1, indicating MRLs acting like import barriers. Even though the number of cases with protectionist intention does not seem to show a severe problem, it somewhat provides a clear signal of protectionism phenomena. The principal causes of these trade restriction incidents are essential information for policymakers. The binary model with estimated marginal effect is thus considered as a suitable method to address these causes and examine the case of increasing protective trend on international trade. This is because it can express the effect of individual-specific explanatory variables on the probability of policy shift to protectionism (Scheve & Slaughter, 2001). Policy-wise, the estimated result of the binary model and marginal effect would allow for insightful information on the key factors that could

raise the possibility of governments using MRLs as trade protection over consumers' welfare promotion.

In contrast, the result of OLS regression offers the size of the impact of explanatory variables on MRLs implementation, which is not useful information to indicate the possibility of extending trade restriction trends. Moreover, technically, as the dependent variable, the index has relatively little variation in its value, and a number of indexes can be either 0 or 1, the binary model is more suitable in this circumstance (Farnsworth, 2012). Therefore, the binary, logit model is employed in this study as a main econometric tool to analyze the trade protective effect of MRLs implementation.

The logit equation can be presented in the logarithmic linear form as:

$$\ln \left(\frac{\Pr(\text{Index}_{j,k} = 1)}{\Pr(\text{Index}_{j,k} = 0)} \right) = (a - bx_i) a + b_1x_1 + b_2x_2 + \dots + b_ix_i \quad (2)$$

where $\text{Index}_{j,k}$ is a binary variable. This equation estimates coefficient b_i of variable x_i , where $i = 1, 2, 3, \dots, I$. The estimated logit model of the determinants of MRLs can be stated as:

$$\text{IN}_{j,k} = \alpha + \sum_{i=1}^I \beta_i X_{j,k} + \varepsilon_{j,k} \quad (3)$$

where $\text{IN}_{j,k}$ is an index, calculated for food product k imported by ASEAN country j . α and β_i are interesting parameters to be estimated and $\varepsilon_{j,k}$ is the disturbance term. $X_{j,k}$ is a vector of independent variables.

Apart from the logit model, the marginal effect of each independent variable is also estimated to examine its impact on the changes in the probability of ASEAN countries implementing stricter MRLs than the international standard levels. Additionally, test statistics for a significant impact of each variable is under the null hypothesis of individual estimated marginal effect indifferent from zero.

To conduct the estimation mentioned above, 14 independent variables are employed based on the political economy concept together with country dummies. These variables composed from various cross-sectional data for 2014 are collected from several sources. Data on MRLs which each ASEAN country sets for its each imported food product and each pesticide or drug or substance are obtained from the database of Foreign Food Service, US Department of Agriculture (USDA, 2014) from the website www.mrldatabase.com. A number of data relating to exports and imports are acquired from Trade Map database of International Trade Centre through www.trademap.org. Data on GDP, expenditures, population, and employment are drawn from the World Bank's World Development Indicators database. Food production data come from Food and Agriculture Organization (FAO)'s FAOSTAT database. Data on import tariffs and regional trading arrangements are obtained from the WTO database. And last, an index on government's regulatory quality is taken from the World Bank's Worldwide Governance Indicators. The full list and description of all explanatory variables are shown in Appendix A. As reported in Table 1, the mean of the dependent variable, the index, is quite low, 0.1593. This is consistent with the high number, 665 out of 791, of the index with the value equal to or less than 1. Moreover, $\ln\text{GDP}$ and $\ln\text{pop}$ show their maximum and minimum values which are not so varied and S.D. are quite low. This reflects that the discrepancy among countries subject to estimation here is not so significant. Descriptive statistics of all variables are presented in Table 1.

Although at present all 10 members of ASEAN, namely Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam, enjoy a rather deep level of economic integration, they are still quite free in implementing their own different MRLs. In spite of their attempts to speed up the process of harmonizing member countries' MRLs, ASEAN's common MRLs are far-fetched. Consequently, each ASEAN country independently sets and uses

Table 1. Descriptive statistics of variables

Variables	Mean	S.D.	Max	Min
IN	0.1593	0.3662	1	0
lnimport	5.5064	3.6583	13.8105	0
lnexport	3.3445	3.6911	15.3017	0
Netimp	0.6865	0.4642	1	0
lnproduction	3.1792	5.0567	16.3769	0
empag	26.8857	20.4951	54.1000	0.6000
Foodexp	7.9714	5.1732	14.4000	0.2000
Foodimp	8.0857	3.4623	15.0000	3.5000
lnGDP	8.8513	1.4002	10.9263	6.9321
lnhealth	5.7915	1.2022	7.8366	4.1010
Pubhealth	2.6000	1.3436	5.3000	1.4000
lnpop	16.6989	1.8210	18.3961	12.9276
lnrta	2.3464	0.3797	3.0910	1.7918
Tariffs	4.3429	2.4480	8.0000	0.5000
Reg	0.4143	0.8345	2.0000	-0.6000

