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

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Abstract: *In this paper we construct a dissimilarity indicator to measure the degree to which a product may face different sets of regulations in two countries (the export country and the import country). Since the indicator is highly scalable, we can also construct the difference in regulations applied at the sector or country levels. In this study, we mainly utilise country-level information to compare regulatory regimes across countries to see how much a country's set of regulations differs from the global norm. We also use this indicator to suggest a way to approach regulatory harmonisation in various regional integration efforts in East Asia. This allows us to identify which country can serve as a benchmark for regulatory harmonisation, by allowing countries to negotiate around a base set of regulations. This approach provides more concrete policy guidance on the issue of regulatory harmonisation compared to the tariff-equivalent approach.*

Keywords: non-tariff measure, regulations, regional integration, RCEP, TPP, ASEAN
JEL Classification: F13, F14, F15

1. Introduction

There has been increasing interest in non-tariff measures (NTMs) and their impact on international trade. As global trade expands thanks to the lowering of tariffs, the impacts of NTMs are becoming more important. NTMs and the regulations of importing countries have been subjects of interest for researchers, policymakers, and businesses. To export to another country, an exporter (as well as the original manufacturers or producers) must comply with the regulations of the importing country. For instance, the United Nations Industrial Development Organization (UNIDO) reports that an estimated $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, the European Union [EU], Japan, and the United States [US]) in 2010, because these products violated the food safety regulations of the importing countries in some way (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 set of regulations in these areas, and this creates difficulties for exporters, especially those in developing countries. In addition to agriculture and food products, manufactured products also face a number of regulations, in many cases on product safety and quality. In recent years, a number of regulations have been introduced, especially in the EU, to make products more 'green'. This has led to the introduction of product-related environmental regulations,[3] with which anyone exporting to the EU must comply. This has prompted manufacturers located in East Asia to change their production processes and inputs used, and to increase the testing of their inputs and products.

The issue of NTMs is becoming even more important in the current scenario of slowing international trade. The slowdown and consequent concerns as to the future of

[1] See UNIDO (2010; 2015) for a global-level perspective on import rejection, and the Institute of Developing Economies Japan External Trade Organization and UNIDO (2013) for a more detailed examination of import rejections in East Asian countries.

[2] For instance, Crivelli and Groeschl (2016) found that the existence of SPS affects market entry by exporters to that country. However, if exporters are able to enter, the trade volume is high. Fontagné et al. (2015) also found that restrictive SPS measures reduce the probability of a firm exporting to that market.

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

international trade was brought about by the actions of President Trump of the US who has introduced a number of trade-restrictive measures, such as imposing higher tariffs on key imported materials. China has been significantly affected by this. While President Trump's actions initially focussed on raising tariffs, in recent years the focus has shifted to other instruments, namely regulations. One such example is his intention to introduce legislation to ban the use of products by Huawei (a Chinese telecommunications manufacturer), not only by the Government of the US but also by suppliers to the government. Depending on how far back in the supply chain this requirement will be imposed, this could have a significant impact on products made by Huawei in the US and elsewhere.

However, it has been difficult to conduct a systematic study of NTMs due to the lack of internationally comparable data on these. Traditionally, the impact of NTMs has been computed as the tariff equivalents by looking either at the quantity traded or at the prices of imported products. The quantity-based approach estimates the ad valorem tariff equivalents by comparing the estimated and actual trade values, and determining at what tariff levels the actual trade value would be observed based on international trade data.[4] The price-based approach utilises extensive data on domestic prices, information on transportation costs, and international prices. Any price gap is attributed to the impact of NTMs.[5] In both approaches, the issue of NTMs is implied but not addressed specifically. This is especially so if a product faces multiple regulations in both the importing and exporting countries. The traditional approach of using tariff equivalents indicates only that there might be some trade restrictiveness on the whole concerning imports of a given product, but does not reveal where that restrictiveness might arise.[6] This approach makes it difficult to identify a suitable approach to deeper integration, which may include regulatory harmonisation. In essence, the tariff equivalent approach leaves the NTM component as a black box. However, it was necessary to use this approach given the lack of a systematic database of NTMs.

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4 See for instance, Kee, Nicita, and Olarreaga (2009) who followed this approach.

5 See Cadot and Gourdon (2016); Cadot, et al. (2015); and Cadot and Ing (2015) for this approach.

6 In addition, the quantity-based approach is based on the assumption that the model (often a gravity-type model) is specified correctly. Any misspecification could turn up as the ad valorem equivalent. For the price-based approach, the question remains as to how much market structures in each country differ. Higher domestic prices could be the result of a more concentrated market structure, which may or may not be the result of NTMs.

In this study, we utilise a new data set created by the United Nations Conference on Trade and Development (UNCTAD) in collaboration with many other entities to calculate what we call the 'dissimilarity indicator'. This indicator measures to what degree regulations in one country differ from those in other countries. One advantage of this indicator is that it is highly scalable. One can calculate this measure at the product, sector or industry, or country level as long as the underlying data on regulations are collected. The indicator also allows us to compare different regulatory regimes in each country. Such analysis is especially useful for a group of countries considering 'deep' integration. We will illustrate this using the regional integration efforts currently ongoing in East Asia.

