Institut Barcelona d'Estudis Internacionals

2019-2020



USING MACHINE LEARNING TO ESTIMATE IMPACTS OF FREE TRADE

AGREEMENTS ON EXPORT PERFORMANCE:

A CASE OF EAST ASIAN ECONOMIES

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in partial fulfillment of the requirements for the degree of

ERASMUS MUNDUS MASTER IN PUBLIC POLICY

CEU eTD Collection

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Signature

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Afore

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Abstract

This study uses two machine learning methods, namely text as data analysis and principal component analysis to create two indicators of trade facilitation depth of legal commitments, namely Wordscores estimates and principal component analysis depth (PCA depth), and compare these two indicators with simple additive scores. Each of the three indicators, together with bilateral tariff, serves a predictor in a gravity equation in order to study the impacts of qualitative and quantitative commitments on the export of seventeen East Asian economies. The results suggest that Wordscores estimates and PCA depth, instead of additive scores, are a better representation of trade facilitation depth. While tariff maintains a significant negative correlation with export, trade facilitation depth of legal commitments shows an insignificant positive relationship with export for the full sample of East Asian economies. However, the correlation between trade facilitation depth and export becomes significant and positive for a sub-sample of six East Asian exporters with high implementation rates of trade facilitation measures, but still insignificant and negative for the rest of East Asian exporters.

Acknowledgments

I would like to thank my supervisors, who have made this work a reality. I am indebted to Professor Caitlin Brown for her introduction to machine learning in policy analysis. I wish to express my sincere gratitude to Professor Yannis Karagiannis for his encouragement and detailed feedback during my second year, especially when I first thought about giving up during the Covid-19 pandemic. His assistance at formulating research questions and reframing literature reviews helps transform my simple thesis report into a more comprehensive thesis.

Table of Contents

| Abstract i |
|---|
| Acknowledgmentsii |
| Table of Contentsiii |
| List of Figuresv |
| List of Tablesvi |
| Introduction1 |
| Chapter 1. Literature Review |
| 1.1 Trade theories |
| 1.2 Methods to estimate the effect of free trade agreements4 |
| 1.3 Trade facilitation measures and trade facilitation indicators7 |
| Chapter 2. Methodology11 |
| 2.1 Text as data analysis11 |
| 2.1.1 Representing legal commitments as a document feature matrix |
| 2.1.2 Mapping the document-feature matrix to trade facilitation scores of accumulated |
| legal commitments |
| 2.2 Principal component analysis17 |
| Chapter 3. Empirical discussion |
| 3.1 Case study selection |
| 3.2 Model specification |

| 3.3 Data collection and data description |
|--|
| 3.3.1 Export |
| 3.3.2 Trade facilitation scores of legal commitments |
| 3.3.3 Control variable |
| 3.4 Empirical results |
| 3.4.1 Text as data analysis29 |
| 3.4.2 Principal component analysis |
| 3.4.3 Main estimation results |
| 3.4.4 Robustness checks |
| Conclusion |
| Bibliography |
| Appendices |
| Appendix 1: List of Figures |
| Appendix 2: List of Tables |
| Appendix 3: List of trading partners |
| Appendix 4: Codebook60 |
| Appendix 5: List of free trade agreement texts |

List of Figures

| Figure 1: Number of trade agreement texts signed, by country (1992-2018) | .48 |
|---|-----|
| Figure 2: Percentage of free trade agreement texts containing trade facilitation measures | .49 |
| Figure 3: Wordscores estimates of 146 legal commitments on trade facilitation measures | .50 |
| Figure 4: Score of words | .50 |
| Figure 5: Variation of data set taken into account by components | .51 |
| Figure 6: Relationship between additive scores and PCA depth | .51 |
| Figure 7: Relationship between additive scores and Wordscores estimates | .52 |
| Figure 8: Correlation among thirty-one trade facilitation measures | .52 |
| Figure 9: Comparison among East Asia economies in terms of eleven trade faciliation areas | .53 |

List of Tables

| Table 1: Trade facilitation score of legal commitments and export in the full sample33 |
|--|
| Table 2: Comparison between two sub-samples of countries with the high and low trade faciliation |
| implementation rates |
| Table 3: Summary statistics - by observation (exporter-importer-year) |
| Table 4: Words in free trade agreements with comprehensive and narrow trade facilitation |
| measures |
| Table 5: Examination of data suitability for principal component analysis |
| Table 6: Loadings of the first three principal components |
| Table 7: Robustness check with bigram |
| Table 8: Correlation between Rasch depth and trade faciliation scores 57 |

Introduction

Over the past few decades, the proliferation of free trade agreements has created an intense debate on their purpose, structure, and impact. Their structures often share similarities with regards to commitments on traditional fields like trade in goods, and trade in services. However, free trade agreements could have their own purposes, which generates focuses on new aspects like trade facilitation and intellectual property rights. Among these fields, trade facilitation has recently attracted more attention after a long time playing a marginal role in the discussion and negotiation among Member States. Higher popularity of trade facilitation may come from the fact that governments started realizing the need to expand their trade agenda beyond tariff policies and the launch of World Trade Organization (WTO) negotiations on Trade Facilitation Agreement in 2004 (Neufeld 2014, 4). Trade facilitation has been received considerable attention by scholars, but few investigate the impact of trade facilitation measures on the export value of Member States in these free agreements.

To address the gap, the thesis employs text as data analysis and principal component analysis, two machine learning techniques in assessing how free trade agreements affect export performance of East Asian economies¹. These machine learning techniques would help to construct synthetic scores of trade facilitation depth, which measure the coverage or breath of trade facilitation measures in free trade agreements. Using the scores, the thesis will provide additional insight into how tariff barriers and trade facilitation measures in free trade agreements could affect the export of East Asian economies. Understanding tariff barriers and the depth of trade facilitation measures

¹ The paper defines East Asian economies as ten ASEAN member states plus Japan, South Korea, Australia, New Zealand, India, China, and Hong Kong. ASEAN member states are Indonesia, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, Vietnam, Lao PDR, Myanmar, and Cambodia.

embedded into the legal texts of free trade agreements would help policymakers take advantage of signing the agreements when drafting the upcoming legal texts. Regarding case selection, the thesis chooses East Asian economies in order to apply text analysis in a relatively large number of free trade agreements and review the relationship between the adoption of these legal commitments and export performance. The paper proceeds as follows. Chapter 1 reviews the available analytical and empirical literature on trade theories, methods to estimate the effect of free trade agreements, concepts of trade facilitation measures, and trade facilitation indicators. Chapter 2 describes the theoretical background behind the text as data analysis and principal component analysis. Chapter 3 discusses case selection, the regression model, data collection and description, and empirical results. The last part of the paper concludes and provides policy implications.

Chapter 1. Literature Review

1.1 Trade theories

Theories of absolute advantage and comparative advantage in the late 18th and early 19th century not only create a foundation about reasons for the participation of countries in international trade but also promote latter studies on the benefits of international trade. According to absolute advantage, each country is likely to export the products that the country has higher labor productivity. Comparative advantage introduces the importance of opportunity cost, which implies that all countries, even those with less productivity at producing all goods, can benefit from providing certain products and engaging in trade with other countries. Based on the comparative advantage theory, Eli Heckscher and Bertil Ohlin introduced the international trade model in the 1930s. This model focuses on differences in production factors such as labor and capital between countries, which are sources of international trade. In other words, countries tend to manufacture and export commodities that the country has a comparative advantage and might produce at a much lower opportunity cost. The above grounding theories facilitate investigation into the competitiveness of countries and benefits of international trade; see, for example Krueger (1998) mentions about positive effects of resource allocation on trade liberalization, Jayawickrama and Thangavelu (2010) analyze changes in export competitiveness of Singapore over time when Singapore forms trade linkages with China and India.

Recent studies describe the potential benefits of free trade agreements to trade flows between countries. After the adoption of the very first multilateral trade agreement named the General Agreement on Tariffs and Trade (GATT) in 1948 and the establishment of World Trade Organization (WTO) in 1995 with basic multinational rules, both developed and developing countries show their attempt to develop higher integration by designing their own regional trade agreements. Regional trade agreements would facilitate better integration among a few parties with their reconcilable interest in typical areas and enrich multilateral trade agreements which fail to address complex issues like customs traffic, and electronic trade (Trakman 2008, 380 - 381). Compared with multilateral trade agreements, one country can grant greater market access to foreign partners through lower tariff barriers or reduced non-tariff barriers (Lynch 2010, 3).

Free trade agreements may, however, come with negative consequences. Trakman (2008, 379 – 380) argues that the agreements could create a reduction in trade with non-parties, and negative trade distortion especially in agricultural trade which is diverted from developing to developed countries. Some parties that gain more negotiation power when they are part of a large group may experience a disadvantageous position in a bilateral trade agreement negotiation (Ibid, 381). To tackle the above disadvantages of regional trade agreements, Trakman emphasizes the reduction of barriers to trade as a necessity to achieve closer integration between economies (Ibid, 370 - 371). Given potential unfavourable effects of tariff and non-tariff barriers, United Nations ESCAP (2018, 2-3) encourages Asia and the Pacific to adopt trade facilitation measures since digital trade facilitation can boost export by nearly \$257 billion a year and lift annual GDP by 0.32% between 2015 and 2030.

1.2 Methods to estimate the effect of free trade agreements

The emergence of preferential trade agreements attracts the global interest of qualitative and quantitative scholars in recent years. While qualitative studies provide a general picture of liberalization process and legal structures of free trade agreements, quantitative literature mainly investigates the relationship between export value and other macroeconomic indicators in computable general equilibrium (CGE) models, and gravity models. Both these studies overlook the relationship between legal terms of free trade agreements and export performance of Parties in

the agreements. By adopting machine learning tools, including text analysis and principal component analysis, the thesis presents an opportunity to overcome these issues.

First, this study adds a dynamic component to the current literature by assessing the strategic plans of countries in promoting their export when they enter a negotiation round with other countries. Although countries already made commitments with foreign trading partners in the negotiation, they could sometimes violate their commitments. Existing literature on free trade agreements of East Asian economies usually is silent about assessing how the formulation of legal texts of free trade agreements could affect the export of countries in the free trade agreements. These qualitative research only analyze institutional issues of trade agreements (Low 2003), provide general description of commitments of parties in trade agreements (Tongzon 2003), and conduct qualitative assessment of restrictive regulatory barriers in trade facilitation in service industries (U.S. International Trade Commission 2003, x, xix-xx). Park (2018) mainly explains the liberalization process through regional trade agreements in East Asia and general characteristics of these agreements. In addition, U.S. International Trade Commission 2003 (Ibid, x) not only acknowledges the potential economic impact of the reduction of non-tariff barriers related to services and investment, and better enforcement of intellectual property rights, but also emphasizes difficulties in measuring the impact. In summary, by using qualitative methods, recent scholars only review the legal terms of trade agreements, but fail to offer a way to understand the relationship between the legal terms of the free trade agreements and export performance. This failure comes from the fact that trade agreements vary in their structure and contain long texts, which is difficult to process.

Second, the thesis methodologically complements recent studies on the impact evaluation of trade agreements. Scholars have adopted three common empirical tools: computable general equilibrium

(CGE) models, and gravity models. CGE models seem to be the most common approach which offer a chance to examine two scenarios with and without trade agreements. These CGE models were applied in some trade agreements between Singapore and partners, especially the U.S. (U.S. International Trade Commission 2003), and the EU (European Parliament 2018). However, CGE models have some disadvantages. One drawback is overlooking the removal of non-tariff barriers which can facilitate deeper integration (Toh Mun Heng and Khine Thet Suu 2009, 10). Traditional gravity models help scholars to study the impact of trade agreements by including dummy variables that capture the existence of economic integration agreements between two countries, but these scholars do not provide further classification to these agreements. For example, Baier, Bergstrand, and Clance (2015) classify economic integration agreements into free trade agreement, customs union, common market and economic union; Egger et al. (2011) create an binary dummy which takes value one if two countries belong to a common preferential trade agreement since 2005 or earlier. However, both traditional gravity models, and CGE models still fail to address the changes of wording in free trade agreements in general and non-tariff barriers embedded free trade agreements in particular. Different wording in these agreements can lead to differing levels of export facilitation. For example, when comparing a trade agreement that requires the submission of a paper certificate of origin and one that allows Parties to use an electronic certificate of origin, enterprises tend to favour the latter one since it helps reduce their export time and lower export cost.

To tackle drawbacks of the qualitative and quantitative methodologies, text analysis can process high-dimensional data and allow researchers to investigate large amounts of text quantitatively (Gentzkow, Kelly, and Taddy 2017, 2). To be more specific, high-dimensional data of legal commitments is characterized by a document-feature matrix, which is then beneficial for mapping the relationship between legal commitments and trade facilitation scores of legal commitments. Trade facilitation scores of legal commitments or the depth of trade facilitation measures can be measured on a continuous scale by Wordscores, a text scaling method. This method has proven particularly useful for analyzing latent measures of ideology from Convention texts in Benoit et al. (2005), and speeches of 453 individual legislators in Bernauer and Bräuninger (2009), and for creating a democracy index from newspaper articles in Marzaggo (2014). Following the scholars, the thesis will create trade facilitation scores from free trade agreement texts and employ the scores as a explanatory variable in regression models which allows to predict export performance in upcoming free trade agreements. The prediction also encourages legislators to review their negotiation plans in order to reach a higher level of export value in the future.

1.3 Trade facilitation measures and trade facilitation indicators

The design of trade facilitation measures in regional free trade agreements follows basic rules made in World Trade Organization (WTO) negotiation rounds. WTO negotiation rounds initiated the very first ideas about trade facilitation in Article V (Freedom of transit), Article VIII (Fees and formalities), and Article X (Transparency) under The General Agreement on Tariffs and Trade 1994 (GATT). Since 2004, the members of the World Trade Organization (WTO) had negotiated multilateral trade facilitation rules in order to clarify the three articles of GATT. After ten years of negotiation, WTO members agreed to implement Trade Facilitation Agreement (TFA) in 2014. While GATT provides general obligations about transparency, fees and formalities, transit, Trade Facilitation Agreement stipulates detailed obligations in all three categories. Following the changes in multilateral rules, trading nations tend to update their free trade agreements in order to incorporate multilateral rules at the regional and bilateral levels. Commitments on trade facilitation measures in free trade agreements theoretically cover technical trade facilitation measures, and

other mechanisms supporting the implementation of technical trade facilitation measures like special and differential treatment, capacity building (Mcdougall 2017, 1-2). Technical trade facilitation measures consist of individual measures on transparency, fees and formalities, transit, and exchange of information.

Based on the structure of legal commitments in GATT and TFA, the existing literature has constructed trade facilitation indicators in order to examine the effect of trade facilitation measures on trade flows and trade costs. Moïsé and Sorescu (2013) create sixteen trade facilitation variables that capture both the regulatory framework and implementation state of trade facilitation measures. These trade facilitation variables show a significant effect of trade facilitation measures like the availability of trade-related information, the simplification and harmonization of documents, the streamlined procedures and the use of automated processes on trade volumes and trade costs. Duval, Neufeld, and Utoktham (2016, 7) create a Regional Trade Facilitation Commitment (RTFC) index, which is an additive number of 28 trade facilitation agreement-related provisions featured in regional trade agreements. The RTFC index helps to explain a statistically significant but small discriminatory impact of trade facilitation measures on trade costs. However, Moïsé and Sorescu (2013) only tackle technical trade facilitation measures and ignore special and differential treatment regimes for implementation and capacity building. Despite the inclusion of trade facilitation measures on special and differential treatment, and capacity building, the RTFC index may overestimate the effects of individual trade facilitation measures due to potential multicollinearity between trade facilitation measures and the application of equal weight on 28 trade facilitation agreement-related provisions.

