WP-2025-023

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October 2025

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This paper develops a comprehensive dataset and new severity indices to evaluate the Rules of Origin (RoO) in India's trade agreements. RoO, while essential for preventing trade deflection, can act as a non-tariff barrier if excessively stringent. The study distinguishes between product-specific rules (PSR) and regime-wide rules (RwR), further classifying the latter into compliance and facilitation provisions. Using detailed coding of 17 India-specific agreements, the paper constructs composite indices that capture the severity and heterogeneity of origin rules. RwR provisions, spread across 39 indicators, have also been taken into consideration. Results show considerable variation across agreements: the India–EFTA agreement is the most restrictive overall, while India–ASEAN emerges as the most liberal. Partial scope agreements exhibit lower severity due to limited product coverage, whereas newer comprehensive FTAs tend to adopt more stringent RoO regimes. Robustness checks, including sensitivity to weighting, normalization, and other statistical properties, confirm the indices' stability across methodological variations. The indices and dataset presented provide a replicable framework for systematically assessing RoO severity and its policy implications.

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Acknowledgement: The author gratefully acknowledges Prof. Beena P.L., Dr. Ritika Jain, and Dr. Amartya Paul for valuable suggestions on earlier drafts. Thanks are also due to the participants and discussants of the first PhD Colloquium at the Centre for Development Studies, Kerala, for their constructive feedback. Special gratitude is extended to Prof. A. Ganesh-Kumar for his detailed comments to strengthen this article.

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1 Introduction

Rules of Origin (RoO) are criteria used to determine the economic nationality of a product in trade. According to the World Customs Organization, "the basic role of rules of origin is the determination of the economic nationality as opposed to the geographical nationality". RoO are classified into two types: Non-preferential and Preferential. Non-preferential RoO apply generally to products outside free trade areas and are used for purposes like import quotas or anti-dumping duties, typically set unilaterally without negotiation.

Preferential Rules of Origin (RoO)[1]are a specific phenomenon to Free Trade Agreements (FTAs), which grant tariff benefits exclusively to partner countries. These rules, negotiated mutually by FTA members, are vital because they ensure that only products genuinely originating within the FTA qualify for preferential treatment. Their primary purpose is to prevent trade deflection, stopping non-partner countries from exploiting tariff advantages by routing goods through FTA partners. Suppose two countries, A and B, sign an FTA and there are no RoO, a non-partner country might use this loophole by sending its products to low-tariff country A and using this country as a launching pad to send its products again to the FTA country B, where it enjoys zero tariff from B. In a nutshell, an FTA without RoO will induce transshipment, eventually killing the idea of FTA. Hence, RoO are an integral part of any FTA. In fact, many FTAs are concluded just because each party to the agreement is satisfied with the design of the RoO. Duttagupta and Panagariya (2007) argue that RoO can improve the political viability of an FTA.

However, RoO vary widely across FTAs, as they are negotiated and implemented differently by each agreement. Some FTAs have liberal RoO, while others enforce stringent ones. The severity of RoO significantly impacts the welfare of member countries. When overly strict, RoO can hinder trade flows and undermine the purpose of FTAs, effectively acting as non-tariff barriers. For this reason, UNCTAD classifies RoO as a type of non-tariff measure (NTM), as illustrated in Figure 1.

In India's case, scrutinizing RoO is crucial for several reasons. India has raised concerns over limited market access under its FTAs and intends to review agreements with key partners like Japan, Korea, and ASEAN[2]. At the same time, it seeks stricter RoO in new deals to curb trade re-routing and protect domestic

[1]In this article, Rules of Origin means Preferential Rules of Origin, unless stated otherwise.

industries[3]. These stricter rules may, however, contribute to the low utilization of FTAs. Jha (2013) also points out the low utilization of India's FTAs. Currently, India has signed a bilateral trade agreement with its key partner, the UK, and is negotiating with the US and the EU as well. Hence, this becomes even more important to explore and assess the RoO in India's trade agreements to understand the trade dynamics under an FTA.

Hence, the objectives of this study are multi-pronged. First is to know the structure of the Rules of Origin. Second is to understand the components of RoO contributing to the overall severity of any trade agreement. Third is to measure the aggregate restrictiveness of the RoO for an FTA, and finally, to do a cross-comparison to understand the severity level for each India-specific agreement.

For these purposes, in Section 2, an overview of the RoO, with several examples, will be discussed. Section 3 is a literature review of the existing studies trying to assess the severity of RoO. Section 4 will provide the conceptual framework behind the measurement of the RoO severity for India's trade agreement. In Section 5, RoO data preparation work will be discussed, while Section 6 will elaborate on the detailed methodology for developing the severity indices for India's trade agreements. Section 7 will discuss several developed indices as a result, while Section 8 will comment upon the properties of the developed indices. Finally, Section 9 will conclude.

2 Rules of Origin: An Overview

RoO are an inevitable part of a trade agreement. A commodity or product must fulfill both criteria for beneficial treatment under a preferential trading scheme. In case of failure of origin establishment, the import duty has to be paid. This is how RoO work. They are of two types- Product Specific Rules (PSR) and Regime-wide Rules (RwR). The former may be called 'Origin criteria' and the latter 'Administrative criteria.' The textbook classification of the RoO has been presented as a tree map in Figure 2.

In trade agreements, there are different patterns or modalities for defining the origin rules or criteria. Each India-specific trade agreement contains RoO as either a general origin rule with a list of differentiated origin rules for the negotiated products, or a general origin rule only for all negotiated products. For

[3]India has asked Japan, South Korea to renegotiate FTAs
[3]India for stricter Rules of Origin in auto sector under India, UK trade agreement

example, suppose there are 100 negotiated products under an agreement. Out of 100 products, differentiated origin rules may be applicable for the 10 products, and for the rest 90, the general origin rule may be applied. But, this is not the only pattern for origin rules. Some agreements do not contain differentiated rules, while some agreements do not contain any general origin rule, meaning each commodity has been assigned a particular rule.

For example, the India-Japan trade agreement mentions general as well as differential origin rules for the negotiated products. Article 29(1) of Chapter 3 of this agreement mentions the general rule as,

> *"The good should have a qualifying value content of not less than 35 percent; and all non-originating materials used in the production of the good have undergone in the Party a change in tariff classification at the six-digit level (i.e., a change in tariff subheading) of the Harmonized System"*

The above-mentioned origin rule is applicable to all negotiated goods except those that have a particular rule mentioned in the Annex. In this regard, Article 29(2) of Chapter 3 explicitly articulates,

> *"Notwithstanding Article 29(1), a good subject to product-specific rules shall qualify as an originating good of a Party if it satisfies the applicable product-specific rules set out in Annex"*

This way, the Annex contains the specific origin rule for several products, which may be different from the general rule. For example, products with HS 090230 to HS 090240 should not have a qualifying value content less than 50 percent.

On the contrary, the India-Lanka trade agreement has only a general rule for all negotiated goods, which says that the parts or produce originating from countries other than the Contracting Parties or of undetermined origin used should not exceed 65% of the fob value of the products produced or obtained. The India-Australia agreement has no general rule; instead, it prescribes an origin rule for each negotiated commodity at the HS-6 level. Either the differentiated or the general rules are applied at the HS-6 commodity level. Hence, together, they may be called product-specific rules (PSR) because, technically, for each product, there is an origin rule that has to be satisfied for preferential benefits.

Apart from this, there is also a heterogeneity in terms of defining the PSR. They may be defined at the Chapter level (HS-2 digit), or the heading level (HS-4 digit), or the sub-heading level (HS-6 digit). Even a combination of different

levels is also used in some agreements. Hence, there is not a single thumb rule for defining PSR.

PSR may be further divided into two parts: Wholly obtained (WO) and Substantial Transformation Criteria (STC). The WO rule is applied mostly on the primary products, including 'live animals born and raised in the Contracting Party', 'animals obtained by hunting, trapping, fishing, gathering, or capturing in the Party', 'plants and plant products harvested, picked or gathered in the Party', 'minerals and other naturally occurring substances extracted or taken in the Party,' etc. The STC rule is applied mostly to non-primary products, which require several inputs to be in the final stage of the good. All kinds of product-specific rules except WO come under the STC rule, as mentioned in 2.

The STC, further, can be divided into four categories- Change in Tariff Classification (CTC), Qualifying Value Content or Value Content Ratio (VCR), Technical requirement, and Input requirement. It should be noted here that the international conventions, including the Revised Kyoto Convention, and the literature of RoO consider only three categories of the STC, the first three mentioned earlier. The 'Input requirement' is generally clubbed with the 'Technical requirement.' The clubbing of both criteria into one is incorrect because the Technical requirements require a specific manufacturing process, like a Chemical process, etc, for making any product, while the Input requirement is about specific intermediate inputs in any product.

Further classification may be done for the CTC, which is 'Change in Chapter,' 'Change in heading', and 'Change in sub-heading.' All these categories of the CTC are in terms of the HS code system. These are the types of PSR that are used in the negotiation of any trade agreement. They may be used in singular forms like CTC, VCR, Technical requirement, or Input requirement. They may also be used in the composite form, meaning, for any particular product, more than one PSR is applied, like 'CTC with VCR' or 'CTC with Technical requirement.'

The second category of RoO, which is 'administrative criteria,' is called Regime-wide Rules (RwR). Since they all are applied to each negotiated product or entire preferential regime, they are called Regime-wide Rules. Generally, there is no classification or categorization of RwR in the literature, but it can be done in two ways. One categorization may be done in terms of the nature of RwR provisions. RwR generally contain the administrative side of the RoO such as Certification, Verification, Dispute settlement mechanism, Suspension of preferential treatment, Record-keeping, etc. However, some other provisions like De

minimis, Cumulation are not purely administrative provisions, in fact, in nature, they are closer to the VCR origin criteria. This classification of RwR in terms of Administrative and Non-administrative may be considered a naive one.

Another way of classifying the RwR may be in terms of trade effect. Each kind of provision has a certain trade effect, which may either facilitate or inhibit trade flows. Hence, RwR may be classified into two parts: compliance and facilitation. Though Estevadeordal and Suominen (2004) has developed a facilitation index for RwR, there is no such classification in the literature. However, to understand RwR and its impact on trade flows in its entirety, it is necessary to examine both aspects. Section 4 discusses this classification and the reasoning behind it in detail.

Each agreement has a different distribution of PSR. This may vary at the sectoral and aggregate levels. Moreover, each agreement has a different structure for the RwR also; some may have more compliance-related provisions, whereas others may have more facilitation provisions. This becomes a matter of rigorous analysis of the text of the agreements, which will be done subsequently. A detailed discussion of RoO classification has been done in the following subsections.

2.1 Product Specific Rules

As shown in Figure 2, RoO is bifurcated into PSR and RwR. PSR is further divided into two major criteria which are 'wholly obtained' and 'substantial transformation criteria'.

2.1.1 Wholly Obtained

Under an FTA, this rule is basically applied to the goods that are produced entirely in a partner country, not outside the territory of it. According to the World Customs Handbook on Rules of Origin, "Wholly obtained goods are: goods naturally occurring; or live animals born and raised in a given country; or plants harvested in a given country; or minerals extracted or taken in a single country. The definition of wholly obtained also covers goods produced from wholly obtained goods alone or scrap and waste derived from manufacturing or processing operations or from consumption". When a product is produced in a single stage or is wholly obtained (WO) in one country, the origin of the product is relatively easy to establish (Brenton and Imagawa (2005)). Hence, when the WO rule is

applied to any product under an FTA, it does not create any economic hurdle because it is easy to establish the origin criteria here. Some products are listed below from India's trade agreements for which the WO rule is applied; however, the list below is not exhaustive. Though the product categories under the WO are almost identical in each agreement, it may not be the same at the six-digit disaggregation.

- Raw or mineral products extracted from its soil, its water, or its seabeds;
- plants and plant products harvested, picked, or gathered after being grown there;
- live animals born and raised there; and goods obtained from animals;

2.1.2 Substantial Transformation Criteria

When a product is not wholly obtained from a single country (FTA partner country), in other words, when a final product has intermediate inputs from any non-partner country, it is quite complicated to establish the origin criteria. In such cases, the Substantial Transformation Criteria (STC) is applied to determine the origin of a product. By nature, there may be two kinds of STC rules: positive and negative.

