Waseda University Institute of Asia-Pacific Studies
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WIAPS Discussion Paper

Series No.2018-E-3

Regulatory Dissimilarity: A First Look at the Newly Collected Non-Tariff Measure Database

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02/2019

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February 5, 2019

Abstract

In this paper we construct an indicator called dissimilarity indicator to measure what degree a product face different sets of regulations in two countries (exporters and importers). Since the indicator is highly scalable, we can also construct the difference in regulations applied at the sector or at the country level. In this study, we utilized mainly the country-level information to compare regulatory regimes across countries to see how different a country's set of regulations differ from the global norm. In addition, we utilize this indicator to suggest a way to approach regulatory harmonization in various integration efforts in East Asia. Using this indicator, we can identify which country can serve as a base when considering regulatory harmonization. Then countries can negotiate around this base sets of regulations. This approach provides more concrete policy guidance on the issue of regulatory harmonization compared to the tariff-equivalent approach.

1. Introduction

There has been an increasing interest on non-tariff measures and its impact on international trade. When the global trade was expanding thanks to the lowering of tariffs, the impacts stemming from non-tariff measures are becoming relatively more important. The issues of non-tariff measures or the regulations of importing countries have been a subject of interest by researcher, policymakers, and businesses. In order to export to another country, an exporter (and the original manufacturers or the producers) need to comply with regulations of the importing countries. For instance, UNIDO reports that an estimated US$123 million worth of agriculture and food products (fish and fishery products, nuts and seeds, herbs and spices, and fruits and vegetables) were rejected at the borders of four markets (Australia, EU, Japan, and US) in 2010, because these products violated the food safety regulations of the importing countries in some ways (UNIDO 2010).[1] Agriculture and food products have been subject to stringent regulations such as sanitary and phytosanitary standards (SPS)[2] and food safety regulations. Each country has their own sets of regulations in these areas, and it poses difficulties for exporters, especially for developing countries. In addition to the agriculture and food products, manufactured products also face a number of regulations, in many cases on product safety and quality. However, in recent years, a number of regulations are introduced, especially in the European Union to make products more "green". This has led to the introductions of product related environmental regulations.[3] Any one exporting to EU needs to comply with these regulations and this has prompted various actions by manufacturers relocated in East Asia.

The issue of non-tariff measure is becoming even more important in the current state of slowing international trade. This slowdown and concerns on the future of international trade was brought by the actions of the President Trump of the United States. He has introduced a number of trade restrictive measures, especially imposing higher tariffs on key imported materials. A country that has been significantly affected by this is China. While at the initial stage, the focus of the actions by the President Trump has been on raising tariffs, in recent years it has shifted to other instruments, namely regulations. One such example is his intention of introducing a legislation to ban the use

[1] See UNIDO (2010;2015) for the global-level view of import rejection, and IDE-JETRO and UNIDO (2013) for a more detailed examination of import rejections in East Asian countries.

[2] For instance, Crivelli and Groeschl (2016) find that existence of SPS affects market entry by exporters to that country. However, conditional on that they enter, the trade volume is high. Fontagné and others (2015) also finds that restrictive SPS reduce the probability of a firm exporting that market.

[3] On the issue of product related environmental regulations and diffusion of such regulations across countries, please see Michida, Humphrey and Nabeshima (2017).

of products by Huawei (a Chinese telecommunication manufacturer), not only by the US government but also the suppliers to the US government. Depending on how far back that requirement will be imposed on the supply chain, this could have a large impact on the products made by Huawei in the United States and elsewhere.

However, it has been difficult to conduct a systematic study on non-tariff measures since internationally comparable data on these were unavailable. Traditionally the impact of non-tariff measures were computed as the tariff equivalents either by looking at the quantity or prices. Quantity based approach estimates the *ad valorem* equivalent (AVE) tariffs by comparing the estimated and the actual trade values, and at what tariff levels, the actual trade value would be observed based on international trade data.[4] The price based approach utilizes extensive data on domestic prices, information on transportation costs, and international prices. Any price gap is attributed as the impact coming from non-tariff measures.[5] In either of the approach, the issue of non-tariff measure was implied but not exactly pinned down in this kind of approach. This is especially so if a product faces multiple regulations in importing and exporting countries. With the traditional approach of tariff-equivalents, one can only detect that there might be some trade restrictiveness as a whole concerning imports of this product, but where does that restrictiveness arise is left unanswered.[6] Using this approach, one will be faced with difficulties in identifying a suitable approach towards deeper integration which may include regulatory harmonization. In essence, the current tariff equivalent approach leaves the non-tariff measure component as a black box. This kind of approach was taken since there was no systematic database on non-tariff measures.

In this study, we utilize a newly created data set by UNCTAD in collaborations with many entities, to calculate what we call, "dissimilarity indicator". This indicator measures to what degree regulations in one country differ from the other countries. One advantage of this indicator is that it is highly scalable. One can calculate this measure at the product, sector/industry, or the country level as long as the underlying data on regulations are collected. In addition, this indicator also allows us to compare the difference in regulatory regimes in each country. Such analysis is useful, especially for a group of countries that are considering "deep" integration. We will illustrate this using

[4] See for instance, Kee, Nicita and Olarreaga (2009) who follow this approach.
[5] See Cadot and Gourdon (2016); Cadot and Ing (2015) for this approach.
[6] In addition, for the quantity-based approach, the assumption is that the model (often gravity-type model) is correctly specified. Any misspecification could turn up as the AVE. For the price effect, the question remains on the difference in market structure in each country. Higher domestic prices could be the result of more concentrated market structure, which may or may not be the result of non-tariff measures.

the regional integration efforts currently undergoing in East Asia.

The organization of the paper is as follows: Section 2 explains in detail the underlying data on non-tariff measures and how we construct the dissimilarity indicator. Section 3 provides overview of the regulatory differences across countries. Section 4 utilizes the dissimilarity indicator to explore the regulatory harmonization issues in the East Asian context, and section 5 concludes.

2. Data and method

We begin with introducing our source of comprehensive data for non-tariff measures in section 2.1. We then explain how we quantify the degree of regulatory differences in terms of the implementation pattern of non-tariff measures between countries in section 2.2.