Source: Author's calculation.

its own MRLs. Li and Beghin (2013) classify the pattern of the 10 ASEAN countries determining their MRLs into three groups. First, countries use a combination of formulating their own MRLs and following the Codex MRLs, such as Cambodia, Malaysia, Singapore, Thailand, and Vietnam. Second, countries totally adopt the international standards of Codex, such as Laos and the Philippines. And the last group is countries, such as Brunei, Indonesia, and Myanmar, whose MRLs are unknown of their origins. However, Saraithong (2015) looks into ASEAN's MRLs and finds that Cambodia and the Philippines completely implement their MRLs according to the Codex standards. Laos and Myanmar have not yet evidently established their own MRLs. Also, there is too limited information on Indonesia's MRLs. This could be a result of the fact that this country determines very few MRLs. As a consequence, MRLs data of Laos, Myanmar, and Indonesia cannot be systematically collected for analysis. Therefore, this study includes only the remaining seven ASEAN countries, i.e., Brunei, Cambodia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam.

This study focuses on 113 food products imported by ASEAN members from the rest of the world. Under the four- or six-digit HS, these products fall into HS 0201, 0202, 0206, 0207, and 0210, meat products; HS 07 and its various subheadings, vegetables; HS 08 and its various subheadings, fruits; and HS 10 and its various subheadings, cereals. A logit equation is estimated for a whole set of seven ASEAN members. On the other hand, other five equations are also separately estimated for Brunei, Malaysia, Singapore, Thailand, and Vietnam. Cambodia and the Philippines are excluded from the single-country analysis because these two countries simply follow the Codex in determining their MRLs, thus no hidden trade protectionism in their MRLs enforcement. Therefore, for the all-countries analysis, the dataset is a cross section of seven countries and 113 food products, consisting of 791 observations.

4. Results and discussions

The investigation on the determinants of MRLs in this study examines whether the implementation of MRLs is to improve consumers' welfare through food safety enforcement or to create import barriers. It employs the logit model and marginal effects which can offer more precise estimation for the changes in the probability of ASEAN countries using MRLs as import barriers when there are changes in an explanatory variable. The six logit models are separately estimated with 14 independent variables and country dummies. Among them, five models are conducted for each of the five countries and another model for all seven countries. For the five single-country models, there is no significant variable explaining the implementation of MRLs in the case of Brunei and Vietnam.

This may be because the implementing pattern of MRLs in these two countries is still unclear. As for the other three countries, Malaysia, Singapore, and Thailand, their separate models show the statistical significance of different variables.

The significant variable in the case of Malaysia is the import value of food products. The high value of food imports is often due to domestically uncompetitive products. Its positive relationship with the opportunity that Malaysia enforces stricter MRLs indicates the Malaysian government's attempts to help protect domestic producers from more competitive imports which flood the internal market. It clearly points out the trade restriction effects of MRLs implementation. This is coherent with the status quo model. Feenstra and Bhagwati (1982) test a hypothesis and find that protection is higher in sectors adversely affected by import competition. Lavergne (1983) supports this argument with his finding, which shows that the comparative disadvantage of a sector plays a significant role in determining tariff levels and other protectionist policy measures. Other empirical works on NTMs which also find the positive relationship between the protective effect of NTMs and the high levels of import penetration include, for instance, Trefler (1993) and Lee and Swagel (2000). More recently, Herghelegiu (2018), in her study of the determinants of NTMs, finds that sectors confronted with import competition are the ones with a higher probability of receiving NTM protection.

As for Thailand, the significantly positive relationship between the production value of food products and the probability of the country applying stricter MRLs could signal the Thai government's policy of food safety improvement. The more production of food products could reflect more competitive domestic production, especially in terms of higher quality. The excellent quality and safety of domestically produced food products make it appropriate for the government to ensure comparable standards by setting stricter MRLs for imports. The statistical significance of the value of food production in explaining the probability of Thailand enforcing stricter MRLs is in line with the notion of the status quo model.

The statistical significance of the negative relationship between the country's status as a net importer of food products and the probability of Singapore implementing stricter MRLs implies its government's intention to use MRLs chiefly to improve consumers' welfare through food safety implementation. As a net importer of food products, Singapore's import value is higher than its export. This may be because Singapore is a small, urban, and industrialized country, hence, hardly producing food products itself. Therefore, there is no reason for the country to implement MRLs to protect domestic food producers; instead, they are employed mainly to enhance people's well-being. It can be seen that for these three countries, in spite of being a member of the same economic group and having their various policy aspects harmonized, when it comes to the implementation of such trade-related matter as, MRLs, their rationales can be very different. While Malaysia is quite clear to pursue this policy to restrict imports and protect its domestic producers, Thailand and Singapore are more on promoting their people's welfare.