To solve the problems of overestimation and equal treatment, this thesis follows recent studies about preferential trade agreements when using principal component analysis on the data set of trade facilitation measures. The principal component analysis is a statistical procedure that uses an orthogonal transformation to convert a large set of possibly correlated variables into a small set of linearly uncorrelated variables called principal components. In addition to the dimension reduction, the transformation helps extract the weights of trade facilitation measures in the first component and compute trade facilitation depth for each free trade agreement. Recent literature adopts principal component analysis to examine the relationship between the overall depth of free trade agreements and bilateral trade. Orefice and Rocha (2011) compute a PCA top 5 index in order to capture the depth of preferential trade agreements in five areas, namely state trading enterprises, TRIPS, competition policy, intellectual property rights, and movement of capital. The PCA top 5 index helps to predict that signing deeper agreements increases production networks trade between member countries by nearly 35%. By computing a PCA_9 index from nine provisions which have the highest factor loadings and theoretically strong relationship with global value chains, Choi (2019) concludes that a deep regional trade agreement has heterogeneous effects on global value chains depending on the regional clusters. Hofmann, Osnago, and Ruta (2017) use principal component analysis to assess of the content of preferential arrangements, and legal enforceability of provisions, and compute PCA depth index. This PCA depth index then allows Laget et al. (2018) to find a positive relationship between the depth of preferential trade agreements and global value chain integration.

In summary, considering mixed effects of free trade agreements on trade flows between countries and potential benefits of trade facilitation measures, this study will assess the impact of legal commitments, especially tariff and trade facilitation measures, on export performance of East Asian economies. This study will test one main hypothesis: "More comprehensive inclusion of trade facilitation measures in free trade agreements, i.e., higher depth of trade facilitation measures, will increase the export of East Asian economies", and one additional hypothesis: "Higher tariffs will lower the export of East Asian economies".

Chapter 2. Methodology

The thesis surveys the existence of thirty-one trade facilitation measures and then applies two machine learning techniques, namely text as data analysis, and principal component analysis (PCA) in order to create two indicators for trade facilitation depth of legal commitments. These two indicators, namely Wordscores estimates and PCA depth, will be compared with the third measure of trade facilitation depth, which is an additive score of legal commitments on trade facilitation. The additive score is the simple sum of trade facilitation measures included in legal texts.

2.1 Text as data analysis

Following the suggestion of Gentzkow, Kelly, and Taddy (2017, 2-3) about adopting text analysis approach, the thesis will conduct three steps, namely representing legal commitments between East Asian economies and their trading partners (legal document D) as a document-feature matrix (a numerical array C), mapping the document-feature matrix to trade facilitation scores of legal commitments (outcome of interest V), and adding trade facilitation scores from scaling or Wordscores model into gravity equations. This thesis performs the above three steps using the 'quanteda' package (version 2.0.1) and 'quanteda.textmodels' package (version 0.9.1) in R (Benoit et al. 2018).

2.1.1 Representing legal commitments as a document feature matrix

The thesis will follow three kinds of simplification suggested by Gentzkow, Kelly, and Taddy (2017, 5-7) about construction of individual documents, feature selection, determination of n-grams. These three steps aim to create a representation of legal commitments as a document-term matrix in which rows are accumulated legal commitments, columns are terms, and cells indicates

the frequency of each term in each accumulated legal commitment. First, individual documents are accumulated legal commitments between East Asian countries and their trading partners since the independent variable of interest is trade facilitation depth of legal commitments and one country can be a signatory of multiple free trade agreements at one time.

Second, in order to reduce feature selection in high-dimensional data of legal commitments, the thesis will pre-process accumulated legal commitments, as suggested by Denny and Spirling (2017, 6-9) The thesis removes punctuation and numbers, lowercase, and eliminate stop words. Removal of punctuation aims to eliminate uninformative components, including markup, punctuation, and special characters (\$, %, &, *, etc.). The exclusion of numbers from text is necessary because the feature of interest are non-tariff barriers in legal texts while tariff barriers are presented in a control variable in the main regression equations. Lowercasing of all letters in words is suitable for corpus analysis because of the same meaning between words with their first letter having uppercase and lowercase. Regarding the removal of stopwords, the thesis eliminates both English stopwords provided by 'quanteda' package in R and additional stopwords². The additional stopwords contain words that occur many times in free trade agreements, but reflect no difference among the agreements. Stemming is not included in the pre-processing step of this study because stemming reduces the effectiveness of the Wordscores method, according to Ruedin (2013, 542).

Third, a document-term matrix will be created for representing the corpus of accumulated legal commitments in a bag-of-words format. Regarding the extent of dependence limitation among language elements, Gentzkow, Kelly, and Taddy (2017, 7) consider bag-of-words representation

² Additional stopwords are "article", "chapter", "section", "party", "country", "member", "states", "articles",

[&]quot;chapters", "sections", "parties", "countries", "members", "shall", "agreement", "agreements", "amend",

[&]quot;amendment", "amended", and "amendments".

as a way to encode features of text. Since representation depends on research interest of words and phrases (n-grams), the choice of n-grams in this thesis depends on single words and phrases that provide insight on the level of trade facilitation and trade barriers. When applying the bag-ofwords, the thesis will count one-word gram (unigram) in the main estimation analysis and use twoword grams (bigram) in the robustness check. Since each term provides unequally informative content of accumulated legal commitments, Welbers, Van Atteveldt, and Benoit (2017, 10-11) suggest two ways to create a document term matrix. The first technique is to filter rare terms. If rare terms provide little information about trade facilitation, filtering very rare terms by using thresholds for minimum and maximum proportion of these terms in documents would help to improve accuracy. The second technique is weighting scheme which use term frequency-inverse document frequency (tf-idf). Tf-idf is the product of two metrics namely term frequency (tf) and inverse document frequency (idf). While term frequency essentially counts how often a term occurs in a document, inverse document frequency assigns less weight to terms that frequently occur across documents and more weight to those that happens in a few numbers of documents. However, this weighting scheme gives higher scores to uncommon words, potentially leading to higher biased scores of rare words in text analysis methods like Wordscores (see Part 2.1.2). Therefore, the thesis will only apply the filtering technique, which keeps terms appear in at least five documents.

2.1.2 Mapping the document-feature matrix to trade facilitation scores of accumulated legal commitments

In order find positions of accumulated legal commitments on trade facilitation, the thesis will adopt Wordscores as a scaling method. The adoption of Wordscores in this study comes from the idea that the existence of certain words or phrases can create typical ideologies or positions of free trade agreements about trade facilitation. In other words, Wordscores can provide scores of words or phrases related to trade facilitation and scores of legal commitments. In addition, Wordscores is a more suitable method when reference free trade agreements are available. Despite these advantages, Wordscores may generate problems about informative words and biased word scores, as suggested by Lowe (2008, 360 - 365). The disadvantages of Wordscores will be addressed in the thesis as follows:

First, since Wordscores assumes that each word has the same contribution to information about document, Wordscores fails to recognize the difference between informative politically centrist words and functional linguistic words (Ibid, 360 - 361). This problem can be partly solved by removing general stop words like "a", "an", "the" and an additional stop word list of typical words in legal documents like "article", and "parties".

Second, Wordscores may create biased word scores due to insufficient overlap of word distributions across reference documents (Ibid, 365). In other words, rare words that are unique to a reference document tend to receive the highest scores, leading to the difference between correct and estimated scores of these rare words. To tackle this potentially biased word score, the thesis will use a reasonable number of reference documents and eliminate rare words in the pre-processing step.

According to Laver, Benoit, and Garry (2003), main procedures of Wordscores approach includes three following steps:

2.1.2.1 Identify reference legal commitments that represent the extremes of trade facilitation like deep-trade and shallow-trade positions

The thesis will choose some legal commitments as reference documents and set reference scores to these documents. Reference documents can be determined by calculating the number of trade facilitation measures in free trade agreements. To solve insufficient overlap of word distributions across reference documents, this study chooses ten reference free trade agreements whose additive numbers of trade facilitation measures are 1, 7, 14, 21, and 27. The selection of these reference free trade agreements will allow to get free trade agreements which contain the deepest, average, and shallowest legal commitments on trade facilitation. As a result, ten reference free trade agreements with their additive scores serve as anchors in the Wordscores method are listed as follows: Agreement on the Common Effective Preferential Tariff Scheme for the ASEAN Free Trade Area (1), Framework Agreement on Comprehensive Economic Cooperation Among the Governments of the Member Countries of the Association of Southeast Asian Nations and the Republic of Korea (7), Panama – Singapore Free Trade Agreement (14), Trans-Pacific Strategic Economic Partnership (21), Eurasian Economic Union (EAEU) - Viet Nam Free Trade Agreement (21), Free Trade Agreement between EFTA states and Hong Kong, China (21), Korea–India Comprehensive Economic Partnership Agreement (21), Free Trade Agreement between New Zealand and the Republic of Korea (21), Free Trade Agreement between the United States of America and the Republic of Korea (21), and Free Trade Agreement between the Republic of Singapore and the Republic of Turkey (27).

Out of ten reference agreements, the Agreement on the Common Effective Preferential Tariff Scheme for the ASEAN Free Trade Area has a reference score of 1 because it only contains general commitments on cooperation on custom and other trade facilitation matters. In contrast, the Free Trade Agreement between the Republic of Singapore and the Republic of Turkey covers 27/31 trade facilitation measures, except for four measures, namely 'consularization', 'harmonization of regulations and formalities', 'preshipment inspections', and 'special and differential treatment'.

2.1.2.2 Calculate word score of reference legal commitments

Wordscores calculates a score for each word *w* as follows:

$$w_i = \sum_{r=1}^{n} s_r P(f_i)$$

Word scores (w_i) are feature frequencies weighted "reference scores". s_r is the score of legal commitment document *r* in the training set ("reference score") and P(f_i) is the probability of feature *f* in the training set.

Ten reference texts will be given their respective reference scores (s_r) in the Wordscores model as follows: Framework Agreements on Enhancing ASEAN Economic Cooperation (-1), Framework Agreement on Comprehensive Economic Cooperation Among the Governments of the Member Countries of the Association of Southeast Asian Nations and the Republic of Korea (-0.5), Panama – Singapore Free Trade Agreement (0), Trans-Pacific Strategic Economic Partnership (0.5), Eurasian Economic Union (EAEU) - Viet Nam Free Trade Agreement (0.5), Free Trade Agreement between EFTA states and Hong Kong, China (0.5), Korea–India Comprehensive Economic Partnership Agreement (0.5), Free Trade Agreement between New Zealand and the Republic of Korea (0.5), Free Trade Agreement between the United States of America and the Republic of Korea (0.5), and Free Trade Agreement between the Republic of Singapore and the Republic of Turkey (1).

2.1.2.3 Predict document score of remaining legal commitments

Predicted scores of remaining legal commitments are placed between the reference legal commitments. Predicted document scores are word scores weighted by feature frequencies.

$$s_d = \sum_{k=1}^{k} w_k P(f_k | d)$$

 $P(f_k|d)$ is the probability of feature *f* in document *d* in the test set.

 s_d is the predicted score of legal commitment document *d* in the test set.

Following Laver, Benoit, and Garry (2003), this thesis uses textmodel_wordscores function with its default options such as a smoothing parameter of 0 and linear scale, and then adopts a predict () method to get the score of documents (s_d) from a fitted textmodel_wordscores object. In predict () method, if the rescaling option takes value of none, this method produces raw scores of documents. The main estimation analysis of this thesis will use predict () method with no rescaling option, and the robustness checks will change the rescaling option from none to lbg in order to address potential incorrect variance of s_d , suggested by Lowe (2008, 359-360).

2.2 Principal component analysis

By using an unsupervised learning algorithm, principal component analysis seeks to reduce a large number of variables to a few components which explain the maximum amount of variance in the data set. The first principal component has the largest variance among all components. According to James et al. (2013, 375-379), the loading vector Φ_{11} with its elements $\Phi_{11}, \Phi_{21}, ..., \Phi_{p1}$ for the first principal component is computed as follows:

The first principal component (Z₁) of a set of features X₁, X₂, ..., X_p is the normalized linear combination of the features, where $\Phi_{11}, \Phi_{21}, ..., \Phi_{p1}$ are the loadings of the first principal component and $\sum_{j=1}^{p} \Phi_{j1}^{2} = 1$:

$$Z_1 = \Phi_{11} * X_1 + \Phi_{21} * X_2 + \dots + \Phi_{p1} * X_p$$

Among all n observations of n x p data set X, suppose that the linear combination (z_{i1}) a sample of $(x_1, x_2, ..., x_p)$ has the largest sample variance: $z_{i1} = \Phi_{11} * x_1 + \Phi_{21} * x_2 + \dots + \Phi_{p1} * x_p$. The first principal component loading vector has to meet the two following criteria: $\max_{\Phi_{11}, ..., \Phi_{p1}} \left\{ \frac{1}{n} \sum_{i=1}^{n} (\sum_{j=1}^{p} \Phi_{j1} x_{ij})^2 \right\}$ and $\sum_{j=1}^{p} \Phi_{j1}^2 = 1$.

After the determination of the first principal component, the second component is defined as the linear combination of X_1 , X_2 , ..., X_p variables which has maximal variance out of all linear combinations that are uncorrelated with the first principal component. If p > 2, other multiple distinct principal components are determined in a similar manner.

Based on a data set which examines the existence of 31 trade facilitation measures in free trade agreements of East Asian economies, this paper uses principal component analysis to reduce the high dimensionality of the data set. In other words, principal component analysis transforms the 31 trade facilitation measures into a set of orthogonal variables called components. The first component, which captures the highest variance of the data set, is a weighted average of 31 trade facilitation measures.

The number of retained variables from the first components varies among recent studies. Some studies choose the most important provisions or policy areas. For example, Orefice and Rocha (2011, 8) opt for top five areas, which present the highest coefficients, from all weights associated to the first component of the principal component analysis (PCA). Choi (2019, 19) chooses nine provisions that have the highest factor loadings and theoretically strong relationship with global value chains. The nine provisions cover sanitary and phytosanitary measures, technical barriers to trade, state trade enterprises, anti-dumping duties, state aid, public procurement, trade-related

investment measures, General Agreement on Trade in Services, environmental laws, and labor market regulation. In contrast, Hofmann, Osnago, and Ruta (2017, 16) select all 52 provisions regardless of the factor loadings of provisions in the first component. Following Hofmann, Osnago, and Ruta (2017, 16), this paper will take into account all 31 trade facilitation measures, rather than select several trade facilitation measures with their highest factor loadings, in order to compute a comprehensive PCA trade facilitation depth index. The coefficients or factor loadings of the first component is w_p , PCA trade facilitation depth is computed by the following formula:

PCA trade facilitation depth =
$$\sum_{p=1}^{31} w_p * measure_p$$

Chapter 3. Empirical discussion

3.1 Case study selection

The thesis selects seventeen East Asian economies as a case study for several reasons. First, East Asian economies offer a relatively large number of free trade agreements to be examined by text analysis. East Asia economies have had ninety-one free trade agreement texts, which include eighty main agreements of East Asian economies and six framework agreements, and five implementing agreements and protocols in the period from 1992 to 2018 (see appendix 5). Only framework agreements, implementing agreements and protocols covering trade facilitation measures are examined in this study. The number of trade agreement texts between each East Asian economy and its trading partners is plotted in figure 1. Among East Asian economies, Singapore records the highest number of 36 trade agreement texts, while Hong Kong has the lowest number of 5 trade agreement texts. On average, East Asian economies are members of 17.9 legal trade agreement texts. The number of intra-East Asia regional trade agreement texts is 32, while that of extra-East Asia regional trade agreement texts is 59. East Asian economies have signed free trade agreements with 60 countries outside the East Asia region.