2.1. UNCTAD's newly collected non-tariff measure database

The UNCTAD has been leading the global effort in uncovering the universe of the existing non-tariff measures all over the world and in developing a comprehensive database for non-tariff measures, in collaboration with its partners of international and regional organizations. Under the initiative of the UNCTAD, national teams of consultants scrutinize legal and regulatory documents to gather information on a comprehensive set of mandatory and official regulations that are currently imposed by the country and that potentially affect imported or exported merchandise products. The gathered information is translated into a database format, by linking the contents of the detected non-tariff measures and the descriptions of the affected products to the predefined non-tariff measure classification codes and the Harmonized System (HS) product classification codes, respectively.

The collected and processed data for non-tariff measures are disseminated sequentially to the public through the UNCTAD's TRAINS: The global database on Non-Tariff Measures.[7] As of the latest update of March 2017, the UNCTAD's non-tariff measure database covers 57 countries listed in Appendix A.

In the M3 version of the UNCTAD's non-tariff measure classification (UNCTAD 2015), non-tariff measures are categorized based on the purposes of the measures into 16 chapters (A to P), each of which is further differentiated into groups in most chapters and into subgroups as well in other chapters. The scope of the worldwide data collection under the UNCTAD's initiative has been limited to Chapters A to I and P. Among them, we limit our attention to non-tariff measures implemented against imported merchandise

[7] http://trains.unctad.org/.

products in this paper, by omitting Chapter P of export-related measures. We also exclude Chapter D (contingent trade protective measures) from our data analysis due to the data incompleteness as of March 2017.[8] We ultimately focus on non-tariff measures categorized under Chapters A (Sanitary and phytosanitary (SPS) measures), B (Technical barriers to trade (TBT)), C (Pre-shipment inspection and other formalities), E (Non-automatic licensing, quotas, prohibitions and quantity control measures other than SPS or TBT reasons), F (Price control measures including additional taxes and charges), G (Finance measures), H (Measures affecting competition), and I (Trade-related investment measures), for which there exist 208 codes in total if including all the possible codes at any aggregation level.

Meanwhile, the products affected by the detected non-tariff measures are reported based on either H2, H3, or H4 version of the HS classification. For the consistency, we convert all the product information to the 6-digit codes of the H2 version.[9] There are 5,226 product codes at the 6-digit level in the H2 version.

2.2. Cosine similarity-based indicator for regulatory differences

To quantify the degree of regulatory differences in terms of the implementation pattern of non-tariff measures between countries, we employ the proximity measure called Cosine similarity, which is often used to compare the content between documents represented by thousands of attributes such as the frequency of a particular keyword. Cosine similarity has been applied not only to information retrieval and text mining, but to biological taxonomy, gene feature mapping, POS and buying history data analysis. In the economics field, the patent literature such as Jaffe (1986) and Branstetter (2006) utilizes the Cosine similarity to measure the proximity of one firm to another in terms of patenting pattern across technology-based patent categories.

Specifically, we first construct a vector representing a set of non-tariff measures implemented by country *i* against imports from the rest of the world as follows:

$$F_i = (F_{i1}, \cdots, F_{ik}, \cdots, F_{iK}),$$

[8] For Chapter D, data is not collected in the same year of the latest data collection as other chapters for some countries. Typically, old data for non-tariff measures categorized under D is just combined with newly collected measures under other chapters. Moreover, we would refrain from analyzing temporary measures categorized under D in a similar way to other permanent measures because they are different in nature.

[9] The conversion tables from the newer version to the older version of the HS classification codes are obtained from the webpage of the Trade Statistics Branch of the UNSD: https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp.

where F_{ik} is a binary variable taking 0 or 1 for the incidence of any non-tariff measure that affects a particular product category and is classified under a particular regulation category. That is, k indicates a particular product-regulation pair. K is 1,087,008 (= 5,226 product codes x 208 regulation codes) at maximum. But K will practically become much lower (353,713 or below in our data analysis) because we do not need to care about the product-regulation pairs that are not observed for any country at all when calculating the Cosine similarity.

Next, using the vectors representing the implementation pattern of non-tariff measures, we calculate the Cosine similarity between a certain pair of countries. In order to provide an overview of international regulatory differences in the next section, we calculate the Cosine similarity for respective countries with respect to the world average implementation pattern of non-tariff measures. We construct the world average vector of

$$F_W = (F_{W1}, \cdots, F_{Wk}, \cdots, F_{WK}),$$

where $F_{Wk} = \sum_j F_{jk}$ and F_{jk} is a binary variable (0 or 1) indicating the incidence of any non-tariff measure implemented by country j for a product-regulation pair k.[10] The Cosine similarity between the country i's vector of F_i and the world average vector of F_W is calculated as

$$\mathrm{Cos}(\theta)_i = \frac{F_i \cdot {F_W}'}{\|F_i\| \|F_W\|} = \frac{\sum_{k=1}^{K} F_{ik} F_{Wk}}{\sqrt{\sum_{k=1}^{K} {F_{ik}}^2} \sqrt{\sum_{k=1}^{K} {F_{Wk}}^2}},$$

where $\mathrm{Cos}(\theta)_i$ is represented using an inner product of the two vectors and their magnitudes. θ is the measure of an angle between the vectors and takes a value between 0 degree (identical) and 90 degree (orthogonal) because both F_i and F_W are composed only of elements with positive values.

At last, we obtain the dissimilarity indicator for the country i's implementation pattern of non-tariff measures with respect to the world average pattern as follows:

$$Dissimilarity_i = 1 - \mathrm{Cos}(\theta)_i.$$

The resulting regulatory dissimilarity indicator ranges from 0 meaning exactly the same to 1 indicating orthogonality or decorrelation.

Although we are not the first to try to quantify the degree of differences in the implementation pattern of non-tariff measures between countries, our Cosine similarity-based regulatory dissimilarity indicator is preferable to the previously proposed method. For example, Olivier Cadot and his coauthors proposed an indicator,

[10] Note that what does matter in calculating the Cosine similarity is not a nominal frequency but the relative size of frequency (i.e., a fraction of the overall number of observations), thereby taking an average and aggregation are substantially the same.

which they call regulatory distance measure (Cadot and Gourdon 2016; Cadot and Ing 2015). The authors calculate the regulatory distance for a pair of countries, i and j, as $d(i,j) = \frac{p-m}{p}$, where p is the maximum possible number of product-regulation pairs (irrespective of the actual incidence) and m is the number of matched product-regulation pairs that are observed in both countries. First, unlike the regulatory distance measure, our regulatory dissimilarity indicator is not dependent on the possible number of product-regulation pairs, that is, the number of components in the vector representing the implementation pattern of non-tariff measures, because Cosine similarity is constructed to be adjusted for the magnitudes of the two vectors to be compared. This feature will be useful when we examine the degree of cross-country regulatory differences by broad type of non-tariff measures (e.g., comparison between SPS measures and TBT) or by industry (e.g., comparison between agricultural and manufactured goods).

