The impact of tariff rates on the probability of trade relationships survival: evidence from ASEAN+6 manufactured goods

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This article explores the links between imported trade relationships, duration, and tariff rates. We investigate how the probability of survival of trade relationships affected due to the difference in the tariff rates based on survival analysis. Using ASEAN+6 as the reporter with 89 trading partners on manufactured goods from 1996 to 2011. A series of findings are as follows. First, low-tariff trade survives longer than high-tariff trade on manufactured goods. Second, a significantly negative correlation between tariff rates and duration is evidenced, which increases around 4% hazard ratios. Also, the reduction of tariff rates in intra-regional trade is helpful to prolong the length of trade relationships. Third, low tariff rates have 9.1% lower hazard ratios. We also obtain robust results in production networks and Rauch product's classification. Finally, we consider these findings could be the references for other economic organizations, which is aimed at the diminution of tariff rates.

I. Introduction

When survival analysis was first applied in international trade (Besedeš and Prusa, 2006a, 2006b), many studies started to concentrate on the issue of trade relationships, examining the probability of survival in the duration of relationships with trading partners. The survival and death of trade relationships depend on whether positive trade values exist in country-product pairs without question. Besedeš (2008) indicates that higher initial export value is associated with the positive duration of trade relationships. Besides, intensive margin has a significant effect on export growth and further spreads the duration of trade relationships (Besedeš and Prusa, 2007; Helpman, Melitz, and Rubinstein 2008; Felbermayr and Kohler, 2006).

Other essential factors may affect the volume of trade values, directly impacting things like costs. For example, sunk costs significantly affect firm performance on the probability of exports as well as entry costs (Roberts and Tybout, 1997; Bernard and Jensen, 1999, 2004; Impullittia, Irarrazabal, and Opromolla 2013); trade costs have fallen given the trade value increase (Bridgman, 2013; Novy, 2013). As previously mentioned, those studies do not directly explore the impact of costs on the probability of trade relationships survival, particularly as this impact is defined in survival analysis.

Fugazza and Molina (2011) use the time required to export as a proxy for export costs and import as a proxy for import costs, investigating the impact of per-period fixed costs to the duration of trade relationships by employing survival analysis. He also mentioned that higher tariff rates accompany lower hazards for the duration of trade relationships because of less competition for incumbent firms; this result is also in line with Besedeš and Prusa (2006b). In other words, they evidence the significant positive relationship between tariff rates and durations of trade relationships.

Tariff rates could be seen as transaction cost, which is an effective tool of protection for domestic and foreign firms. However, we infer if firms face tariff rates too high to afford, possibly leading to the exit of trade due to high export/import costs. It is intuitive that high tariff causes the reduction of trade value[1] which means negative correlations with trade values. Based on this concept, presumably, tariff rates cause a negative effect on the duration of trade relationships, instead of positive correlations that evidenced by previous studies. In short, we set the hypothesis that

[1] This intuition is evidenced by Hayakawa (2013), which investigates the impact of omitting bilateral tariff rates employed in the gravity model. Also, Florensa *et al*. (2015) indicate that high tariffs cause a negative effect for intermediate goods in the exports of Latin America.

low tariff rates of trade relationships are more likely to survive. Moreover, we consider the fact that once the trade relationships are formed or when products are traded, each country's each product corresponds varied tariff rates and changes over time. In other words, tariff rates are distinct according to the type of products as well as the trading partners. For example, a variety of tariff rates are possible in parts and components as well as in differentiated products, reference prices, or homogeneous goods. Similarly, international trade agreements and regional integration also lead the difference of the tariff rates.

With the development of multilateral trade negotiation, increased importance has been attached to regional economic integration. The evolution of ASEAN members increased from its initial ten member nations to ASEAN+3 and further expanded to ASEAN+6. At this moment, ASEAN+6 has become one of the largest economies, particularly with her extensive scale, influential economic strength, and abundant population. The basic aim of regional trade agreements (RTAs) is to promote trade liberalization in intraregional trade through tariff diminution. The difference of tariff rates is likely to shock the stability of trade relationships with upstream and downstream trading partners caused a collapse in international production networks. In particular, international production networks in East Asia have been played a significant role in transactions in intra-regional trade (Athukorala, 2010). In other words, the correlation between regional trade and tariff rates is pertinently considered.

We set ASEAN+6 as the reporter and 89 countries[2] as the trading partners, including intraregional and interregional trade from 1996 to 2011 to be our samples and follow two steps. First, tariff rates are included to investigate the impact of tariffs on the probability of the survival of trade relationships in imports and further expand its application to the type of products that previous studies ignore (i.e. production networks and Rauch product's classification)[3], based on Kaplan–Meier estimation. To do this, we deal with the data management of tariff rates according to the strategy of Hayakawa (2013) and then further expand on the decomposition of the

[2] The trading partners are divided into nine regions, such as ASEAN+6, East Europe, West Europe, Middle East, North America, Central America, South America, Africa and other Asian countries. See more detail in Appendix Table A1.