This paper is organised as follows: Section 2 explains in detail the underlying data on NTMs and how we construct the dissimilarity indicator. Section 3 provides an overview of the regulatory differences across countries. Section 4 utilises the dissimilarity indicator to explore regulatory harmonisation issues in the East Asian context, and Section 5 concludes.

2. Data and Method

First, we introduce our source of comprehensive data for NTMs (Section 2.1). We then explain how we quantify the degree of regulatory differences in terms of the implementation pattern of NTMs between countries (Section 2.2).

2.1. The United Nations Conference on Trade and Development's Newly Collected Non-Tariff Measure Database

The UNCTAD has been leading the global effort to shed light on existing NTMs all over the world and to develop a comprehensive database of NTMs in collaboration with its partners, which include international and regional organisations. Under the guidance of the UNCTAD, national teams of consultants are scrutinising legal and regulatory documents to gather information for a comprehensive set of mandatory and official regulations currently imposed by countries that potentially affect imported or exported merchandise products. The gathered information is translated into a database format by linking the contents of the detected NTMs to predefined NTM classification codes, and descriptions of the affected products to the Harmonized System product classification codes.

The collected and processed data on NTMs are disseminated sequentially to the public through the Trade Analysis Information System (TRAINS): The Global Database on NTMs (UNCTAD). As of the update in March 2017, the UNCTAD's NTM database covered 57 countries (see Appendix A).

In the UNCTD-Multi-Agency Support Team (MAST) Classification of Non-Tariff Measures 2012 (known as the M3 version, or the third revision of the MAST NTM classification) (UNCTAD, 2015), NTMs are categorised (based on the purposes of the measures) into 16 chapters (A–P), each of which is further differentiated into groups (in most chapters) and subgroups (in some chapters). The scope of the worldwide data collected under the UNCTAD's initiative has been limited to chapters A–I and P. In this paper, we limit our attention to NTMs implemented against imported merchandise products by omitting Chapter P (export-related measures). We also exclude Chapter D (contingent trade-protective measures) from our data analysis as these data were incomplete as of March 2017.[7] We ultimately focus on NTMs categorised under chapters A (SPS); 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); F (price control measures, including additional taxes and charges); G (finance measures); H (measures affecting competition); and I (trade-related investment measures). These chapters include 208 codes in total, including all possible codes at any aggregation level.

Meanwhile, the products affected by the detected NTMs are reported based on versions H2, H3, or H4 of the HS classification. For consistency, we convert all product information to the 6-digit codes of the H2 version (there are 5,226 product codes at the 6-digit level in the H2 version).[8]

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[7] For some countries, data for Chapter D are not collected in the same year as those of other chapters. Typically, old data for NTMs categorised as D are simply combined with newly collected measures under other chapters. Moreover, we refrain from analysing temporary measures categorised under D in a similar way to other permanent measures because they are different in nature.

[8] The conversion tables from the newer version to the older version of the HS classification codes are obtained from the website of the Trade Statistics Branch of the United Nations Statistics Division https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp (accessed 31 March 2017).

2.2. Cosine Similarity-Based Indicator for Regulatory Differences

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

First, we constructed a vector representing a set of NTMs implemented by country i against imports from the rest of the world as follows:

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

where F_{ik} is a binary variable taking 0 or 1 for the incidence of any NTM 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; however, in practical terms, K will become much lower (353,713 or less in our data analysis) because we do not need to consider product-regulation pairs not observed for any country when calculating the cosine similarity.

Next, using the vectors representing the implementation pattern of NTMs, we calculate the cosine similarity between a certain pair of countries. To provide an overview of international regulatory differences in the next section, we calculate the cosine similarity for each country with respect to the world average implementation pattern of NTMs. 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 NTM implemented by country j for a product-regulation pair k.[9] The cosine similarity between country i's vector of F_i and the world average vector of F_W is

[9] What matters in calculating the cosine similarity is not a nominal frequency but rather the relative size of the frequency (i.e. a fraction of the overall number of observations); thus, taking an average and an aggregation are substantially the same.

calculated as

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

where $\text{Cos}(\theta)_i$ 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 degrees (identical) and 90 degrees (orthogonal) because both F_i and F_W are composed only of elements with positive values.