Second, this case study selection allows to examine variance in the implementation of legal commitments on trade facilitation among East Asian economies. According to United Nations ESCAP, the implementation rate of trade facilitation measures is quite heterogeneous in East Asian economies. Singapore and Australia have the highest implementation rates of over 90% while Brunei Darussalam, Viet Nam, and Myanmar have relatively low level of implementation, at 52.7%, and 51.6% respectively (United Nations ESCAP 2018, 9; 2017, 9). The East and North-

East Asia sub-region, covering China, Japan, Republic of Korea and Mongolia has an average implementation rate of 73.7% (United Nations ESCAP 2017, 2).

3.2 Model specification

To assess the impact of power in trade agreements on trade flows, this study estimates a standard gravity model where EX_{ijt} designates export value from exporter i to importer j in year t. γ_{it} , ς_{jt} , τ_{ij} respectively capture exporter-year, importer-year, and exporter-importer fixed effects, and ε_{ijt} is the error term. LE_{ijt} represents trade facilitation scores of legal commitments between exporter i to importer j in year t. This thesis includes annual trade-weighted average tariff from exporters to importers as one control variable. Main specification is described as follows:

$$EX_{ijt} = a_0 + \beta_1 LE_{ijt} + \beta_2 \operatorname{tariff}_{ijt} + \gamma_{it} + \varsigma_{jt} + \tau_{ij} + \varepsilon_{ijt}$$

This study uses the Poisson pseudo maximum likelihood (PPML) estimator suggested by (Santos Silva and Tenreyro (2006), which allows to account for zero trade flows. The Stata commands for PPML estimator are the ppml_panel_sg, as described in Larch et al. (2019), in order to capture exporter-year, importer-year, and exporter-importer fixed effects and cluster standard errors at the importer-exporter level. Therefore, this thesis does not include other control variables which will be collinear with the exporter-year, importer-year, and exporter-importer fixed effects, which are already captured by the ppml_panel_sg command. Take for example economic indicators like annual Gross Domestic Product, exchange rates of exporters and importers, Logistics Performance Index of exporters and importers, or time-invariant variables like distance between exporters and importers and importers. The regressions use data on total trade in goods between 17 East Asian economies and their 222 trading partners from 1988 to 2018.

3.3 Data collection and data description

In this section, this study describes data collection, and presents some descriptive statistics. Table 3 of appendix 2 summarizes the descriptive statistics of the main variables to be used in the empirical analysis at the importer-exporter-year level.

3.3.1 Export

The dependent variable is export value between East Asian economies and their trading partners. Data on annual export during the period from 1988 to 2018 is provided by United Nations Conference on Trade and Development (UNCTAD). The list of trading partners is included in appendix 3. Annual export of East Asian economies ranges between 0 and 480 million USD, with a mean of 1.16 million USD (see table 3 of appendix 2).

3.3.2 Trade facilitation scores of legal commitments

This study measures trade facilitation scores of legal commitments in three ways, namely estimating scores of legal texts by the Wordscores model, adding the total number of trade facilitation measures in legal texts, and computing PCA depth by principal component analysis. All three approaches need a dataset on the existence of legal commitments trade facilitation measures in free trade agreement texts.

This study collects ninety-one individual free trade agreement texts which includes eighty free trade agreements of East Asian economies and six framework agreements, and five implementing agreement and protocols from two types of databases (see the list of ninety-one legal trade agreements in appendix 5). The first is the regional trade agreements database of the World Trade Organization. World Trade Organization (2020) often refers to the second database; that is the link of national or regional trade databases, which provides framework agreements, implementing agreement and protocols to amend trade agreements. Based on these individual legal agreements,

this thesis creates and examines accumulated legal texts, which add commitments from more than two individual free trade agreement texts because two countries can share a multiple of free trade agreements. The total number of individual and accumulated legal texts which are imported into the Wordscores model and principal component analysis is 146.

Based on the groupings of trade facilitation measures suggested by Neufeld (2014, 38), this thesis reviews and extracts all articles governing thirty-one individual trade facilitation measures in the ninety-one individual free trade agreement texts. These thirty-one trade facilitation measures are grouped into four categories: 'Transparency' (Category 1), 'Fee and formalities' (Category 2), 'Transit' (Category 3), and 'Supporting measures' (Category 4). 'Exchange of customs-related information' measure is put under Category 2 instead of being separated in a stand-alone category in Neufeld (2014, 38). When reviewing each text, the paper breaks down the level scope of commitments under thirty-one measures into two options, which are coded by 0 if these trade facilitation measures exist in the legal text and 1 if these measures do not (see codebook in appendix 4). To find the meaning of the legal commitments on trade facilitation, this study uses NVivo software to code all phrases and sentences which convey the certain scope of commitments in thirty-one individual trade facilitation measures.

While cross-checking with Neufeld (2014), this thesis discovers and rectifies some coding errors in the existence of trade facilitation measures listed in Neufeld (2014, 38-58). For example, regarding penalty disciplines, Neufeld (2014) misses coding 1 for Panama – Singapore Free Trade Agreement (Article 4.12), Agreement between Japan and the Republic of Peru for an Economic Partnership (Article 84), Republic of Korea-Singapore Free Trade Agreement (Article 5.12), China-Costa Rica Free Trade Agreement (Article 55), Malaysia-Chile Free Trade Agreement (Article 5.13). 'Enquiry points' measure is not recorded in Agreement between Japan and the Republic of Peru for an Economic Partnership (Article 76), Agreement between New Zealand and Singapore on a Closer Economic Partnership (Article 69).

This section describes the content of thirty-one trade facilitation measures under the above four categories in free trade agreements of East Asian countries. The percentage of legal texts containing trade facilitation measures are presented in figure 2 of appendix 1.

Category 1- 'Transparency':

Among eight measures in category 1, 'Publication and availability of information' (PAI) measure is the most frequent measure which appears in 78 out of 91 legal texts (85.71%). 'Publication and availability of information' measure prescribes the types of information that governments publish, and the manner of publication. In contrast, 'Obligation to consult traders and businesses' (OCT) measure is the least frequent measure accounting for 13.19% of 91 legal texts.

Regarding 'Internet publication' (IP) measure, Member States have to publish information about their import, export and transit procedures, and practical guides to these procedures on the internet. Some free trade agreeements, such as Free Trade Agreement between the Republic of Singapore and the Republic of Turkey (Article 6.4 and Article 1 of Annex 6-A) and Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) (Article 5.11), further requires Member States to publish in English or any WTO official languages.

'Enquiry points' (EP) measure, which occurs in 63.74% of 91 legal texts, calls for the establishment of national or regional enquiry points which provide traders, governments, or any other interested person specific the information about import, export or transit requirements. Most free trade agreements use general terms to describe the scope of enquiries; take for example "enquiry points to answer reasonable enquiries from any interested person of the Parties

concerning customs matters" in Article 4.3 (Agreement between Japan and Australia for an Economic Partnership). A few free trade agreements, such as Free Trade Agreement between The Government of the People's Republic of China and the Government of the Republic of Chile (Article 42) limit the application of 'Enquiry points' measure to rules of origin.

'Publication prior to implementation' (PPI) measure requires Member States to publish their national laws and regulations before they come into force. Although most free trade agreements directly elaborate this measure, a few free trade agreements only refer to GATT Article V without adding any commitment. Agreement on Trade in Goods of the Framework Agreement on Comprehensive Economic Co-operation between the Association of Southeast Asian Nations and the People's Republic of China, for example, prescribes that "Article X of the GATT 1994 shall, mutatis mutandis, be incorporated into and form an integral part of this Agreement" (Article 4). The Article 4 is deemed to contain provisions on publication before implementation because Article X: 2 the GATT 1994 states that no new requirements and restriction "shall be enforced before such measure has been officially published".

'Commenting on proposed regulations' (CPR) measure grants businesses and other interested parties an opportunity and reasonable time to comment on laws or secondary legal acts. 'Advance rulings' (AR) measure aims to provide traders reliable "binding" information about the tariff classification, origin, or other customs treatment of their goods before their importation or exportation. 'Appeals' (APP) measure provides traders have the rights to administrative appeal or review, and/or judicial appeal or review about decisions previously made by Member States. While most free trade agreements only elaborate the content of GATT 1994 about the allowance of both administrative and judicial review, only Free Trade Agreement between the Republic of Singapore

and the Republic of Turkey (Article 4 of Annex 6-A) further requires Parties to conduct the review in a non-discriminatory manner.

Category 2 – 'Fee and formalities':

Out of 20 measures in category 2, 'Cooperation on custom and other trade facilitation matters' (COOP) measure has the highest frequency of 82.42%. Following Neufeld (2014, 18), this paper separates two trade facilitation measures, namely 'Cooperation on custom and other trade facilitation matters' (COOP) and 'Exchange of customs-related information' (EI) with occurrence frequency of 17.6%. Although most of free trade agreements contain cooperation languages in customs chapter, some agreements added a separate chapter elaborating fields of cooperation. Since the seperate "cooperation chapter" cover all cooperation activities, such as trade in goods, trade in services, investment, intellectual property rights, this study examines only articles which directly relates to trade faciliation and decribes fields of cooperation³. 'Cooperation on custom and other trade facilitation matters' measure includes cooperation between border agencies and customs authorities. Cooperation and coordination activities include 'alignment of working days and hours; alignment of procedures and formalities; development and sharing of common facilities; joint controls; establishment of one stop border post control' (Wolffgang and Kafeero 2014, 32). 'Exchange of customs-related information' measure regulates the exchange of information between custom agencies with regards to verifying import and export declarations and specify how to handle and protect confidential information.

³ See, for instance, article 53 in Chapter 8. Economic Cooperation (Agreement on Comprehensive Economic Partnership among Japan and Member States of the Association of Southeast Asian Nations) or article 129 in Chapter 13. Cooperation (Comprehensive Economic Partnership Agreement between Japan and the Republic of India

'Simplification of formalities and procedures' (SFP), 'Harmonization of regulations and formalities' (HRF), and 'Use of international standards' (UIS) measures often co-occur in free trade agreements. 'Simplification of formalities and procedures' measure, which accounts for 79.12% of 91 legal texts, includes requirements about the reduction of customs procedures for the efficient release of goods. When free trade agreements incorporate Article VIII of the GATT 1994 as a part of these agreements like Korea- Viet Nam (Article 2.10), these free trade agreements are deemed to include simplification measures because Article VIII requires Member States to minimize "the incidence and complexity of import and export formalities and for decreasing and simplifying import and export documentation requirements". 'Harmonization of regulations and formalities' measure, which covers 59.34% of all legal texts, facilitates the harmonization of documentation and data requirements of its respective agencies associated with the importation, exportation or transit of goods. 'Use of international standards' measure promotes the application of standards which are recommended by international organizations such as the World Customs Organization (WCO) or the Revised International Convention on the Simplification and Harmonisation of Customs Procedures (Revised Kyoto Convention).

Each of 'Fees and charges connected with import and export' (FC), 'Consularization' (CON), 'Penalty disciplines' (PD), 'Pre-arrival processing' (PP), 'Automation and electronic submission' (AE), 'Risk management' (RM), 'Release times' (RT), 'Expedited shipments' (ES), 'Temporary admission of goods' (TAG) measures appear in more than 20% of 91 legal texts. In contrast, 'Separation of release from clearance' (SRC) and 'Post-clearance audit' (PA) measures are less common, with occurence frequency of 18.68% and 10.99%.

Several rare trade facilitation measures are found in less than 10% of 91 legal texts. For example, provisions on 'Single window' (SW), which aims to facilitate a single, electronic submission of

all customs information, exist only in Agreements among Association of Southeast Asian Nations (ASEAN) Member States, Agreement between Singapore and the Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu on Economic Partnership, Agreement establishing the ASEAN-Australia-New Zealand Free Trade Area. Regarding 'Preshipment inspections' (PI), only three free trade agreements eliminate the mandatory use of pre-shipment inspection firms to carry out customs-related controls on imported goods. 'Customs brokers' (CB) measure, which regulates the use of customs brokers in import, export or transit operations, appears in 7 legal texts.

Category 3 - 'Transit':

'Transit' category covers only 'Freedom of transit for goods' measure. This measure appears in 80.22% of legal documents. 'Freedom of transit for goods' measure includes commitments on the prohibition on customs charges and unnecessary delays or restrictions, exemptions from fees and charges not commensurate with administrative expenses, equal treatment for goods in transit and the vessels and transport means among other different trading partners, customs transit procedures and controls, the use and discharge of required guarantees in connection with transit operations, and coordination between countries on transit matters.

Category 4 - 'Supporting measures':

'Supporting measures' category includes two measures. 'Technical assistance and capacity building' measure is prescribed in 18 out of 91 legal documents while 'Special and differential treatment' measure is contained in only 4 documents. 'Special and differential treatment' measure describes special implementation modalities for developing or least-developed country members. 'Technical assistance and capacity building' measure covers activities and programs to support developing or least-developed country members.
3.3.3 Control variable

This thesis uses one control variable, namely annual trade-weighted average tariff from exporters to importers. The summary statistics of this control variable is described in table 3 of appendix 2. Trade-weighted average tariffs from exporters to importers reflect quantitative barriers applied on trade flows from exporters to importers. Trade-weighted average tariffs take into account the preferential tariffs applied to imports from each country and the share of each exporter in the total imports of each importer. Trade-weighted average tariff data come from World Integrated Trade Solution (2020). The minimum trade-weighted average tariffs are 0% while the maximum trade-weighted average tariff is 3000%. Athough the extremely high tariff of 3000% may be caused by reporting errors, this study does not exclude the outlier because the 3000% tariff only occurs in one observation that depicts a tariff of 3000% from Myanmar to Palau in 2017.

3.4 Empirical results

3.4.1 Text as data analysis

The Wordscores method in text as data analysis produces scores of words and legal commitments. The score of words ranges between -1 and 1 (see figure 4). Words scoring -1 are typical words in legal commitments having comprehensive trade facilitation measures while words scoring 1 are common words in those having the least comprehensive trade facilitation measures. Table 4 lists ten of the high-scoring words on both ends of the two dimensions (1 and -1), or words in free trade agreements with respectively narrow and comprehensive trade facilitation measures. 'Communications', 'council', 'research', 'food', 'capital', 'postal', 'trends', 'better', 'liberalisation', 'flexibility', which are prominent in 'Fees and formalities' category, belong to free trade agreements with comprehensive trade facilitation measures. In contrast, "website', 'answering', 'postponement', 'practical', which are typical words in 'Transparency' category, are

associated with free trade agreements with narrow trade facilitation measures. Using the textmodel_wordscores() function and its associated predict () method, this thesis computes Wordscores estimates or estimated positions of 146 unique accumulated legal commitments on trade facilitation measures (see figure 3 of appendix 1). Plotted in the y-axis of Figure 3, the scores of legal commitments range between -0.58 and 0.51.