However, when turning attention to the overall case of ASEAN countries, according to Saraithong (in press), in the all-countries model, there are six variables which can significantly explain the probability of ASEAN countries implementing stricter MRLs than the Codex-determined levels. These six variables consist of public health expenditure as a percentage of GDP, trade-weighted average applied import tariffs, the value of food imports by product, the value of food production by commodity, total food imports as a percentage of total imports, and employment in the agricultural sector as a percentage of total employment. As shown in Table 2, compared with three single-country models, there are four additional variables with explanatory power in the all-countries model. All six significant variables present an unclear picture of the determination of MRLs. Unlike the conclusive results in the case of Malaysia, Singapore, and Thailand, the all-countries model provides mixed evidence of the rationale for the implementation of MRLs by ASEAN as a whole.

Table 2. Estimation results of logit model and marginal effects

Variables	All seven countries			Malaysia		Singapore		Thailand	
	Coefficient	Marginal effects		Coefficient	Marginal effects	Coefficient	Marginal effects	Coefficient	Marginal effects
Pubhealth	1.026175*	0.0673795*	-	-	-	-	-	-	-
Tariffs	-1.024308*	-0.067256*	-	-	-	-	-	-	-
Inimport	0.0837164**	0.0054969**	0.5238219**	0.0186811*	-	-	-	-	-
Inproduction	0.0443306***	0.0029108***	-	-	-	0.1114971**	-	0.0122172**	-
Foodimp	0.1802194*	0.0118334*	-	-	-	-	-	-	-
Empag	0.0626062*	0.0041108*	-	-	-	-	-	-	-
Netimp	-	-	-	-	-	-4.517853**	-0.8090767*	-	-

Source: Author's calculation.

Note: *statistical significance at least at $\alpha = 0.01$; **statistical significance at least at $\alpha = 0.05$; ***statistical significance at least at $\alpha = 0.1$.

The results of the whole-ASEAN model indicate that countries with a large number of workers hiring in the agricultural sector are likely to impose restrictive policy measures on food imports to protect their domestic producers and employment, thus, people's welfare. The positive relationship between employment in the agricultural sector and the change in the probability that ASEAN governments use stricter MRLs than the international levels, as found here, is consistent with the adding machine model. Empirically, Anderson and Baldwin (1987) point out that most of their cross-national studies support the importance of the employment size of an industry as a determinant of the level of protection. Trefler (1993) and Belloc (2015) argue that sectors with sizeable employment receive superior protection, as governments may want to maintain their political support. Herghelegiu (2018) also finds that sectors characterized by the high level of employment are likely to obtain higher trade protection from NTMs.

The positive relationship between public health expenditures and the probability of ASEAN members enforcing stricter MRLs shows that when governments spend a lot of their budget on health care, it means they concern about people's welfare, hence apply strict MRLs on imported food to ensure an inflow of safe food products. The significance of this variable is consistent with the social change model. It is also supported by Farnsworth (2012), which finds that public health expenditure is the most consistently significant explanatory variables across all specifications of his study.

The negative relationship between average applied import tariffs and the chance that ASEAN countries pursue stricter MRLs, as found in the all-countries model, is consistent with the findings of earlier works by Moore and Zanardi (2011), Li et al. (2014), and Orefice (2017). They suggest that a movement in the opposite direction between tariffs and NTMs implies hidden protectionist agenda behind the adoption of NTMs. Furthermore, Herghelegiu (2018) studies the political economy aspect of the determinants of NTMs and finds that products or sectors that have experienced the reduction in tariffs have more opportunity to obtain NTM protection. It can be argued that the ASEAN governments interchangeably implement applied import tariffs and MRLs. As the use of import tariffs decreases in importance, the governments may opt to stricter MRLs to keep their domestic producers protected against import competition. And import tariffs and MRLs become policy substitutes. The significance of import tariffs stresses the explanatory power of the status quo model.

In addition to considering the factors influencing the implementation of NTMs, particularly MRLs, as explained earlier, comparing them with the case of employing the political economy framework to identify the determinants of tariffs can find some similar patterns. For example, Ray (1981), Takacs (1981), and Marks and McArthur (1990), in their studies of the determinants of tariffs, find the importance of import competition issue. Sectors or products facing with deep import penetration tend to receive or maintain government's protection in the form of high tariff levels. The significance of variables relating to import competition is also apparent here. As shown in Table 2, two variables, both the value of food imports by commodity ($\ln import$) and the value of total food imports as a percentage of total imports ($foodimp$), perform quite well in explaining the probability of ASEAN countries adopting more restrictive MRLs than the Codex-determined levels. It is evident that ASEAN countries, indifferent from the case of tariffs determination, mentioned above, are likely to implement standard-like NTMs, such as MRLs to help domestic producers fight import competition. It can be seen that, over time, tariffs and NTMs share a common ground, serving as a tool for governments to achieve their various policy objectives.