- **Positive test of Origin:** A positive test of origin is a criterion for the intermediate imported inputs that will provide the originating status for the final product. This test explicitly tells what could be taken as inputs. Example- In the India-Korea agreement, the rule for the product HS 220890[4](Spirits, liqueurs, and other spirituous beverages) states that the inputs may be taken from any other heading of tariff classification to prepare it.
- **Negative test of Origin:** A negative test will state that the usage of which inputs will not be considered for grant of origin. Example- In the same India-Korea agreement, the rule for the product HS 740811 (copper wire made of refined copper with a maximum cross-sectional dimension that exceeds 6 mm) states that in the making of this product, inputs may be taken from any other heading except from the heading 7407 (copper bars, rods, and profiles). Since this kind of origin test disallows the use of certain inputs, that's why this is called the negative test.

There are four methods to ascertain the origin- 'Change in Tariff Classification,' 'Value Content Ratio,' 'Technical requirement,' and 'Input requirement.' The positive and negative tests apply to all except the value content ratio method.

2.1.2.1 Change in Tariff Classification (CTC) This rule is applied when the final exported product falls into a different HS category than that of the intermediate inputs used in it. This tariff-shift method is based on the Harmonized System of the commodity classification.

The World Trade Organization Agreement on Rules of Origin recommends adopting positive standards for the rules of origin, but allows negative standards in case of clarification of the rules. In India-specific agreements' rules of origin, the frequency of the negative standards is negligible in comparison to the positive standards. On the other hand, Brenton and Imagawa (2005) mentions that the negative standards are abundant in the EU and the NAFTA rules of origin. The CTC rule, once defined, is clear and straightforward. The scope of misinterpretation is very small in it. It is easy for the business to follow. From the origin management perspective, it is not cumbersome to trace. The CTC rule is further classified into three categories according to the product code of the HS system.

- **Change in Chapter (CC):** This means that the inputs used in the final product should be from a different chapter than the chapter level of the final product. For example, HS code 200710 (chapter 20) is used for homogenized preparations of jams, fruits, jellies, etc. In the India-Mauritius Agreement, the rule for this product is 'Change in Chapter,' which means an imported product HS 200710 will be granted preferential benefit under the FTA in either of the countries if it has inputs from any chapter except Chapter 20.

- **Change in heading (CTH):** This rule is similar to CC, but here the inputs may be from the same chapter, but not from the same heading. Explaining from the last example itself, suppose the rule is 'Change in Heading' for the product HS 200710, then inputs may be taken from any chapter, including

[4]The Harmonized System, a standardized codes compilation to classify goods, comprises 96 chapters (two-digit level), 1,241 headings (four-digit level), and around 5,000 subheadings (six-digit level). In any HS six-digit code, e.g., 200710, the first two digits stand for the chapter, the first four digits (including the next two digits) are for the heading, and all six digits are for the subheading. Six-digit product is further divided into eight-digit codes (item level). In this article, explanations up to six digits will be made.

chapter 20, but not heading 2007, which lies in chapter 20. Only the heading 2007 is prohibited, not the entire chapter. In a sense, CH is more liberal than CC as it expands the input space for the producer.

- **Change in Subheading (CTSH):** This rule is defined at the subheading level. Take the same example with the CTSH rule that is, 'Change in Subheading.' If a product has taken raw materials or inputs from any subheading from the entire HS subheadings except subheading 200710, it will be granted preferential treatment under the FTA. In terms of severity, the CTSH is even more liberal than the CTH because it further relaxes the input constraint.

2.1.2.2 Value Content Ratio (VCR) The value content ratio is a product-specific rule that provides preferential treatment on a final product if the value of the input content in this final product reaches a certain threshold. For example, in the India-Malaysia Agreement, HS 441290 (wood articles) qualifies for the FTA benefit if it contains 35% domestic value-added content. The VCR is defined in two ways- the minimum domestic value-added content (bottom-up approach) and the maximum import value-added (top-down approach) content. The above-mentioned example from the India-Malaysia Agreement is an example of the bottom-up approach, while the same can be written as a top-down approach. 'A maximum of 65% value of the final product may come from non-originating materials or materials from an undetermined origin' is an example of the top-down approach VCR rule.

Prima facie, the value-added rule is clear, simple, and unambiguous in its definition, but it may create complications in actual implementation. The reason behind the complication lies in the administrative rules related to the VCR. The rules like how the VCR should be calculated, what should be the formula, what should constitute the production cost, etc; these types of administrative rules create complications for the producers. Apart from this, the VCR rule is not agnostic to the fluctuations in the exchange rates, wages, rents, and commodity prices. These administrative rules associated with the VCR origin rule will be discussed in detail in a subsequent section.

2.1.2.3 Technical Requirement Technical requirements or specific processes for any product mean that it must undergo such a process to get preferential treatment under an FTA. For e.g., In the India-Australia agreement, the rule for

all the Iron and steel and their goods is that they should be melted and poured into the FTA-member territory. Another instance from the India-Mauritius Agreement, 'woven fabrics of synthetic staple fibers' (HS 5512- HS 5515) must be woven and dyed or printed in one of the parties to the agreement to get eligibility under the FTA.

These criteria also come in the form of positive and negative tests of origin, but in India-specific agreements, only positive criteria have been observed. Once defined, this rule is clear and straightforward because there is no scope for confusion regarding the originating status of the related product. Yet, this method suffers from some drawbacks. First, it may be costly to follow certain processes in making up any product; second, in the modern world of changing technology, the process may become obsolescent, which may put a producer at a disadvantage in terms of competitiveness.

2.1.2.4 Input Requirement This product-specific rule requires that a finished product must have used a particular input to be eligible for the benefits. E.g., Apparel goods falling in Chapter 61 to Chapter 63 should be manufactured from imported yarn only to get benefits under the India-Korea trade agreement. This particular rule is a type of positive test of origin. On the other hand, rule for the HS 8541 (semiconductor devices, including diodes, transistors, and other similar devices) in the India-Japan Agreement states, "A change to heading 85.41 from any other chapter, provided that components not classified in 8541.10, 8541.21, 8541.29, 8541.30, 8541.40, 8541.50, 8542.31, 8542.32, 8542.33 and 8542.39 are disregarded." which means that the manufacturing of any product under heading 8541 should not use the inputs from the mentioned subheading (i.e., 8541.10, 8541.21... etc.). This particular rule is an example of a negative test of origin regarding the input requirement.

Though input rules are simple, the mandate to use particular inputs or not to manufacture a final product may become restrictive and affect cost competitiveness. Moreover, the negative tests are more restrictive than the positive ones, in general.

Apart from the agricultural products, no single rule applied for a product in one agreement has been applied across each agreement. In other words, a rule or criteria for a product in one agreement may change in another agreement for the same product. For agricultural products, the criterion is 'wholly obtained' and is

applied more or less across each agreement. Hence, there is no dominance of one rule over the other. Also, there is no thumb rule for any product in terms of rules of origin. It solely depends on the negotiations and the economic profile of the FTA partners.

The above-mentioned rules are basic or atomistic, or stand-alone product-specific rules. Most of the time, in an agreement, they are applied in combination with two or more. For example, in the India-UAE trade agreement, products under chapter 30 (pharmaceutical products) must fulfill the criteria 'CTSH + VCR 40%' that says apart from fulfilling the criteria of Change to sub-heading level, it also must satisfy the minimum domestic value-added of 40% in the final product.

2.2 Regime-Wide Rules

The other part of RoO is the Regime-wide Rules (RwR). While the PSR imply the trade-related aspect, RwR are mostly the administrative side of RoO, like 'Certification', 'Verification', 'Dispute settlement mechanism', 'Penalty', 'Advanced rulings', 'Trade invoicing', etc. The reason behind calling them regime-wide is that these provisions are not related to a particular product but applied to the entire range of products that have been negotiated in an FTA. Though there are no clear-cut definitions but from the business point of view, these may be classified further into 'compliance' and 'facilitation' subgroups.

A provision or rule is a bigger term here, comprising many sub-provisions or sub-rulings. E.g., 'Certification' is a regime-wide provision; this provision contains the sub-rules for the issuance of the certificates, record-keeping of the certificates, conditionalities for certificate exemptions etc. In the very same way, 'Verification' is a provision found in almost every text of the agreement. This provision has sub-provisions for the competent authority to conduct the verification, the timeline for conducting the verification, etc. In this way, some sub-rulings of one provision may be related to compliance, while some may be in the facilitation subgroup.

In this study, we have clubbed regime-wide rules under seven provisions: 'Certification,' 'Verification,' 'Cumulation,' 'De minimis,' 'Value content ratio rules,' 'Dispute mechanism,' and 'Miscellaneous.' Apart from the Cumulation and the De minimis, other provisions are self-explanatory which have been explained below.

2.2.1 Cumulation

Cumulation is a provision that allows the procurement of intermediate inputs or materials from FTA partners or the processing taking place in FTA partners as originating inputs or processing. For e.g., the India-Singapore Agreement allows cumulation of 40%, which means any producer in either country may procure the raw materials or intermediate inputs up to 40% value from the FTA partner country, and the finished product will not lose the originating status. In fact, the imported inputs will be granted originating status. With cumulation, to fulfill VCR criteria, the producer is not bound to procure from the domestic market only. This kind of provision is liberal in the sense that it expands the input space for the producers, but again, that depends on the cumulation rule and type of cumulation.

If the cumulation rule is high in percentage terms, it will be beneficial for the producers as they may procure more input from the FTA partner country, and the other way around is in the case of a low percentage rule. Apart from the rule, the type of cumulation is also important. There are three main types of cumulation: bilateral, diagonal, and full cumulation. Bilateral cumulation is a specification of the bilateral trade agreement, while diagonal cumulation is a phenomenon observed in the multilateral trade agreement. In bilateral accumulation, one contracting party may procure and use inputs or materials of a certain threshold value from the other party. Diagonal cumulation is bilateral but with more than two contracting parties. In full cumulation, a producer may procure from any country. In this way, the diagonal rules are more liberal than the bilateral ones, while the full cumulation is the most liberal. In India-specific agreements, only bilateral and diagonal cumulation is observed.

2.2.2 De Minimis

"De minimis" is a Latin expression that denotes matters so minor or trivial that they are considered negligible, unimportant, or insignificant, and not worthy of any action or consideration. In the context of RoO, De-minimis, or the tolerance rule, is a provision that allows a certain share of non-originating (or imported) inputs in the final product without losing the originating status. This rule may be in terms of either value or volume or both. If such a certain share of value/weight does not fulfill the PSR provided for the final product, the final good will not lose its originating status.

For e.g., in the India-Malaysia agreement, De-minimis is allowed up to 10% of the value of the product. That means the producer may procure inputs up to that value from any country without losing the originating status of its final products. This is also considered a liberal provision in trade agreements. The more the De-minimis value, the more liberal the preferential regime.
The above-mentioned RwR are quite common in each India-specific agreement, but several may not contain them. It also depends on the type of agreement. Since the partial scope agreement (PSA) does not have many RwR provisions as compared to a comprehensive free trade agreement, the former is less likely to have De-minimis.

3 Literature Review

There have been several attempts to quantify the restrictiveness of the rules of origin in the literature. Several scholars have taken an index approach to measure the severity or get an idea about the severity. The very first related study is by Estevadeordal (1999). In this study of market access using NAFTA, the author created a restrictiveness index of Rules of Origin, where the index is an ordered categorical one ranging from 1 (least restrictive) to 7 (most restrictive). This index has considered only PSR with a major focus on Change in tariff classification. Estevadeordal and Suominen (2004) extended the earlier work of Estevadeordal (1999) by including an index for RoO facilitation. In this facilitation index, the authors have considered five regime-wide provisions, namely, de minimis, diagonal, full cumulation, drawback, and self-certification. The value of this index ranges from 0 (least liberal) to 5 (most liberal). Cadot et al. (2006) followed the same methodology for severity index creation as used by Estevadeordal (1999) with some little modifications. The former used a threshold for the value content ratio, while the latter did not. Harris (2007) also created an index for the RoO severity using the methodology of Estevadeordal (1999), but the former is a more detailed one than the latter's. Also, the Harris index is different from the Cadot index in some sense as Harris (2007) has considered 'exceptions' and 'additions' in Change in tariff classification with much emphasis. All these indices except Estevadeordal and Suominen (2004) focused mainly on the PSR or rules applied for a product as origin criteria, neglecting the effects of regime-wide rules. Gretton and Gali (2005) also created an index for RoO severity for

20 agreements using the weight and score method. These authors have considered product-specific rules as the primary criteria for establishing origin, while regime-wide rules and others have been classified as secondary criteria where the primary criteria get a weight of 0.6 while the other one gets 0.4. Here, many provisions, like cumulation, duty drawback, outward processing, etc., have been considered in the supplementary criteria. Kelleher (2012) while criticizing the early decade literature, which ignored the importance of RWR in the estimation of the impact of RoO, has amended the Harris index by incorporating three RWR provisions- cumulation, de minimis, and certification type. The author calls this amended index the 'Regime weighted Harris Index.' While working on an India-specific study of select trade agreements, Nag and De (2011) followed Gretton and Gali (2005) for getting RoO severity quantitative values in their study. Das and Ratna (2011) has developed an RoO development index using a score and weight approach. In this development index, such provisions have been given weights that may contribute to additional economic activities. For e.g., PSR has been assigned a value of 0 because they are not prone to contributing to the development goals, while duty-drawback has been given a value of 0.1 as it induces some economic activity, though less in intensity, as per the authors.