3.4.2 Principal component analysis

Following the suggestion of Constantin (2014, 27) to check whether the data set is suitable for principal component analysis, this thesis firstly runs two tests, namely Kaiser-MeyerOlkin (KMO) Measure of Sampling Adequacy (MSA) and Bartlett's Test of Sphericity. These tests confirm data adequacy since overall MSA is 0.83, which is higher than 0.5, and the Bartlett's Test of Sphericity is significant (p-value <0.05) (see table 5 of appendix 2).

After checking data suitability, this thesis uses PCA() function in the 'FactoMineR' package proposed by Lê, Josse, and Husson (2008) to conduct principal component analysis. Within PCA() function, scale.unit option equals FALSE because all thirty-one trade facilitation measures are binary-coded variables. Figure 5 plots the share of variation in the data set taken into account by components. In this study, 80% of the total variation would retain nine components, while a cutoff of 55% would further reduce the number of components to three. Following Hofmann, Osnago, and Ruta (2017, 33), this study chooses only the first component for simplification of analysis. The first component helps to explain 35.59% of the variance of the data set in this thesis.

Table 6 shows the coefficients or loadings of the first three principal components. The loadings indicate the correlations between each trade facilitation measure and the component. The higher the loadings, the more relevant in defining the component's dimensionality. In the first column of the first component, all of thirty-one trade facilitation measures have positive loadings, suggesting

a positive impact relationship between these measures and the first component. The first component is most highly correlated with three trade facilitation measures, namely 'Expedited shipments', 'Internet publication', and 'Enquiry points'. In contrast, 'Customs brokers', 'Freedom of transit for goods', and 'Preshipment inspections' measures are least correlated with the first component.

3.4.3 Main estimation results

Using three indicators for trade facilitation depth, this paper reports the correlations between export and two independent variables, namely trade facilitation scores of legal commitments, and trade-weighted average tariff. The main estimation results are described in table 1 for the whole sample of seventeen East Asian economies, and table 2 for two sub-samples of countries with the high and low trade facilitation implementation rates. Specifically, the first three columns of table 2 report regression results for six countries Australia, New Zealand, Hong Kong, Japan, Singapore, and Korea (Republic of), while the last three columns cover the second sample of Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Vietnam, and Brunei Darussalam.

The division into two sub-samples is based on the differences among economies in terms of their trade facilitation implementation rates. Although trade facilitation implementation rates of Member States in all free trade agreements have not been recorded in official databases, the OECD Trade Facilitation Indicators (TFIs) and United Nations (UN) surveys on the implementation of trade facilitation measures in WTO's Trade Facilitation Agreement can provide a rough approximation. While the 2019 OECD TFIs compute an average trade facilitation performance based on eleven areas of information availability, the involvement of the trade community, advance rulings, appeal procedures, fees and charges, documents, automation, procedures, internal

border agency co-operation, external border agency co-operation, governance and impartiality (OECD 2020), the 2019 UN Global Survey on Trade Facilitation and Paperless Trade Implementation which covers 47 trade facilitation measures related to the WTO's Trade Facilitation Agreement (United Nations ESCAP 2020). Among seventeen economies, Australia, New Zealand, Hong Kong, Japan, Singapore, and Korea (Republic of) are six countries having their 2019 OECD TFIs above the best practice level of 17.211 (see figure 9 in the appendix 1). In addition, the 2019 UN Global Survey reports that Australia, New Zealand, Hong Kong, Japan, Singapore, and Korea (Republic of) have the highest trade facilitation implementation rates of WTO's Trade Facilitation Agreement in 2019 (over 90%) (United Nations ESCAP 2020). This study includes Hong Kong in the group of the highest trade faciliation implementation rates, although United Nations ESCAP does not provide an official report on Hong Kong. Hong Kong is grouped with the four high-income countries, instead of being grouped with China since Hong Kong, like the above four high-income countries, designates all trade facilitation provisions contained in Articles 1 to 12 of the Trade Facilitation Agreement (TFA) under Category A, which will be implemented upon entry into force of the Agreement. In other words, Hong Kong is committed to fully implement all provisions of the TFA upon its entry into force on 22 February 2017 while China, a developing country, still chooses phased-in implementation for some trade facilitation measures like Single Window (World Trade Organization 2020a).

| | (1) | (2) | (3) | | |
|--------------------------------------|--------------|----------------|--------------|--|--|
| Export | Wordscores | Additive score | PCA depth | | |
| Γ | estimates | | | | |
| Trade facilitation score of | 0.0354 | -0.00000319 | 0.0233 | | |
| legal commitments | (0.124) | (0.00170) | (0.0819) | | |
| | | | | | |
| Trade-weighted average | -0.00849* | -0.00844* | -0.00854* | | |
| tariff | (0.00445) | (0.00437) | (0.00448) | | |
| Exporter-year, importer- | \checkmark | \checkmark | \checkmark | | |
| year, exporter-importer | | | | | |
| fixed effects | | | | | |
| | | | | | |
| Observations | 2,346 | 2,346 | 2,346 | | |
| R-squared | 0.9991 | 0.9991 | 0.9991 | | |
| Note: Standard errors in parentheses | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | |

Table 1: Trade facilitation score of legal commitments and export in the full sample

Table 2: Comparison between two sub-samples of countries with the high and low trade

faciliation implementation rates

| | (1) | (2) | (3) | (4) | (5) | (6) |
|----------------|--------------|----------------|--------------|--------------|----------------|--------------|
| Export | Wordscores | Additive score | PCA depth | Wordscores | Additive score | PCA depth |
| | estimates | | | estimates | | |
| Trade | 0.482*** | -0.00283 | 0.299** | -0.109 | 0.00411* | -0.102 |
| facilitation | (0.148) | (0.00232) | (0.127) | (0.183) | (0.00239) | (0.132) |
| score of legal | | | | | | |
| commitments | | | | | | |
| Trade-weighted | -0.0142** | -0.0116 | -0.0143** | -0.0131* | -0.0144** | -0.0129* |
| average tariff | (0.00692) | (0.00709) | (0.00689) | (0.00724) | (0.00720) | (0.00732) |
| Exporter-year, | \checkmark | \checkmark | \checkmark | \checkmark | \checkmark | \checkmark |
| importer-year, | | | | | | |
| exporter- | | | | | | |
| importer fixed | | | | | | |
| effects | | | | | | |
| Observations | 897 | 897 | 897 | 1,449 | 1,449 | 1,449 |
| R-squared | 0.9993 | 0.9992 | 0.9993 | 0.9995 | 0.9995 | 0.9995 |

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Note: The first three columns cover the first sample of Australia, New Zealand, Hong Kong, Japan, Singapore and Korea (Republic of). The last three columns cover the second sample of Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Vietnam, and Brunei Darussalam. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In almost all regression specifications, the trade-weighted average tariff consistently shows a significant and negative relationship with export. On average, every 1% increase in trade-weighted average tariff is predicted to reduce the total export of all East Asian economies by 0.85% (Table 1)⁴, the total export of Australia, New Zealand, Hong Kong, Japan, Singapore and Korea (Republic of) by 1.328% (Column 1 to 3 of table 2)⁵, and the total export of the rest East Asian economies by 1.334% (Column 4 to 6 of table 2)⁶. The R² in table 1 and 2 ranges between 0.9991 and 0.9995, suggesting these regressions in line with a typical good fit of gravity model (Larch et al. 2019, 11).

In contrast, the sign and significance of coefficients of trade facilitation scores vary among tables. The interpretation of trade facilitation depth scores produced by the Wordscores model and principal component analysis (PCA) is more abstract than the interpretation of additive trade facilitation depth scores. In the full sample presented in table 1, the coefficients of trade facilitation scores are insignificant. The additive trade facilitation score has the lowest estimated coefficient of -0.00000319 (Column 2), while the coefficient of Wordscores estimates is 0.0354 (Column 1), and PCA depth coefficient is 0.0233 (Column 3).

In the sub-sample of countries with high trade facilitation implementation rates, the association between trade facilitation commitments and export become statistically significant. Column 1 and 3 of table 2 suggest that export is significantly related to trade facilitation scores of legal commitments which are computed by the Wordscores model and principal component analysis. Controlling for other variables, for each unit increase in PCA depth of legal commitments, export is expected to increase by 34.85%⁷, while each unit increase in Wordscores estimates of legal

⁴ Based on the coefficients of weighted average tariff from column 1 to 3 of table 1: $100 * (e^{-0.0085} - 1) = -0.85\%$

⁵ Based on the coefficients of weighted average tariff from column 1 to 3 of table 2: $100 * (e^{-0.01337} - 1) = -1.328\%$

⁶ Based on the coefficients of weighted average tariff from column 4 to 6 of table 2: $100 * (e^{-0.01347} - 1) = -1.338\%$

⁷ Based on the coefficients of trade facilitation score from column 3 of table 2: $100 * (e^{0.299} - 1) = 34.85\%$

commitments may expand export by 61.93%⁸. In contrast, column 4 and 6 indicate that trade facilitation measures have an insignificant impact on export for countries with the lowest trade facilitation implementation rates. In addition, the coefficients of Wordscores estimates and PCA depth become negative, standing at -0.109 and -0.102 respectively (Colum 4 and 6 of table 2). The coefficients of additive scores are negative and insignificant for countries with high implementation rates of trade facilitation measures (Column 2 of table 2), but are positive and significant at 10% for countries with low implementation rates (Column 5 of table 2). The changes in size and significance of the coefficients of the additive score may come from the fact that additive scores overestimate the depth of trade facilitation measures, which is acknowledged by Duval, Neufeld, and Utoktham (2016, 25-26).

This study discovers some reasons for changes in the effect of trade facilitation measures on export:

First, higher trade facilitation depth is not necessarily related to higher export because free trade agreements include both soft and hard legal terms, which offer Member States room to maneuver in national regulations. While hard legal terms in free trade agreements is represented by "shall" as a modal verb in a sentence, soft terms like "use their best endeavours", "to the extent permitted by domestic law", "when applicable", "where available", and "where possible" are sometimes added to increase the implementation flexibility of Member States. The differences in soft and hard legal terms have not been quantified by three indicators of the trade facilitation depth which are produced by three methods. For example, the Wordscores model cannot distinguish between

⁸ Based on the coefficients of trade facilitation score from column 1 of table 2: $100 * (e^{0.482} - 1) = 61.93\%$

sentences with soft and hard requirements since Wordscores treats individual words as "data" regardless of their syntactic context.

Second, the implementation ability of Member States could matter more than the number of signed legal commitments. Despite sharing the same commitments in many agreements, East Asian countries have different implementation rates of trade facilitation measures in practice.

According to the 2019 UN Global Survey on Trade Facilitation and Paperless Trade Implementation, which covers 47 trade facilitation measures related to the WTO's Trade Facilitation Agreement, Australia, New Zealand, Japan, Singapore, and the Republic of Korea achieve world-leading implementation rates of over 90%. The five countries are followed by China, Malaysia, Thailand, Philippines, Indonesia, and India implementation rates ranging from 80% to 83%. Myanmar, Lao PDR, Viet Nam, Brunei Darussalam, and Cambodia have the lowest implementation rates ranging from 60% to 77% (United Nations ESCAP 2020). ASEAN countries have low implementation rates of cross-border paperless trade despite their early global lead in this area with the ASEAN Single Window (United Nations ESCAP 2019, ii).

Third, simple additive scores become more biased and overestimate the depth of bilateral commitments, especially when free trade agreements are heavily copy-pasted without strict supervision on the implementation of legal commitments. Allee and Elsig (2016, 27) discover that the percentage of copy-pasting content among 378 preferential trade agreements signed during the period from 1954 to 2013 is over 90%. The overestimation of additive scores, which is acknowledged by Duval, Neufeld, and Utoktham (2016, 25-26), can be detected by examining the correlation between pairs of thirty-one trade facilitation measures. High correlation appears in several pairs of measures like 'Internet publication' (IP) and 'Enquiry points' (EP) (r = 0.866), 'Risk management' (RM) and 'Automation and electronic submission' (AE) (r = 0.814),

'Automation and electronic submission' (AE) and 'Simplification of formalities and procedures' (SFP) (r = 0.791) (see figure 8). The bias of additive scores is also confirmed by comparing the relationship between additive scores and PCA depth in figure 6 and the relationship between additive scores and Wordscores estimates in figure 7. Despite a strong and positive association between additive scores and PCA depth when additive scores are lower than 50, PCA depth seems to level off after additive scores reach 50. Wordscores estimates are positively related to additive scores when additive scores are lower than 25, but Wordscores estimates gradually decrease when additive scores increase from 25 to 100, and finally slightly increase until additive scores reach the highest value of 178.

Fourth, trade facilitation measures in free trade agreements do not necessarily facilitate export in practice because of the variance in national regulations. Take for example advance rulings systems in China, Taiwan and the European Union (Chen 2016, 58-59). In China, the advance rulings issued by Chinese central customs offices have a binding effect in all local customs offices, while the ones issued by one Chinese local customs office are only limited to that local customs office. In contrast, Taiwan allows the binding effect of advance rulings issued by a local customs office to cover all other local customs offices. Appeals to a binding administrative ruling have to undergo a lengthy appeal process in both China and Taiwan. In the EU, the explanatory notes to Combined Nomenclature prevail over European Binding Tariff Information, which traders already received from customs authorities of European Member States.

3.4.4 Robustness checks

First, this paper checks the robustness of Wordscores estimates by using two-word gram or bigram (see column 1 to 3 of table 7 in appendix 2) and rescaling raw predicted score of legal commitments (see column 4 to 6 of table 7 in appendix 2). Table 7 confirms the insignificant and positive

association between trade facilitation depth score which is estimated by the Wordscores model in the full sample. Only the sub-sample of six countries, namely Australia, New Zealand, Hong Kong, Japan, Singapore, and Korea (Republic of) sees a significant and positive relationship between their commitments on trade facilitation measures and export. In contrast, the sub-sample of Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Vietnam, and Brunei Darussalam shows a negative and insignificant coefficient of Wordscores estimates.

Second, the paper examines the construct or predictive validity of trade facilitation depth scores. Following Bruinsma and Gemenis (2019, 220), and Carmines and Zeller (1979, 5-8), this study analyzes the relationship between trade facilitation depth and overall depth of free trade agreements. Trade facilitation depth scores are theoretically positively correlated with the overall depth of free trade agreements because both trade facilitation measures and other deep integration measures on different fields like services, investment aim at enhancing the contestability of markets for firms in partner economies. To be more precise, deep integration provisions strengthen three main policy areas, namely protection of firms and their interests, liberalization of trade barriers, and harmonization of domestic trade rules with international rules (Martin and Kim 2015, 360). Therefore, the theoretical prediction is that the higher trade facilitation depth scores, the higher overall depth of free trade agreements.