[3] Besedeš and Prusa (2006b), and Fugazza and Molina (2011) only present a positive correlation between tariff rates and the duration of trade relationships but do not discuss the impact of tariff by the type of product, as well as the mention in production networks. In addition, we expect that tariff rates and the duration of trade relationships have a negative correlation, unlike their results. Obashi (2010, 2011), Ando and Kimura (2012), and Okubo, Kimura, and Teshima (2014) only indicate parts and components are longer-lived than final products. Nevertheless, they do not explore the impact of the tariff rates on the survival rates, and the relationships between tariff rates and duration of trade relationships in production networks.

tariff as high and low tariff rates. Second, we exploit the Cox proportional hazards model to re-investigate the correlation between tariff rates and the duration of trade relationships. Otherwise, we also verify whether low tariff rates exist lower hazard ratio compared to high tariff rates.

This article is organized as follows. Section II explains the management of tariff rates. Section III presents the empirical strategy. Section IV provides the empirical results in the Kaplan-Meier estimation and the Cox proportional hazard model. Section V discusses the influence for upcoming integrated economic organizations. Section VI concludes.

II. The Management of Database

In this section, we explain how we construct the database of the tariff rates. We manage the tariff data by following the strategy of Hayakawa (2013). First, the database is obtained from World Integrated Trade Solution (WITS) based on the TRAINS database, which only consisted of ad valorem rather than non-ad valorem tariff rates in order to avoid the tariff schemes becoming complicated. Second, the lowest tariff is selected depending on importers, exporters, products, and years even though multiple tariff schemes are available. For example, if exporter face MFN applied rates and preferential tariffs for the specific products in particular years, the lower tariff duty type will be chosen[4]. Third, missing data of the tariff rates is possible. Some cases may report the import value but not report tariff rates. To solve this problem, we replace the missing year by employing the nearest previous year that tariff schemes are available[5]. Fourth, four types of HS classification have been observed in our samples, i.e. HS1992, HS1996, HS2002, and HS2007. We convert all varied version of HS classification to HS1992, by employing a conversion table[6]. Consequently, we obtain the tariff data at the six-digit product level of the HS1992 classification.

Survival analysis employed in international trade studies refers to trade in a single period of consecutive years until exit (Nitsch, V., 2009; Besedeš and Blyde,

[4] Hayakawa (2013) assumes that all firms always chose the lowest rates, but some firms may use higher tariff rates due to higher fixed costs for preferential tariff rates (Demidova and Krishna, 2008).
[5] Only Cambodia as the reporter uses the nearest later year of tariff rates between 1996 and 2000 due to the data availability from WITS.
[6] Our analysis period is from 1996 to 2011 due to the availability of the conversion table. HS classification is transformed again to HS2012 after 2012; however, related conversion table to HS1992 in official version is not confirmed.

2010). To insert tariff rates into the survival analysis, tariff data is matched with trade data, which is obtained from United Nations Commodity Trade Statistics Database (UN Comtrade) at the six-digit product level. In other words, each traded product corresponds its specific tariff rate in each destination as well as in particular year. Then, we take a simple average over the life period of a trade relationship. For example, suppose that imports are active in three consecutive years, corresponded with 3%, 2%, and 1% tariff rates for each year, then the average tariff rate is 2% for this life period of the imported trade relationship. After taking the average tariff rate for each country-product pair, we decompose tariff rates into high and low tariff rates by using the median of average tariff rates. If the average tariff rates of products are higher than those of median tariff rates, those products are defined as high tariff products; on the contrary, another group belongs to low tariff products. In sum, the tariff rates employed survival analysis is completed, through a series of data management.

The basic concept of the survival analysis is to measure the length of the trade relationships with trading partners. This duration of the trade relationship is defined as a "spell" in the literature on the survival analysis employed in trade. For instance, if Japan imports a particular good from a given country in six consecutive years, this is defined as one spell with a length of six years. However, trade may restart in the importing market, meaning the trade relationships have ever been disrupted. An example is if a particular product is imported from 1996 to 2000 and then discontinued until imported again from 2008 to 2011. One spell has a length of four consecutive years, and another one is a spell with three consecutive years[7]. In our samples, the total independent spells are 2 755 420 for manufactured goods[8]. Sources of *Distance*, *Common language*, and *Colony* are obtained from CEPII database. As for sources for *Gross Domestic Product per Capita, GDP per capita of exporter* are obtained from the World Bank.

III. Theoretical Model

Regarding the statistical techniques of the survival analysis, the traditional Kaplan–Meier estimation and the Cox proportional hazards model are commonly

[7] The multiple spells are viewed as two independent spells (Besedeš and Prusa, 2006a, 2006b).

[8] Initial samples include 472 875 country-product pairs for non-manufactured goods. We also test the comparison between manufactured and non-manufactured goods by using the effect of the tariff cut, inspecting that manufactured goods with low tariff rates survive longer relative to other specifications, but not reported.

employed in trade. The objective of the former is to calculate the survival rate based on the duration of trade relationships. The latter is mainly to investigate which determinants can significantly affect the duration.