Hence, it is evident that all these studies look at the measurement of the severity of RoO using the index approach. Though this approach has its own limitations, it seems to be a justified way to determine the severity of RoO in case of cross-comparisons or impact evaluation. Earlier attempts have mostly focused on the PSR, while recent ones have also considered the RWR. Still, several issues need to be considered.

First, the composite index developed by Gretton and Gali (2005) or Das and Ratna (2011) has taken the arbitrary weights for the index components, which might have been more data-driven as suggested by Nardo et al. (2005) and Greco et al. (2019).

The second issue is the ignorance of the heterogeneity of Product-specific rules in the RoO severity index. More heterogeneity or a greater number of rules applied in any agreement may increase the severity level of RoO in that agreement. With a more heterogeneous (or more diverse) RoO regime, a firm may need to understand and comply with multiple, differing rules across its product range, which may escalate the compliance cost and reduce FTA utilization. Kawai and Wignaraja (2009) also supports the view of higher compliance costs in the presence of multiple rules. Hence, the heterogeneity must be considered in a severity

index along with the PSR severity.

The third issue may be counted as a lack of comprehensive inclusion of Regime-wide rules in the severity index. Except Angeli (2020), almost all studies discussed above give less space to the Regime-wide rules in the index calculation.

These issues are significantly important to understand the RoO regimes of any country. Since certain lacunae are still present in this particular literature, therefore, there is a need for a more comprehensive assessment of RoO severity in light of the issues discussed above. This will not just fill the gaps, but also provide a way forward for the severity assessment of RoO for any trade agreement.

4 Conceptual Framework

To start with the construction of the RoO severity Index, a theoretical understanding is needed. As a first step, a concept regarding the contribution by the RoO components to the overall severity needs to be understood.

The idea of preferential RoO (or RoO) is to provide preferential treatment to the traded commodities by establishing their economic identity. However, at core, RoO work as a non-tariff measure which actually increase the cost of accessing preferential trade. When a particular origin rule is applied to a product, the producer has to choose inputs from a particular set to get preferential treatment. This ultimately limits his choices for the inputs, or in other words, the origin rules shrink the input space for the producer. For example, suppose a firm in country A procures 70% intermediate inputs from an efficient firm in country B, and produces a cost-efficient product which is exported to many countries, including country C. But country A signs a trade agreement with country C, and now to export to country C, firms in country A have to fulfill the rules of origin, including the origin rule. If there is an origin rule that says that 45% value content of the product should be from the domestic market to get preferential treatment under the agreement, the firm in country A would have to procure less efficient intermediate inputs from the domestic market. Earlier, both input markets were available to the producer; now, only the domestic market is available for the 45% of the inputs. The more the domestic value rule, the smaller the input space. And, this is equally true for other origin rules, including Change in Tariff Classification, Input requirement, or Technical process, etc. This is how origin rules add severity to the preferential regime by shrinking the input choices of the firm, as explained by Krishna (2006).

$$\text{Origin Rule Severity} \uparrow \xrightarrow{\text{increases}} \text{RoO Severity} \uparrow$$

The heterogeneity or diversity of PSR also adds to the severity in terms of implicit additional business cost. Suppose a firm in a particular sector produces and exports several products to other countries. As per one agreement, only one origin rule is applied across all the products in this sector, while according to the other agreement, there are several rules for different products in this sector. This would compel the firm to change its compliance and production strategy if it wants to export to both countries. For example, the India-Malaysia agreement prescribes only one origin rule for the entire Electronics sector, while the India-EFTA agreement contains four different rules for the sector. This way, the origin rule diversity in a trade agreement also adds severity to that preferential regime. In the survey study by Crivelli et al. (2024), around 97.5% of surveyed firms either agree or totally agree that a convergence of PSR across the FTAs would be business-friendly and reduce compliance costs.

$$\text{Origin Rule Heterogeneity} \uparrow \xrightarrow{\text{increases}} \text{RoO Severity} \uparrow$$

Regime-wide Rules may be cumbersome or may not. It depends on the number of trade-facilitating provisions in the text of the agreement. In other words, if the agreement contains more provisions related to compliance cost in comparison to trade-facilitating provisions, it would be a stringent RwR regime. Though in literature, there is no clear demarcation of compliance and facilitation, it would be useful to segregate the provisions according to their business effect to ascertain the correct severity level of an agreement and recommend policy solutions accordingly. The idea behind proposing this kind of classification is the business cost or the cost added to the business because of any RwR provision. If any rule or provision is cumbersome to follow and adds extra cost, apart from the production cost, to the business, it may be called a 'Compliance-related provision.' For e.g., a provision of record-keeping of origin-related documents for five years may be cumbersome for firms to maintain, in comparison to two-year record-keeping. Hence, this provision will be labeled as a compliance-related one because this practice will incur extra spending for the business. Whereas a provision that removes or lessens the administrative burden or relaxes the input constraint may be called a 'Facilitation-related provision.' For e.g., a self-certification for the certificate of origin will remove the need for pre-export veri-

fication by the authorities. This will save time and money and make the business hassle-free, hence a facilitation-related provision.

$$\text{Compliance} \uparrow \xrightarrow{\text{increases}} \text{RoO Severity} \uparrow$$

$$\text{Facilitation} \uparrow \xrightarrow{\text{decreases}} \text{RoO Severity} \downarrow$$

Figure 3 shows the conceptual outline for developing the aggregate RoO severity index. An aggregation of both PSR components and both RwR components will be further aggregated to create the aggregate severity index for the entire RoO regime. The methodology will be explained for these aggregations in the Methodology section. The next section discusses the data creation part.

5 Data

In this study, we develop a comprehensive dataset for Rules of Origin for India-specific trade agreements. Since one of the objectives of this study is to calculate severity indices for India-specific trade agreements, therefore, data for both PSR and RwR are needed. In this regard, there is a lacuna, at least for India. The one dataset available is by Angeli (2020). This dataset surveys and compiles the data for the PSR and the RwR for around 350 trade agreements worldwide. Though this dataset also has information on India's agreements, it falls short of some expectations regarding India-specific agreements. There are several reasons to claim that this dataset contains less and scant information for India-specific trade agreements, which are as follows-

- In this dataset, for Product-specific rules, it has information only for three agreements, namely, India-Korea, India-Singapore, and India-Malaysia.
- For Regime-wide rules, this dataset is more or less updated and contains information on 15 agreements.
- In Regime-wide rules data, some entries don't match the information in the concerned text of the agreement. For example, in the text of the India-Japan agreement, Annex 2 of Chapter 3 is related to the PSR of the concerned agreement, but according to the above-mentioned dataset, there is no PSR.
- In this dataset, some critical questions have been missed, and so has the data for them. For example, 'If third-party invoicing is allowed?', 'If there

is a provision for the sets?' These missing regime-wide rules may become important in determining the severity level. In Product-specific rules, the question regarding a particular input requirement is missing.

Hence, a necessity for such data to create the severity index is the key motivation for developing such a comprehensive dataset of RoO for India's agreements, which not only comprises information for all the agreements but also addresses the absence of key features of agreements. This lacuna is also filled by this study by providing such a dataset for India. In this study, the developed dataset on the Rules of Origin contains two parts: Regime-wide and Product-specific rules. The developed dataset has information for 17 agreements mentioned in Table 1. To create the dataset, the official text of the agreements from the Ministry of Commerce and Industry, Government of India, has been extracted and analyzed. In each text, the chapter on Rules of Origin and the attached annexures have been considered.

5.1 Product-specific Rules

For product-specific rules, the information has been compiled for negotiated products at the HS six-digit level. Each agreement has a different number of negotiated commodities, as mentioned in Table 1. The variation in the number of negotiated commodities between the contracting parties may depend upon several factors, including the nature of the trade deal. It can be observed that the Partial scope agreements' (PSA) negotiated list contains a smaller number of commodities compared to that of full or comprehensive Free trade agreements (FTA). However, it may not be true for all cases, as APTA, a PSA, has more commodities than other PSA. At the same time, the India-Mauritius agreement has very few commodities to offer compared to other FTAs. Still, as a general rule, it may be asserted that the FTAs have broader commodity coverage compared to the PSAs.

The information for all the negotiated commodities has been compiled using two main methods of origin criteria: wholly obtained, and Substantial transformation criteria (STC). The STC is further broken down into four methods, which are CTC, VCR, Technical process, and Input requirement. Figures 4, 5, 6, 7, and 8 show the PSR distribution in each sector for each agreement. Several patterns may be observed from these figures, which are as follows.

- There is a lot of variation in the distribution of PSR across the sectors and

the agreements. In PSAs, the sectors generally comprise a single rule for the entire sector, while in FTAs, several rules have been applied across a sector.

- In aggregate terms, also, the PSAs contain less heterogeneity of PSR compared to the FTAs. For PSAs, the number of rules varies between two (IND-AFG, IND-CHL, IND-MERCOSUR) to five (IND-THA), whereas for FTAs, it varies from two (IND-LKA, IND-ASEAN) to twenty-two (IND-EFTA).
- Generally, 'wholly obtained (who)' is the origin rule for the 'Animal_Products' and 'Vegetables' sectors, but some other rules like 'Change in Chapter (CC)', and VCR, etc., have also been used.
- The 'Food Products' sector exhibits the highest average number of PSR($\sim$3) across the agreements, indicating greater complexity, while the 'Fuels' sector has the lowest average ($\sim$1), reflecting minimal rule imposition.
- The newer trade agreements seem to be more heterogeneous sectorally in terms of PSR application compared to older ones.
- The 'Metals' sector displays a high variation in the number of applied rules across agreements, from 14(EFTA), the highest, to only a single rule (ASEAN, LKA, etc.), highlighting a stark regulatory disparity.
- In contrast, sectors like 'Hide skin' and 'Minerals' exhibit minimal dispersion, with a maximum of just 2 rules applied across all agreements.

5.2 Regime-wide Rules

The regime-wide rules contain a total of seven provisions or areas, and these seven areas comprise a total of 39 indicators (or variables or questions), which are classified into compliance and facilitation sub-groups. The seven provisions are, namely, Certification, Verification, Cumulation, De-minimis, Value content ratio rules, Dispute settlement mechanism, and Miscellaneous. Table 2 provides these details about the regime-wide rules.

After the RoO dataset development, severity indices have been created, as mentioned in the next section.

6 Index Methodology

Like the RoO data, the aggregate severity index for an agreement has two parts: one is the Composite PSR index, and the other is the Composite RwR index, as depicted in Figure 3. The Composite PSR index has two parts: Origin severity and Origin heterogeneity. The RwR index has also been classified into two: compliance and facilitation. For PSR severity, both components' severity is calculated and then aggregated to get a composite PSR severity index. Likewise, the composite RWR index is calculated by first calculating its components of Compliance and Facilitation. The detailed methodology behind developing these indices is as follows.

6.1 Composite PSR Index

As it has been discussed in earlier Sections that the heterogeneity of the PSR, along with applied origin rule (PSR) severity, also plays a crucial role in determining the aggregate severity of RoO regime, the PSR index must capture both the factors. Hence, both the methodology behind both sub-indicators have been discussed below.

6.1.1 Origin Rule Severity

To develop the PSR severity sub-indicator, a score according to the scoring scheme mentioned in Table 3 is assigned to each negotiated HS six-digit commodity in each agreement. These scores are according to the negotiated rule in the text of the agreement. The scoring scheme has utilized the concepts of already existing indices and the literature. PSR has two parts, wholly obtained (WO) and Substantial transformation criteria (STC). In the scoring scheme, a score of zero is assigned for the WO because the WO does not contribute to the severity. This has been corroborated by many scholars, including Brenton and Imagawa (2005). The severity effectively arises from the STC part. This is why only the STC has been considered in the scoring scheme.