Based on the theory, this study assesses the relationship between trade facilitation depth scores and the general depth index of preferential trade agreements which is computed by the DESTA project in Dür, Baccini, and Elsig (2014). In the DESTA project, the general Rasch depth indicator is produced by the Rasch model for a dataset of 48 variables related to services liberalization, trade-related investment measures, public procurement intellectual property rights, and standards. Table 8 in appendix 2 shows that the general Rasch depth indicator is positively related to PCA depth at the 5%-level. Also, the coefficient of Wordscores estimates generated by the Wordscores model with bigram is significant at the 10%-level. The coefficient of additive score is also positive, but insignificant. These coefficients not only confirm the validity of estimates of Wordscores model and principal component analysis, but also underline the overestimation of additive trade facilitation depth scores.

Conclusion

The econometric analysis shows that while tariff clearly shows a negative relationship with export, trade facilitation measures in free trade agreements of East Asian economies have a positive but discriminatory impact on export between RTA members. Trade facilitation measures are only significantly and positively related to export only in a sub-sample of Australia, New Zealand, Hong Kong, Japan, Singapore, and Korea (Republic of), which has the highest implementation rate of trade facilitation measures in the East Asia region. In contrast, the rest of East Asian economies see an insignificant impact of trade facilitation measures on their export. The discriminatory impact suggests that all countries should make further efforts to systematically implement what they already committed in their free trade agreements in order to seize the benefits of these trade facilitation measures.

Despite the main findings, this thesis is not without drawbacks. First, this study mainly investigates the correlation between trade facilitation commitments and export, which does not imply causation. Second, future research should take further steps to expand the measurement scale of trade facilitation commitments. This study chooses binary categories to examine the existence of trade facilitation measures in free trade agreements. The binary categories facilitate the reliability of coding but not provide precise measurement of variables. In contrast, a higher measurement level would capture both the existence of trade facilitation measures in free trade agreements and implementation status or legal enforceability of these measures at national levels.

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46

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Appendices

Appendix 1: List of Figures



Figure 1: Number of trade agreement texts signed, by country (1992-2018)







Figure 3: Wordscores estimates of 146 legal commitments on trade facilitation measures



Figure 4: Score of words



Figure 5: Variation of data set taken into account by components



Figure 6: Relationship between additive scores and PCA depth



Figure 7: Relationship between additive scores and Wordscores estimates



Figure 8: Correlation among thirty-one trade facilitation measures⁹

⁹ Note: darker shading suggests a higher degree of correlation. The values were calculated using Pearson correlation.



Figure 9: Comparison among East Asia economies in terms of eleven trade faciliation areas

Appendix 2: List of Tables

| Variable | Observation | Mean | Std.Dev. | Min | Max |
|-----------------------|-------------|--------------|--------------|-------|----------------|
| Export | 74 112 | 1 160 000 00 | 8 880 000 00 | 0.00 | 480,000,000,00 |
| (thousand USD) | 74,112 | 1,100,000.00 | 8,880,000.00 | 0.00 | 480,000,000.00 |
| Trade-weighted | 20 788 | 10.16 | 21.75 | 0.00 | 3 000 00 |
| average tariff (%) | 29,788 | 10.10 | 21.75 | 0.00 | 3,000.00 |
| Wordscores estimates | | | | | |
| of legal commitments | 4,253 | 0.12 | 0.26 | -0.58 | 0.51 |
| on trade facilitation | | | | | |
| Additive score of | | | | | |
| legal commitments | 4,253 | 30.80 | 36.66 | 1 | 178 |
| on trade facilitation | | | | | |
| PCA depth of legal | | | | | |
| commitments on | 4,253 | 0.44 | 0.31 | 0.01 | 0.98 |
| trade facilitation | | | | | |
| Geometric average | 13 745 | 3.06 | 0.40 | 1.50 | 1 18 |
| LPI overall score | 13,743 | 5.00 | 0.40 | 1.30 | 4.10 |

Table 3: Summary statistics - by observation (exporter-importer-year)

Table 4: Words in free trade agreements with comprehensive and narrow trade facilitation

measures

| Words in free trade agreements with | Words in free trade agreements with |
|---|-------------------------------------|
| comprehensive trade facilitation measures | narrow trade facilitation measures |
| communications | cause |
| council | website |
| research | located |
| food | meets |
| capital | answering |
| postal | postponement |
| trends | generally |
| better | packing |
| liberalisation | practical |
| flexibility | depending |

| Test | Indicator | Value |
|---|----------------------|-----------|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | Overall MSA | 0.83 |
| Bartlett's Test of Sphericity | Bartlett's K-squared | 651.18 |
| | df | 30 |
| | p-value | < 2.2e-16 |

Table 5: Examination of data suitability for principal component analysis

Table 6: Loadings of the first three principal components

| Trade facilitation measures | Component 1 | Component 2 | Component 3 |
|--|-------------|--------------|--------------|
| Expedited shipments | 0.802206568 | -0.04684445 | -0.335842724 |
| Internet publication | 0.801565327 | -0.293620378 | -0.230739797 |
| Enquiry points | 0.79518089 | -0.258769501 | -0.140020051 |
| Pre-arrival processing | 0.778458044 | -0.117371101 | 0.140527558 |
| Consularization | 0.745311583 | -0.010068695 | -0.374146583 |
| Release times | 0.741516823 | -0.230776173 | -0.072786457 |
| Advance rulings | 0.727702243 | -0.113439487 | -0.020684445 |
| Fees and charges connected with import and | 0.683008746 | -0.158276652 | -0.213639263 |
| export | | | |
| Automation and electronic submission | 0.682800238 | 0.039028368 | 0.300932914 |
| Appeals | 0.672824381 | 0.091543694 | 0.190508967 |
| Post-clearance audit | 0.617889007 | 0.228482567 | 0.029345417 |
| Risk management | 0.602739083 | 0.073637517 | 0.081528986 |
| Publication prior to implementation | 0.602581773 | 0.147230029 | 0.132359477 |
| Penalty disciplines | 0.588440884 | -0.27544109 | -0.004867076 |
| Temporary admission of goods | 0.572978207 | 0.022599413 | 0.312195036 |
| Single window | 0.541344228 | 0.42495543 | -0.49806996 |
| Commenting on proposed regulations | 0.534452565 | -0.242214644 | 0.375343767 |
| Use of international standards | 0.523245249 | 0.225929721 | 0.356320885 |
| Separation of release from clearance | 0.511962752 | -0.2995689 | 0.133559762 |
| Simplification of formalities and procedures | 0.507294669 | 0.280153262 | 0.301449168 |
| Publication and availability of information | 0.468220913 | 0.099857796 | 0.147677272 |
| Exchange of customs-related information | 0.467890415 | 0.19717504 | 0.175274243 |

| Trade facilitation measures | Component 1 | Component 2 | Component 3 |
|--|-------------|--------------|--------------|
| Authorized operators | 0.437440432 | 0.205825467 | 0.19691485 |
| Obligation to consult traders and businesses | 0.429827058 | 0.209978423 | 0.139558115 |
| Special and differential treatment | 0.357628214 | 0.715373508 | -0.380236345 |
| Harmonization of regulations and formalities | 0.326505753 | 0.247242767 | 0.665157634 |
| Cooperation on custom and other trade | 0.191134005 | 0.242653294 | 0.143647575 |
| facilitation matters | | | |
| Technical assistance and capacity building | 0.173202301 | 0.753875577 | -0.241823548 |
| Customs brokers | 0.161073705 | -0.123352165 | 0.27957686 |
| Freedom of transit for goods | 0.106218083 | 0.660443541 | 0.413284752 |
| Preshipment inspections | 0.098126009 | -0.098289313 | 0.115832019 |

| Export | Wordscores | | | Rescaled | | | |
|----------------|------------------|---------------------|-------------------|--------------|-------------------|----------------|--|
| (Dependent | | estimates (bi-gram) | | | Wordscores | | |
| variable) | | _ | | | estimates (one-g | ram) | |
| | (1) | (2) | (3) | (4) | (5) | (6) | |
| | Full | High | Low | Full | High | Low | |
| | sample | implementation | implementation | sample | implementation | implementation | |
| | | group | group | | group | group | |
| Wordscores | 0.0637 | 0.296*** | -0.0335 | 0.0103 | 0.140*** | -0.0319 | |
| estimates | (0.0946) | (0.109) | (0.158) | (0.0362) | (0.0432) | (0.0533) | |
| (2-gram) | | | | | | | |
| Trade- | -0.00858* | -0.0142** | -0.0132* | -0.00849* | -0.0142** | -0.0131* | |
| weighted | (0.00445) | (0.00692) | (0.00726) | (0.00445) | (0.00692) | (0.00724) | |
| average tariff | | | | | | | |
| Observations | 2,346 | 897 | 1,449 | 2,346 | 897 | 1,449 | |
| R-squared | 0.9991 | 0.9993 | 0.9995 | 0.9991 | 0.9993 | 0.9995 | |
| Nota, T | The full comment | | East Asian asaman | ian IIInh in | lans antation ana | | |

Table 7: Robustness check with bigram

Note: The full sample covers seventeen East Asian economies. High implementation group column reports estimation results for a sub-sample of Australia, New Zealand, Hong Kong, Japan, Singapore and Korea (Republic of). Low implementation group covers the a sub-sample of Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Vietnam, and Brunei Darussalam. Standard errors in parentheses. The first three columns use bi-gram Wordscores estimates while the last three columns use rescaled one-gram Wordscores estimates as an independent variable. *** p<0.01, ** p<0.05, * p<0.1

| Dependent variable: | (1) | (2) | (3) | (4) |
|--------------------------|------------|------------|----------------|-----------|
| Rasch depth | Wordscores | Wordscores | Additive score | PCA depth |
| | estimates | estimates | | |
| | (one-gram) | (bigram) | | |
| | | | | |
| Trade facilitation score | 6.150 | 2.816* | 0.0184 | 2.990** |
| of legal commitments | (4.215) | (1.624) | (0.0341) | (1.265) |
| | | | | |
| Constant | 3.701* | 2.686** | 0.637*** | 0.653*** |
| | (2.182) | (1.247) | (0.212) | (0.0776) |
| | | | | / |
| Dyad and year fixed | v | v | v | v |
| effects | | | | |
| Observations | 264 | 264 | 264 | 264 |
| Number of | 144 | 144 | 144 | 144 |
| exporter-importer pairs | | | | |
| R-squared | 0.425 | 0.431 | 0.342 | 0.458 |

Table 8: Correlation between Rasch depth and trade faciliation scores

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 3: List of trading partners

Afghanistan; Albania; Algeria; American Samoa; Andorra; Angola; Anguila; Antigua and Barbuda; Argentina; Armenia; Aruba; Australia; Australia; Azerbaijan; Bahamas, The; Bahrain; Bangladesh; Barbados; Belarus; Belgium; Belize; Benin; Bermuda; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; British Indian Ocean Ter.; British Virgin Islands; Brunei; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Cape Verde; Cayman Islands; Central African Republic; Chad; Chile; China; Christmas Island; Cocos (Keeling) Islands; Colombia; Comoros; Congo, Dem. Rep.; Congo, Rep.; Cook Islands; Costa Rica; Cote d'Ivoire; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Djibouti; Dominica; Dominican Republic; East Timor; Ecuador; Egypt, Arab Rep.; El Salvador; Equatorial Guinea; Eritrea; Estonia; Faeroe Islands; Falkland Island; Fiji; Finland; Fr. So. Ant. Tr; France; French Guiana; French Polynesia; Gabon; Gambia, The; Georgia; Germany; Ghana; Gibraltar; Greece; Greenland; Grenada; Guadeloupe; Guam; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hong Kong, China; Hungary; Iceland; India; Indonesia; Iran, Islamic Rep.; Iraq; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Kiribati; Korea, Dem. Rep.; Korea, Rep.; Kuwait; Kyrgyz Republic; Lao PDR; Latvia; Lebanon; Lesotho; Liberia; Libya; Lithuania; Luxembourg; Macao; Macedonia, FYR; Madagascar; Malawi; Malaysia; Maldives; Mali; Malta; Marshall Islands; Martinique; Mauritania; Mauritius; Mexico; Micronesia, Fed. Sts.; Moldova; Mongolia; Montserrat; Morocco; Mozambique; Myanmar; Namibia; Nauru; Nepal; Netherlands; Netherlands Antilles; New Caledonia; New Zealand; Nicaragua; Niger; Nigeria; Niue; Norfolk Island; Northern Mariana Islands; Norway; Oman; Pakistan; Palau; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Pitcairn; Poland; Portugal; Qatar; Reunion; Romania; Russian Federation; Rwanda; Saint Helena; Saint Pierre and Miquelon; Samoa; San Marino; Sao Tome and Principe; Saudi Arabia; Senegal; Seychelles; Sierra Leone; Singapore; Slovak Republic; Slovenia; Solomon Islands; Somalia; South Africa; Spain; Sri Lanka; St. Kitts and Nevis; St. Lucia; St. Vincent and the Grenadines; Sudan; Suriname; Swaziland; Sweden; Switzerland; Syrian Arab Republic; Tajikistan; Tanzania; Thailand; Togo; Tokelau; Tonga; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Turks and Caicos Isl.; Tuvalu; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Uzbekistan; Vanuatu; Venezuela; Vietnam; Wallis and Futura Isl.; Western Sahara; Zambia; Zimbabwe.

| ID | Name of measures | Description of measures | Values |
|----|---|--|--|
| 1 | Publication & availability of information (PAI) | References to the types of information that governments publish, and the manner of publication | Is there a provision on publication & availability of information? 0: No 1: Yes |
| 2 | Internet Publication (IP) | References to publication of information about their import, export and transit procedures, practical guides to these procedures on the internet | Is there a provision on Internet Publication? 0: No 1: Yes |
| 3 | Enquiry points (EP) | References to establishment of national or regional enquiry points which provide traders, governments, or any other interested person specific information about import, export or transit requirements | Is there a provision on Enquiry points? 0: No 1: Yes |
| 4 | Publication prior to Implementation (PPI) | Member States have to publish their national laws and regulations before they come into force | Is there a provision on Publication prior to Implementation? 0: No 1: Yes |