Second, each component of the vector representing the implementation pattern of non-tariff measures is not necessarily a binary variable but can be any values. In other words, we could count the number of individual non-tariff measures for a particular product-regulation pair, instead of using a binary variable indicating the incidence of any measure for the product-regulation pair. This feature will enable us to utilize more rich information to quantify the degree of cross-country differences in the implementation pattern of non-tariff measures, compared to the regulatory distance measure, especially when either products or the types of regulations are aggregated into broad categories. In the current paper, however, we simply use a binary variable because we have detailed information on the incidence of non-tariff measures at a finely disaggregated product level and for more than 200 types of regulations.

3. Overview of international regulatory differences

In this section, we provide an overview of international regulatory differences in terms of the implementation pattern of non-tariff measures, using the Cosine similarity-based regulatory dissimilarity indicator as explained in the previous section. A bar chart of Figure 1 shows the regulatory dissimilarity indicators calculated for 57 countries in our dataset with respect to the world average implementation pattern of non-tariff measures. The bars representing respective countries are in descending order according to the score of the regulatory dissimilarity indicator from top to bottom. The score ranges from 0.42 for Russian Federation, whose implementation pattern of non-tariff measures correlates most closely with the world average pattern, to 0.92 for Cote d'Ivoire, whose implementation pattern is most distant form the world average, with the median score of

0.55 indicated by a red vertical line in the figure.

We would notice a few features of the international regulatory differences in the implementation pattern of non-tariff measures: first, neither the EU nor US is placed in the bottom 20% of the bar chart, meaning that their implementation patterns of non-tariff measures are correlated with the world average pattern to a relatively limited extent, compared to other countries listed on the lower part of the chart. Second, developing countries are listed dispersedly across the bar chart. Nevertheless, among developing countries, African countries, except Ghana and Gambia, tend to have higher scores, indicating a large difference from the world average pattern. In contrast, ASEAN and East Asian countries, except China and Cambodia, tend to achieve lower scores, showing a higher correlation with the world average pattern. Third, countries abundant in natural resources, such as Russian Federation, Australia, Brazil, New Zealand, Canada, and Chile, are concentrated in the bottom part of the bar chart. This may suggest the similarity in the implementation pattern of non-tariff measures among resource-rich countries, which appears to contribute to shape the world average pattern.

We look into the international regulatory differences by the type of regulations. In figure 2, radar charts show the regulatory dissimilarity indicators calculated by the chapter of the UNCTAD's non-tariff measure classification for respective countries (blue line), which is compared to the median score across countries (red line). The center of the radar chart indicates the score of 0 while the outer border indicates the score of 1. As the dot plotted on a radiated axis representing a certain chapter, connected by line, is farther apart from the center of the chart, it means that the implementation pattern of non-tariff measures classified under the chapter of interest is more distant from the world average pattern. Countries are listed in descending order of the score of the overall regulatory dissimilarity indicator (as reported in Figure 1) from the top left to the bottom right corner of the figure.

First of all, notice that blue line is potentially displayed in an octagon shape, as the red line showing the median score is, but Argentina is the only country for which we can observe octagon-shaped blue line. As long as we believe that countries in our dataset comprehensively report all the existing non-tariff measures, various cracked octagons shaped by blue line can be interpreted as indicating the diversity in the implementation pattern of non-tariff measures among countries.[11] In particular, non-tariff measures

[11] Some may be skeptical about the comprehensiveness or completeness of the collected and recorded data for the existing non-tariff measures in the UNCTAD's database. In fact, we suspect that the EU data collection team somewhat has failed to detect non-tariff measures classified under Chapter F (Price-control measures). As is

classified under either chapter G (Finance measures), H (Measures affecting competition), or I (Trade-related investment measures) seem unpopular among countries in our dataset. Only 17, 23, and 6 (out of 57) countries report a non-tariff measure or more classified under G, H, and I, respectively.

Secondly, the size of the (potential) octagon shaped by blue line does not shrink in a uniform manner as the score of the overall regulatory dissimilarity indicator becomes lower from the top left to the bottom right corner of the figure. Even the scores for non-tariff measures classified under Chapters A (SPS) and B (TBT), both of which embrace a relatively large number of disaggregated regulation codes, are not always changing in parallel with the overall score. The varying sizes of the blue-colored octagons across countries, as well as their various cracked shapes, would show how diverse the implementation patterns of non-tariff measures are.

Although the radar charts of Figure 2 are useful in spotting a non-negligible degree of the cross-country diversity at a glance, comparing the regulatory dissimilarity indicator calculated for the implementation pattern of so-called technical measures, which are coded under Chapters A to C, with that for non-technical measures enables us more clearly understand the nature of international regulatory differences. Figure 3 plots respective countries' positions, taking the regulatory dissimilarity indicator calculated for technical measures on the vertical axis and that for "hard" measures, that is, traditional instruments of commercial policy, which are classified under Chapters E (Non-automatic licensing and quantity-control measures) and F (Price-control measures), on the horizontal axis. A red horizontal and vertical line indicate the median score for technical measures and hard measures, respectively.

First, African countries are located dispersedly all over the scatter plot. For Ghana and Gambia, which achieve a low score of the overall regulatory dissimilarity indicator (as reported in Figure 1), the regulatory dissimilarity indicator calculated for hard measures is notably low. Second, ASEAN and East Asian countries are concentrated in the lower part of the scatter plot, indicating a low score for technical measures. China and Cambodia have a relatively higher score for technical measures as well as for the overall regulatory dissimilarity indicator, compared to their neighboring countries. China has a notably high score for hard measures as well. More importantly, despite the commonly observed tendency of the scores for technical measures to be low, the score for

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evident from Figure 2, no measure is recorded under F for EU imports. However, EU definitely implements seasonal duties, which is coded as F5 under F, on some fruits and vegetables, as reported, for example, in the USDA webpage: http://www.usda-eu.org/trade-with-the-eu/tariffs/eu-import-duties/.

hard measures varies greatly among ASEAN and East Asian countries, ranging from 0.19 for Lao PDR to 0.97 for China. Similarly, natural resource-rich countries tend to have a low score for technical measures behind the low overall score commonly observed but vary in the scores for hard measures.