Let's first take the change in tariff classification (CTC). As explained in subsection 2.1.2.1, the change in subheading (CTSH) is the most liberal PSR rule, while the most restrictive one is the Change in chapter (CC). Moreover, Harris (2007) assigns an equal number of points to TECH and CTSH. Hence, in terms of severity, these can be written as

$$CTSH = TECH = INP = VCR1 \tag{1}$$

$$CC > CTH > CTSH \tag{2}$$

This expression in equation 2 is for the positive test of origin; however, for the negative test of origin, this pattern will remain the same. That is

$$CC\_exc > CTH\_exc > CTSH\_exc \tag{3}$$

where $CTSH\_exc$ is the negative test, meaning a change from other subheadings except particularly mentioned, and likewise for the CTH_exc and CC_exc. If we may combine both positive and negative tests of origin using eq. 2 & 3, it will be like $CC\_exc > CC$, $CTH\_exc > CTH$, and $CTSH\_exc > CTSH$. Or,

$$CC\_exc > CC > CTH\_exc > CTH > CTSH\_exc > CTSH \tag{4}$$

The severity patterns of eq. 3 & 4 have been considered in Estevadeordal (1999), Harris (2007) and Cadot et al. (2006) indices.

Now, let's consider the value content ratio (VCR) criterion. In terms of severity score assignment, it is straightforward. The higher the requirement for the domestic value-added, the higher the severity of the rules of origin. This analysis has classified the VCR into four strata: VCR1, VCR2, VCR3, and VCR4. VCR1 stands for the domestic value content ratio up to 20%; for VCR2, this is up to 30%; for VCR3, it means that the value-addition should be up to 40%. The value addition of more than 40% would be in the category of VCR4. In terms of severity, it can be written like

$$VCR4 > VCR3 > VCR2 > VCR1 \tag{5}$$

The severity level for technical (tr) and input requirements (inp) has been equalized with the severity of the CTSH and the VCR1 rule. Harris (2007) and Cadot et al. (2006) have followed the same practice. According to the Harris study, $CTSH \leq VCR \leq CTH$, where VCR contains the value addition up to 40%. The VCR greater than 40% has been equalized with the CC. The same concept has been followed in this article. In this study, the VCR1 has been put equal to the CTSH, VCR2 with the CTH, and the CC has been equalized with the VCR4. VCR3

is between VCR2 and VCR4 in terms of severity, this is why VCR3 has been put between CTH and CC, with CTH_exc. This concept is along the lines of Harris (2007).

One thing also should be noted here in terms of the applicable number of rules on any product. For a given product, more than one rule (generally two) may be applied, and both of these rules have to be satisfied for preferential benefits, which is a case of 'cumulatively' applied rules. For example, for a particular product, VCR *'AND'* CTSH both have to be qualified. In this case, a producer has more restrictions. On the other hand, a product might have to fulfill one of the two rules prescribed, meaning in this case, the rules are being applied 'alternatively'. For example, a particular product has to satisfy either VCR *'OR'* CTSH. Hence, the origin rules are applied alternatively or cumulatively.

The cumulatively applied rules are more cumbersome than the alternatively applied rules. In alternative rules, more than one rule is prescribed as origin criteria, and the producer chooses one of these for the origin establishment. It makes general business sense to choose the most liberal method for production. For example, if for any commodity, the rule is mentioned like this, "Change from any other subheading or domestic value content ratio of 35%", that is, "CTSH or VCR3", the producer would go for the CTSH as it is one of the most liberal methods. In terms of severity, it may be written like this

$$CC\_or\_VCR1 = CTH\_or\_VCR1 = CTSH\_or\_VCR1 \tag{6}$$

The same kind of relationships exist for the other methods as well. Since, $CTH = VCR2$, the following will be equal to each other in terms of severity.

$$CTH = VCR2 = CTH\_or\_VCR2 = CTH\_or\_VCR3 = CTH\_or\_VCR4 \tag{7}$$

The following kind of severity pattern will be observed for cumulative-type (or composite) rules like "a change from another heading and a domestic value content of 30% (CTH_VCR2)" applied on any commodity.

$$CC\_VCR1 > CTH\_VCR1 > CTSH\_VCR1 \tag{8}$$

$$CTSH\_VCR4 > CTSH\_VCR3 > CTSH\_VCR2 > CTSH\_VCR1 \tag{9}$$

Estevadeordal (1999) also observes the severity pattern for singular and composite origin rules, which has been followed in this article, is as follows,

$$CC\_VCR \geq CC \geq CTH\_VCR \geq CTH \geq CTSH\_VCR > CTSH \tag{10}$$

Using all these concepts related to the severity pattern from equations 2-10, the severity scores have been assigned. These rules and their corresponding scores have been tabulated in Table 3.

In this way, all the negotiated commodities in each agreement get a score of severity. Then, for each agreement, the sum of all assigned scores is calculated. Since each agreement has a different number of negotiated products, the aggregated scores are not comparable as of now. To make them comparable, the aggregated scores are then divided by the number of products for each agreement to get an agreement level severity statistic. This gives an average value of the Origin severity sub-indicator for each agreement and brings each value on the same scale.

Since a composite severity index comprising four sub-indicators, as shown in Figure 3 is to be calculated, all the sub-indicators must be on the same scale. For this purpose, an operation of normalization is carried out. The normalization of the above-mentioned origin severity values is carried out using the formula mentioned in equation 11, where min and max values are the minimum and the maximum severity scores. The normalized origin severity values will be in the range of 0 to 100.

$$X_{Normalized} = a + \frac{x - min}{max - min} \times (b - a) \tag{11}$$

where a and b are 0 and 100, respectively.

6.1.2 Origin Rule Heterogeneity

Like the aggregated origin rule severity determined at the agreement level, the heterogeneity is also calculated at the agreement level using the Shannon entropy function, which is as follows.

$$H = -\sum_{i=1}^{n} p_i \ln(p_i)$$

where H is entropy, p_i is the Proportion of rule i in an agreement out of the

total rules, and n is the total number of rules in that agreement.

Entropy, derived from information theory, measures the degree of dispersion or uncertainty in a distribution. In the context of Rules of Origin (RoO), entropy is used to assess how evenly or unevenly product-specific rules (PSRs) are applied across sectors within a trade agreement. A higher entropy value indicates that rules are more uniformly distributed, suggesting a broader application of rules or heterogeneity of rules, while a lower entropy value implies concentration of rules across the sectors in agreement.

The total number of rules applied in an agreement could be taken as a proxy for the rules' heterogeneity, but it may not serve the purpose, as in several agreements, the total number of rules applied may be higher, but the number of effectively applied rules may be a few, which will overestimate the results. For example, in total, an agreement has six origin rules for 100 commodities. Out of this, one rule is applicable for 95 commodities, while the other five rules are applicable for the remaining 5 commodities. Here, it can be observed that one rule is heavily deployed, making its coverage or frequency significant, while the coverage of others is comparatively insignificant.

Hence, entropy has been chosen here for its ability to capture not just the quantity but the distributional characteristics of rules, making it a robust indicator of the complexity and spread of RoO frameworks across sectors. This aligns well with the objective of the heterogeneity sub-indicator, which is to quantify not only the intensity but also the structural severity embedded in PSR design. Angeli (2020) also uses Shannon entropy to measure the PSR heterogeneity across the sectors and agreements. As already mentioned, to get a composite value, all the sub-indicators must be on the same scale. Therefore, after having calculated the entropy for each agreement, these entropy scores are normalized using the equation 11, which are in the range of 0 to 100. The normalized values of the origin severity and the origin heterogeneity are aggregated to get a composite PSR index using the following formula, mentioned in equation 12.

$$\text{Composite PSR Index} = \alpha * (\text{Origin Severity}) + \beta * (\text{Origin Heterogeneity}) \quad (12)$$

As mentioned in equation 12, the Composite PSR Index is a weighted sum of the origin severity and the origin heterogeneity, where α and β are the weights which represent the variation in their respective component. These weights can

be calculated as follows.

$$\alpha = \frac{\text{standard deviation (Origin Severity)}}{\text{standard deviation (Origin Severity)} + \text{standard deviation (Origin Heterogeneity)}} \tag{13}$$

$$\beta = 1 - \alpha \tag{14}$$

Since the values of both Origin rule and Origin heterogeneity lie in the range of 0 to 100, and the Composite PSR index is a convex combination of both the components, the latter's range is also 0—100. Here, the weights α (alpha) and β (beta) are calculated as the proportions of the standard deviations of the normalized origin severity and heterogeneity scores, respectively. The idea behind this approach is that a component exhibiting greater variation across observations contains more explanatory power and thus should receive a higher weight in the composite index. As per Nardo et al. (2005), weights should reflect each component's contribution to the composite index. The above-mentioned data-driven statistical approach accounts for the differing contributions of each component to the overall index's stringency. Although there are more sophisticated statistical methods to choose weights, a simple approach has been taken here to keep things simpler, but this overcomes the criticism of random weights.

6.2 Composite RwR Index

The other part of RoO, RwR is straightforward in understanding and score-assignment. The RwR are first categorized into seven major categories or provisions. All these provisions have some indicators, which are further classified into compliance and facilitation according to their trade effect.

The trade effect of any RwR provision has been inferred from a general understanding, literature review, and the provisions mentioned in the other countries' agreements. Taking an example of the India-CHL trade agreement, under the certification provision, there is a sub-provision of issuing a self-attested certificate of origin (CoO) without a need for pre-export verification by the authorities, which is a facilitating sub-rule. Self-certification and e-Certificate of Origin methods are considered business-friendly systems by the exporters, as mentioned by Crivelli et al. (2024). At the same time, there is another sub-rule regarding record-keeping under the same provision of certification, which mandates to keep all the records related to the origin and CoO intact for five years, which is in the compliance category. The former sub-rule is a facilitating one because it

cuts the cost emanating from the pre-export verification and makes the business process easier, while the latter adds cost to the business, as keeping and maintaining all the records for five years is cumbersome and monetarily expensive. Another example of a verification provision in the India-Malaysia agreement is a sub-rule of retrospective verification, which may be harmful to the business environment. Also, a sub-rule of verification of origin-related things is to be done by the exporting authority only without the need for site inspection is a business-friendly ruling. Cumulative verification time in India's agreements is higher than 180 days, while in agreements like the United States–Mexico–Canada Agreement (USMCA), a strict timeline of 60 days is prescribed.

The developed dataset contains 39 indicators, 15 of which belong to Compliance and 24 to facilitation. For the facilitation group, a score of two is generally assigned to a particular indicator (or sub-provision). A score of four may also be assigned to any sub-provision if it further attenuates the severity of RoO. For example, if the rule for De minimis provision is equal to or less than 10%, a score of two is assigned. However, when this is liberalized further, meaning, when a De minimis rule allows greater than 10% of value addition, it will be assigned a score of four. This way, all indicators are assigned scores, and an aggregated score is computed. Before normalization of aggregated scores, these scores are adjusted according to the maximum possible score for each agreement. There are several agreements, mostly PSAs, which are underdocumented, meaning the text of these agreements contains very few provisions. Hence, an adjustment is needed before normalization to avoid over-penalization of any agreement. It allows for cross-agreement comparability by controlling for the number of provisions evaluated. These adjusted raw scores are then normalized using the same formula mentioned above in equation 11. This is how the Facilitation sub-indicator, with a range of 0—100, is calculated.

The calculation of the compliance sub-indicator also goes through the same process of assigning scores and then aggregating, adjusting, and normalizing them using the same method. The information about the provisions and their related indicators or sub-provisions with their scores and classification has been presented in the Table 2. Since the objective is to find the severity of RwR provisions, the facilitation score must be deducted from the compliance score. Finally, the weighted aggregation of both components gives the Composite RwR Index, which is as follows (eq 15).

$$\text{Composite RwR Index} = \alpha * (\text{Compliance}) - \beta * (\text{Facilitation}) \quad (15)$$

where α and β are the weights, derived using the equations 13 and 14. Though both subindicators, Compliance and Facilitation, are in the range of 0—100, the range of the Composite RwR index is [-100,100]. To keep it at the same scale of [0,100], the index values have been rescaled using the same formula mentioned in equation 11. Now, both the Composite indices are on the same scale, which would give us the Aggregate severity index.

6.3 Aggregate RoO Severity Index

Since one of the objectives of this study is also to calculate the overall severity of an agreement, the values of the Composite PSR index and the Composite RwR index are combined using equal weights. Equation 16 illustrates this aggregation.

$$\text{Aggregate RoO severity Index} = 0.5*\text{Composite PSR} + 0.5*\text{Composite RwR} \quad (16)$$

The Aggregate Rules of Origin (RoO) Severity Index is constructed as a simple average of two sub-components: the Composite PSR (Product-Specific Rules) Severity Index and the Composite RwR (Regime-Wide Rules) Severity Index. Equal weights have been assigned to these two dimensions in the final aggregation to reflect their complementary roles in defining the overall restrictiveness of the RoO regime. Both components are equally important, so a normative approach of equal weights is justified here. The range of this aggregate index is also 0—100.