The significance of the six variables in the all-countries model provides an explanation for the reasons MRLs are implemented in Southeast Asian countries. On the one hand, it presents the evidence of the implementation of MRLs with the objective of improving consumers' welfare, shown by the significance of public health expenditures. On the other hand, with the explanatory power of such variables as average applied import tariffs and the value of food imports, the functioning of MRLs as import barriers to protect domestic producers cannot be overlooked.

5. Conclusion

This study's objective is to investigate the determining factors of the implementation of MRLs, emphasizing the case of ASEAN countries. These factors imply whether the protectionist trade agenda is hidden in the enforcement of welfare-enhancing measures, like MRLs. To carry out this research, data on MRLs for pesticides or drugs or substances on food products of ASEAN countries are drawn from the database of Foreign Food Service, US Department of Agriculture (www.mrldatabase.com). Products under study here come from four product groups as listed by the four- or six-digit HS. They consist of meat products, vegetables, fruits, and cereals. The analysis on ASEAN in general covers seven countries, i.e., Brunei, Cambodia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. However, when estimated separately, Cambodia and the Philippines are dropped because they determine their MRLs exactly according to the Codex.

The determinants of MRLs are analyzed by employing the logit model and marginal effects. The index, calculated according to Li and Beghin (2013)'s method, is used as this study's dependent variable. The initial estimation covers 14 explanatory variables with country dummies. However, the best-estimated model appears to have six variables carrying the statistically significant relationship with the probability of ASEAN countries implementing stricter MRLs than the internationally recognized levels. They are public health expenditure, trade-weighted average import tariffs, the imports value of food products, the value of food production, total food imports as a percentage of total imports, and agricultural employment as a percentage of total employment. The significance of these six variables highlights the effectiveness of the political economy concept in explaining the implementation of MRLs. From the all-countries model, it cannot be concluded whether, in ASEAN countries, MRLs are implemented exclusively for consumers' welfare enhancement through food safety improvement or protecting import-competing producers. Actually, it can be said that the case of MRLs implementation for the whole ASEAN is a result of the governments' policy objectives to achieve both the improvement of people's well-being and trade protectionism at the same time. Nonetheless, looking into the separate models of each country, the trade restriction effects of MRLs can be found in the case of Malaysia. On the other hand, the objective of Singapore and Thailand in implementing MRLs is mainly to help improve people's welfare.

As the implementation of food safety standards, such as MRLs, is quite international, the factors influencing this policy administration can be varied according to changing global context. Therefore, apart from understanding unique domestic characters, it is necessary for parties involved to closely follow both multilateral and bilateral trade-related negotiations.

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Appendix A. Definition and description of variables

Variables	Description
Dependent variable: Index (IN) (dummy)	1 when IN is higher than 1 0 when IN is equal to or less than 1
Independent variables	
Employment in agriculture (empag) (% of total employment)	The number of person employed in the agricultural sector as a percentage of countries' total employment
Exports value by commodity (lnexport) (natural logarithm of US\$1000)	The value of exports of food products by commodity: vegetable, fruit, meat, and cereal
Food exports (foodexp) (% of merchandise exports)	The value of total food exports as a percentage of countries' total merchandise exports
Imports value by commodity (lnimport) (natural logarithm of US\$1000)	The value of imports of food products by commodity: vegetable, fruit, meat, and cereal
Food imports (foodimp) (% of merchandise imports)	The value of total food imports as a percentage of countries' total merchandise imports
Food production by commodity (lnproduction) (natural logarithm of US\$1000)	The value of food production by commodity: vegetable, fruit, meat, and cereal
Net importer of commodity (netimp) (dummy)	1 when countries are a net importer of food product 0 when countries are not a net importer of food product
GDP per capita (lngdp) (natural logarithm of current US\$)	The value of countries' per capita gross domestic product
Health expenditure per capita (lnhealth) (natural logarithm of current US\$)	The value of countries' per capita expenditures on health care
Public health expenditure (pubhealth) (% of GDP)	The value of governments' expenditures on health care as a percentage of countries' GDP
Number of population (lnpop) (natural logarithm of person)	The number of countries' population
Number of membership in regional trading arrangements (lnrta) (natural logarithm of number of group)	The number of regional trading arrangements or economic integration of which countries are a member.
Trade-weighted average applied import tariffs rate (tariffs) (%)	The rate of average applied import tariffs weighted by trading volume
Regulatory quality (reg)	The World Bank's index is used as a measurement of the efficiency of government, ranging from -2.5 to 2.5.



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