In sum, although cross-country differences in the implementation pattern of technical measures can be sorted out in terms of geographical locations and the abundance of natural resources at least to some extent, the implementation patterns of hard measures are more complicatedly diverse across countries and no straightforward tendency can be detected by a casual data observation. It would be worth exploring what factors explain cross-country differences in the implementation pattern of non-tariff measures, in particular, hard measures, in a more statistically sophisticated way, but it is beyond the scope of the current paper and left for future research.

4. Application of the regulatory dissimilarity indicator: Regulatory harmonization

This section demonstrates an example of the application of our regulatory dissimilarity indicator, highlighting its usefulness. As will be shown below, we would be able to utilize the regulatory dissimilarity indicator to think about how a group of countries can efficiently achieve the regulatory harmonization of non-tariff measures through regional integration. In section 4.1, we explain how to approximate the regulatory adoption costs borne by countries in order to coordinate with each other to unify the implementation pattern of non-tariff measures. In section 4.2, taking ongoing regional integration efforts in the East Asian region as examples, we derive one answer to an ideal way of achieving the regulatory harmonization so as to minimize the regulatory adoption costs.

4.1. Calculation of regulatory adoption costs

Let us consider the regulatory harmonization of non-tariff measures among the member countries of a certain regional trade agreement. We are interested in which country's implementation pattern of non-tariff measures would be better served as a benchmark to which the non-tariff measures implemented by other member countries are adjusted through regional integration. We can utilize the regulatory dissimilarity indicator to identify an ideal benchmark in the sense that the regulatory adoption costs borne by the member countries would be minimized.

More specifically, we here consider bilateral regulatory dissimilarity for a certain exporter country with respect to its export destination countries, in a similar way to the with-respect-to-the-world-average indicator introduced in section 2. Suppose there is

regulation A in exporter country while there are regulations A and B in importer country. Because firms operating domestically in the exporter country already comply with regulation A, it is only regulation B that additionally requires compliance by firms to export to the foreign country (in addition to serving a domestic market). Thus, to quantify the degree of bilateral regulatory differences, we should compare regulations implemented by one country against imports from the other country with domestic regulations in the latter country. With this in mind, we define the bilateral regulatory dissimilarity indicator for importer country *i* with respect to exporter country *j* as

$$Dissimilarity_{ij} = 1 - \mathrm{Cos}(\theta)_{ij}$$

with

$$\mathrm{Cos}(\theta)_{ij} = \frac{F_i \cdot F_j{}'}{\|F_i\|\|F_j\|} = \frac{\sum_{k=1}^{K} F_{ik}F_{jk}}{\sqrt{\sum_{k=1}^{K} F_{ik}{}^2}\sqrt{\sum_{k=1}^{K} F_{jk}{}^2}},$$

where F_i is a vector representing a set of non-tariff measures implemented by importer country *i* against imports from country *j*. F_j is a vector representing a set of domestic regulations in exporter country *j*, which is approximated by a set of non-tariff measures implemented by country *j* against imports from the rest of the world. Components of the vectors, F_{ik} and F_{ik}, are binary variables indicating the incidence of any non-tariff measure for a product-regulation pair k.

Let $\mathcal{R}$ be a set of countries participating in a certain regional trade agreement and the total number of the member countries be *N*. Now consider a set of domestic regulations in country $j \in \mathcal{R}$ as a benchmark and other member countries will harmonize their own non-tariff measures with the benchmark regulatory pattern. The bilateral regulatory dissimilarity indicator captures the degree of additional compliance required by firms to export to a certain destination country in addition to their domestic operation. The higher score of the bilateral regulatory dissimilarity indicator implies the higher degree of additional compliance. We therefore approximate the magnitude of the overall adjustment costs for the regulatory harmonization by taking a square-sum of the bilateral regulatory dissimilarity indicators calculated for country j with respect to all the other member countries $i \neq j$. To adjust for the number of countries involved in a regional trade agreement, we divide the square-sum by the degree of freedom (*N*-1), which can be interpreted as the adjustment cost that must be borne on average by countries other than the benchmark country.

The lower the (adjusted) square-sum of bilateral regulatory dissimilarity indicators is, the less the member countries (on average) require additional compliance. In other words, when countries aim at regulatory harmonization through regional integration, taking the country with the lowest square-sum as a benchmark would be ideal because the

regulatory adoption costs borne (on average) by the member countries are minimized. We identify an ideal benchmark country j^* for a regional trade agreement of interest as follows:

$$j^* = \text{argmin}_{j \in \mathcal{R}} \frac{\sum_{i \neq j} \left(Dissimilarity_{ij}\right)^2}{N-1}.$$

4.2. Examples of East Asian regional integration efforts

We take ongoing regional integration efforts in the East Asian region through ASEAN Economic Community (AEC), Regional Comprehensive Economic Partnership (RCEP), and Trans-Pacific Partnership (TPP) as examples and derive an answer to which country's regulatory pattern would be better served as a benchmark to achieve the regulatory harmonization through each regional integration. Although data for non-tariff measures implemented by Republic of Korea is not available in the UNCTAD's database as of March 2017, we have data for all the other countries involved in the above regional integration efforts.

We calculate square-sums of the bilateral regulatory dissimilarity indicators for each of the countries that are involved in a regional integration effort of interest and identify the ideal benchmark country with the lowest square-sum. To compare the magnitude of the regulatory adoption costs, or the ease of achieving the regulatory harmonization, between regional integration efforts, we calculate the degree-of-freedom-adjusted square-sums. In addition, we calculate the square-sums by including large economies in the world market such as the US, EU, Japan, and China, which are of important destination markets for most East Asian countries of our interest. By so doing, we are interested in examining how an ideal benchmark country will be changed when coordination with important trading partner countries outside the regional integration is required, in relation to an argument for open regionalism.