7 Severity Indices

In this section, the developed indices will be discussed as the results. Three indices are discussed here: PSR, RWR, and Aggregate. A cross-comparison among the agreements, as well as the sectoral comparison and trends, has been done for the PSR severity. For RWR, agreement level comparison and trends have been elucidated.

7.1 PSR Severity Index

In this section, the developed index of the Composite PSR severity will be discussed. Table 4 presents the raw values for origin severity (PSR_score), origin heterogeneity (Entropy), their normalized values, and the Composite Index.

The Entropy column captures the heterogeneity in the types of origin rules (PSRs) applied within a trade agreement. A high entropy value indicates that a wide variety of PSR types are used across sectors, suggesting complexity and potentially a greater administrative burden for exporters. For example, EFTA exhibits the highest entropy (2.19), reflecting the presence of a highly diverse set of origin rules across its product coverage, which can also be seen in the Figure 8. In contrast, MERCOSUR (Figure 4) has a very low entropy value (0.17), implying more uniformity or concentration of the rules applied across sectors. The PSAs have relatively low entropy value because of less diversity in the application of origin rules, while FTAs are more diverse.

The PSR Score column reflects the restrictiveness or stringency of the specific rules of origin, based on a predefined scoring system (Table 3) that assigns higher values to more restrictive rules. A higher score indicates that the rules are more burdensome to comply with. For instance, MERCOSUR and Sri Lanka (LKA) show high PSR scores of 7.68 and 7.26, respectively, meaning they use more stringent rules of vcr4 and Cth_vcr2, respectively, which attract a severity score of 8, whereas EFTA, despite its high entropy, has a relatively moderate PSR score of 3.95. SAFTA is the most stringent regime among comprehensive FTAs, while Japan is the most lenient or simpler origin requirement.

The Composite PSR Severity Index combines both the normalized entropy and normalized PSR score (weights being 0.51 and 0.49, respectively, calculated using equation 13 and 14) to provide a summary measure of the overall restrictiveness of product-specific origin rules. This index captures both the diversity and the difficulty of complying with PSRs. For instance, Korea (KOR) has moderate values for both components, resulting in a balanced composite score of 51.52. On the other hand, EFTA's high composite score of 61.76 is driven by its extreme entropy, whereas MERCOSUR's score of 49.00 is driven by the high severity of its rules despite low heterogeneity of rules. Mauritius (MUS) has the most cumbersome rules of all, signifying that the newly concluded agreements (MUS, UAE, EFTA), except Australia (AUS) are more stringent compared to the earlier concluded agreements. In comprehensive agreements, the ASEAN agree-

ment is the most liberal one, while in PSAs, the Afghanistan (AFG) deal is the one.

A sectoral analysis has also been done for both origin severity and heterogeneity. Table 5 displays the PSR severity scores for individual sectors under different trade agreements. Each row represents a sector, while each column corresponds to a trade agreement. The numerical values indicate the restrictiveness of origin rules applied in each sector for a given agreement. A higher score denotes more complex or stringent rules, while NA signifies that the sector was not covered or negotiated in the agreement.

'Food Products' and 'Minerals' sectors consistently show high restrictiveness across most agreements (e.g., scores of 8.00 in CHL, MERCOSUR, LKA), suggesting these are tightly regulated sectors. 'Electronics' (Elctrns) and 'Transportation' (Trnsp) also see high PSR scores in many FTAs like MUS, KOR, and THA, indicating more intricate origin requirements likely due to complex value chains. 'Vegetable' and 'Animal Products' sectors often show low scores or NA, suggesting either lenient rules or their exclusion from agreements, possibly due to limited trade in those sectors or existing domestic sensitivities. EFTA and JPN generally apply less restrictive rules (e.g., lower scores in Chemicals and Metals), whereas CHL, MERCOSUR, and LKA apply more severe PSRs across almost all sectors.

Table 6 presents the sector-wise entropy scores for each trade agreement, indicating a measure of the complexity and heterogeneity of PSR within each sector under a given agreement. A higher entropy score (e.g., ¿1.0) implies greater heterogeneity of rules, meaning rules vary widely across tariff lines in a particular sector, suggesting more complexity and less predictability for exporters. A lower entropy score (e.g., 0.00) indicates uniform or identical rules across all tariff lines, making compliance simpler and rule structure more transparent.

Sectors like 'Metals', 'Stone Glass' (Stn_Gls), 'Transport' (Trnsp), and 'Miscellaneous' (Miscl) show high entropy values in EFTA and CHL, indicating that these FTAs apply highly differentiated rules across products in these sectors. Uniformity (0.00 entropy) appears frequently in agreements like ASEAN, MYS, and SAFTA across many sectors, suggesting consistent rule design within sectors, offering a simplified rules structure, and less compliance. EFTA stands out as having generally high entropy scores across many sectors (e.g., 2.16 in Metals, 1.65 in Stn_Gls, 1.60 in Food_Prod), highlighting its complex rule structures. Vegetable, Animal_Prod, and Fuels often have low or zero entropy, possibly due

to either a lack of rule variation or limited negotiation coverage.

As a robustness check for the Composite PSR index, several properties of a composite index have been checked, which are described in the Appendix Section.

7.2 RwR Severity Index

Table 7 provides a detailed, provision-wise scoring of compliance-oriented Rules of Origin (RoO), according to the scoring scheme defined in Table 2, for each trade agreement. These provisions typically represent administrative strictness or procedural rigidity that traders must comply with to claim preferential treatment on their products. Australia (AUS) scores highest (0.80), suggesting a high compliance intensity of the RwR framework, with most compliance-related provisions being present. UAE (0.73) and Malaysia (MYS, 0.73), EFTA (0.71) also show substantial inclusion of compliance-oriented rules. Agreements like Korea (KOR, 0.67) and Mauritius (MUS, 0.60) display moderate to high compliance severity. Thailand (THA, 0.36), MERCOSUR (0.40), and APTA (0.40) show relatively low scores, reflecting fewer compliance provisions. Nepal (NPL, 0.50) and Afghanistan (AFG, 0.57) also lie toward the lower to mid spectrum. This shows that the newly concluded agreements (MUS, AUS, UAE, EFTA) are highly cumbersome in administrative provisions.

Table 8 codifies and scores facilitation-related provisions in each trade agreement's Rules of Origin regime. Facilitation provisions are intended to simplify, streamline, or make it easier for exporters and importers to comply with RoO requirements. With a raw facilitation score of 38 out of 52 (adjusted score of 0.73), Mauritius (MUS) exhibits high facilitation due to the presence of simplified certification, cumulation, and value content rules flexibility. UAE and Korea (with a raw score of 34) both incorporate extensive flexibility and facilitation measures, including emergency provisions, VCR alternatives, and good dispute resolution coverage. The agreements with LKA, AFG, and NPL (with raw scores of only 14) offer very minimal facilitative measures, which likely implies RoO administration in these FTAs is stricter, less transparent, or more administratively burdensome. Their lower value is driven by the underdocumentation of the required provisions.

Table 9 provides the aggregate RwR severity index with its components, Compliance and Facilitation. The weighted severity index takes weights (α and β) as 0.47 and 0.53 for compliance and facilitation, respectively. Negative values

of the Composite Index signify a facilitative / less severe regime (facilitation outweighs compliance), and vice versa for the positive values.

THA (-45.43) is the most facilitative regime here, along with SAFTA (-33.01), MUS (-23.15), ASEAN (-19.85), APTA (-14.72), SGP (-12.84), MERCOSUR (-5.09). All show facilitation dominating compliance, meaning their Rules of Origin regimes are designed with strong facilitative provisions, reducing compliance costs for the traders. MYS (31.77), AUS (30.69), LKA (22.74), AFG (22.74), EFTA (13.44), NPL (15.16), CHL (11.62) have comparatively high compliance normalized scores and low facilitation normalized scores, so overall these regimes are more compliance demanding. KOR (0.23), JPN (2.39), and UAE (7.31) are close to a balanced approach but slightly more restrictive. The same trend is observed for the Normalized Composite index also.

7.3 Aggregate Rules of Origin Severity Index

Table 10 is the final table that shows the overall restrictiveness of the RoO regime, combining both PSR and RwR. The higher this value, the more burdensome the rules of origin regime is. The positive value for the aggregate severity index shows that all RoO regimes introduce restrictiveness, add burden to the business process.

EFTA has the highest overall restrictiveness, driven by a very high PSR (61.76) and high RwR (56.72). Apart from EFTA, LKA, UAE, and MUS are the agreements with the most burdensome rules of origin, likely to create compliance costs for traders. ASEAN is the most liberal regime of all the active trade agreements analyzed. SAFTA, APTA, and AFG are also less restrictive RoO regimes. AUS, and KOR are moderately restrictive deals. As a thumb rule, the agreements with severity scores higher than 50 may be considered as a restrictive regime, while agreements having scores less than 50 may be regarded as a liberal one.

The newer agreements (EFTA, UAE, MUS) appear to be more restrictive because of their rules heterogeneity and commodity coverage. Since an exhaustive list of commodities for these agreements has been negotiated, rules heterogeneity also comes into play. PSAs show less restrictiveness of RoO because of their limited product coverage and uniformity in the applied rules. The FTAs are also negotiated well in terms of administrative provisions, while PSAs are mostly underdocumented.

8 Index Properties

A good index has to satisfy some fundamental properties. An index, following a set of properties, shows the degree of robustness. In this section, properties of both the PSR index and the RWR index will be analyzed.

8.1 PSR Severity Index Properties

Here, several index properties for a composite PSR index will be examined.

Property 1: Interpretability

The PSR index ranges from low to high severity where higher values indicate a more complex and restrictive origin rules regime, combining both frequent use of stricter rules and a wider variety of rule types. Lower values reflect simpler and less burdensome PSR regimes, either due to lenient rules or the dominance of fewer rule types.

Property 2: Weight Sensitivity

This subsection assesses the weight sensitivity of the composite index. Original weights for origin severity and heterogeneity are 0.49 and 0.51. To test robustness, alternative weights in the vicinity were applied. The Spearman correlation (Table 11) between the original and modified indices remains high for $\pm 10\%$ deviations, indicating robustness of the index. Larger weight shifts show moderate expected changes. Overall, the index is not highly weight-sensitive.

Apart from the Spearman coefficient, the Coefficient of Variation (CV) has also been examined for different weights. CV values range narrowly between 0.31 and 0.36, as shown in Table 12. This shows that changing weights between PSR and Entropy hardly changes the overall variability of the index. Hence, the index is robust to reasonable changes in the weighting scheme.

Property 3: Normalization Sensitivity

A sensitivity test on normalization methods was conducted. While the original index uses min-max normalization (0–100 scale), z-score and robust-scale methods were tested as alternatives. As shown in Table 13, the index remains highly robust to these changes.

Property 4: Scale Invariance

A scale invariance test was conducted to verify whether changes in the units of input and output variables affect the ranking of the composite index. In the input scale test, the PSR component was multiplied by 100 and the entropy score divided by 5 before normalization. In the output scale test, the final composite index values were rescaled from a 1–100 to a 1–10 scale. In both cases, the Spearman rank correlation coefficient (Table 14) remained 1.00, indicating that the index is fully invariant to linear scale transformations.

Property 5: Monotonicity

Monotonicity in a composite index ensures that if one of the components of the index increases (or decreases), the index should also move in the same direction proportionally, provided other components remain constant. To check monotonicity, Spearman correlations were computed between each component and the composite index. In Table 15, both PSR ($\rho = 0.20$) and Entropy ($\rho = 0.56$) show positive monotonic relationships, indicating that increases in component values are associated with increases in the overall index. This confirms the index satisfies the monotonicity property as well as the property of interpretability. Though the relationship with entropy is stronger than the PSR, it is worthwhile to note the index is not solely driven by just one component. This also corroborates the theoretical underpinning of the composite index.

Property 6: Additivity/Decomposability

The composite PSR index satisfies the additivity property through its PSR component. For each agreement, the weighted average of sectoral PSR values (weighted by the number of commodities) equals the aggregate PSR score, confirming additivity. However, entropy, being non-linear, does not exhibit this property. Therefore, the composite index can be considered quasi-additive, which is a result of its design rather than a flaw.

8.2 RwR Severity Index Properties

Like the Composite PSR index, the properties for the composite RwR index will also be examined.

Property 1: Interpretability

The RwR severity index increases from low to high, meaning the high index value for any agreement would increase compliance burden, while a low value would simplify and streamline the business process.

Property 2: Weight Sensitivity

The original weights for Compliance and Facilitation in the RwR index are 0.47 and 0.53, respectively. As shown in Table 16, the index remains highly robust across a wide weight range (0.4 to 0.6) for either component. Apart from the Spearman coefficient, the Coefficient of Variation is also highly stable for changes in the weighting scheme. It ranges between 0.15 to 0.16, as shown in Table 17, showing the robustness of the developed index.