Finally, we obtain the dissimilarity indicator for country *i*'s implementation pattern of NTMs with respect to the world average pattern as follows:

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

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

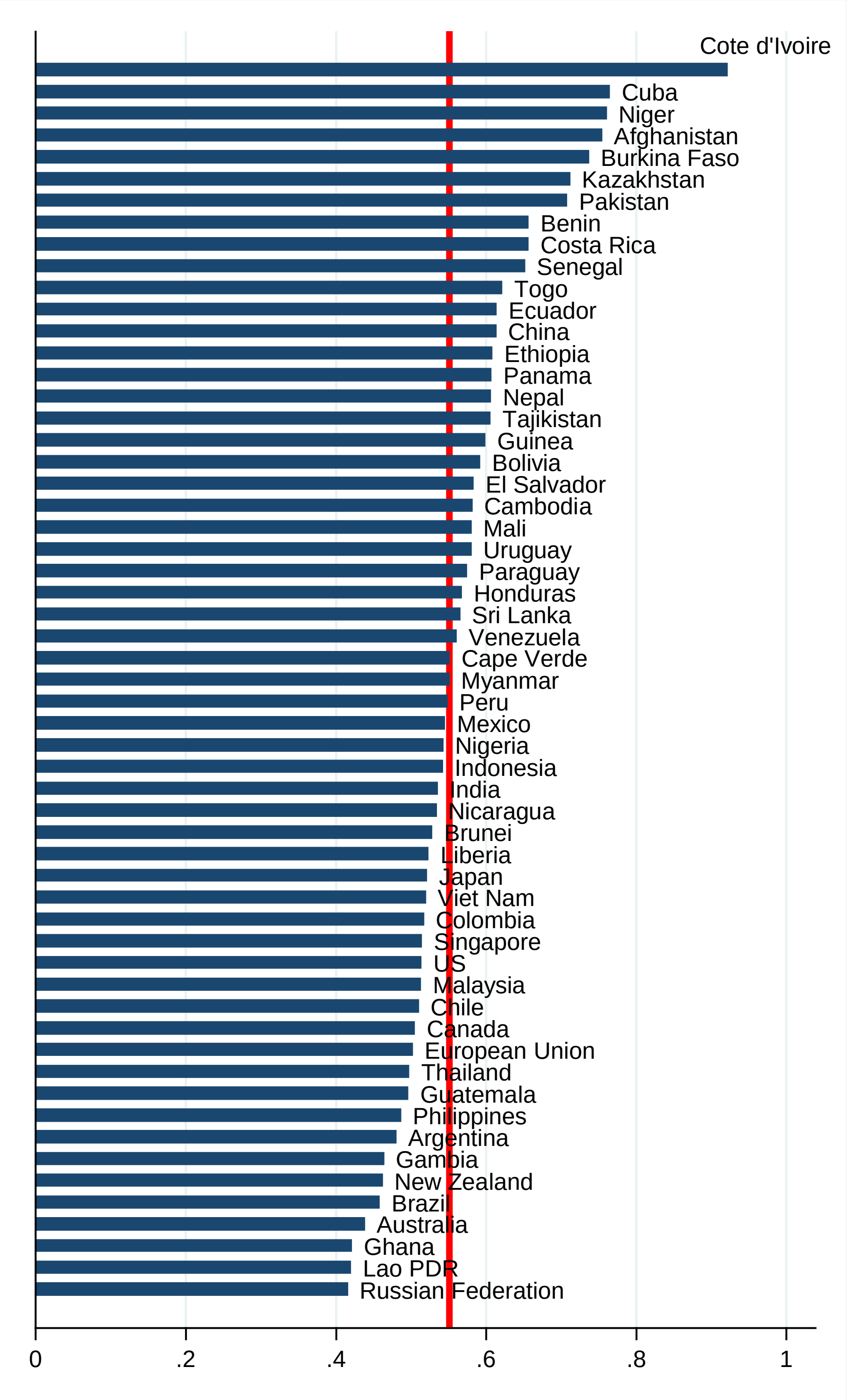
Although we are not the first to try to quantify the degree of differences in the implementation pattern of NTMs between countries, our cosine similarity-based regulatory dissimilarity indicator is preferable to the previously proposed method. For example, Olivier Cadot and his co-authors proposed an indicator that they called the regulatory distance measure (Cadot, Asprilla, Gourdon, Knebel, and Peters 2015; Cadot and Ing 2015). The authors calculated 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 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 NTMs—because the 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 NTMs (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 NTMs is not necessarily a binary variable but can be any values. In other words, we can count the number of individual NTMs 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 utilise more detailed information to quantify the degree of cross-country differences in the implementation pattern of NTMs, compared to the regulatory distance measure, especially when either products or types of regulations are aggregated into broad categories. Here, however, we simply use a binary variable because we have detailed information on the incidence of NTMs at a finely disaggregated product level 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 NTMs using the cosine similarity-based regulatory dissimilarity indicator as explained in the previous section. Figure 1 shows the regulatory dissimilarity indicators calculated for 57 countries in our dataset with respect to the world average implementation pattern of NTMs. The bars representing different countries are arranged in descending order according to the score of the regulatory dissimilarity indicator. Scores range from 0.42 for the Russian Federation, whose implementation pattern of NTMs correlates most closely with the world average pattern, to 0.92 for Côte d'Ivoire, whose implementation pattern is most distant from the world average, with the median score of 0.55 indicated by a vertical red line.