Appendix 4: Codebook

| ID | Name of measures | Description of measures | Values |
|----|--|--|--|
| 5 | Obligation to consult traders/business (OCT) | Governmental agencies to conduct consultations with traders and businesses about proposed laws and regulations. | Is there a provision on Obligation to consult traders/business? 0: No 1: Yes |
| 6 | Commenting on proposed regulations (CPR) | Businesses and other interested parties have an opportunity and reasonable time to comment on laws or secondary legal acts | Is there a provision on Commenting on proposed regulations? 0: No 1: Yes |
| 7 | Advance Rulings (AR) | Traders have an opportunity to receive binding rulings from Customs on tariff classification, origin, or other customs treatment | Is there a provision on Advance Rulings? 0: No 1: Yes |
| 8 | Appeals (APP) | Traders have the rights to administrative and or judicial appeal/review about decisions previously made by Member States | Is there a provision on Appeals? 0: No 1: Yes |
| 9 | Fees and charges connected with import/export (FC) | 'Fees and charges connected with import and export' measure requires Member States to publish and periodically review their fees and charges imposed on or in | Is there a provision on fees and charges connected with import/export? |

| ID | Name of measures | Description of measures | Values |
|----|---|---|--|
| | | connection with importation and exportation | 0: No 1: Yes |
| 10 | Penalty disciplines (PD) | 'Penalty disciplines' measure allows Member States to apply civil or administrative customs penalties for violations of the customs laws. | Is there a provision on Penalty disciplines? 0: No 1: Yes |
| 11 | Prearrival processing (PP) | 'Pre-arrival processing' measure allows traders to submit the documents required for the release of imported goods to customs and other border agencies prior to arrival of the goods. | Is there a provision on prearrival processing? 0: No 1: Yes |
| 12 | Automation electronic submission (AE) | 'Automation and electronic submission' measure facilitates the use of information technology to support customs operations. | Is there a provision on automation electronic submission? 0: No 1: Yes |
| 13 | Separation of release from clearance (SRC) | 'Separation of release from clearance' measure allows importers to obtain release of their goods, under a reasonable guarantee, prior to the final determination and payment of customs duties, taxes, fees and charges. | Is there a provision on separation of release from clearance? 0: No 1: Yes |

| ID | Name of measures | Description of measures | Values |
|----|-------------------------------|---|--|
| 14 | Risk management (RM) | 'Risk management' measure requires customs authorities to apply methodology or practices to determine which import, export or transit transactions should be inspected and the type and degree of control to be applied. | Is there a provision on risk management? 0: No 1: Yes |
| 15 | Post clearance audits (PA) | 'Post-clearance audit' measure helps customs authorities to verify the accuracy and authenticity of customs declarations and examine the commercial data, and records of traders. | Is there a provision on post clearance audits? 0: No 1: Yes |
| 16 | Release times (RT) | 'Release times' measure requires Member States to publish their average release time of goods. | Is there a provision on release times? 0: No 1: Yes |
| 17 | Authorized operators (AO) | 'Authorized operators' measure grants a special customs treatment to reliable traders | Is there a provision on authorized operators? 0: No 1: Yes |
| 18 | Expedited shipments (ES) | 'Expedited shipments' measure aims to facilitate express shipment and establish criteria for expedited release treatment. | Is there a provision on expedited shipments? 0: No 1: Yes |

| ID | Name of measures | Description of measures | Values |
|----|--|--|--|
| 19 | Consularization (CON) | 'Consularization' measure regulates requirement of a consular transaction, including related fee or charge, in connection with the importation of goods. | Is there a provision on consularization? 0: No 1: Yes |
| 20 | Cooperation on custom and other trade facilitation matters (COOP) | Cooperation between border agencies and customs authorities related to importation, exportation, and transit transactions | Is there a provision on cooperation on custom. other trade facilitation matters? 0: No 1: Yes |
| 21 | Simplification of formalities/procedures (SFP) | References to the reduction of customs procedures for the efficient release of goods | Is there a provision on simplification of formalities/procedures? 0: No 1: Yes |
| 22 | Harmonization of regulations/formalities (HRF) | References to harmonization of documentation and data requirements of its respective agencies associated with the importation, exportation or transit of goods | Is there a provision on harmonization of regulations/formalities? 0: No 1: Yes |
| ID | Name of measures | Description of measures | Values |
|----|---|---|--|
| 23 | Use of international standards (UIS) | References to the application of standards which are recommended by the World Customs Organization (WCO) or the Revised International Convention on the Simplification and Harmonisation of Customs Procedures (Revised Kyoto Convention) | Is there a provision on use of international standards? 0: No 1: Yes |
| 24 | Single Window (SW) | References to a single, electronic submission of all information required by customs and other legislation for the exportation, importation and transit of goods. | Is there a provision on Single Window? 0: No 1: Yes |
| 25 | Preshipment inspections (PI) | References to the elimination of mandatory pre-shipment inspection for carrying out customs-related controls on imported goods | Is there a provision on preshipment inspections? 0: No 1: Yes |
| 26 | Customs brokers (CB) | References to the use of customs brokers in in import, export or transit operations | Is there a provision on customs brokers? 0: No 1: Yes |
| 27 | Temporary admission of goods (TAG) | 'Temporary admission of goods' (TAG) measure allows goods to be imported | Is there a provision on temporary admission of goods? |

| ID | Name of measures | Description of measures | Values |
|----|---|---|--|
| | | without payment of import duties and taxes under certain conditions. | 0: No 1: Yes |
| 28 | Freedom of transit for goods (FTG) | References to the control of the regulations and formalities that are applied by customs authorities, and the use and discharge of guarantees required by customs authorities relating to transit operations | Is there a provision on freedom of transit for goods? 0: No 1: Yes |
| 29 | Exchange of customs- related information (EI) | References to exchange of information between custom agencies with regards to verifying import and export declarations and specify how to handle and protect confidential information | Is there a provision on exchange of customs- related information? 0: No 1: Yes |
| 30 | Special and differential treatment (SDT) | References to special implementation modalities for developing or least- developed country members | Is there a provision on special and differential treatment? 0: No 1: Yes |
| 31 | Technical assistance and capacity building (TACB) | References to activities and programs to assist and support developing or least- developed country members | Is there a provision on technical assistance and capacity building? 0: No |

| ID | Name of measures | Description of measures | Values |
|----|------------------|-------------------------|--------|
| | | | 1: Yes |

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|---|----------------|--------------------|
| 1993 | Agreement on the Common Effective Preferential Tariff Scheme for the ASEAN Free Trade Area | Main agreement | Intra- regional |
| 2001 | Agreement between New Zealand and Singapore on a Closer Economic Partnership | Main agreement | Extra- regional |
| 2002 | Japan–Singapore Economic Arrangement for a New-Age Partnership | Main agreement | Intra- regional |
| 2003 | Mainland and Hong Kong Closer Economic Partnership Arrangement | Main agreement | Intra- regional |
| 2003 | Mainland and Macao Closer Economic Partnership Arrangement | Main agreement | Intra- regional |
| 2003 | Agreement between the EFTA States and Singapore | Main agreement | Extra- regional |
| 2003 | Singapore-Australia Free Trade Agreement | Main agreement | Extra- regional |
| 2004 | United States-Singapore Free Trade Agreement | Main agreement | Extra- regional |
| 2004 | Free trade Agreement between the Republic of Korea and Chile | Main agreement | Extra- regional |
| 2005 | Thailand-Australia Free Trade Agreement | Main agreement | Extra- regional |
| 2005 | Agreement on Trade in Goods of the Framework Agreement on Comprehensive Economic Co-operation between the Association of Southeast Asian Nations and the People's Republic of China | Main agreement | Intra- regional |
| 2005 | Agreement between Japan and the United Mexican States for the Strengthening of the Economic Partnership | Main agreement | Extra- regional |

Appendix 5: List of free trade agreement texts

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|---|----------------|--------------------|
| 2005 | New Zealand-Thailand Closer Economic Partnership Agreement | Main agreement | Extra- regional |
| 2006 | Free Trade Agreement between the EFTA States and Republic of Korea | Main agreement | Extra- regional |
| 2006 | Agreement between the Government of Japan and the Government of Malaysia for an Economic Partnership | Main agreement | Intra- regional |
| 2005 | Singapore - Jordan Free Trade Agreement | Main agreement | Extra- regional |
| 2006 | Republic of Korea-Singapore Free Trade Agreement | Main agreement | Intra- regional |
| 2006 | Free Trade Agreement between The Government of the People's Republic of China and the Government of the Republic of Chile | Main agreement | Extra- regional |
| 2007 | Agreement between Chile and Japan for a Strategic Economic Partnership | Main agreement | Extra- regional |
| 2005 | Comprehensive Economic Cooperation Agreement between the Republic of India and the Republic of Singapore | Main agreement | Extra- regional |
| 2007 | Agreement Between Japan and the Kingdom of Thailand for an Economic Partnership | Main agreement | Intra- regional |
| 2006 | Panama – Singapore Free Trade Agreement | Main agreement | Extra- regional |
| 2006 | Trans-Pacific Strategic Economic Partnership | Main agreement | Extra- regional |
| 2008 | Agreement between Japan and Brunei Darussalam for an Economic Partnership | Main agreement | Intra- regional |
| 2008 | Agreement between Japan and the Republic of Indonesia for an Economic Partnership | Main agreement | Intra- regional |
| 2008 | Agreement between Japan and the Republic of the Philippines for an Economic Partnership | Main agreement | Intra- regional |

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|--|----------------|--------------------|
| 2007 | Free Trade Agreement between the Government of the People's Republic of China and the Government of the Islamic Republic of Pakistan | Main agreement | Extra- regional |
| 2008 | Agreement between the Government of the Islamic Republic of Pakistan and the Government of Malaysia for a Closer Economic Partnership | Main agreement | Extra- regional |
| 2008 | Agreement on Comprehensive Economic Partnership among Japan and Member States of the Association of Southeast Asian Nations | Main agreement | Intra- regional |
| 2008 | Free Trade Agreement Between The Government of the People's Republic of China And the Government of New Zealand | Main agreement | Extra- regional |
| 2009 | China-Singapore Free Trade Agreement | Main agreement | Intra- regional |
| 2009 | Agreement on Free Trade and Economic Partnership between Japan and the Swiss Confederation | Main agreement | Extra- regional |
| 2009 | Agreement between Japan and the Socialist Republic of Viet Nam for an Economic Partnership | Main agreement | Intra- regional |
| 2009 | Peru-Singapore Free Trade Agreement | Main agreement | Extra- regional |
| 2010 | Agreement establishing the ASEAN-Australia- New Zealand Free Trade Area | Main agreement | Extra- regional |
| 2010 | Agreement on Trade in Goods under the Framework Agreement on Comprehensive Economic Cooperation Between the Republic of India and the Association of Southeast Asian Nations | Main agreement | Extra- regional |
| 2010 | Agreement on Trade in Goods under the Framework Agreement on Comprehensive Economic Cooperation Among the Governments of the Member Countries of the | Main agreement | Intra- regional |

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|--|----------------|--------------------|
| | Association of Southeast Asian Nations and the Republic of Korea | | |
| 2010 | Korea–India Comprehensive Economic Partnership Agreement | Main agreement | Extra- regional |
| 2010 | Free Trade Agreement between the Government of the People's Republic of China and the Government of the Republic of Peru | Main agreement | Extra- regional |
| 2011 | Free Trade Agreement between the European Union and its Member States, of the one part, and the Republic of Korea, of the other part | Main agreement | Extra- regional |
| 2011 | Hong Kong, China-New Zealand Closer Economic Partnership Agreement | Main agreement | Extra- regional |
| 2011 | Comprehensive Economic Partnership Agreement between Japan and the Republic of India | Main agreement | Extra- regional |
| 2011 | Comprehensive Economic Cooperation Agreement between the Government of Malaysia and the Government of Republic of India | Main agreement | Extra- regional |
| 2011 | Peru - Korea Free Trade Agreement | Main agreement | Extra- regional |
| 2011 | China-Costa Rica Free Trade Agreement | Main agreement | Extra- regional |
| 2012 | Free Trade Agreement between EFTA States and Hong Kong, China | Main agreement | Extra- regional |
| 2012 | Agreement between Japan and the Republic of Peru for an Economic Partnership | Main agreement | Extra- regional |
| 2012 | Free Trade Agreement between the United States of America and the Republic of Korea | Main agreement | Extra- regional |

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|---|----------------|--------------------|
| 2010 | Malaysia-New Zealand Free Trade Agreement | Main agreement | Extra- regional |
| 2012 | Malaysia-Chile Free Trade Agreement | Main agreement | Extra- regional |
| 2013 | Costa Rica - Singapore Free Trade Agreement | Main agreement | Extra- regional |
| 2013 | Republic of Korea-Turkey Free Trade Agreement | Main agreement | Extra- regional |
| 2013 | Malaysia-Australia Free Trade Agreement | Main agreement | Extra- regional |
| 2013 | The Agreement between New Zealand and the Separate Customs Territory of Taiwan, Penghu, Kinmen, and Matsu on Economic Cooperation | Main agreement | Extra- regional |
| 2014 | Free Trade Agreement between Hong Kong, China and Chile | Main agreement | Extra- regional |
| 2014 | Free Trade Agreement Between the Government of the People's Republic of China and the Government of Iceland | Main agreement | Extra- regional |
| 2014 | Free Trade Agreement between the Government of Australia and the Government of the Republic of Korea | Main agreement | Extra- regional |
| 2014 | Agreement between Singapore and the Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu on Economic Partnership | Main agreement | Intra- regional |
| 2014 | Free Trade Agreement between the Swiss Confederation and the People's Republic of China | Main agreement | Extra- regional |
| 2015 | Free Trade Agreement Between Canada and The Republic of Korea | Main agreement | Extra- regional |
| 2014 | Free Trade Agreement Between Chile and Vietnam | Main agreement | Extra- regional |

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|---|----------------|--------------------|
| 2013 | Free Trade Agreement between Singapore and the Gulf Cooperation Council (GCC) | Main agreement | Extra- regional |
| 2015 | Agreement between Japan and Australia for an Economic Partnership | Main agreement | Extra- regional |
| 2015 | Free Trade Agreement between New Zealand and the Republic of Korea | Main agreement | Extra- regional |
| 2015 | Free Trade Agreement between the Government of Australia and the People's Republic of China | Main agreement | Extra- regional |
| 2015 | Free Trade Agreement between the Government of the People's Republic of China and the Government of the Republic of Korea | Main agreement | Intra- regional |
| 2016 | Agreement between Japan and Mongolia for an Economic Partnership | Main agreement | Intra- regional |
| 2016 | Colombia-Korea Free Trade Agreement | Main agreement | Extra- regional |
| 2015 | Free Trade Agreement between the Government of the Republic of Korea and the Government of the Socialist Republic of Viet Nam | Main agreement | Intra- regional |
| 2015 | Free Trade Agreement between the Government of the Republic of Chile and the Government of the Kingdom of Thailand | Main agreement | Extra- regional |
| 2016 | Eurasian Economic Union (EAEU) - Viet Nam Free Trade Agreement | Main agreement | Extra- regional |
| 2017 | Hong Kong special administrative region and Macao special administrative region closer economic partnership arrangement | Main agreement | Intra- regional |
| 2015 | Free Trade Agreement Between the Government of the Republic of Turkey and the Government of Malaysia | Main agreement | Extra- regional |
| 2018 | Free Trade Agreement between the Government of Georgia and the Government of the People's Republic of China | Main agreement | Extra- regional |