Table 1 shows the overall regulatory adoption costs that are approximated for respective countries taken as a benchmark within a certain group of countries. And the associated, adjusted (average) regulatory adoption costs are in parenthesis. Each column corresponds to the East Asian regional integration effort that is indicated on the top row of the table. "Intraregional" indicates that the regulatory adoption costs reported in the column are based on the bilateral regulatory dissimilarity indicators calculated for a country listed in the leftmost column as a benchmark (exporter) country with respect to all the other (export destination) countries involved in the regional integration. "Open" indicates that the reported regulatory adoption costs are approximated by including the US, EU, Japan, and China (as needed) in addition to intraregional member countries of

the regional integration. For each column, the lowest value is highlighted in the darkest green, the second lowest in medium green, and the third lowest in light green. In addition, Table 2 complements Table 1 by reporting the underlying bilateral regulatory dissimilarity indicators behind the approximation of regulatory adoption costs.

For AEC, although taking Brunei's domestic regulations as a benchmark regulatory pattern minimizes the overall (and adjusted) regulatory adoption cost down to 4.45 (and 0.495) within the region, Thailand, which is ranked as the second lowest in both "intraregional" and "open" settings, appears to be better served as a benchmark country if eventually moving to a wider, open regional setting. Yet, as expected, the overall regulatory adoption costs increase as more countries are included in the open regional setting. Moreover, even the adjusted regulatory adoption costs tend to be higher in the open regional setting than in intraregional setting, with exceptions of Vietnam, Indonesia, and Cambodia, suggesting that a transition to open regionalism would not be that easy.

In RCEP, which embraces more countries involved compared to AEC, not only the overall regulatory adoption costs but also the adjusted figures tend to be high, with exceptions of Lao PDR and Philippines. The mounting costs are prominent in the cases in which domestic regulations in India or China are taken as a benchmark regulatory pattern. The overall (and adjusted) regulatory adoption cost balloons to 9.40 (and 0.672) for India and 8.94 (and 0.638) for China, respectively. Regulatory patterns of these two countries are distant from every pattern of the other countries involved in East Asian regional integration efforts including RCEP (see Table 2). Nevertheless, Australia appears to be an ideal benchmark country both in the intraregional and open regional settings. The adjusted regulatory adoption costs with Australia as a benchmark are 0.495 in the intraregional setting and 0.490 in the open regional setting, which reaches as low as the level of the minimized costs for the case of AEC.

With regard to TPP, we calculate the regulatory adoption costs in the one case of achieving regulatory harmonization among TPP11 and in the other case for TPP12 including the US. For TPP11, Australia appears to be an ideal benchmark as in RCEP and is followed by Japan and Malaysia. The adjusted regulatory adoption cost with Australia as a benchmark is 0.481. For TPP12, however, taking the US as a benchmark minimizes the cost burden though the rounded figures of the adjusted regulatory adoption costs are 0.475 both with Australia and with the US as a benchmark. Also, including the US results in a decline in the adjusted regulatory adoption costs in the cases in which Australia, Japan, New Zealand, or Canada is served as a benchmark. In contrast, interestingly, the presence of the US pushes up the adjusted regulatory adoption costs if either ASEAN countries except Vietnam, Chile, or Mexico is a benchmark.

Comparing East Asian regional integration efforts, it is striking that the adjusted regulatory adoption costs borne by ASEAN and East Asian countries are higher across the board, irrespective of which country to be a benchmark, in RCEP than in TPP. Unlike the TPP, ASEAN latecomers such as Cambodia, Laos and Myanmar where the level of economic development is behind, as well as India and China whose regulatory patterns are little correlated with the other member countries, are involved in RCEP. It appears to be difficult to achieve the regulatory harmonization through RCEP by overcoming the diversity. The adjusted adoption costs for the case of AEC lie somewhere between the levels for RCEP and TPP.

5. Conclusion

In this paper we construct an indicator called dissimilarity indicator to measure what degree a product face different sets of regulations in two countries (exporters and importers). Since the indicator is highly scalable, we can also construct the difference in regulations applied at the sector or at the country level. In this study, we utilized mainly the country-level information to suggest a way to approach regulatory harmonization in their various integration efforts. Using this indicator, we can identify which country can serve as a base when considering regulatory harmonization. Then countries can negotiate around this base sets of regulations. This approach provides more concrete policy guidance on the issue of regulatory harmonization compared to the tariff-equivalent approach. In future studies, researchers can look at in more details on which component of regulations in a set of countries are contributing the most to dissimilarity and explores the way in which these differences can be narrowed.

Appendix A. List of 57 countries included in the UNCTAD's non-tariff measure database, as of March 2017.

Country names	ISO codes	Country names	ISO codes
Afghanistan	AFG	Kazakhstan	KAZ
Argentina	ARG	Lao PDR	LAO
Australia	AUS	Liberia	LBR
Benin	BEN	Malaysia	MYS
Bolivia	BOL	Mali	MLI
Brazil	BRA	Mexico	MEX
Brunei	BRN	Myanmar	MMR
Burkina Faso	BFA	Nepal	NPL
Cambodia	KHM	New Zealand	NZL
Canada	CAN	Nicaragua	NIC
Cape Verde	CPV	Niger	NER
Chile	CHL	Nigeria	NGA
China	CHN	Pakistan	PAK
Colombia	COL	Panama	PAN
Costa Rica	CRI	Paraguay	PRY
Cote d'Ivoire	CIV	Peru	PER
Cuba	CUB	Philippines	PHL
Ecuador	ECU	Russian Federation	RUS
El Salvador	SLV	Senegal	SEN
Ethiopia	ETH	Singapore	SGP
European Union	EUN	Sri Lanka	LKA
Gambia	GMB	Tajikistan	TJK
Ghana	GHA	Thailand	THA
Guatemala	GTM	Togo	TGO
Guinea	GIN	Uruguay	URY
Honduras	HND	US	USA
India	IND	Venezuela	VEN
Indonesia	IDN	Vietnam	VNM
Japan	JPN		

Table 1. Comparison of regulatory adoption costs, East Asian regional integration.