Figure 1: Regulatory Dissimilarity Indicator Ranking

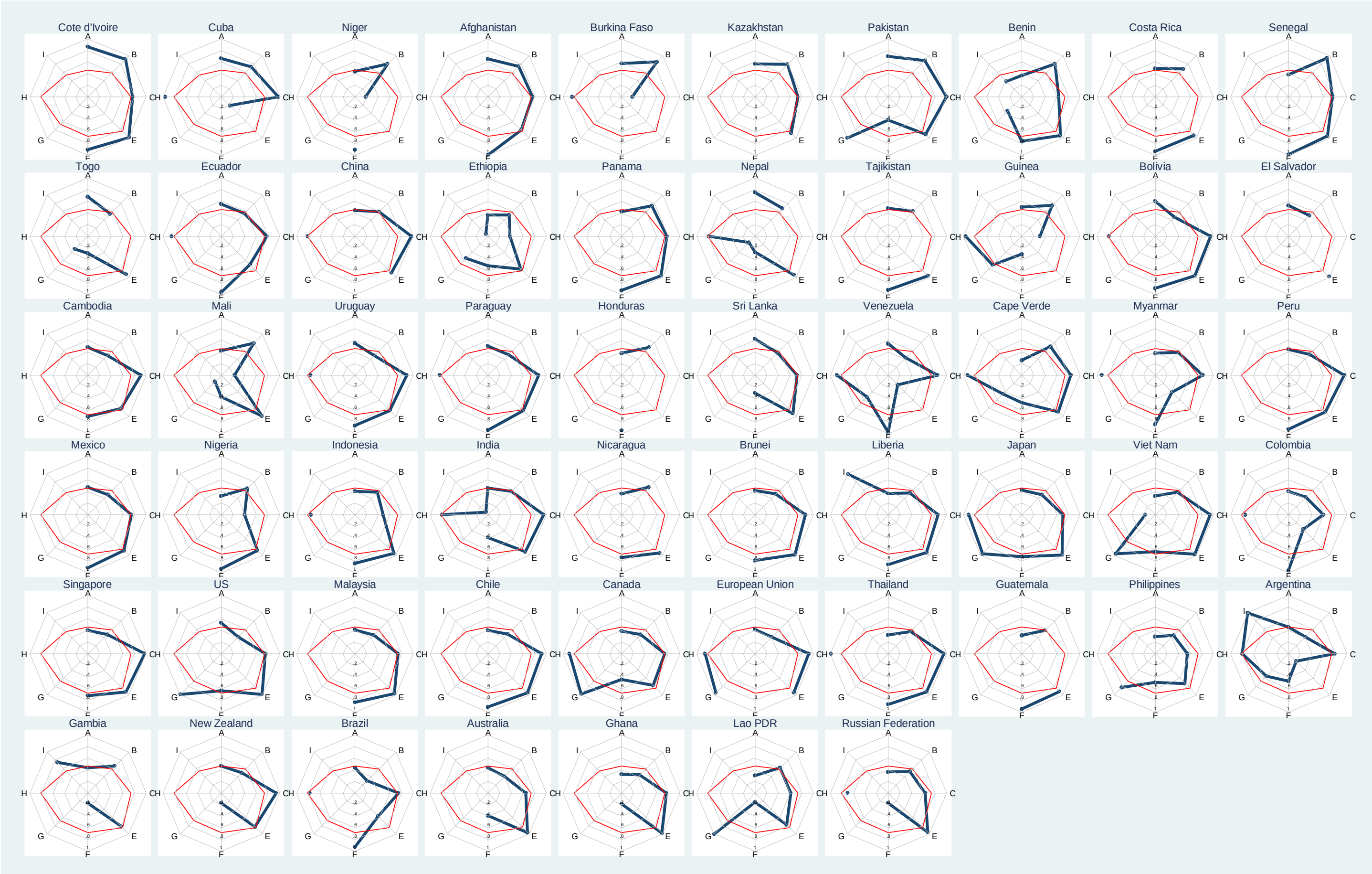


Brunei = Brunei Darussalam, Lao PDR = Lao People's Democratic Republic, US = United States.
Notes: The regulatory dissimilarity indicators are calculated for each country with respect to the world average implementation pattern of non-tariff measures. The vertical red line indicates the median score across countries.
Source: Authors' calculation.

There are a few notable features of international regulatory differences in the implementation pattern of NTMs: first, neither the EU nor US is placed in the bottom 20% of the bar chart, meaning that their implementation patterns of NTMs correlate to the world average pattern to a relatively limited extent compared to other countries listed in the lower part of the chart. Second, although developing countries are dispersed across the bar chart, African countries (except for Ghana and the Gambia) tend to have higher scores, indicating a large difference from the world average pattern. In contrast, the Association of Southeast Asian Nations (ASEAN) and East Asian countries (except for China and Cambodia) tend to have lower scores, showing a higher correlation with the world average pattern. Third, countries with abundant natural resources such as the Russian Federation, Australia, Brazil, New Zealand, Canada, and Chile are concentrated in the bottom part of the bar chart. This suggests the similarity of the implementation pattern of NTMs amongst resource-rich countries, which appears to shape the world average pattern.