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|---|------------------------------------|--------------------|
| 2018 | Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) | Main agreement | Extra- regional |
| 2018 | Free Trade Agreement between the EFTA States and the Philippines | Main agreement | Extra- regional |
| 2017 | Free Trade Agreement between the Republic of Singapore and the Republic of Turkey | Main agreement | Extra- regional |
| 2016 | Protocol to amend the Framework Agreement on Comprehensive Economic Co-operation between the Association of Southeast Asian Nations and the People's Republic of China | Implementing agreement/Protocol | Intra- regional |
| 2015 | The First Protocol to Amend the Agreement Establishing the ASEAN-Australia- New Zealand Free Trade Area | Implementing agreement/Protocol | Extra- regional |
| 2016 | Third Protocol to Amend the Agreement on Trade in Goods under the Framework Agreement on Comprehensive Economic Cooperation among the Governments of the Member Countries of the Association of Southeast Asian Nations and the Republic of Korea | Implementing agreement/Protocol | Intra- regional |
| 2003 | Framework Agreement on Comprehensive Economic Co-operation between the Association of Southeast Asian Nations and the People's Republic of China | Framework Agreement | Intra- regional |
| 2004 | Framework Agreement on Comprehensive Economic Cooperation Between the Republic of India and the Association of Southeast Asian Nations | Framework agreement | Extra- regional |
| 2003 | Framework for Comprehensive Economic Partnership between Japan and Member States of the Association of Southeast Asian Nations | Framework agreement | Intra- regional |
| 1992 | Framework Agreements on Enhancing ASEAN Economic Cooperation | Framework agreement | Intra- regional |

| Year of entry into force | Name of free trade agreement texts | Type of texts | Type of region |
|-----------------------------|---|------------------------------------|--------------------|
| 2000 | ASEAN Framework Agreement on the Facilitation of Goods in Transit | Framework agreement | Intra- regional |
| 2009 | ASEAN Trade in Goods Agreement | Main agreement | Intra- regional |
| 1997 | ASEAN Agreement on Customs 1997 | Main agreement | Intra- regional |
| 2014 | ASEAN Agreement on Customs 2012 | Main agreement | Intra- regional |
| 2008 | Protocol amending the Agreement between Japan and the Republic of Singapore for a New- Age Economic Partnership | Implementing agreement/Protocol | Intra- regional |
| 2017 | Agreement between the Government of Japan and the Government of Malaysia for an Economic Partnership: Operational Procedures referred to in Chapter 3 (Rules of Origin) | Implementing agreement/Protocol | Intra- regional |
| 2006 | Framework Agreement on Comprehensive Economic Cooperation Among the Governments of the Member Countries of the Association of Southeast Asian Nations and the Republic of Korea | Framework agreement | Intra- regional |

Appendix 6: Thesis report

CENTRAL EUROPEAN UNIVERSITY/

INSTITUT BARCELONA D'ESTUDIS INTERNACIONALS

Using machine learning to estimate impacts of free trade agreements on export

performance: A case of East Asian economies

Nguyen Mai Hao

Erasmus Mundus Master's Program in Public Policy

Author's Declaration

I, the undersigned Nguyen Mai Hao hereby declare that I am the sole author of this thesis report. To the best of my knowledge this thesis report contains no material previously published by any other person except where proper acknowledgement has been made. This thesis report contains no material which has been accepted as part of the requirements of any other academic degree or non-degree program, in English or in any other language. This is a true copy of the thesis report, including final revisions.

Date: 20 September 2019

Name: Nguyen Mai Hao

Signature:

Apre

Using machine learning to estimate impacts of free trade agreements on export performance: A case of East Asian economies

1. Introduction

Considerable attention has been paid in the literature on the impact of trade liberation and free trade agreements on trade performance of countries. However, few research reviews wordings of the agreements and assesses which substance in the agreements promote or hinder export performance of countries. To address the gap, the thesis employs text analysis in general and Wordscores in particular as one of machine learning tools in assessing how free trade agreements affect export performance of East Asian economies¹⁰.

The thesis will provide additional insight on how substance, especially trade barriers and trade facilitation measures, in the agreements could affect export performance of East Asian economies. Understanding trade barriers and trade facilitation elements embedded into the legal texts of free trade agreements would help policy makers take advantage of signing the agreements when drafting the upcoming legal texts. Regarding case selection, the thesis chooses East Asian economies in order to apply text analysis in a relatively large number of trade agreements and review relationship between the adoption of these legal commitments and export growth. Thesis report includes six main parts, namely problem specification, initial literature review, methodology, hypotheses and case study selection, and work plan.

2. Problem specification

The emergence of preferential trade agreements attracts global interest of qualitative and quantitative scholars in recent years. While qualitative studies provide a general picture of liberalization process and legal structures of free trade agreements, quantitative literature

¹⁰ The paper defines East Asian economies as ten ASEAN member states plus Japan, South Korea, Australia, New Zealand, India, China, Hong Kong – China, and Chinese Taipei. ASEAN member states are Indonesia, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, Vietnam, Lao PDR, Myanmar, and Cambodia.

mainly investigates the relationship between export value and other macroeconomic indicators in computable general equilibrium (CGE) models, the gravity model, and export and import demand function. Both these studies overlook the relationship between legal terms of free trade agreements and export performance of Parties in the agreements. By adopting text analysis, the thesis presents an opportunity to overcome these issues.

First, it adds a dynamic component by assessing the strategic plans of countries in promoting their export when they enter a negotiation round with other countries. Existing literature on free trade agreements of East Asian economies usually is silent about assessing how the formulation of legal texts of free trade agreements could affect export of countries in the free trade agreements. These qualitative research only analyze institutional issues of trade agreements (Low 2003), provide general description of commitments of parties in trade agreements (Tongzon 2003), and conduct qualitative assessment of restrictive regulatory barriers in trade facilitation in service industries (U.S. International Trade Commission 2003, x, xix-xx). Park (2018) mainly explains liberalization process through regional trade agreements in East Asia and characteristics of these agreements. In addition, U.S. International Trade Commission 2003 (Ibid, x) not only acknowledges the potential economic impact of the reduction of non-tariff barriers related to services and investment, and better enforcement of intellectual property rights, but also emphasizes difficulties in measuring the impact. In summary, by using qualitative methods, recent scholars only review the legal terms of trade agreements, but fail to offer a way to understand the relationship between the legal terms of the free trade agreements and export performance. This failure comes from the fact that trade agreements vary in their structure and contain a large amount of texts, which is difficult to process.

Second, the thesis methodologically complements recent studies on the impact evaluation of trade agreements. Recent studies often adopt three common empirical tools: computable general equilibrium (CGE) models, the gravity model, and export and import demand functions.

CGE models seems to be the most common approach which offer a chance to examine two scenarios with and without trade agreements. However, CGE have a number of disadvantages. One drawback is overlooking the removal of non-tariff barriers which can facilitate deeper integration (Toh Mun Heng and Khine Thet Suu 2009, 10). These CGE models were applied in some trade agreements between Singapore and partners, especially the U.S (U.S. International Trade Commission 2003), and the EU (European Parliament 2018). Gravity model helps to capture non-quantifiable aspects of free trade agreements as control variable in estimated equations, but provide insufficient evidence to the inclusion of the explanatory variables and potential strong bias effect in the gravity model (Toh Mun Heng and Khine Thet Suu 2009, 11). Export and import demand functions provide an ex-post evaluation of free trade agreements (Ibid, 12, 27-31). However, both gravity model, and export and import demand functions still fail to address the changes of wordings in free trade agreements in general and non-tariff barriers embedded free trade agreements in particular. Wordings in these agreements are important and can lead to differing levels of export facilitation. For example, when comparing trade agreements that require submission of a paper certificate of origin and a free trade agreement that allows Parties to use electronic certificate of origin, enterprises tend to favour the latter trade agreement since it helps reduce their export time and lower export cost.

To tackle drawbacks of qualitative and quantitative methodologies used in analyzing trade agreements, text analysis can process high-dimensional data and allow researchers to investigate large amounts of text quantitatively (Gentzkow, Kelly, and Taddy 2017, 2). To be more specific, high-dimensional data of legal commitments is characterized by a document-feature matrix, which is then beneficial for mapping the relationship between legal commitments and trade facilitation scores of legal commitments. These trade facilitation scores will act as an input in regression models which allows to predict export performance in

upcoming free trade agreements. The prediction also encourages legislators to review their negotiation plans in order to reach a higher level of export value in the future.

Considering complex effects of free trade agreements on export performance, policy makers should consider the impact of legal terms of free trade agreements on export performance of exporting Parties when building negotiation plans. In this context, the thesis aims to answer the following question: Do the changes in legal texts of trade agreements strongly affect the export performance of East Asian economies?

3. Initial literature review

Theories of absolute advantage and comparative advantage in the late 18th and early 19th century not only contribute to basic understanding of participation of countries in international trade but also promote latter studies on the benefits of international trade. According to absolute advantage, each country is likely to export the products which the country has higher labor productivity. Comparative advantage introduces the importance of opportunity cost, which implies that all countries, even ones with less productive at producing all goods, can benefit from producing certain products and engaging in trade with other countries. The grounding theories facilitate recent studies to investigate competiveness of countries and benefits of international trade; see, for example Krueger (1998) mentions about positive effects of resource allocation on trade liberalization, Jayawickrama and Thangavelu (2010) analyzes changes in export competiveness of Singapore over time when Singapore forms trade linkages with China and India. Given the role of comparative advantage in international trade, the thesis will examine comparative advantage of East Asia countries in typical industries and how East Asia countries exploit their advantage in negotiating tariff and non-tariff commitments under free trade agreements. Recent studies describe potential benefits of free trade agreements to trade flows between countries. After the adoption of the very first multilateral trade agreement named the General Agreement on Tariffs and Trade (GATT) in 1948 and the establishment of World Trade Organization (WTO) in 1995 helps to create basic multinational rules governing tariff, antidumping measures, non-tariff measures, and services, both developed and developing countries show their attempt to develop higher integration, which results in a proliferation of over 250 regional trade agreements in force globally. Regional trade agreements would facilitate better integration among a few parties with reconcilable interest in typical areas and enrich multilateral trade agreements which fails to address complex issues like customs traffic, and electronic trade (Trakman 2008, 380 - 381). Compared with multilateral trade agreements, one country can grant greater market access to foreign partners through lower tariff barriers or reduced nontariff barriers (Lynch 2010, 3).

Free trade agreements may, however, come with negative consequences. When analyzing four negative effect of regional trade agreements on the overall wealth fare of the world, Trakman (2008) argues that the agreements could create a reduction in trade with non-parties, and negative trade distortion especially in agricultural trade which is diverted from developing to developed countries (379 – 380). Some parties that gain more negotiation power when they are part of a large group may experience a disadvantageous position in a bilateral trade agreement negotiation (Ibid, 381). To tackle the above disadvantages of regional trade agreements, Trakman emphasizes the reduction of barriers to trade as a necessity to achieve closer integration between economies (Ibid, 370 - 371). Given potential unfavourable effects of tariff and non-tariff barriers, United Nations ESCAP (2018, 2-3) encourages Asia and the Pacific to adopt trade facilitation measures since digital trade facilitation can boost export by nearly \$257 billion a year and lift annual GDP by 0.32% between 2015 and 2030.

82

Considering mixed effects of free trade agreements on trade flows between countries and potential benefits of trade facilitation measures, the thesis will assess the impact of legal commitments, especially on tariff, non-tariff and trade facilitation measures, on export performance of East Asian economies.

4. Methodology

4.1 Concepts and theoretical framework about trade barriers and trade facilitation

By reviewing and comparing different types of trade barriers and trade facilitation measures in free trade agreements of East Asian economies, the thesis would assess the relationship between trade facilitation measures, trade barriers and export performance of East Asian economies over time.

4.1.1 Trade barriers

Parties in a free trade agreement can apply trade protective measures which include tariff barriers or nontariff barriers. While tariff barriers are clearly prescribed in the tariff schedule of countries in the agreement, nontariff barriers are more complicated in terms of forms. Non-tariff measures (NTMs) are generally defined as "policy measures that could have an economic effect on international trade in goods, that is, changing quantities traded, prices, or both" (The World Bank 2018, 12). World Customs Organization (n.d., 6-8) describes several discriminatory trade measures where countries can abuse rules of origin for preventing export flow, which goes beyond the initial purpose of rules of origin in determining the economic nationality of a typical good. For example, environmental or sanitary measures can prevent the import of contaminated food and plants, hazardous material and waste. Safeguard measures or tariff quotas to supplying countries could reduce their export volume. Lower export value of one country can come from measures of other countries to protect local industry or give preference to countries in regional cooperation agreements. Administrative barriers of each

country seem to create more obstacles to the implementation of trade facilitation measures. Local customs administrations still require the proof of origin in paper format, despite the legal allowance of electronic certificates of origin (World Customs Organization 2017, 185). The limitation in adoption electronic certificates is confirmed by a survey conducted by World Customs Organization. In the survey, 5% out of 108 Customs administrations indicates their acceptance of electronic format (Ibid, 188).

4.1.2 Trade facilitation

Enterprises, especially small and medium-sized enterprises, have long acknowledged the hurdles in cross border transaction due to "red tape" of other countries. Given the difficulties, members of World Trade Organization signed the Trade Facilitation Agreement which entered into force on 22 February 2017. International organizations have similar definitions of trade facilitation. Trade facilitation is generally considered as the simplification, modernization and harmonization of export and import processes (World Trade Organization 2019a). United Nations Economic Commission for Europe (2019) adds information flow as an element of trade facilitation: "the simplification, standardization and harmonization of procedures and associated information flows required to move goods from seller to buyer and to make payment". According to Trade Facilitation Agreement Facility (n.d.), trade facilitation measures would enhance effective cooperation between customs and relevant authorities on customs compliance issues, increase participation of enterprises in global value chains, and reduce the scope for corruption.

Regarding trade facilitation measures in regional trade agreements, WCO (2018) examines the list of 43 main customs-related trade facilitation measures in seven categories namely transparency and predictability, disciplines on fees and charges, border agency cooperation, formalities and documentation requirements, transit and temporary admission, and customs

cooperation. The list will provide a reference for examining which trade facilitation measures in free trade agreements can facilitate export volume of Parties in free trade agreements of East Asian economies.

4.2 Description of text analysis and machine learning tools

The thesis follows recent developments in using text analysis and machine learning tools in economic research. Text analysis has recently been used to assess the textual similarity of free trade agreements. For example, by using textual similarity approach, Alschner, Seiermann, and Skougarevskiy (2017) construct an indicator comparing preferential trade agreements to the Trans-Pacific Partnership (TPP) in order to assess the impact of TPP on trade between member countries. Textual similarity approach also allows Seiermann (2018) to create an indicator capturing the resemblance of preferential trade agreements and claims that the exports of countries that had a greater influence on the treaty text increase more than their partners. Some new machine learning tools like Multiple Correspondence Analysis and Principal Component Analysis have investigated the relationship between depth of trade agreements and trade volume. Multiple Correspondence Analysis helps to capture depth of trade agreements and proves higher depth leads to higher trade Ahcar, Siroen, and Siroën (2014). Principal Component Analysis also helps to confirm that depth of trade agreements is also highly correlated with higher domestic value added and foreign value added of intermediates Laget et al. (2018).

Following suggestion about adopting text analysis approach, provided by (Gentzkow, Kelly, and Taddy (2017, 2-3), the thesis will conduct three steps, namely representing legal commitments between East Asian economies and their trading partners (legal document D) as a document-feature matrix (a numerical array C), mapping the document-feature matrix to trade facilitation scores of legal commitments (outcome of interest V), and applying trade facilitation

scores in predicting export value. This part of the thesis report will describe details of the first two steps and the third step will be presented in Part 6.2 of the thesis report.

4.2.1 Representing legal commitments as a document feature matrix

The thesis will follow three kinds of simplification suggested by Gentzkow, Kelly, and Taddy (2017, 5-7) about construction of individual documents, feature selection, determination of ngrams. These three steps help to create a representation of legal commitments as a documentterm matrix in which rows are accumulated legal commitments, columns are terms, and cells indicates the frequency of each term in each accumulated legal commitment.