	AEC		RCEP		TPP		
	Intra-		Intra-		Intraregional		
Benchmark	Regional	Open	Regional	Open	11	12	Open
Brunei	4.45	6.76	7.38	8.52	5.06	5.64	6.81
	(.495)	(.520)	(.527)	(.532)	(.506)	(.512)	(.523)
Malaysia	4.66	6.90	7.55	8.63	4.99	5.52	6.81
	(.518)	(.531)	(.540)	(.540)	(.499)	(.502)	(.524)
Singapore	4.64	6.87	7.57	8.67	5.15	5.69	6.85
	(.515)	(.528)	(.541)	(.542)	(.515)	(.517)	(.527)
Vietnam	5.17	7.25	8.01	8.95	5.48	5.94	7.01
	(.575)	(.557)	(.572)	(.559)	(.548)	(.540)	(.539)
Indonesia	5.31	7.58	8.30	9.43	..	..	..
	(.591)	(.583)	(.593)	(.589)			
Cambodia	5.28	7.46	8.19	9.30	..	..	..
	(.586)	(.573)	(.585)	(.581)			
Lao PDR	5.57	8.57	8.36	9.87	..	..	..
	(.619)	(.660)	(.597)	(.617)			
Myanmar	5.07	7.78	8.52	9.82	..	..	..
	(.563)	(.598)	(.609)	(.614)			
Philippines	5.36	7.75	8.33	9.52	..	..	..
	(.596)	(.596)	(.595)	(.595)			
Thailand	4.50	6.58	7.29	8.28	..	..	..
	(.500)	(.506)	(.521)	(.518)			
Japan	..	7.05	7.91	8.64	4.95	5.31	6.35
		(.542)	(.565)	(.540)	(.495)	(.483)	(.488)
China	..	8.04	8.94	9.98	..	..	8.17
		(.618)	(.638)	(.624)			(.629)
Australia	..	..	6.93	7.84	4.81	5.22	6.25
			(.495)	(.490)	(.481)	(.475)	(.481)
New Zealand	..	..	7.60	8.60	5.44	5.93	7.16
			(.543)	(.537)	(.544)	(.539)	(.551)
India	..	..	9.40	10.61	..	..	..
			(.672)	(.663)			
Canada	..	..	..	..	5.50	5.87	6.99
					(.550)	(.534)	(.538)
Chile	..	..	..	..	5.27	5.82	6.92
					(.527)	(.529)	(.532)
Mexico	..	..	..	..	5.74	6.38	7.70
					(.574)	(.580)	(.592)
Peru	..	..	..	..	5.89	6.48	7.76
					(.589)	(.589)	(.597)
US	..	6.57	..	8.03	..	5.22	6.09
		(.506)		(.502)		(.475)	(.469)
European Union	..	7.04	..	8.64	..	..	6.46
		(.542)		(.540)			(.497)

Source: UNCTAD's non-tariff measure database.

Notes: The overall regulatory adoption costs calculated by taking a country listed in the leftmost column as benchmark are shown and the adjusted figures are in parenthesis. For each column, the lowest value is highlighted in the darkest green, the second lowest in medium green, and the third lowest in light green. Data for Korea is not available.

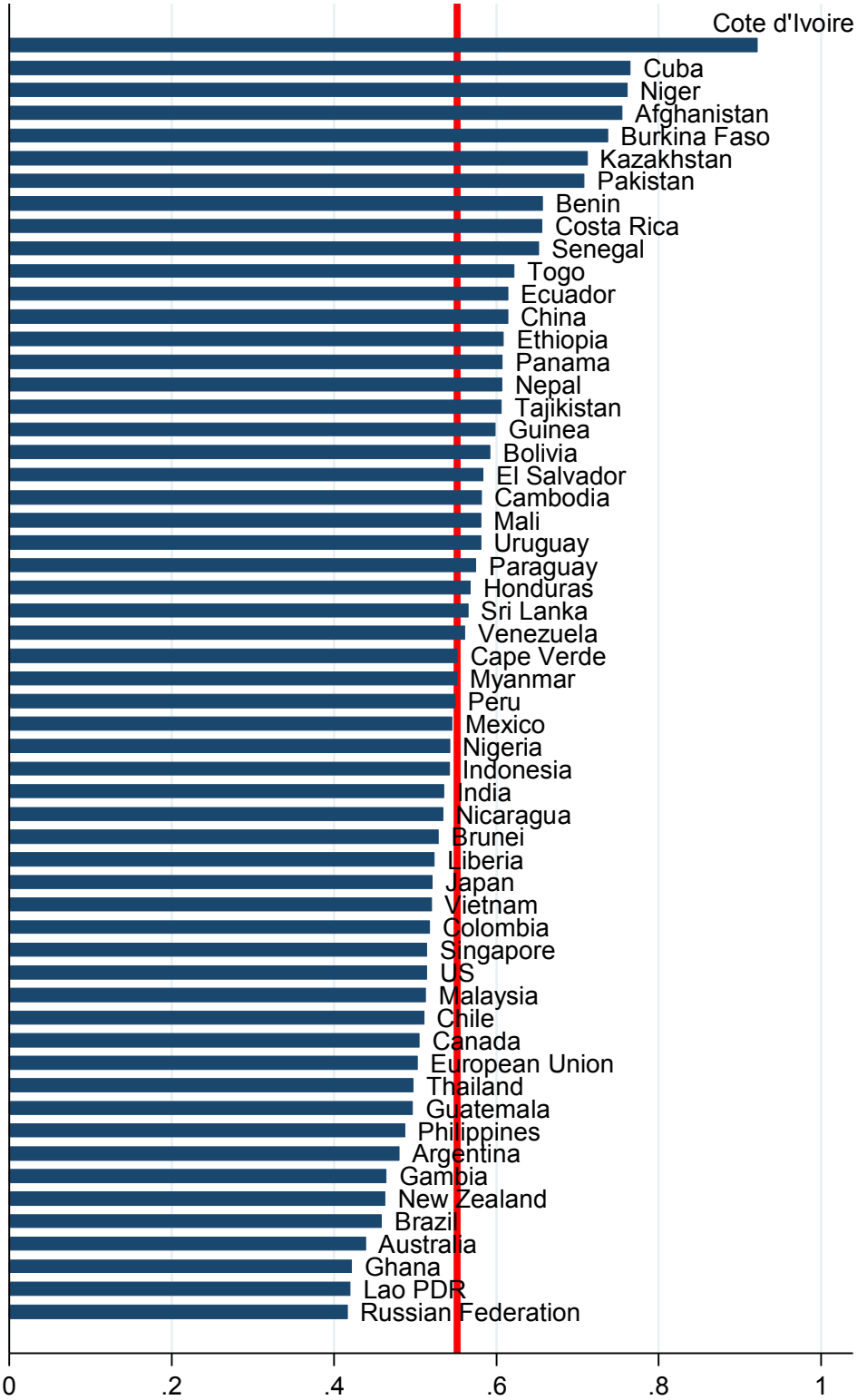
Table 2. Bilateral regulatory dissimilarity indicators between countries involved in East Asian regional integration efforts.