Property 3: Normalization Sensitivity

The RwR index is perfectly robust to changes in the normalization method. Any normalization method used will preserve the ranking order of the severity of the agreement as shown in Table 18.

Property 4: Monotonicity

The RwR index satisfies the monotonicity property. As shown in Table 19, it is positively correlated with Compliance ($\rho = 0.56$) and negatively correlated with Facilitation ($\rho = -0.79$). This indicates that higher Compliance increases the severity, while greater Facilitation reduces it.

Property 5: Scale Invariance

A change in either input or output scale does not change the ranking order of the agreement. Ranks are invariant as shown in Table 20.

Property 6: Additivity/Decomposability

The index preserves the additivity property as well. For both compliance and facilitation, a provision-wise score addition for any agreement will result in the total score of that agreement in that component. For example, an addition of facilitation score provision-wise (Table 8) will give a total score of 32. The same is with the compliance.

9 Conclusion

This study evaluates the severity of India's trade agreements through a cross-comparison of preferential Rules of Origin (RoO), offering one of the first systematic and novel attempts to quantify the restrictiveness of such provisions. A custom dataset was developed to capture both product-specific rules (PSRs) and regime-wide rules (RwRs), which were then aggregated into a composite severity index. The index construction proved robust across methodological variations, including changes in weighting schemes and other functional forms. Agreement rankings remained stable under alternative specifications, as confirmed through several robustness checks (Index properties) such as Spearman correlation tests and coefficient of variation analysis. These statistics showed minimal fluctuation in indices across different kinds of changes, underscoring that the index is not overly sensitive to weighting assumptions, normalization methods. The indices also follow other index properties such as interpretability, scale invariance, additivity, and monotonicity.

The findings reveal clear patterns in India's RoO design. The India–EFTA agreement emerges as the most restrictive overall, reflecting the defensive approach India often adopts with advanced economies. On the other hand, the India–ASEAN agreement is the most liberal and consistent with India's strategic emphasis on strengthening regional value chains. A broader temporal comparison suggests that India's newer trade agreements tend to incorporate stricter rules, possibly reflecting both India's rising global trade share and its domestic policy push for localization. Conversely, Partial Scope Agreements (PSAs) show limited rule variation, which may stem from narrow commodity coverage or domestic sensitivities.

India's trade agreements exhibit considerable and significant variation in RoO severity, which poses challenges for exporters who must navigate inconsistent and sometimes restrictive regimes. From a policy perspective, three key recommendations can be drawn. First, in negotiating future agreements, India should avoid unnecessarily restrictive RoO provisions and instead draw on best practices from its own liberal agreements, such as India–Australia, India-Japan, etc. While product-specific rules will inevitably vary across agreements due to sectoral interests of partner countries, regime-wide rules should consistently reflect facilitative practices. Provisions such as third-party invoicing, cumulation, and self-certification mechanisms not only reduce procedural burdens but also may

enhance the utilization of trade agreements.

Second, when engaging with smaller developing economies like Nepal, Bhutan, or Afghanistan, India should adopt a more accommodating stance. Since these economies pose limited risk of trade deflection or large-scale market disruption, their inclusion through liberal RoO could expand India's export potential and promote regional goodwill. Lessons can be drawn from India's approach toward Brunei under the ASEAN agreement, where concessional duties and liberal RoO were offered. Similar strategies, including generous cumulation clauses and simplified verification procedures, could be adopted to strengthen India's neighborhood trade architecture.

Third, India should pursue harmonization of RoO at the domestic level by aligning regime-wide provisions across its various trade agreements. The current patchwork of rules creates uncertainty, raises compliance costs, and undermines India's export competitiveness. Moving toward a single, internally consistent framework for regime-wide rules, particularly in areas like certification, de minimis thresholds, and dispute settlement, would enhance predictability for traders and support greater utilization of FTAs. This harmonization agenda is especially important as India explores deeper economic partnerships with both developed and developing partners.

Overall, the analysis highlights that while RoO are a necessary safeguard against trade deflection, excessively stringent provisions undermine the very purpose of trade agreements by discouraging utilization. Since India is currently involved in negotiation and renegotiation of several trade agreements, India's challenge, therefore, is to strike a balance between protecting domestic industries and fostering integration into global and regional value chains. A systematic effort to design more facilitative, predictable, and harmonized RoO regimes would not only improve India's FTA utilization rates but also support its broader trade and industrial policy objectives in an increasingly fragmented global economy.

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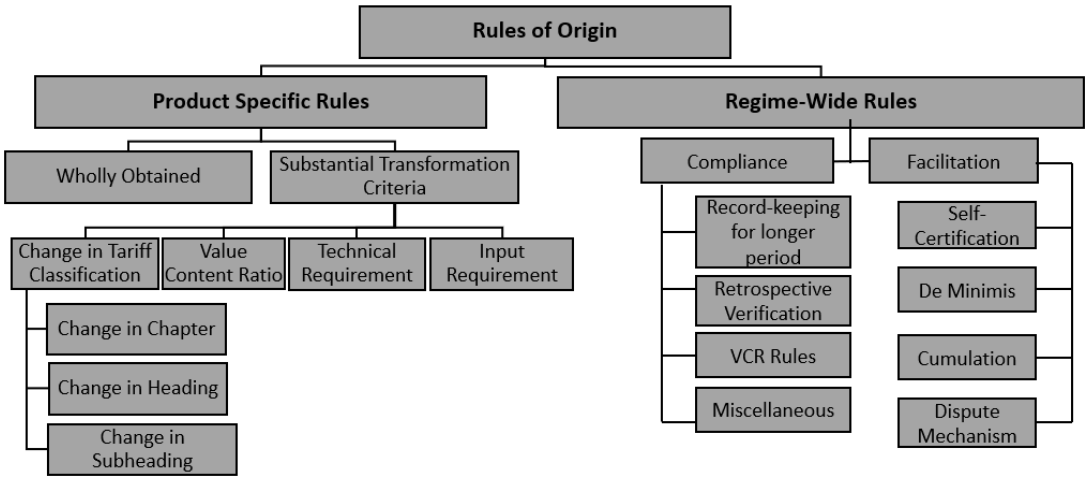
Figures

Imports	Technical measures	A SANITARY AND PHYTOSANITARY MEASURES B TECHNICAL BARRIERS TO TRADE C PRE-SHIPMENT INSPECTION AND OTHER FORMALITIES
	Non technical measures	D CONTINGENT TRADE-PROTECTIVE MEASURES E NON-AUTOMATIC LICENSING, QUOTAS, PROHIBITIONS AND QUANTITY-CONTROL MEASURES OTHER THAN FOR SPS OR TBT REASONS F PRICE-CONTROL MEASURES, INCLUDING ADDITIONAL TAXES AND CHARGES G FINANCE MEASURES H MEASURES AFFECTING COMPETITION I TRADE-RELATED INVESTMENT MEASURES J DISTRIBUTION RESTRICTIONS K RESTRICTIONS ON POST-SALES SERVICES L SUBSIDIES (EXCLUDING EXPORT SUBSIDIES UNDER P7) M GOVERNMENT PROCUREMENT RESTRICTIONS N INTELLECTUAL PROPERTY O RULES OF ORIGIN
	Exports	P EXPORT-RELATED MEASURES

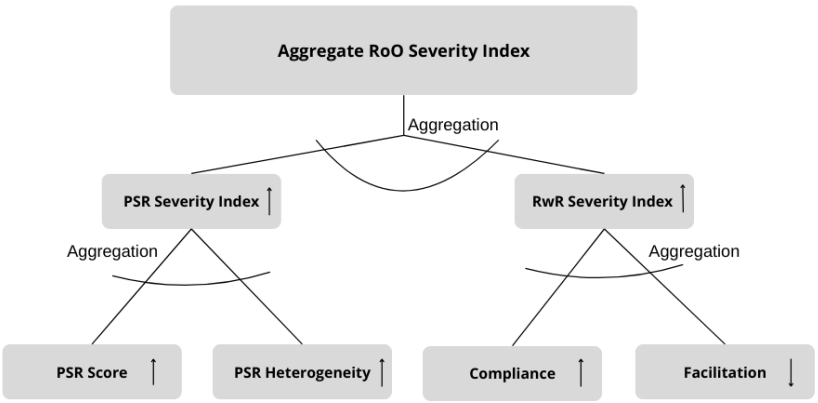
Source: UNCTAD MAST Group

Figure 1: Classification of NTMs



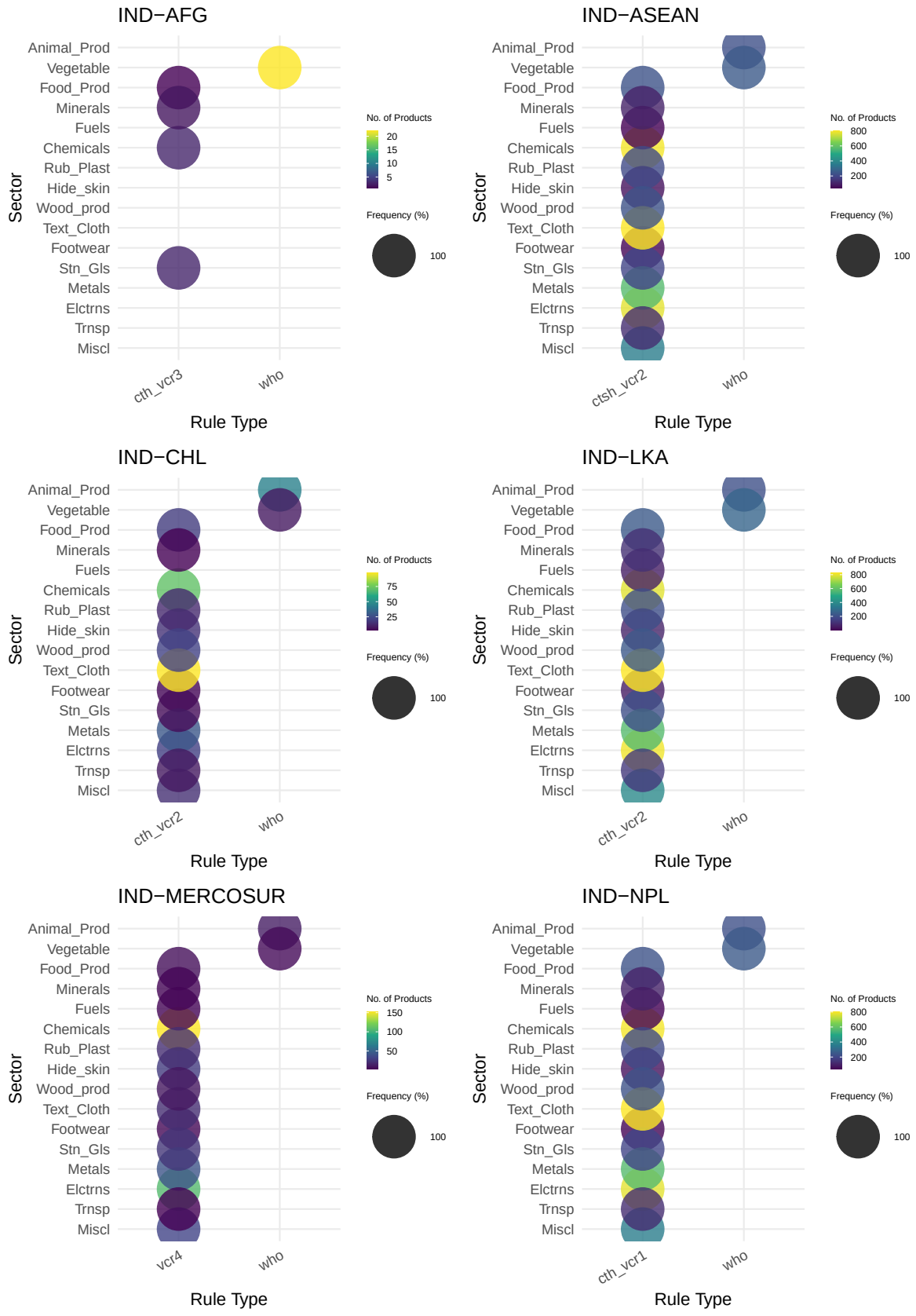
Source: Author

Figure 2: Tree map of Rules of Origin



Source: Author

Figure 3: Schematic Diagram for Severity Indices



Source: Author

Figure 4: Sector-wise PSR Distribution: No.1

Source: Author

Figure 5: Sector-wise PSR Distribution: No.2

Source: Author

Figure 6: Sector-wise PSR Distribution: No.3

Source: Author

Figure 7: Sector-wise PSR Distribution: No.4

Source: Author

Figure 8: Sector-wise PSR Distribution: No.5

Tables

Agreement	Entry_year	Type	No. of Commodities
IND-LKA	2001	FTA	5133
IND-AFG	2003	PSA	31
IND-THA	2004	EHS	84
IND-SGP	2005	FTA	5248
IND-CHL	2007	PSA	373
APTA	2008	PSA	3482
IND-MERCOSUR	2009	PSA	480
IND-NPL	2009	PSA	5052
IND-KOR	2010	FTA	5080
ASEAN	2010	FTA	5052
IND-JPN	2011	FTA	4814
IND-MYS	2011	FTA	4992
SAFTA	2011	FTA	4779
IND-MUS	2021	FTA	435
IND-UAE	2022	FTA	5353
IND-AUS	2022	FTA	5363
IND-EFTA	2025	FTA	5612

Source: Ministry of Commerce, GoI; Rules of Origin Facilitator

Table 1: India's trade agreements

Note: FTA stands for the Free (Comprehensive) Trade Agreement; PSA stands for the Partial Scope Agreement; EHS is the Early Harvest Scheme (Interim Agreement). The entry year shows the year when the agreement came into force.