Assume T be a random variable referring time to the failure event[9], and t expresses that it has already survived the consecutive years. The survival function of T, S(t), is given as

$$\mathrm{S(t)} = p(T \geq t) \qquad (1)$$

The non-parametric estimate of survival function is driven by Kaplan-Meier estimation:

$$\hat{S}(t) = \prod_{t_j \leq t} \left(\frac{n_j - d_j}{n_j}\right) \qquad (2)$$

where n_j means that the number of country-product pairs is at risk at time t_j, and d_j indicates the number of country-product pairs that trade relationships have broken off. Besides, the hazard function is considered as the alternative way to express the hazard rate at which trade relationships end.

$$\mathrm{h}(t_j) = p(T = t_j | T \geq t_j) \qquad (3)$$

The non-parametric estimator of the hazard function is given as

$$\hat{\mathrm{h}}(t_j) = \frac{d_j}{n_j} \qquad (4)$$

Then, the survival and hazard functions have specific relationships while the hazard rate is too high (low) to survive (die in) trade relationships.

$$\hat{\mathrm{S}}(\mathrm{t_j}) = \prod\nolimits_{\mathrm{t_j} \leq \mathrm{t}} \left(1 - \hat{\mathrm{h}}(\mathrm{t_j})\right) \qquad (5)$$

Besedeš and Prusa (2006b) wrote the first article exploring the determinants that affect the duration by employing the Cox proportional hazards model[10], which was proposed by Cox (1972).

$$\mathrm{h(t|x_i)} = \mathrm{h_0(t)} e^{\beta \mathrm{x_i}} \qquad (6)$$

where x means country-product specific covariates and the coefficient β are estimated from the database in the regression. The baseline hazard rate function, $\mathrm{h_0(t)}$, is

[9] Our data consists of complete and censored data. The former indicates that a failure event is observed during the analysis period, but not to be observed for the latter data. Two types of censored data are left and right censoring, respectively. For simplicity, we set the dummy of failure event equal to zero while no failure event appeared in the right censoring data.

[10] Cox proportional hazards model is the popular technique employed in survival analysis. Given that the distribution of hazard is uncertain, the advantage of the Cox model is that there are no necessary assumptions for hazard functions.

non-parametric and left unestimated. If all covariates are zero, the baseline hazard is presented. The hazard ratio is smaller (higher) than one, which is likely to cause the negative (positive) relationship with the hazard rate. In other words, a positive (negative) effect on the duration is caused while a lower (higher) hazard rate is presented. A ratio equals to one, meaning a specific covariate has no impact on trade relationships. Tariffs, the dummy variables for the type of the products, regional effect[11] and other explanatory variables based on gravity literature are included. The variables used are logarithmic[12].

IV. Estimation Results

The first step of this section investigates the survival rate of imported trade relationships in ASEAN+6 with trading partners, highlighting the impact of tariff rates in intraregional and interregional trade, by employing the Kaplan–Meier estimation. The second step of this section applies survival analyses to examine whether the covariates of product-specific and country-specific characteristics cause the difference in the duration of trade by the Cox proportional hazard model.

Kaplan–Meier estimates

Inclusion of tariff rates on the manufactured goods. Table 1 reports the probability of the survival of trade relationships on intraregional and interregional manufactured goods without considering the effect of the tariff rates. The result evidences that the imported trade relationships of ASEAN+6 on manufactured goods survive longer in intraregional trade compared to those in other regions except North America. Other regions such as West Europe and other Asian countries are also significant trading partners/regions in imports. There is no doubt that these four regions are major exported sources of manufactured goods and effectively support the stability of trade relationships.

<Insert Table 1>

In the view that the tariff rates may potentially affect the duration of trade relationships, the inclusion of the tariff effect is presented in Table 2. Overall, we find that the country-product pairs with high-tariffs are greater than those with low-tariff

[11] Note that our tariff data is shown under product line at the six-digit level between reporters and trading partners, which includes the characteristic of products, as well as the effect of importer-exporter.

[12] The log of the tariff is presented as ln (1+Tariff). See Hayakawa (2013) and Florensa *et al.* (2015).

products. Obviously, we evidence the difference in duration[13] after including the tariff effect. The trade relationships with low tariffs are longer-lived, relative to those with high tariffs. In other words, the country-product pairs with high tariff accompany with large possibility breaking the trade relationships off. In the case of ASEAN+6 in intra-regional trade, the probability of survival is approximately 58.22% in the first year and only 19.22% in the fifteenth year, without considering the tariff effect. However, after dividing country-product pairs into high and low tariffs, low-tariff trade relationships rise up to 60.04% probability of survival in the first year and 24.24% probability of survival in the fifteenth year, relative to trade relationships with high tariffs, which exhibit 56.62% survival in the first year and only 15.12% in the fifteenth year. Through the tariff's effect on the duration of trade relationships, we obtain inspiring evidence that low tariffs are likely to improve the connection of trade relationships significantly.