Next, we examine international regulatory differences by type of regulations. In Figure 2, radar charts show the regulatory dissimilarity indicators calculated chapter by chapter according to the UNCTAD NTM classification chapter for each country (blue line), compared to the median score across countries (red line). The centre of the radar chart indicates a score of 0 and the outer border indicates a score of 1. When the dot representing a certain chapter (plotted on a radiated axis and connected by a line) is further from the centre of the chart, this means that the implementation pattern of NTMs classified under the chapter of interest is more distant from the world average pattern. Countries are listed in descending order according to 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.

Figure 2: Regulatory Dissimilarity Indicator, by Regulation Type



Brunei = Brunei Darussalam, Lao PDR = Lao People's Democratic Republic, US = United States.

Notes: Blue lines indicate the regulatory dissimilarity indicators calculated by the chapter of the United Nations Conference on Trade and Development's non-tariff measure classification (focusing on chapters A–C and E–I) for each country with respect to the world average implementation pattern. Red lines indicate the by-chapter median score across countries.

Source: Authors' calculation.

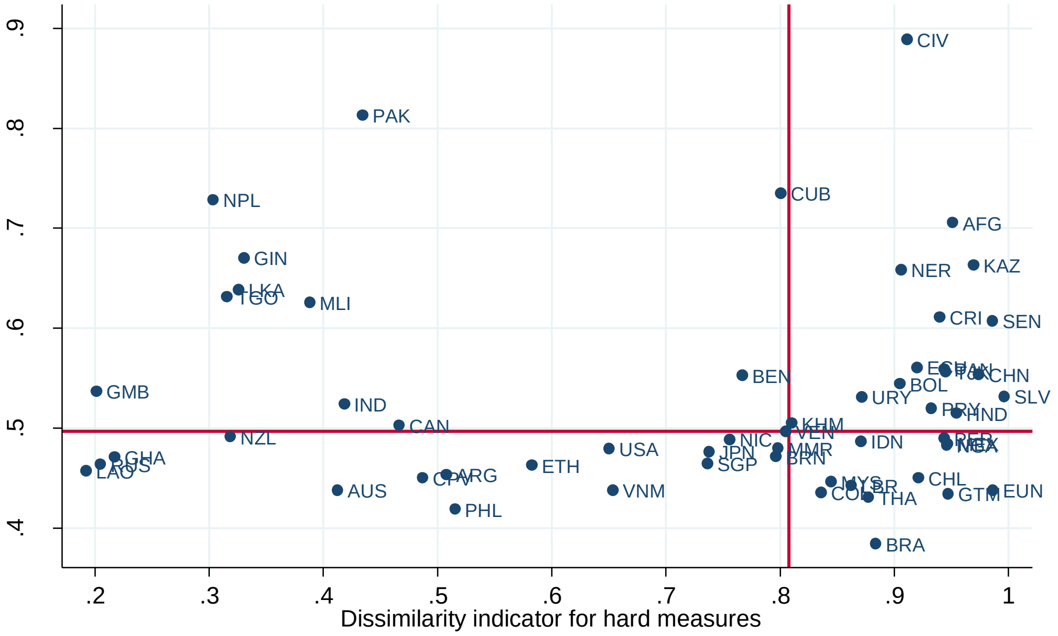
It is notable that, although it is possible for the blue line to take an octagon shape (as does the red line showing the median score), Argentina is the only country for which an octagon-shaped blue line is observable. Assuming that the countries in this dataset comprehensively report all existing NTMs, various cracked octagons shaped by the blue line can be interpreted as indicating the diversity of the implementation pattern of NTMs amongst countries.[10] In particular, NTMs classified under chapters G (finance measures), H (measures affecting competition), or I (trade-related investment measures) appear to be unpopular in the 57 countries in our dataset. Only 17, 23, and 6 countries, respectively, report one or more NTMs classified under G, H, and I.

Secondly, the size of the (potential) octagon shaped by the blue line does not shrink in a uniform manner as the score of the overall regulatory dissimilarity indicator decreases from the top left to the bottom right corner of the figure. Even the scores for NTMs classified under chapters A (SPS) and B (TBT), both of which embrace a relatively large number of disaggregated regulation codes, do not always change parallel to the overall score. The varying sizes of the blue octagons across countries, as well as their various cracked shapes, show the diversity of the implementation patterns of NTMs.

Although the radar charts of Figure 2 are useful for spotting a non-negligible degree of cross-country diversity at a glance, comparing the regulatory dissimilarity indicator calculated for the implementation pattern of so-called technical measures (coded under chapters A–C) with that of non-technical measures enables us to understand more clearly the nature of international regulatory differences. Figure 3 plots each country's position, taking the regulatory dissimilarity indicator calculated for technical measures on the vertical axis and that on the horizontal axis 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). The median score is indicated by a red horizontal line for technical measures, and a red vertical line for hard measures.