Provisions	Question Id	Score	Type	Questions/Elaboration
Certificate	CER_adm	2	Compliance	if the CoO be issued by the competent authority only
	CER_sel	2	Facilitation	if the CoO be issued on the basis of self-certification/self-attestation by the exporter / producer / manufacturer without need for pre-export verification by the competent authority?
	CER_pre	2	Compliance	if the CoO be issued by the competent authority only after the pre-export verification by the authority
	CER_val_comp	2	Compliance	If Certificate validity is less than 12 months
	CER_val_fac	2	Facilitation	If certificate validity is equal to or greater than 12 months
	CER_rec_comp	2	Compliance	if record-keeping is more than 2 years
	CER_rec_fac	2	Facilitation	if record-keeping is equal to or less than 2 years
	CER_rec_aut	2	Facilitation	if the records-keeping related to CoO be kept by the competent authority
	CER_rec_exp	2	Compliance	if the records-keeping related to CoO be kept by the exporter/producer/manufacturer as well as competent authority
	CER_rec_imp	2	Compliance	if the records-keeping related to CoO be kept by the exporter/producer/manufacturer along with importer as well as competent authority
	CER_exmp	2	Facilitation	if certificate is exempted in minor cases
	CER_err	2	Facilitation	if minor errors in CoO are tolerated
	CER_emr	2	Facilitation	if CoO is allowed in emergency situations
Verification	VER_exp	2	Facilitation	if there is provision for verification process to be done by the exporting authority only
	VER_site	2	Compliance	if there is provision for verification process to be done by the exporting authority and importing authority including site inspection
	VER_retr	2	Compliance	if there is a provision for retrospective verification
	VER_time_comp	2	Compliance	if verification process time is greater than 180 days
	VER_time_fac	2	Facilitation	if verification process time is less than or equal to 180 days
Cumulation	CUM_bil	2 or 4	Facilitation	if CUM_bil =2 if rulei 30, 4 if rule ¿=30
	CUM_dia	2 or 4	Facilitation	if CUM_dia =2 if rulei 30, 4 if rule ¿=30
De Minimis	DM_val_rule	2 or 4	Facilitation	DM_val_rule=2 if rulei10 ,4 if rule¿=10
	DM_wght_rule	2 or 4	Facilitation	DM_wght_rule=2 if rulei10 ,4 if rule¿=10
Value Content Ratio	VCR_rbd	2	Facilitation	if the build down method/indirect method is used in vcr estimation
	VCR_rbu	2	Compliance	if only the build up method/direct method is used in vcr estimation
	VCR_altc	2	Facilitation	if either of rbd or rbu may be used in vcr estimation
	VCR_prc	2	Compliance	Is the content threshold be determined on the basis of ex-works price of final exported product
	VCR_fob	2	Facilitation	Is the content threshold be determined on the basis of fob price of final exported product
	VCR_altp	2	Facilitation	if there are multiple alternatives for determination of content threshold.(e.g. fob or prc etc.)
	VCR_dvc	2	Compliance	if the content threshold is defined in terms of domestic value content
	VCR_nvc	2	Facilitation	if the content threshold is defined in terms of non-originating value content
	VCR_per	2	Compliance	If a different threshold of vcr has been defined for different formula(i.e. rbd and rbu)
Dispute mechanism	roo_rev	2	Facilitation	if there is a provision for review of Rules of Origin
	roo_disp	2	Facilitation	if there is a provision for any mechanism to resolve the process-related disputes like classification of products, certificate of origin, preferential treatment etc
Miscellaneous	roo_fng	2	Facilitation	if there is a provision for joint storage of originating and non-originating inputs when these inputs are interchangeable, 0 otherwise
	roo_adr	2	Facilitation	if there is a provision for advanced ruling, 0 otherwise
	roo_set	2	Facilitation	if there is a provision for the sets
	roo_phbt	2	Compliance	If the agreement does contain any prohibition clause
	roo_pnlt	2	Compliance	if there is a penalty clause in the agreement
	roo_trd_invc	2	Facilitation	if third party invoicing is allowed

Source: Author

Table 2: RwR Provisions and scoring scheme

Product Specific Rules of Origin at Application level (HS6)	Score
(cc_vcr4)	16
(cc_vcr3)	14
(cc_vcr2) (cth_vcr4)	12
(cc_exc) (cc_vcr1), (cc_tr), (cc_inp), (vcr4_inp), (vcr4_tr) (ctsh_vcr4), (cth_vcr3)	10
(cc), (vcr4) (cc_or_vcr4) (ctsh_vcr3), (cth_vcr2), (vcr3_inp), (vcr3_tr)	8
(cth_exc) (vcr3) (cc_or_vcr3) (cth_vcr1), (ctsh_vcr2), (cth_tr), (cth_inp), (vcr2_inp), (vcr2_tr)	6
(cc_or_vcr2) (cth), (vcr2) (cth_or_vcr4) (cth_or_vcr3) (cth_or_vcr2), (ctsh_vcr1),(ctsh_tr), (ctsh_inp), (vcr1_tr), (vcr1_inp), (tr_inp)	4
(cc_or_vcr1), (cc_or_inp), (cc_or_tr) (cth_or_vcr1), (cth_or_inp), (cth_or_tr) (ctsh), (vcr1), (tr), (inp) (ctsh_or_vcr4) (ctsh_or_vcr3) (ctsh_or_vcr2) (ctsh_or_vcr1), (ctsh_or_tr), (ctsh_or_inp)	2
who	0

Source: Author

Table 3: PSR and the scoring scheme

Note: CTSH means “Change from any other sub-heading”; CTH: “Change from any other heading”; CC:“Change from any other chapter”; tr:“technical requirement”; inp: “input requirement”; VCR: “Value content ratio”. ctsh_or_tr should be read like this, “a change from any other subheading or technical requirement”; ctsh_tr should be read like this, “a change from any other subheading and technical requirement”. who means ”wholly obtained”.

Country	Entropy	PSR_Score	Norm_entropy	Norm_PSR	Composite Index
AFG	0.6	2.9	21.29	0.00	10.86
APTA	0.73	5.09	27.72	45.82	36.59
ASEAN	0.32	5.43	7.43	52.93	29.72
AUS	0.61	5.32	21.78	50.63	35.92
CHL	0.4	6.88	11.39	83.26	46.61
EFTA	2.19	3.95	100.00	21.97	61.76
JPN	1.42	3.63	61.88	15.27	39.04
KOR	1.22	5.34	51.98	51.05	51.52
LKA	0.31	7.26	6.93	91.21	48.23
MERCOSUR	0.17	7.68	0.00	100.00	49.00
MUS	1.79	5.24	80.20	48.95	64.89
MYS	0.37	5.42	9.90	52.72	30.88
NPL	0.32	5.43	7.43	52.93	29.72
SAFTA	0.43	7.28	12.87	91.63	51.46
SGP	0.5	7.11	16.34	88.08	51.49
THA	1.18	6.26	50.00	70.29	59.94
UAE	1.15	5.9	48.51	62.76	55.50

Source: Author

Table 4: PSR Severity Indices

Sector	AFG	APTA	ASEAN	AUS	CHL	EFTA	JPN	KOR	LKA	MERCOSUR	MUS	MYS	NPL	SAFTA	SGP	THA	UAE
Animal_Prod	NA	0.26	0.00	2.22	0.00	0.31	0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.00	NA	0.00
Vegetable	0.00	0.00	0.00	0.19	0.00	0.15	0.08	0.00	0.00	0.00	0.08	0.00	0.00	0.03	0.00	0.00	1.72
Food_Prod	10.00	5.97	6.00	6.22	8.00	5.14	0.31	7.40	8.00	8.00	5.50	5.99	6.00	7.83	7.73	2.00	7.68
Minerals	10.00	6.00	6.00	6.00	8.00	5.65	3.96	6.00	8.00	8.00	4.00	6.00	6.00	7.89	8.00	0.00	6.00
Fuels	NA	4.65	6.00	6.00	NA	5.16	4.00	5.49	8.00	8.00	NA	6.00	6.00	8.00	8.00	NA	6.00
Chemicals	10.00	5.41	6.00	6.00	8.00	2.84	4.20	5.64	8.00	8.00	4.00	5.99	6.00	8.00	7.94	8.00	6.00
Rub_Plast	NA	5.18	6.00	6.00	8.00	2.91	4.04	5.60	8.00	8.00	4.17	5.99	6.00	8.00	7.98	8.00	5.88
Hide_skin	NA	6.00	6.00	6.41	8.00	4.49	8.00	4.65	8.00	8.00	4.00	6.00	6.00	8.00	8.00	NA	6.93
Wood_prod	NA	6.00	6.00	6.03	8.00	4.21	3.95	5.85	8.00	8.00	4.00	5.71	6.00	7.84	7.03	8.00	6.05
Text_Cloth	NA	6.00	6.00	5.94	8.00	6.50	3.88	5.23	8.00	8.00	6.81	6.00	6.00	8.00	8.00	NA	7.01
Footwear	NA	4.81	6.00	6.00	8.00	5.19	5.90	6.69	8.00	8.00	4.00	6.00	6.00	8.00	8.00	NA	7.40
Stn_Gls	10.00	5.93	6.00	5.92	8.00	4.83	4.17	5.92	8.00	8.00	4.78	5.99	6.00	7.98	8.00	4.50	5.87
Metals	NA	5.17	6.00	5.09	8.00	4.57	4.08	5.38	8.00	8.00	6.56	5.98	6.00	7.99	8.00	7.80	5.01
Elctrns	NA	5.98	6.00	6.00	8.00	3.39	4.23	6.02	8.00	8.00	8.00	6.00	6.00	7.39	7.61	7.11	8.00
Trnsp	NA	6.00	6.00	6.00	8.00	5.79	5.17	6.61	8.00	8.00	9.33	6.00	6.00	7.88	7.64	8.00	8.22
Miscl	NA	5.99	6.00	6.00	8.00	5.61	4.11	5.96	8.00	8.00	5.41	6.00	6.00	7.82	7.84	7.50	6.61

Source: Author

Table 5: Sector-wise PSR Scores

Sector	AFG	APTA	ASEAN	AUS	CHL	EFTA	JPN	KOR	LKA	MERCOSUR	MUS	MYS	NPL	SAFTA	SGP	THA	UAE
Animal_Prod	NA	0.18	0.00	0.62	0.00	0.27	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	NA	0.00
Vegetable	0.00	0.00	0.00	0.26	0.00	0.09	0.08	0.00	0.00	0.00	0.16	0.00	0.00	0.04	0.00	0.00	0.75
Food_Prod	0.00	0.08	0.00	0.55	0.00	1.60	0.17	0.89	0.00	0.00	1.42	0.03	0.00	0.18	0.27	0.00	1.13
Minerals	0.00	0.00	0.00	0.00	0.00	0.29	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00
Fuels	NA	0.63	0.00	0.00	NA	0.88	0.00	0.57	0.00	0.00	NA	0.00	0.00	0.00	0.00	NA	0.00
Chemicals	0.00	0.61	0.00	0.00	0.00	0.81	0.85	0.82	0.00	0.00	0.00	0.02	0.00	0.01	0.08	0.00	0.00
Rub_Plast	NA	0.91	0.00	0.00	0.00	1.07	0.72	0.69	0.00	0.00	0.17	0.03	0.00	0.00	0.03	0.00	0.10
Hide_skin	NA	0.00	0.00	0.50	0.00	0.56	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA	0.69
Wood_prod	NA	0.00	0.00	0.08	0.00	0.34	0.07	0.26	0.00	0.00	0.00	0.46	0.00	0.19	0.59	0.00	0.12
Text_Cloth	NA	0.00	0.00	0.06	0.00	0.56	0.33	0.65	0.00	0.00	0.93	0.00	0.00	0.00	0.00	NA	0.74
Footwear	NA	0.68	0.00	0.00	0.00	1.19	1.15	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA	0.61
Stn_Gls	0.00	0.16	0.00	0.17	0.00	1.65	0.20	0.43	0.00	0.00	1.19	0.03	0.00	0.03	0.00	0.56	0.24
Metals	NA	0.68	0.00	0.54	0.00	2.16	0.69	1.09	0.00	0.00	0.91	0.05	0.00	0.01	0.00	0.33	0.59
Elctrns	NA	0.06	0.00	0.00	0.00	1.25	0.26	0.20	0.00	0.00	0.00	0.00	0.00	0.50	0.42	0.69	0.00
Trnsp	NA	0.00	0.00	0.00	0.00	1.34	0.68	0.62	0.00	0.00	0.35	0.00	0.00	0.14	0.30	0.00	0.72
Miscl	NA	0.03	0.00	0.00	0.00	1.53	0.19	0.19	0.00	0.00	1.04	0.00	0.00	0.21	0.20	0.56	0.61