< Insert Table 2>

International production networks. As previously mentioned, survival analysis applied to the international production networks has verified that parts and components[14] are longer-lived than final products in duration of the trade relationships (Obashi, 2010, 2011; Ando and Kimura, 2012; Okubo, Kimura, and Teshima 2014). However, we mention that even parts and components include high- and low-tariff products as well as final products. Therefore, it is reasonable to distinguish the impact of the tariff on the probability of survival in international production networks, which is presented in Table 3. We find that parts and components still display a higher survival rate than final products do based on the same tariff levels. As for the impact of inclusion, parts and components with low tariffs survive longer than those with the high tariff, and similar results for final products with low tariffs compared to those with high tariffs. In particular, final products with low tariffs show a higher survival rate in the fifteen years, relative to parts and components with high tariffs. Those results are in evidence of a noticeable difference in survival rate even among products with distinct and similar attributes over time. The aim of regional integration in ASEAN+6 is to eliminate the tariff barrier in order to enhance trade flow more freely. Table 4 further explains the difference in survival probability for inter-regional and intra-regional trade

[13] To compare the differences in survival rates for distinct types of products, we use the log-rank test to verify whether significant differences exist, and our tests are statistically significant and robust.

[14] The machinery products of parts and components, as well as final products, are defined according to Ando and Kimura (2005).

relationships in ASEAN+6 production networks. Overall, intra-regional trade relationships show a higher survival rate in terms of parts, components, and final products compared to corresponding specifications in inter-regional trade. Besides, parts and components with low tariffs in regional trade exhibit the highest survival rate, 34.7% in the fifteenth year.

< Insert Table 3>

< Insert Table 4>

Rauch product's classification. This section complements the influence that tariff rates attack the probability of survival applied in Rauch product's classification[15], which Besedeš and Prusa (2006b) as well as Fugazza and Molina (2011) ignore. The overall results are consistent with their findings that differentiated goods survive longer than reference-priced and homogeneous goods. However, further evidence has confirmed again that low tariff rates are likely to continue trade relationships for all products. In particular, reference-priced goods with low tariffs present a higher survival rate compared to differentiated goods with high tariffs, verifying a significant impact due to the difference in tariff rates. Nevertheless, differentiated goods with low tariffs express a higher probability of survival at any point in time.

< Insert Table 5>

Fig. 1 graphs survival functions for manufactured goods as well as production networks and Rauch's product classification, based on the difference of tariffs and regional trade. Overall, the survival curve is displayed as a decreasing zigzag pattern with negative slopes. Survival rates decrease as time increases. All specifications show that low-tariff trade has a higher survival rate compared to high-tariff trade. With respect to manufactured goods, the gap in survival rates between low and high tariffs displays its largest difference around the eighth year and does not spread afterwards. As for the regional trade for manufactured goods, ASEAN+6 shows a relatively higher survival rate than other regions, except for North America, which possesses close economic trade relationships with East Asia. Nevertheless, the gap in survival rate between ASEAN+6 and North America decreases over time. Moving attention to production networks in intra- and inter-ASEAN+6, low-tariff trade of parts and components in intra-regional trade

[15] Homogeneous, reference priced goods and differentiated products are defined by Rauch product's classification on manufactured goods.

exhibits higher survival rates than others, particularly as the gap in survival rate gets larger and larger over time. Since previous studies have evidenced that parts and components have a higher survival probability than final products, we further indicate that tariff cuts have a leading effect on the difference in survival rate, even in parts and components trade with high tariffs. The last survival function graphed is based on Rauch's product classification; again, the effect of a tariff cut is clearly identified; for example, the low-tariff trade of reference-priced goods survives longer than the high-tariff trade of differentiated goods, but the low-tariff trade of differentiated goods achieves the highest survival rate.

<Fig. 1>

Cox proportional hazard model

Table 6 explains how the duration of trade relationships essentially influenced through related covariates by employing Cox proportional hazard model. Columns (1) reports the results based on gravity covariates. Columns (2) holds crucial explanatory variable, tariff rates, investigating the influence of the duration. Intraregional effect is presented in Columns (3). As for Columns (4) considers regional dummies to examine the difference in trade relationships. All estimated coefficients are expressed as hazard ratios, and standard errors show in parentheses.

< Insert Table 6>

All gravity covariates estimated in Columns (1) are according with the expected signs and are statistically significant. That means common language, colonial background, and exporters' GDP per capita are the negative correlation with hazards, indicating the positive effect of the duration of trade relationships. In addition, distance shows the negative impact significantly for the duration of trade relationships. In other words, the closer distance between exporter and importer is likely to maintain the duration of trade relationships; conversely, far distance is likely to disrupt the trade relationships. Columns (2) introduces the tariff rates and support our previous hypothesis that tariff rates are induced to the negative impact with the duration of trade relationships[16]. This finding is not consistent with the result of previous studies. However, we consider trade relationships may be discontinued due to too high tariff

[16] This result is robust while we did the robustness check for the single spell, first spell, and one-year gap adjustment for manufactured goods as well as similar specifications for production networks and for Rauch product's classification.

rates that firms are not able to afford. Consequently, reduction of tariff rates is conductive to enhance the duration of trade relationships.

We find the effect of intra-regional trade contributes to expanding the length of trade relationships, which is reported in Columns (3). In other words, intra-regional trade shows a 19.4 lower hazard ratio, compared to inter-regional trade. As for regional dummies are included in Columns (4). We find ASEAN+6, West Europe, and North America have lower hazard ratios, relative to other regions such as East Europe, Central America, South America, Middle East, and Africa. This evidence is completely reflected from the results of Kaplan–Meier estimates.