[10] There is some scepticism about the comprehensiveness or completeness of the collected and recorded data for the existing NTMs in the UNCTAD's database. In fact, we suspect that the EU data collection team has somewhat failed to detect NTMs classified under Chapter F (price-control measures). As Figure 2 shows, no measure is recorded under F for EU imports; however, the EU definitely implements seasonal duties (coded as F5 under F) on some fruits and vegetables (see United States Department of Agriculture).

Figure 3: Regulatory Dissimilarity Indicator – Technical Versus Hard Measures



Notes: Blue dots labelled with the International Organization for Standards alpha-3 country codes represent the regulatory dissimilarity indicators calculated for technical measures (classified under chapters A–C) and for hard measures (chapters E–F) for each country with respect to the world average implementation pattern. The median score across countries is indicated by a horizontal red line for technical measures, and a vertical red line for hard measures.
Source: Authors' calculation.

African countries are dispersed all over the scatter plot. For Ghana and the Gambia, which score low on the overall regulatory dissimilarity indicator (see Figure 1), the regulatory dissimilarity indicator calculated for hard measures is particularly low. ASEAN and East Asian countries are concentrated in the lower part of the scatter plot, indicating a low score for technical measures. Compared to their neighbouring countries, China and Cambodia have relatively higher scores both for technical measures and for the overall regulatory dissimilarity indicator. China also has a notably high score for hard measures. More importantly, despite the commonly observed tendency for technical measures scores to be low, the score for hard measures varies greatly amongst ASEAN and East Asian countries, ranging from 0.19 for the Lao People's Democratic Republic (PDR) to 0.97 for China. Similarly, countries rich in natural resources tend to have a low score for technical measures in addition to the low overall score commonly observed, but varying 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 location and the abundance of natural resources (at least to some extent), the implementation patterns of hard measures are more complicated and diverse across countries, and no straightforward tendency can be detected from a casual observation of the data. In the future, it would be worth exploring what factors explain cross-country differences in the implementation pattern of NTMs (especially hard measures) in a more statistically sophisticated way.

4. Application of the Regulatory Dissimilarity Indicator: Regulatory Harmonisation

This section demonstrates the application of the regulatory dissimilarity indicator and highlights its usefulness. As shown below, we can use the regulatory dissimilarity indicator to determine how a group of countries can efficiently achieve regulatory harmonisation of NTMs through regional integration. In Section 4.1, we explain how to approximate the regulatory adoption costs that countries bear to coordinate with each other to unify the implementation pattern of NTMs. In Section 4.2, we use ongoing regional integration efforts in the East Asia region as examples to derive an answer as to the ideal way of achieving regulatory harmonisation so as to minimise the regulatory adoption costs.

4.1. Calculation of Regulatory Adoption Costs

Next, we consider the regulatory harmonisation of NTMs amongst the member countries of certain regional trade agreements to determine which country's implementation pattern of NTMs would best serve as a benchmark to which the other member countries should adjust their NTMs as part of regional integration efforts. We can utilise the regulatory dissimilarity indicator to identify an ideal benchmark that would minimise the regulatory adoption costs borne by the member countries.

Specifically, we consider bilateral regulatory dissimilarity for a certain exporter country with respect to its export destination countries, similar to the indicator with respect to the world average introduced in Section 2. For example, if the exporter country has Regulation A and the importer country has regulations A and B, firms need only ensure additional compliance with Regulation B to export to the foreign country, since they already comply with Regulation A when operating domestically. Thus, to quantify the degree of bilateral regulatory differences, we should compare import regulations implemented by the importer country with domestic regulations in the exporter 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 NTMs 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 NTMs 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 NTM for a product-regulation pair k.

Let $\mathcal{R}$ be a set of countries participating in a certain regional trade agreement and *N* be the total number of the member countries. Now consider a set of domestic regulations in country $j \in \mathcal{R}$ as a benchmark; other member countries will harmonise their own NTMs 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 operating domestically. The higher the value of the bilateral regulatory dissimilarity indicator, the higher the necessary degree of additional compliance. We therefore approximate the magnitude of the overall adjustment costs of regulatory harmonisation by taking the square sum of the bilateral regulatory dissimilarity indicators calculated for country j with respect to all of 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 average adjustment cost that must be borne by countries other than the benchmark country.