		Importer																				
		BRN	IDN	KHM	LAO	MMR	MYS	PHL	SGP	THA	VNM	JPN	CHN	AUS	NZL	IND	CAN	CHL	MEX	PER	USA	EUN
Exporter	BRN		0.75	0.82	0.80	0.65	0.62	0.81	0.50	0.61	0.69	0.74	0.78	0.70	0.77	0.82	0.79	0.71	0.75	0.77	0.76	0.75
	IDN	0.76		0.73	0.81	0.81	0.78	0.78	0.75	0.72	0.77	0.77	0.75	0.73	0.83	0.79	0.79	0.73	0.77	0.80	0.75	0.75
	KHM	0.80	0.70		0.79	0.79	0.74	0.74	0.73	0.80	0.80	0.74	0.72	0.72	0.81	0.82	0.75	0.81	0.77	0.75	0.71	0.77
	LAO	0.80	0.82	0.81		0.78	0.82	0.68	0.78	0.76	0.83	0.85	0.88	0.67	0.54	0.74	0.76	0.82	0.81	0.81	0.86	0.88
	MMR	0.65	0.81	0.81	0.77		0.60	0.84	0.76	0.65	0.81	0.81	0.87	0.79	0.81	0.88	0.78	0.73	0.76	0.77	0.81	0.80
	MYS	0.63	0.77	0.77	0.82	0.60		0.80	0.64	0.59	0.80	0.65	0.86	0.72	0.73	0.83	0.69	0.71	0.72	0.77	0.73	0.74
	PHL	0.80	0.77	0.75	0.65	0.83	0.79		0.77	0.77	0.80	0.78	0.77	0.72	0.74	0.84	0.74	0.77	0.81	0.80	0.75	0.79
	SGP	0.51	0.75	0.76	0.78	0.76	0.64	0.78		0.70	0.74	0.73	0.77	0.62	0.80	0.88	0.77	0.75	0.76	0.81	0.73	0.75
	THA	0.61	0.71	0.82	0.75	0.65	0.58	0.78	0.70		0.73	0.69	0.78	0.74	0.74	0.78	0.74	0.67	0.76	0.75	0.71	0.70
	VNM	0.66	0.74	0.80	0.81	0.79	0.78	0.80	0.71	0.71		0.73	0.78	0.65	0.81	0.78	0.80	0.70	0.74	0.77	0.68	0.68
	JPN	0.74	0.76	0.76	0.84	0.80	0.64	0.79	0.72	0.68	0.75		0.81	0.70	0.65	0.83	0.62	0.63	0.78	0.77	0.60	0.61
	CHN	0.77	0.73	0.74	0.88	0.88	0.85	0.77	0.76	0.77	0.79	0.81		0.74	0.85	0.82	0.81	0.79	0.86	0.80	0.76	0.69
	AUS	0.68	0.71	0.73	0.64	0.78	0.69	0.71	0.59	0.72	0.66	0.68	0.73		0.63	0.86	0.74	0.73	0.74	0.77	0.64	0.70
	NZL	0.76	0.82	0.82	0.49	0.79	0.70	0.73	0.78	0.72	0.82	0.63	0.85	0.62		0.71	0.67	0.77	0.82	0.79	0.70	0.71
	IND	0.82	0.78	0.84	0.74	0.87	0.83	0.85	0.88	0.78	0.80	0.84	0.82	0.87	0.73		0.77	0.80	0.88	0.87	0.80	0.75
	CAN	0.78	0.78	0.77	0.75	0.77	0.67	0.74	0.76	0.74	0.81	0.62	0.81	0.75	0.68	0.76		0.74	0.80	0.77	0.61	0.68
	CHL	0.72	0.72	0.83	0.82	0.73	0.71	0.79	0.75	0.68	0.73	0.65	0.80	0.75	0.78	0.81	0.75		0.72	0.69	0.74	0.68
	MEX	0.75	0.75	0.79	0.81	0.75	0.72	0.82	0.75	0.76	0.76	0.78	0.87	0.76	0.83	0.88	0.81	0.72		0.69	0.80	0.75
	PER	0.77	0.79	0.78	0.81	0.77	0.75	0.82	0.81	0.75	0.79	0.78	0.82	0.79	0.80	0.87	0.78	0.69	0.69		0.77	0.78
	USA	0.72	0.71	0.72	0.84	0.78	0.70	0.77	0.72	0.67	0.68	0.57	0.74	0.62	0.69	0.77	0.62	0.71	0.77	0.74		0.57
	EUN	0.74	0.75	0.79	0.87	0.80	0.73	0.80	0.74	0.69	0.70	0.61	0.69	0.71	0.73	0.75	0.68	0.67	0.75	0.78	0.61	

Source: UNCTAD's non-tariff measure database.

Notes: Bilateral regulatory dissimilarity indicators calculated for respective pairs of countries, denoted by ISO codes, are shown. The scores that are less than 0.6 are displayed in dark green and those between 0.6 and 0.7 in light green. Data for Korea is not available.