Through the finding of estimated results on the manufactured goods based on the effect of related covariates, we wonder whether this experience can be duplicated consist results in international production networks, as well as the type of product in Rauch product's classification. In addition, the interaction term of ASEAN+6 and tariff rates is also included, which is defined as the intra-regional tariff, is reported in Table 7.

<Insert Table 7>

Most gravity variables are significantly estimated with their expected signs, except for the covariate of the common language and intra-regional tariff in homogeneous goods. As for tariff rates, are again significantly evidenced to be raise (low) the duration of trade relationships once hazard ratios decrease (increase). As for interaction term of ASEAN+6 and tariff rates, the esticmated results are statistically significant, except for the homogenous goods, which is not significant but with expected sign. The result of interaction term indicates that the tariff rates of ASEAN+6 (intra-regional trade) reduce will lead the extension to the duration of trade relationships, particularly in terms of parts and components in production networks and differentiated products in Rauch product's classification, which are more sensitive to the effect. This inspiring evidence explains the features of regional trade and tariff diminution, as well as the formation of regional economic integration organization.

We have already verified a robust negative relationship between duration and tariff rates through a series of evidence acquired from previous estimations. However, we decompose tariff rates into high and low tariff by adopting the median of tariff rates previously. Therefore, this section explains whether a significant difference between high and low tariff, describing the effect of tariff cut and regional trade, the magnitude of influences is presented in Table 8, according to the type of industry and

product. To shed light the effect of low tariff rates, we control for low tariff rates by adding a dummy that is 1, and also introduce the interaction term of the type of product and low tariff, the interaction term of ASEAN+6 and low tariff, as well as the interaction term of the type of product, ASEAN+6, and low tariff. Regional dummies and gravity variables are also controlled but not report.

First of all, low tariff rates show positive relationships with the duration of trade relationships, implying 8.1% lower hazard ratio for the manufactured goods, as well as 8.4% lower hazard ratio for the interaction term of low tariff in intra-regional trade. This result is reasonable; firm would like to export or export because of more free mobility and lower transaction costs and through regional integration and tariff cut. Next, we find parts and components with low tariff show 20.2% in Columns (2) and 18.4% in Columns (3) lower hazard ratios in international production networks. In particular, parts and components of ASEAN+6 with low tariff show 16.8% lower hazard ratios. Similar applied in Rauch product's classification, it is noticeable that differentiated products with low tariff exhibit 11% lower hazard ratios in Columns (4). Besides, differentiated products of ASEAN+6 with low tariff show 7.7% lower hazard ratios. The results of homogenous goods are in line with Besedeš and Prusa (2006b), even though we consider the effect of tariff cut. However the results are inverse with inclusion of intra-regional effect, indicating the importance of regional trade. Our findings provide the presence of lower hazard ratios due to effect of regional trade and tariff cut regarding production networks and Rauch product's classification that previous studies ignore.

<Insert Table 8>

V. Discussion

In this section, we explain the influence of inactive and potential trading partners and the implication for upcoming integrated economic organizations based on our findings. Appendix Fig. A1 shows the survival rate of low and high tariff, by country dimension in the initial and the last year. The member nations of ASEAN+6, such as Cambodia, Lao PDR, Myanmar and Brunei, show relative low survival rates[17] in

[17] The probabilities of survival of Cambodia, Lao PDR, Myanmar and Brunei are 0.3952, 0.3569, 0.3669, and 0.3185 in the first year, and 0.0796, 0.0590, 0.0371, 0.0110 in the fifteenth year under a low-tariff level. Under high-tariff trade, the probabilities are 0.3359, 0.3352, 0.3248, and 0.2177 in the first year, and 0.0000, 0.0106, 0.0255, 0.0000 in the fifteenth year.

intra-regional trade. Their trade relationships are not active compared to other member nations of ASEAN+6, even though the probability of survival advances slightly due to low-tariff trade. On the contrary, some Asian countries that are not member nations of ASEAN+6 exhibit high survival rates of trade that are above average of ASEAN+6, such as Hong Kong and Taiwan. If they participate in the regional trade agreement and face lower tariffs afterwards, the overall survival rate of trade relationships is likely to integrate closely. Besides, the United States shows a quite high survival rate in trade relationships with ASEAN+6, as always; this could be seen as an integrated global production network (Wang, Powers, and Wei 2009; Ando and Kimura, 2013). In particular, low-tariff induced-trade relationships are more likely to survive. This finding can be applied to the integrated trade relationships between the United States and Asian countries for upcoming trade treatment, such as The Trans-Pacific Partnership (TPP), which is aimed at the diminution of tariff rates completely.