The lower the (adjusted) square sum of bilateral regulatory dissimilarity indicators, the less additional compliance (on average) is required from the member countries. In other words, when countries target regulatory harmonisation through regional integration, using the country with the lowest square sum as a benchmark is ideal because this minimises the average regulatory adoption costs borne by the member countries. We identify an ideal benchmark country j^* for a regional trade agreement of interest as follows:

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

4.2. Examples of East Asian Regional Integration Efforts

Using ongoing regional integration efforts in the East Asian region—namely, the ASEAN Economic Community (AEC), Regional Comprehensive Economic Partnership (RCEP), and Trans-Pacific Partnership (TPP)—as examples, we can derive an answer as to which country's regulatory pattern would best serve as a benchmark to achieve regulatory harmonisation through each regional integration. Although data for NTMs implemented by the Republic of Korea (henceforth, Korea) were not available in the UNCTAD's database as of March 2017, we have data for all of the other countries involved in the regional integration efforts listed above.

We calculate the square sums of the bilateral regulatory dissimilarity indicators for each country involved in a regional integration effort of interest and identify the ideal benchmark country with the lowest square sum. To compare the magnitude of regulatory adoption costs or the ease of achieving regulatory harmonisation between regional integration efforts, we calculate the square sums adjusted for degree of freedom. We also calculate the square sums by including large economies in the world market, such as the US, EU, Japan, and China, which are important destination markets for most East Asian countries that we address. This allows us to examine how the ideal benchmark country can change when coordination with important trading partner countries outside the regional integration is required, which carries implications for the argument for open regionalism.

Table 1 shows the overall regulatory adoption costs approximated for the countries taken as a benchmark within a certain group of countries (the associated, adjusted [average] regulatory adoption costs are listed in parentheses). Each column corresponds to the East Asian regional integration effort indicated in 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 the country listed in the left 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 the member countries of the regional integration. For each column, the lowest value is highlighted in dark green, the second lowest in medium green, and the third lowest in light green. Table 2 complements Table 1 by reporting the underlying bilateral regulatory dissimilarity indicators upon which the approximation of regulatory adoption costs is based.

For the AEC, although using Brunei Darussalam's domestic regulations as a benchmark regulatory pattern minimises the regulatory adoption costs (to 4.45 overall and 0.495 adjusted) within the region, Thailand, which is ranked second lowest in both the 'intraregional' and 'open' settings, appears to serve best 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 the intraregional setting (with the exception of Viet Nam, Indonesia, and Cambodia), suggesting that a transition to open regionalism would not be easy.

In the RCEP, which embraces more countries than the AEC, both the overall regulatory adoption costs and the adjusted figures tend to be high, with the exceptions of the Lao PDR and the Philippines. The mounting costs are prominent in cases in which domestic regulations in India or China are taken as the benchmark regulatory pattern. The overall regulatory adoption cost balloons to 9.40 for India and 8.94 for China, while the adjusted regulatory adoption cost is 0.672 for India and 0.638 for China. The regulatory patterns of these two countries are distant from that of every other country involved in East Asian regional integration efforts, including the RCEP (see Table 2). Nevertheless, Australia appears to be an ideal benchmark country in both 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, comparable to the level of minimised costs in the case of the AEC.

Table 1: Comparison of Regulatory Adoption Costs, East Asian Regional Integration

	AEC		RCEP		TPP		
					Intraregional		
Benchmark	Intraregional	Open	Intraregional	Open	11	12	Open
Brunei	4.45 (0.495)	6.76 (0.520)	7.38 (0.527)	8.52 (0.532)	5.06 (0.506)	5.64 (0.512)	6.81 (0.523)
Malaysia	4.66 (0.518)	6.90 (0.531)	7.55 (0.540)	8.63 (0.540)	4.99 (0.499)	5.52 (0.502)	6.81 (0.524)
Singapore	4.64 (0.515)	6.87 (0.528)	7.57 (0.541)	8.67 (0.542)	5.15 (0.515)	5.69 (0.517)	6.85 (0.527)
Viet Nam	5.17 (0.575)	7.25 (0.557)	8.01 (0.572)	8.95 (0.559)	5.48 (0.548)	5.94 (0.540)	7.01 (0.539)
Indonesia	5.31 (0.591)	7.58 (0.583)	8.30 (0.593)	9.43 (0.589)	..	..	..
Cambodia	5.28 (0.586)	7.46 (0.573)	8.19 (0.585)	9.30 (0.581)	..	..	..
Lao PDR	5.57 (0.619)	8.57 (0.660)	8.36 (0.597)	9.87 (0.617)	..	..	..
Myanmar	5.07 (0.563)	7.78 (0.598)	8.52 (0.609)	9.82 (0.614)	..	..	..
Philippines	5.36 (0.596)	7.75 (0.596)	8.33 (0.595)	9.52 (0.595)	..	..	..
Thailand	4.50 (0.500)	6.58 (0.506)	7.29 (0.521)	8.28 (0.518)	..	..	..
Japan	..	7.05 (0.542)	7.91 (0.565)	8.64 (0.540)	4.95 (0.495)	5.31 (0.483)	6.35 (0.488)
China	..	8.04 (0.618)	8.94 (0.638)	9.98 (0.624)	..	..	8.17 (0.629)
Australia	..	..	6.93 (0.495)	7.84 (0.490)	4.81 (0.481)	5.22 (0.475)	6.25 (0.481)
New Zealand	..	..	7.60 (0.543)	8.60 (0.537)	5.44 (0.544)	5.93 (0.539)	7.16 (0.551)
India	..	..	9.40 (0.672)	10.61 (0.663)	..	..	..
Canada	..	..	..	..	5.50 (0.550)	5.87 (0.534)	6.99 (0.538)
Chile	..	..	..	..	5.27 (0.527)	5.82 (0.529)	6.92 (0.532)
Mexico	..	..	..	..	5.74 (0.574)	6.38 (0.580)	7.70 (0.592)
Peru	..	..	..	..	5.89 (0.589)	6.48 (0.589)	7.76 (0.597)
US	..	6.57 (0.506)	..	8.03 (0.502)	..	5.22 (0.475)	6.09 (0.469)
European Union	..	7.04 (0.542)	..	8.64 (0.540)	..	..	6.46 (0.497)