4.2.1.1 Accumulating legal commitments

The thesis will determine the content of accumulated legal commitments as individual documents. Given the fact that the division of text into individual documents depends on the level at which the outcome of interest V are defined (Ibid), the thesis will examine legal commitments of East Asian economies with individual economies over the period from 1971 to 2019. Based on above research questions, final outcome of interest is annual export value or export growth of East Asian economies to their trading partners in free trade agreements. Accordingly, individual documents are legal commitments of each East Asian economy to its trading partners in free trade agreements. Legal commitments include the most important chapters like trade in goods, trade in services, and trade facilitation. Besides these main chapters, other chapters which contain commitments having certain influence on trade performance will be added to accumulated legal commitments.

The thesis uses regional trade agreements database, provided by World Trade Organization (WTO) from <u>http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx</u>. This repository link only attaches main texts and annexes of free trade agreements which member states notified World Trade Organization. In case there is any amendments to the trade agreements, the thesis needs

to go directly to national or regional trade databases which provide protocols to amend trade agreements.

4.2.1.2 Pre-processing accumulated legal commitments

In order to reduce feature selection in high-dimensional data of legal commitments, the thesis preprocess accumulated legal commitments. Following suggestion of Denny and Spirling (2017, 6-9) about preprocessing text, the thesis will describe several procedures namely removing punctuation and numbers, lowercasing, stemming, eliminating stop words, and adding n-grams to document-term matrix.

Removal of punctuation aims to eliminate uninformative components in legal commitments like markup, punctuation, special characters (\$, %, &, *, etc) and extra white-space characters. The exclusion of numbers from text is necessary because feature of interest are non-tariff barriers in accumulated legal commitments while tariff barriers are presented in a control variable. Lowercasing of all letters in words is suitable for corpus analysis because of same meaning between words with their first letter having uppercase or lowercase. Stemming, which reduce a word to its basic form, includes several types namely Porter stemmer, Snowball stemmer. Regarding removal of stop words, Natural Language Toolkit (NLTK) provides a default list of stop words. Beside the list, the thesis will consider adding more stop words like "country", "Party", "article", "agreement". The additional stop words contain words occur many times in free trade agreements, but reflect no difference among the agreements.

4.2.1.3 Creating a document term matrix

The thesis will produce create document-term matrix for representing corpus of accumulated legal commitments in a bag-of-words format. With regards to the extent of dependence limitation among language elements, Gentzkow, Kelly, and Taddy (2017, 7) consider bag-of-words representation as a way to encode features of text. Since representation depends on

research interest of words and phrases (n-grams), the choice of n-grams in this thesis depends on single words and phrases which provide insight on the level of trade facilitation and trade barriers. When applying the bag-of-words, the thesis will count 1-gram, 2-grams and 3-grams in order to capture meaning of words and phrases like "electronic declaration", "predetermination of origin", "advance rulings", "electronic commerce", "border cooperation" and "e-customs".

Since each term provides unequally informative content of accumulated legal commitments, Welbers, Van Atteveldt, and Benoit (2017, 10-11) suggest two ways to create a document term matrix. The first technique is to filter rare term. If rare terms provide little information about trade facilitation, filtering very rare terms by using thresholds for minimum and maximum proportion of these terms in documents would help to improve accuracy. The second technique is weighting scheme which use term frequency-inverse document frequency (tf-idf). Tf-idf is the product of two metrics namely term frequency (tf) and inverse document frequency (idf). While term frequency essentially counts how often a term occurs in a document, inverse document frequency assigns less weight to terms that occur often across documents and more weight to those that happens in a few numbers of documents. However, this weighting scheme gives higher score to rare words, which may lead to higher bias of rare words' score in text analysis methods like Wordscore (see Part 4.2.2). Therefore, the thesis will only apply filtering technique if adopting Wordscores.

4.2.2 Mapping the document-feature matrix to trade facilitation scores of accumulated legal commitments

In order find positions of accumulated legal commitments on trade facilitation, the thesis will adopt Wordscores as a scaling method. The selection of Wordscore comes from the idea that the existence of certain words or phrases can create typical ideologies or positions of free trade agreements about trade facilitation. In other words, Wordscore can provide scores of words or phrases related to trade facilitation and scores of legal commitments. Despite these advantages, Wordscore may generate problems about informative words and biased word scores (Lowe 2008, 360 - 365), which will be addressed in the thesis as follows:

First, Wordscore approach assumes that each word has same contribution to information about document (Ibid, 360 - 361) suggests that Wordscore will fail to recognize the difference between informative politically centrist words and functional linguistic words. This problem can be solved by removing general stopwords like "a", "an", "the" and an additional stopword list of typical words in legal documents like "article", and "parties".

Second, Wordscore approach may create biased word scores due to insufficient overlap of word distributions across reference documents (Ibid, 365). In other words, rare words that is unique to a reference document tends to receive highest score, which leads to difference between correct scores and estimated scores of these rare words. To tackle this potential biased word score, the thesis will use a reasonably large number of reference documents and eliminate rare words in pre-processing step.

According to Laver, Benoit, and Garry (2003), main procedures of Wordscore approach includes three following steps:

4.2.2.1 Identify reference legal commitments that represent the extremes of trade facilitation like deep-trade and shallow-trade positions

The thesis will choose some accumulated legal commitments as reference documents and set reference scores to these documents.

This reference values could be assigned by reviewing depth index of regional trade agreements provided by the Design of Trade Agreements (DESTA) project (Dür, Andreas 2014). DESTA project provides two indexes about depth of trade agreements that have been signed since 1945. First, an additive index combines scores of seven key provisions about tariff reduction, and

cooperation in areas like services trade, investments, standards, public procurement, competition and intellectual property rights. Second, a latent index, computed by latent trait analysis, provides a continuous measurement of depth. These indexes would help to identify scores of reference legal commitments in Wordscore approach.

4.2.2.2 Calculate word score of reference legal commitments

sr is the score of legal commitment document r in the training set ("reference score")

 $P(f_i)$ is the probability of feature f_i in the training set.

 $P(f_k | d)$ is the probability of feature f_k in document d in the validation set.

Word scores of reference legal commitments (w_i) are feature frequencies weighted "reference scores":

$$w_i = \sum_{r=1} s_r P(f_i)$$

4.2.2.3 Predict document score of remaining legal commitments

Predicted score of remaining legal commitments are placed between the reference legal commitments. Predicted document scores are word scores weighted by feature frequencies.

$$s_d = \sum_{k=1}^{k} w_k P(f_k)$$

sd is the predicted score of legal commitment document r in the validation set and test set

5. Hypotheses and case study selection

5.1 Hypotheses

The thesis will test the following hypotheses, which follow theoretical framework discussed above:

5.1.1 Main hypothesis

H1: "Free trade agreements containing higher proportion of words and phrases related to trade facilitation leads to higher exports of East Asian economies.

The paper will examine the following group of words and phrases related to trade facilitation: Trade facilitation, electronic declaration, pre-determination of code, pre-determination of origin, pre-determination of customs value, advance rulings, customs clearance, e-customs, electronic commerce, Intellectual property rights, expedite, release, uniformity, border cooperation, transit notification, transparency, regulatory cooperation, regulatory convergence, technical regulations, conformity assessment, non-discriminatory terms/ conditions, international standards, information, publication.

This group of words and phrases can be tested by finding sign and absolute value of corresponding coefficients of certain words and phrases.

5.1.2 Additional hypotheses

Additional hypotheses involve analysis of relationship between export performance and control variables like import tariff, export tariff, domestic output of exporting and importing Parties, geographical distance between the countries, and real effective exchange rate.

H2: Lower import tariff of trading partners is related to higher export to these trading partners.

H3: Higher export tariff of East Asian economies is related to their lower export to trading partners.

H4: Domestic output of East Asian economies and importing countries has a positive impact on export performance of East Asian economies.

H5: Logistic performance of East Asian economies and importing economies has a positive influence on export performance of East Asian economies.

H6: Geographical distance between East Asian economies and importing economies is negatively related to export of East Asian economies.

H7: Depreciating real effective exchange rate of East Asian economies has a positive influence on export performance of East Asian economies.

5.2 Case study selection

East Asian economies is considered as an active region in global trade. The average percentage of trade to GDP over the period of 2000 - 2017 is 94.6% for this region, significantly higher than the world aggregate with 44.9%. Out of total trade, export of goods and services from East Asian economies equals to 60.2% of GDP in this period. The thesis selects 18 East Asian economies as a case study for several reasons.

East Asian economies offer a relatively large number of trade agreements to be examined by text analysis. Although there is not a precise number of observations required in Wordscore model, a reasonable number of trade agreements is reasonably enough for choosing reference legal commitments. According to database of regional trade agreements, East Asia economies have 89 single free trade agreements notified to World Trade Organization (World Trade Organization 2019b). In addition, since there is an overlapping membership in free trade agreements, additional accumulated legal commitments extracted from two or more trade agreements will be added to the scaling model.

This case study selection allows to examine variance in export growth and implementation of legal commitments, especially on trade facilitation, among eighteen East Asian economies. According to ESCAP, implementation rate of trade facilitation measures is quite heterogeneous in East Asian economies. Singapore and Australia have highest implementation rate of over 90% while Brunei Darussalam, Viet Nam, and Myanmar have relatively low level of implementation, at 52.7 per cent, and 51.6 per cent respectively (United Nations ESCAP 2018,

9; 2017, 9). The East and North-East Asia sub-region, covering China, Japan, Republic of Korea and Mongolia has average implementation rate of 73.7% (United Nations ESCAP 2017, 2). Annual export growth in the period from 2010 to 2017 also varies among East Asian economies, ranging from -3.72% (Brunei) to 13.4% (Vietnam). Vietnam, Cambodia, Lao PDR have high export growth of 13.4%, 12.5%, 12.4% respectively, while more developed countries like India, Singapore, Japan have a moderate annual export growth of around 5 - 6% (The World Bank 2019).

6. Work plan

| Time | Parts of the thesis |
|--------------------------------|-------------------------------------|
| September 2019 – December 2019 | Collect and process data |
| January 2020 – February 2020 | Complete the first draft of thesis |
| March 2020 – April 2020 | Complete the second draft of thesis |
| May 2020 | Submit final thesis |
| September 2020 | Oral defense of thesis |

6.1 Collect and process data

6.1.1 Data about dependent variables

The thesis uses data on merchandise export and service export from United Nations Conference on Trade and Development (UNCTAD).

- Annual merchandise export value to each member of free trade agreements (time period: 1971

- 2018)

- Annual service export value to each member of free trade agreements (time period: 2000 – 2018)

6.1.2 Data about main independent variables

The main independent variable of interest is trade facilitation scores of legal commitments denoted by LE_{it} . To construct this variable, the thesis follows steps previously mentioned in Part 4.2.1 and 4.2.2.

6.1.3 Data about control variables

Besides the above main independence variable, the thesis adds several control variables as follows:

- The annual level of binding/actual import and export tariff of each Party:

One concern may be that higher export tariff of exporting countries and lower import tariff of importing economies can promote higher export of exporting countries. To address this concern, the thesis includes control variables capturing bilateral tariffs in the regression. Data on tariffs comes from the two portals of United Nations Conference on Trade and Development (UNCTAD) namely Trade Analysis Information System (TRAINS) database and World Integrated Trade Solution (WITS).

- Annual gross domestic product (GDP) of each Party:

Large and developed countries may have higher demand for imported products. If GDP of partnering countries has an effect on export volume from exporting countries, the thesis will control for the effect of GDP. Data on GDP comes from the World Bank Development Indicators database.

- Distance between Parties:

Close geographical distance may facilitate higher trade among neighboring Parties compared to countries far away from each other. To verify this, the thesis controls for distance between Parties.

- Logistics performance index of Parties:

This index measures challenges and opportunities which countries face in their performance on trade logistics (The World Bank 2014). While commitments in free trade agreements portray legal infrastructure of Parties, logistics performance index shows current status of physical infrastructure of the Parties.

- Real effective exchange rate:

Real effective exchange rate measures the real value of a country's currency against a basket of other trading currencies. Real effective exchange rate with a positive sign of its coefficient implies a depreciation of local currency and price competiveness of local industries in relation to foreign industries. annual real effective exchange rate of countries from 1960 to 2018 can be obtained from International Monetary Fund, World Bank and United Nations Conference on Trade and Development.

6.2 Complete the first draft of thesis

In order to check the hypotheses, this step includes running several regressions and report regression results with the addition of control variables to main specification. Adding control variables helps to check robustness of main regression results. Inclusion of lags and leads of trade policy variables in regression models could be necessary in order to address the concern that countries may decide to participate in a trade agreement with a specific partnering economy if these countries expect higher bilateral export in the future.

Main specification is described as follows:

 $EX_{ijt} = a_0 + \beta_1 LE_{ijt} + \beta_2$ control variables $+ \gamma_{it} + \varsigma_{jt} + \varepsilon_{ijt}$

 EX_{ijt} : Log of export volume or export growth of from Party i to Party j in year t

 LE_{ijt} : Trade facilitation scores of legal commitments between Party i to Party j in year t

Control variables: annual level of binding/actual import and export tariff, GDP, distance, real effective exchange rate and logistics performance index of Parties of each Party

 γ_{it} : Exporter-year fixed effect

 ς_{it} : Importer-year fixed effect

 ε_{ijt} : Exporter-Importer time fixed effect

6.3 Complete the second draft of thesis

6.3.1 Model evaluation

Since supervised models like Wordscore can be over-fitted to training data, the thesis will conduct out-of-sample test, which includes several different versions namely split-half validation, n-fold cross-validation, and leave-one-out cross-validation.

a. Split-half validation

The thesis will randomly use half of the manually coded legal commitment documents for training and other half for validation. This split-half validation provides mean squared error of validation set or an estimate of the test error rate.

b. The bootstrap

By repeatedly and randomly sampling from original dataset of N accumulated legal commitments, the bootstrap help to estimate standard errors of estimated scores of legal commitments.

c. Leave-one-out cross-validation

Given N accumulated legal commitments, this leave-one-out cross-validation (LOOCV) uses N-1 legal commitment documents for training and only one legal commitment document for validation but repeat N times. The LOOCV estimate for mean squared error of test error is the average of N test error estimates.

6.3.2 Prediction

After validating Wordscore model and estimating coefficients in the main regression, the thesis will make a prediction about export volume of East Asian economies to Parties in upcoming free trade agreements which are expected to come into force after 2018 (EU-Singapore, ASEAN-Hong Kong, China free trade agreement).

EU-Singapore free trade agreement was signed on 19 October 2018 and is under ratification process of Singapore and EU Member States. The thesis will estimate export volume from Singapore to EU Member States in 2021.

ASEAN-Hong Kong, China free trade agreement enters into force on 11 June 2019 for Hong Kong and five ASEAN Member States, namely, Lao PDR, Myanmar, Singapore, Thailand and Viet Nam. The thesis will predict changes in export from ASEAN Member States and Hong Kong to their partners in 2020.

7. Conclusion

The thesis adopts text analysis which aims to bridge the gap between recent qualitative and quantitative literature about the impact of free trade agreements and export performance of Parties when it comes to elimination of tariff and non-tariff barriers in these agreements. Particularly, Wordscore approach will help to determine scores of trade facilitation for each

legal commitment, and evaluate main hypothesis about the relationship between phrases related to trade facilitation and export volume of Parties in free trade agreements.

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