VI. Conclusion

In this article, we employ ASEAN+6 as the reporter, investigating the probability of survival of imported trade relationships in intraregional and interregional trade, by introducing the impact of tariff rates that previous studies ignore. Through Kaplan-Meier estimator and the application of Cox proportional hazard model, we obtain a series of significant evidence. First, we find low-tariff trade are likely longer-lived than high-tariff trade on manufactured goods and can be applied in production networks and Rauch product's classification. Second, we find a significantly negative correlation between duration of trade relationships and tariff rates. That means the reduction on tariff rates contributes to prolonging the length of trade relationships, particularly in intraregional trade. This evidence provides the aspect for regional economic integration. Third, we also provide the influence of low tariff not only in intraregional trade but also on the type of product, indicating a substantial reduction in hazard ratios. We consider these findings could be the references for other economic organizations, TPP, which is aimed at the diminution of tariff rates. However, the magnitude of reduction is worth to investigate for future research.

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Table 2. Estimated survival rates on manufactured goods: inclusion of tariffs

	N	K-M survival rate				
		1st year	4th year	8th year	11th year	15th year
High Tariffs						
ASEAN+6	467 101	0.5662	0.2981	0.1955	0.1748	0.1512
East Europe	109 757	0.4153	0.1681	0.1067	0.0885	0.0677
West Europe	583 603	0.5429	0.2747	0.1768	0.1555	0.1272
North America	87 324	0.6274	0.3636	0.2419	0.2172	0.1783
Central America	31 889	0.3947	0.1573	0.1018	0.0839	0.0705
South America	49 199	0.3706	0.1238	0.0670	0.0523	0.0368
Middle East	58 274	0.3549	0.1185	0.0639	0.0521	0.0387
Africa	34 853	0.4011	0.1433	0.0826	0.0653	0.0494
Other Asia	147 999	0.5787	0.2657	0.1650	0.1337	0.1154
Total	1 569 999	0.5313	0.2637	0.1697	0.1486	0.1243
Low Tariffs						
ASEAN+6	418 611	0.6004	0.3524	0.2852	0.2600	0.2424
East Europe	70 931	0.4333	0.1891	0.1289	0.1120	0.0973
West Europe	403 350	0.5533	0.2994	0.2183	0.1928	0.1727
North America	68 621	0.6513	0.4275	0.3462	0.3172	0.2928
Central America	24 128	0.4507	0.2068	0.1493	0.1320	0.1183
South America	37 880	0.4222	0.1612	0.1012	0.0831	0.0688
Middle East	38 313	0.3868	0.1495	0.0981	0.0823	0.0713
Africa	24 801	0.4288	0.1588	0.0985	0.0786	0.0645
Other Asia	98 786	0.5776	0.3095	0.2224	0.1805	0.1634
Total	1 185 421	0.5571	0.3073	0.2345	0.2088	0.1907

Notes: Manufactured goods refer to imported products of HS28 to HS 92 at the six-digit level. See Appendix Table A1 for regional classification. High and low tariffs are determined by using the median of average tariff rates based on World Integrated Trade System data.
Source: Author's calculation.

Table 3. Estimated survival rates in machinery: inclusion of tariffs

			K-M survival rate				
		N	1st year	4th year	8th year	11th year	15th year
All	High	441 835	0.5400	0.2799	0.1918	0.1690	0.1315
	Low	469 380	0.5610	0.3236	0.2554	0.2305	0.2136
P&C	High	194 916	0.5769	0.3292	0.2330	0.2107	0.1681
	Low	206 107	0.5919	0.3678	0.3009	0.2789	0.2615
FP	High	246 919	0.5108	0.2407	0.1590	0.1356	0.1023
	Low	263 273	0.5368	0.2888	0.2196	0.1922	0.1757

Notes: All refers to imported products of HS84 to HS92 at the six-digit level in machinery. P&C and FP refer to parts and component products and final products, respectively, at the six-digit level in machinery. High and low tariffs are determined by using the median of average tariff rates based on World Integrated Trade System data.

Source: Author's calculation.

Table 4. Estimated survival rates in machinery: inter- and intra-ASEAN+6

			K-M survival rate			
		N	1st year	4th year	8th year	11th year	15th year
Within ASEAN+6							
P&C	High	51 211	0.6193	0.3710	0.2512	0.2383	0.1811
	Low	58 824	0.6534	0.4417	0.3851	0.3639	0.3470
FP	High	75 235	0.5381	0.2650	0.1697	0.1464	0.1118
	Low	88 380	0.5785	0.3290	0.2658	0.2371	0.2206
Outside ASEAN+6							
P&C	High	143 705	0.5615	0.3138	0.2264	0.2039	0.1634
	Low	147 283	0.5669	0.3376	0.2661	0.2438	0.2263
FP	High	171 684	0.4986	0.2297	0.1541	0.1308	0.0981
	Low	174 893	0.5154	0.2682	0.1960	0.1695	0.1532

Notes: All refers to imported products of HS84 to HS92 at the six-digit level in machinery. P&C and FP refer to parts and component products and final products, respectively, at the six-digit level in machinery. High and low tariffs are determined by using the median of average tariff rates based on World Integrated Trade System data. See Appendix Table A1 for regional classification.

Source: Author's calculation.