AEC = ASEAN Economic Community, Brunei = Brunei Darussalam, Lao PDR = Lao People's Democratic Republic, RCEP = Regional Comprehensive Economic Partnership, TPP = Trans-Pacific Partnership, US = United States.

Notes: This figure shows the overall regulatory adoption costs calculated using a country listed in the left column as a benchmark, with adjusted figures in parentheses. For each column, the lowest value is highlighted in dark green, the second lowest in medium green, and the third lowest in light green. Data for the Republic of Korea are not available.

Source: Authors' calculation.

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	

Notes: Bilateral regulatory dissimilarity indicators calculated for each pair of countries, denoted by International Organization for Standards codes, are shown. Scores lower than 0.6 are displayed in dark green and those between 0.6 and 0.7 in light green. Data for the Republic of Korea are not available.
Source: Authors' calculation.

With regard to the TPP, we calculated the regulatory adoption costs of achieving regulatory harmonisation amongst the TPP11[11] on the one hand and amongst the TPP12[12] (including the US) on the other. For the TPP11, as in the RCEP, Australia appears to be an ideal benchmark, followed by Japan and Malaysia. The adjusted regulatory adoption cost with Australia as a benchmark is 0.481. For the TPP12, however, taking the US as a benchmark minimises the cost burden, although the rounded figures of adjusted regulatory adoption costs are 0.475 with both Australia and the US as the benchmarks. Also, when the US is included, the adjusted regulatory adoption costs decline in the cases in which Australia, Japan, New Zealand, or Canada is used as the benchmark. In contrast, interestingly, the presence of the US pushes up the adjusted regulatory adoption costs if any of the ASEAN countries (except Viet Nam), Chile, or Mexico is used as a benchmark.

When 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 in the RCEP than in the TPP, irrespective of which country is used as the benchmark. Unlike the TPP, the RCEP involves ASEAN latecomers whose economic development is lagging (such as Cambodia, the Lao PDR, and Myanmar), as well as India and China (whose regulatory patterns correlate very little with those of the other member countries). It appears difficult to achieve regulatory harmonisation through the RCEP by overcoming the diversity of regulatory regimes amongst member economies. The adjusted adoption costs for the case of the AEC lie somewhere between those of the RCEP and those of the TPP.

5. Conclusion

In this paper we constructed a dissimilarity indicator to measure to what degree a product will face different sets of regulations in two countries (the export country and the import country). Since the indicator is highly scalable, we can also determine differences in the regulations applied at the sector or country levels. In this study, we mainly utilised country-level information to suggest a way to approach regulatory harmonisation in

[11] Now referred to as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CP-TPP) signed on 8 March 2011. The CP-TPP comprised 11 countries: Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Viet Nam.

[12] TPP12 comprised the US and the 11 countries in CP-TPP.

various integration efforts. Using this indicator, we can identify which country should serve as a base when considering regulatory harmonisation. Countries can then negotiate around this base set of regulations. Compared to the tariff-equivalent approach, this approach provides more concrete policy guidance on the issue of regulatory harmonisation. In future studies, researchers can more closely examine which component of regulations in a set of countries contributes the most to dissimilarity, and explore how these differences can be narrowed.

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Appendix A: List of 57 Countries Included in the United Nations Conference on Trade and Development's Non-Tariff Measure Database (as of March 2017)

Country names	ISO codes	Country names	ISO codes
Afghanistan	AFG	Kazakhstan	KAZ
Argentina	ARG	Lao People's Democratic Republic	LAO
Australia	AUS	Liberia	LBR
Benin	BEN	Malaysia	MYS
Bolivia	BOL	Mali	MLI
Brazil	BRA	Mexico	MEX
Brunei Darussalam	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
Côte 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	United States	USA
India	IND	Venezuela	VEN
Indonesia	IDN	Viet Nam	VNM
Japan	JPN		

ISO = International Organization for Standards.
Source: Created by the authors, using the ISO-alpha3 code list obtained from the website of the United Nations Statistics Division.
https://unstats.un.org/unsd/methodology/m49/ (accessed 31 March 2017).

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