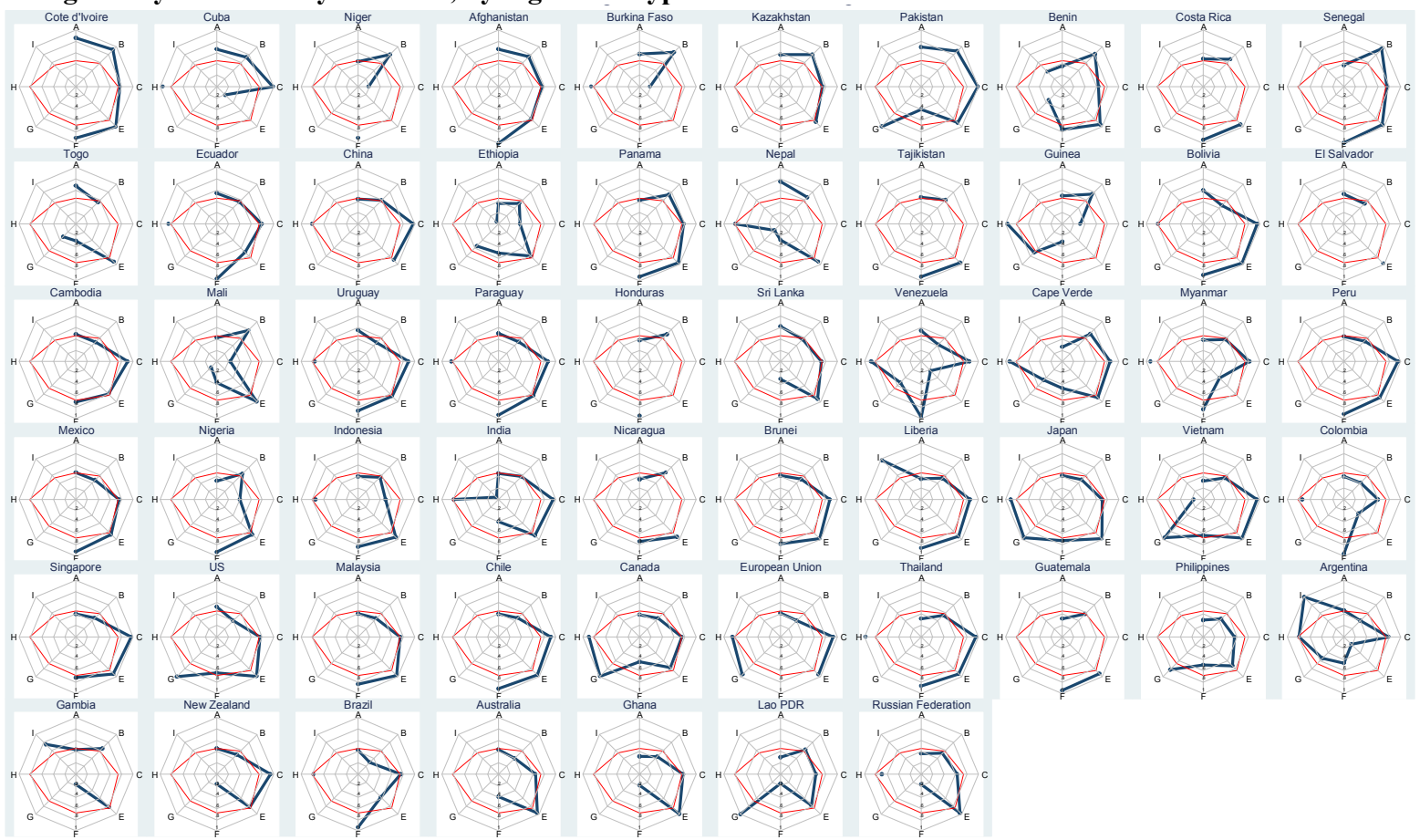
Figure 1. Regulatory dissimilarity indicator ranking.



Source: UNCTAD's non-tariff measure database.

Notes: The regulatory dissimilarity indicators are calculated for respective countries with respect to the world average implementation pattern of non-tariff measures. The red vertical line indicates the median score across countries.

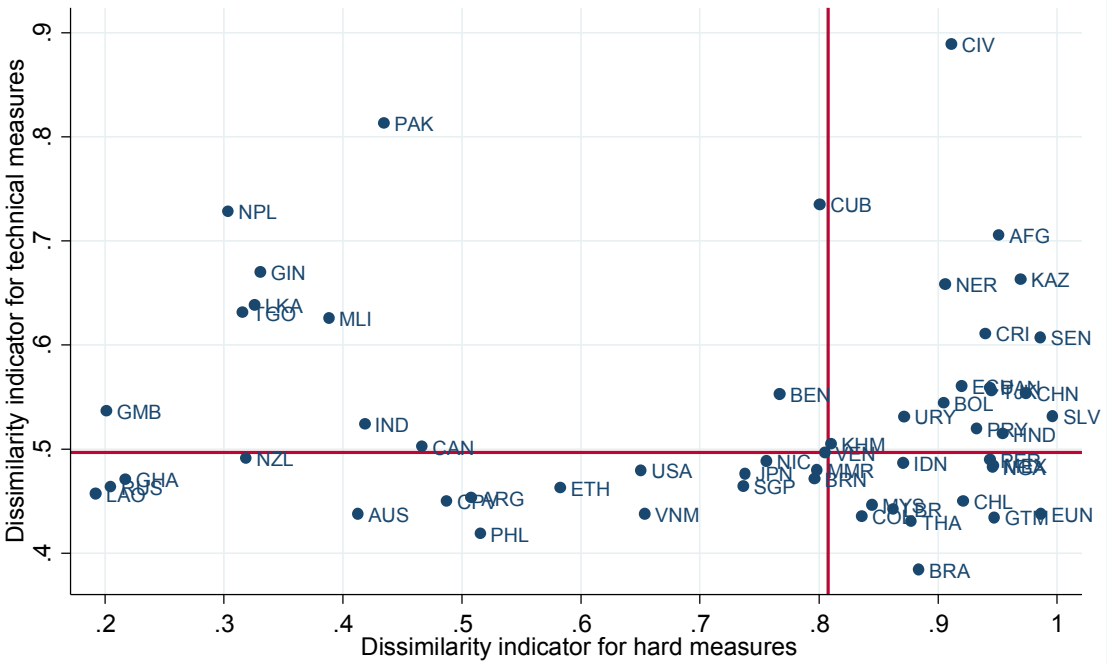
Figure 2. Regulatory dissimilarity indicator, by regulation type.



Source: UNCTAD's non-tariff measure database.

Notes: Blue lines indicate the regulatory dissimilarity indicators that are calculated by the chapter of the UNCTAD's non-tariff measure classification (focusing on Chapters A to C and E to I) for respective countries with respect to the world average implementation pattern. Red lines indicate the by-chapter median score across countries.

Figure 3. Regulatory dissimilarity indicator, technical versus hard measures.



Source: UNCTAD's non-tariff measure database.

Notes: Blue dots, labeled with the ISO alpha-3 country codes, represent the regulatory dissimilarity indicators that are calculated for technical measures (classified under Chapters A to C) and for hard measures (Chapters E and F) for respective countries with respect to the world average implementation pattern. A horizontal and vertical red line indicates the median score across countries for technical measures and hard measures, respectively.

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