Table 5. Estimated survival rates for Rauch product's classification by tariffs

			K-M survival rate				
		N	1st year	4th year	8th year	11th year	15th year
Homogeneous goods	High	26 084	0.4702	0.1928	0.1025	0.0809	0.0519
	Low	33 578	0.5093	0.2479	0.1686	0.1417	0.1222
Reference priced goods	High	302 787	0.5301	0.2485	0.1424	0.1193	0.0959
	Low	285 330	0.5486	0.2889	0.2060	0.1769	0.1546
Differentiated products	High	1 162 481	0.5328	0.2690	0.1782	0.1578	0.1339
	Low	788 219	0.5623	0.3155	0.2459	0.2207	0.2038

Notes: Homogeneous goods, referenced priced goods, and differentiated products are defined by Rauch product's classification. High and low tariffs are determined by using the median of average tariff rates based on World Integrated Trade System data.
Source: Author's calculation.

Table 6. Cox proportional hazard estimates: manufactured goods

	(1)	(2)	(3)	(4)
Tariffs		1.046***	1.041***	1.041***
		(0.001)	(0.001)	(0.001)
Distance	1.100***	1.105***	1.036***	1.035***
	(0.001)	(0.001)	(0.001)	(0.001)
Common language	0.919***	0.933***	0.942***	0.955***
	(0.002)	(0.002)	(0.002)	(0.002)
Colony dummy	0.877***	0.883***	0.864***	0.882***
	(0.004)	(0.004)	(0.004)	(0.004)
GDP per capita of exporter	0.947***	0.944***	0.926***	0.960***
	(0.001)	(0.001)	(0.001)	(0.001)
ASEAN+6			0.806***	0.858***
			(0.002)	(0.002)
East Europe				1.159***
				(0.005)
West Europe				0.981***
				(0.003)
North America				0.794***
				(0.003)
Central America				1.131***
				(0.007)
South America				1.230***
				(0.006)
Middle East				1.308***
				(0.006)
Africa				1.213***
				(0.007)
Number of observations	2 615 276	2 615 276	2 615 276	2 615 276
Number of failures	2 058 629	2 058 629	2 058 629	2 058 629
Time at risk	9 370 229	9 370 229	9 370 229	9 370 229
Log likelihood	-29 441 859	-29 438 949	-29 432 993	-29 425 481

Notes: ***indicates that the results are statistically significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent, respectively. The dependent variable is the hazard of a trade relationship. All explanatory variables are in natural logs, except for dummy variables. Tariffs= ln (1+Tariff). Standard errors are in parentheses.

Table 7. Cox proportional hazard estimates: production networks/Rauch classification

	P&C	Final	Homogeneous	Reference priced	Differentiated
Tariffs	1.027***	1.037***	1.042***	1.033***	1.042***
	(0.002)	(0.002)	(0.005)	(0.002)	(0.001)
Distance	1.041***	1.052***	1.088***	1.065***	1.027***
	(0.004)	(0.004)	(0.010)	(0.003)	(0.002)
Common language	0.920***	0.942***	1.009	1.015***	0.937***
	(0.006)	(0.005)	(0.013)	(0.004)	(0.002)
Colony dummy	0.815***	0.905***	0.938***	0.887***	0.870***
	(0.012)	(0.009)	(0.024)	(0.008)	(0.005)
GDP per capita of exporter	0.906***	0.923***	0.983***	0.960***	0.959***
	(0.002)	(0.002)	(0.004)	(0.001)	(0.001)
Intra-regional tariffs	1.074***	1.026***	1.008	1.007**	1.020**
	(0.004)	(0.003)	(0.009)	(0.003)	(0.002)
Regional dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	380 959	484 234	56 609	561 932	1 848 484
Number of failures	276 483	387 390	48 144	457 824	1 438 433
Time at risk	1 629 499	1 677 003	170 333	1 924 505	6 723 276
Log likelihood	-3 427 882	-4 881 872	-501 724	-5 822 666	-20 075 290

Notes: ***indicates that the results are statistically significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent, respectively. The dependent variable is the hazard of a trade relationship. All explanatory variables are in natural logs, except for dummy variables. Tariffs= ln (1+Tariff). Standard errors are in parentheses.

Table 8. Cox proportional hazard estimates: the effects of tariff cuts and regional trade

	Manufactured goods	Machinery industry	Machinery industry	Rauch classification	Rauch classification
	(1)	(2)	(3)	(4)	(5)
Low tariffs	0.919***				
	(0.002)				
*P&C*Low tariff*		0.798***	0.816***		
		(0.003)	(0.003)		
*ASEAN+6*Low tariff*	0.916***	0.868***		0.911***	
	(0.003)	(0.004)		(0.003)	
ASEAN+6 P&C			0.842***		
**Low tariff*					
			(0.006)		
Homogeneous goods				1.087***	1.087***
**Low tariff*				(0.007)	(0.009)
Differentiated products				0.890***	0.892***
**Low tariff*				(0.002)	(0.012)
ASEAN+6 Homogeneous					0.927***
*goods*Low tariff*					(0.012)
ASEAN+6 Differentiated					0.923***
*products*Low tariff*					(0.003)
Gravity covariates	Yes	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	2 615 276	865 193	865 193	2 467 025	2 467 025
Number of failures	2 058 629	663 873	663 873	1 944 401	1 944 401
Time at risk	9 370 229	3 306 502	3 306 502	8 818 114	8 818 114
Log likelihood	-29 424 435	-8 762 094	-8 762 226	-27 674 824	-27 675 062

Notes: ***indicates that the results are statistically significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent, respectively. The dependent variable is the hazard of a trade relationship. All explanatory variables are in natural logs, except for dummy variables. Tariffs= ln (1+Tariff). Standard errors are in parentheses.