Source: Author

Table 6: Sector-wise Entropy Scores

Questions Id	EFTA	JPN	SGP	UAE	MYS	KOR	AUS	MUS	THA	CHL	LKA	AFG	NPL	MERC-OSUR	SAFTA	ASEAN	APTA
CER_adm	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CER_pre	0	0	2	2	2	2	2	0	2	0	NA	NA	NA	0	2	2	2
CER_val_comp	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	2	0	0	0
CER_rec_comp	2	2	0	2	2	2	2	2	0	2	NA	NA	NA	2	0	0	0
CER_rec_exp	2	2	0	2	2	2	2	2	0	2	NA	NA	NA	2	NA	0	0
CER_rec_imp	2	0	0	2	2	2	2	0	0	0	NA	NA	NA	0	NA	0	0
VER_site	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	0
VER_retr	2	0	2	0	2	2	0	2	2	2	NA	NA	NA	0	2	2	2
VER_time_comp	2	2	2	2	2	2	2	2	NA	2	NA	NA	NA	2	NA	2	2
VCR_rbu	NA	2	2	2	2	0	2	2	0	0	NA	NA	NA	0	NA	2	0
VCR_prc	2	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0
VCR_dvc	0	2	0	2	2	2	2	2	2	0	0	0	0	0	0	2	0
VCR_per	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
roo_phbt	0	0	0	0	0	0	0	0	0	0	2	2	2	0	2	0	2
roo_pnlt	2	2	2	2	2	2	2	2	2	2	2	2	NA	0	2	2	2
Complaince Score (A)	20	16	14	22	22	20	24	18	10	14	8	8	6	12	12	16	12
Max Possible Score (B)	28	30	30	30	30	30	30	30	28	30	14	14	12	30	22	30	30
Adjusted Score (A/B)	0.71	0.53	0.47	0.73	0.73	0.67	0.80	0.60	0.36	0.47	0.57	0.57	0.50	0.40	0.55	0.53	0.40

Source: Author

Table 7: Compliance Provisions and their respective scores

Questions Id	EFTA	JPN	SGP	UAE	MYS	KOR	AUS	MUS	THA	CHL	LKA	AFG	NPL	MERC-OSUR	SAFTA	ASEAN	APTA
CER_sel	2	0	0	0	0	0	0	2	0	2	0	0	0	2	0	0	0
CER_rec_aut	2	2	2	0	0	0	0	0	2	0	0	0	0	0	2	2	2
CER_rec_fac	0	0	2	0	0	0	0	0	2	0	NA	NA	NA	0	2	2	2
CER_val_fac	2	2	2	2	2	2	2	2	2	2	NA	NA	NA	0	2	2	2
CER_exmp	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
CER_err	2	0	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2
CER_emr	0	2	2	2	2	2	0	2	2	0	0	0	0	0	2	2	2
VER_exp	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
VER_time_fac	0	0	0	0	0	0	0	0	NA	0	NA	NA	NA	0	NA	0	0
CUM_bil	4	4	4	4	4	4	4	4	4	4	4	4	4	-	-	-	-
CUM_dia	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	4
DM_val_rule	4	2	0	2	2	2	2	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
DM_wght_rule	0	2	0	2	2	2	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
VCR_rbd	NA	2	2	2	2	2	2	2	2	2	NA	NA	NA	2	NA	2	2
VCR_altc	NA	2	2	2	2	0	2	2	0	0	0	0	0	0	0	2	0
VCR_fob	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
VCR_altp	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
VCR_nvc	2	2	2	2	0	2	0	2	2	2	2	2	2	2	2	0	2
roo_rev	2	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2
roo_disp	2	2	2	2	2	2	2	0	2	0	2	2	2	2	2	2	2
roo_trd_invc	2	0	0	2	2	2	2	2	0	0	NA	NA	NA	2	NA	2	0
roo_fng	2	2	2	2	2	2	2	2	2	2	NA	NA	NA	2	NA	2	0
roo_adr	0	0	2	0	0	2	0	0	0	0	NA	NA	NA	0	NA	0	0
roo_set	0	0	0	0	0	0	0	2	2	2	NA	NA	NA	2	NA	0	0
Facilitation score (A)	32	30	32	34	28	34	30	38	30	22	14	14	14	24	24	30	26
Max Possible Score (B)	52	52	52	52	52	52	52	52	42	44	28	28	28	44	32	44	44
Adjusted score (A/B)	0.62	0.58	0.62	0.65	0.54	0.65	0.58	0.73	0.71	0.50	0.50	0.50	0.50	0.55	0.75	0.68	0.59

Source: Author

Table 8: Facilitation Provisions and their respective scores

Agreement	Complaince	Facilitation	Norm_Compliance	Norm_Facilitation	Composite_Index	Composite_Index (Normalized)
AFG	0.57	0.50	48.39	0.00	22.74	61.37
APTA	0.40	0.59	9.68	36.36	-14.72	42.64
ASEAN	0.53	0.68	39.78	72.73	-19.85	40.08
AUS	0.80	0.58	100.00	30.77	30.69	65.35
CHL	0.47	0.50	24.73	0.00	11.62	55.81
EFTA	0.71	0.62	80.65	46.15	13.44	56.72
JPN	0.53	0.58	39.78	30.77	2.39	51.20
KOR	0.67	0.65	69.89	61.54	0.23	50.12
LKA	0.57	0.50	48.39	0.00	22.74	61.37
MERCOSUR	0.40	0.55	9.68	18.18	-5.09	47.46
MUS	0.60	0.73	54.84	92.31	-23.15	38.43
MYS	0.73	0.54	84.95	15.38	31.77	65.89
NPL	0.50	0.50	32.26	0.00	15.16	57.58
SAFTA	0.55	0.75	42.52	100.00	-33.01	33.49
SGP	0.47	0.62	24.73	46.15	-12.84	43.58
THA	0.36	0.71	0.00	85.71	-45.43	27.29
UAE	0.73	0.65	84.95	61.54	7.31	53.65

Source: Author

Table 9: Regime-wide Rules Severity Indices

Agreement	PSR_Severity_Index	RwR_Severity_Index	RoO_Severity_Index
AFG	10.86	61.37	36.11
APTA	36.59	42.64	39.61
ASEAN	29.72	40.08	34.90
AUS	35.92	65.35	50.63
CHL	46.61	55.81	51.21
EFTA	61.76	56.72	59.24
JPN	39.04	51.20	45.12
KOR	51.52	50.12	50.82
LKA	48.23	61.37	54.80
MERCOSUR	49.00	47.46	48.23
MUS	64.89	38.43	51.66
MYS	30.88	65.89	48.38
NPL	29.72	57.58	43.65
SAFTA	51.46	33.49	42.48
SGP	51.49	43.58	47.53
THA	59.94	27.29	43.61
UAE	55.50	53.65	54.58

Source: Author

Table 10: Rules of Origin Severity Indices

PSR Weight	Entropy Weight	Spearman (ρ)	Interpretation
0.50	0.50	0.99	Highly Robust
0.52	0.48	0.98	Highly Robust
0.48	0.52	1.00	Perfectly Robust
0.54	0.46	0.96	Highly Robust
0.46	0.54	1.00	Perfectly Robust
0.56	0.44	0.91	Robust
0.44	0.56	1.00	Highly Robust
0.58	0.42	0.86	Moderate Sensitivity
0.42	0.58	0.99	Highly Robust
0.60	0.40	0.80	Moderate Sensitivity
0.40	0.60	0.98	Highly Robust

Source: Author

Table 11: Weight Sensitivity test for Composite PSR Index- I

PSR Weight	Entropy Weight	Coefficient of Variation (CV)	Interpretation
0.49 (original)	0.51 (original)	0.32	—
0.50	0.50	0.32	Perfectly Robust
0.52	0.48	0.31	Highly Robust
0.48	0.52	0.32	Perfectly Robust
0.54	0.46	0.31	Highly Robust
0.46	0.54	0.33	Highly Robust
0.56	0.44	0.31	Highly Robust
0.44	0.56	0.34	Highly Robust
0.58	0.42	0.31	Highly Robust
0.42	0.58	0.35	Robust
0.60	0.40	0.36	Robust
0.40	0.60	0.31	Highly Robust

Source: Author

Table 12: Weight Sensitivity test for Composite PSR Index- II

Normalization Method	Spearman (ρ)	Interpretation
Min-max vs. Z-score	0.99	Highly Robust
Min-max vs. Robust scaling	0.97	Highly Robust
Z-score vs. Robust scaling	0.99	Highly Robust

Source: Author

Table 13: Normalization Sensitivity test for Composite PSR Index

Test Type	Transformation	Spearman (ρ)	Interpretation
Input Scale	PSR $\times$ 100, Entropy $\div$ 5 (before normalization)	1.00	Rank invariant
Output Scale	Composite Index: 1–100 $\rightarrow$ 1–10	1.00	Rank invariant

Source: Author

Table 14: Scale Invariance test for Composite PSR Index

Method	Component	Spearman	Interpretation
Pairwise Correlation	PSR	0.20	Positive monotonic
	Entropy	0.56	Positive monotonic

Source: Author

Table 15: Monotonicity test for Composite PSR Index

Compliance Weight	Facilitation Weight	Spearman (ρ)	Interpretation
0.40	0.60	0.99	Highly robust
0.43	0.57	1.00	Perfectly Robust
0.45	0.55	1.00	Perfectly Robust
0.49	0.51	1.00	Perfectly Robust
0.50	0.50	1.00	Perfectly Robust
0.53	0.47	0.99	Highly robust
0.55	0.45	0.98	Highly robust
0.58	0.42	0.97	Highly robust
0.60	0.40	0.95	Highly robust

Source: Author

Table 16: Weight Sensitivity test for Composite RwR Index- I

Compliance Weight	Facilitation Weight	Coefficient of Variation (CV)	Interpretation
0.47 (original)	0.53 (original)	0.16	—
0.4	0.6	0.16	Perfectly Robust
0.43	0.57	0.16	Perfectly Robust
0.45	0.55	0.16	Perfectly Robust
0.49	0.51	0.16	Perfectly Robust
0.5	0.5	0.16	Perfectly Robust
0.53	0.47	0.15	Highly robust
0.55	0.45	0.15	Highly robust
0.58	0.42	0.15	Highly robust
0.6	0.4	0.15	Highly robust

Source: Author

Table 17: Weight Sensitivity test for Composite RwR Index- II

Normalization Methods	Spearman (ρ)	Inference
Min-Max vs. Z-Score	1.00	Ranks Invariant
Min-Max vs. Robust scaling	1.00	Ranks Invariant
Z-Score vs. Robust Scaling	1.00	Ranks Invariant

Source: Author

Table 18: Normalization Sensitivity test for Composite RwR Index

Method	Component	Spearman	Interpretation
Pairwise Correlation	Compliance	0.56	Positive monotonic
	Facilitation	-0.79	Negative monotonic

Source: Author

Table 19: Monotonicity test for Composite RwR Index

Test Type	Transformation	Spearman	Interpretation
Input Scale	Compliance $\times$ 100, Facilitation $\div$ 5 (before normalization)	1.00	Ranks invariant
Output Scale	Composite Index: 1–100 $\rightarrow$ 1–10	1.00	Ranks invariant

Source: Author

Table 20: Scale Invariance test for Composite RwR Index