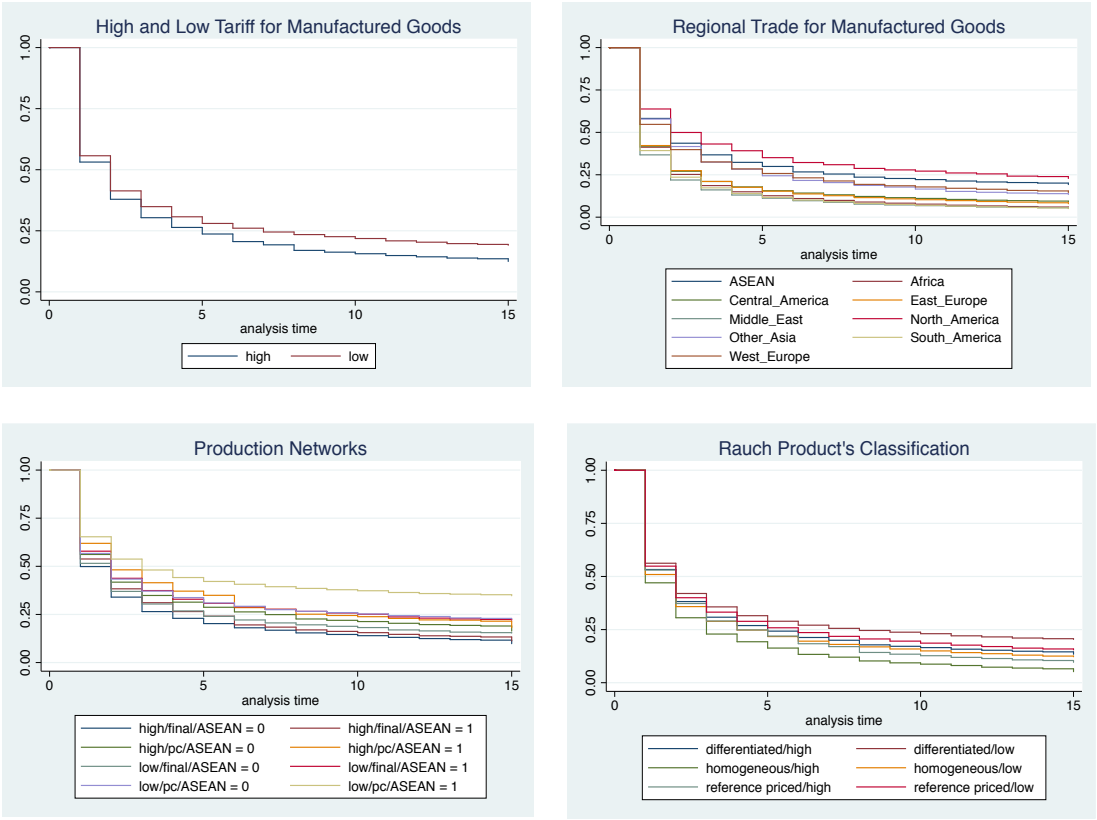

Fig. 1. Survival functions for the type of the products

Source: Author's calculation.

Appendix Table A1: Major trading partners

Region	Country			
ASEAN+6	Thailand	Philippines	Malaysia	China
	Myanmar	Cambodia	Indonesia	India
	Lao PDR	Singapore	Japan	Australia
	Brunei	Vietnam	Korea, Rep.	New Zealand
West Europe	Austria	Denmark	Greece	Netherlands
	Belgium	Spain	Ireland	Norway
	Switzerland	Finland	Iceland	Portugal
	Cyprus	France	Italy	Sweden
	Germany	United Kingdom	Luxembourg	Turkey
	Andorra			
East Europe	Bulgaria	Czech Republic	Estonia	Croatia
	Hungary	Lithuania	Latvia	Macedonia, FYR
	Poland	Romania	Serbia, FR	Slovak Republic
	Slovenia	Ukraine		
Middle East	Iran	Iraq	Israel	Jordan
	Kuwait	Pakistan	Saudi Arabia	Syrian Arab Republic
	Afghanistan			
North America	Canada	United States		
Central America	Nicaragua	Panama	Costa Rica	Cuba
	Guatemala	Honduras	Mexico	El Salvador
	Belize			
South America	Argentina	Brazil	Chile	Colombia
	Peru	Paraguay	Uruguay	Venezuela
	Bolivia			
Africa	Egypt	Morocco	South Africa	
Other Asia	Hong Kong	Macao	Russian Federation	Taiwan
	Nepal	Bangladesh		

Appendix Fig. A1: Estimated survival rates for low and high tariff in the first and fifteenth year by country dimension