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ARTÍCULO ORIGINAL

Trade Facilitation Measures that are necessary, but not sufficient, to improve international trade performance

Medidas de Facilitación del Comercio que son necesarias, pero no suficientes, para mejorar el desempeño del comercio transfronterizo

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Abstract: In 2013, the negotiations for the Trade Facilitation Agreement (TFA) of the World Trade Organization were concluded. Attempts have been made to quantify the impact of TFA implementation on global trade cost and time reduction. For example, a study has determined that the implementation of TFA measures can reduce global trade costs between 10% and 18%, depending on the country. However, more guidance is needed to understand which specific TFA measures are necessary to reduce the time and cost of cross-border trade. Therefore, this study uses a novel quantitative method called "Necessary Condition Analysis" that allows identifying the TFA measures that are necessary to reduce cross-border trade costs and time, but that may not be sufficient to achieve said objective since they may depend on additional factors. But if the necessary conditions are not present, it would be impossible to achieve the desired outcome. This study found that 84 TFA measures, which represents 54.2% of the total analyzed measures, can be considered as necessary, but not sufficient, to achieve high Trading across Borders performance. Ten out of the 84 TFA measures are considered to have a medium or large effect. These ten measures are: independent or higher-level administrative and/or judicial appeal procedures available for customs decisions; establishment of a national customs website; public consultations between traders and other interested parties and government; possibility to provide online feedback to Customs; information on import and export procedures; average clearance time; time to prepare documents for import; time to prepare documents for export; use of pre-shipment inspections required on Customs matters; targeted stakeholders; international Standards compliance; and release of goods separated from the final determination and payment of Customs duties.

Keywords: Customs procedures; Trade barriers;International commerce; Non-tariff measures; Trade policy; Economic impact

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Resumen: En 2013 concluyeron las negociaciones para el Acuerdo sobre Facilitación del Comercio (AFC) de la Organización Mundial del Comercio. Se cuantificado el impacto de la implementación del AFC en la reducción de los costos y tiempos del comercio global. Por ejemplo, un estudio ha determinado que las medidas del AFC puede reducir los costos del comercio global entre un 10% y un 18%, dependiendo del país. Sin embargo, se necesita más orientación para entender qué medidas específicas del AFC son necesarias para reducir el tiempo y los costos del comercio transfronterizo. Por lo tanto, este estudio utiliza un novedoso método cuantitativo llamado "Análisis de Condiciones Necesarias" para identificar las medidas del AFC que son necesarias para reducir los costos y tiempos del comercio transfronterizo, pero que pueden no ser suficientes para lograr dicho objetivo ya que pueden depender de otros factores adicionales. Pero, si no se dan las condiciones necesarias que se identifican con esta metodología sería imposible lograr el resultado deseado. Este estudio encontró que 84 medidas de AFC, que representan el 54,2% del total de medidas analizadas, pueden considerarse necesarias, pero no suficientes para lograr un alto desempeño en el comercio transfronterizo. Se determinó que las siguientes diez de las 84 medidas del AFC tienen un efecto mediano o grande: procedimientos de apelación independientes o de nivel superior disponibles para las decisiones aduaneras; establecimiento de un sitio web de aduanas; consultas públicas entre comerciantes y otras partes interesadas y el gobierno; posibilidad de proporcionar comentarios en línea a la aduana; información sobre trámites de importación y exportación; tiempo medio de despacho; tiempo para preparar los documentos para la importación; tiempo para preparar los documentos para la exportación; utilización de las inspecciones previas al envío requeridas en materia aduanera; partes interesadas; cumplimiento de normas internacionales; y levante con garantía.

Palabras clave: Procedimientos aduaneros; Barreras comerciales; Comercio internacional; Medidas no arancelarias; Política comercial; Impacto económico

1. Introduction

Trade facilitation is "the simplification, modernization, and harmonization of export and import processes" (WTO | Trade Facilitation, n.d.). The importance of implementing trade facilitation measures came at a time when non-tariff border measures, such as complex customs and administrative procedures and regulation, lack transparency, predictability, and consistency in trade measures, have a higher impact than tariffs and quotas. This paper takes a novel approach to look at the impact of trade facilitation measures. Instead of capturing the average effect of trade facilitation measures, it identifies which measures are necessary, yet not sufficient, to achieve a higher trading across border performance score, which is measured in terms of cost and time needed to import and export goods. During the 2013 Bali Ministerial Conference of World Trade Organization (WTO), its Members agreed on the Trade Facilitation Agreement (TFA), which entered into force on 22 February 2017. This Agreement was considered a great milestone since the creation of the WTO in 1995 because it is the first binding multilateral agreement negotiated since the Uruguay round. This Agreement contains provisions to expedite the movement, release, and clearance of goods, including the transit regime.

Even before the negotiations of the TFA concluded, researchers had already analyzed the impact of trade facilitation measures in terms of efficiency and effectiveness in reducing costs and time of trade or its impact in terms of import and export.

For instance, Moïsé et al. (2011) studied the impact of trade facilitation measures on the Members of the Organization for Economic Co-operation and Development (OECD). They constructed twelve Trade Facilitation Indicators (TFIs) derived from the main policy areas under negotiation at the WTO, each of these indicators is composed by specific trade facilitation measures. These authors reported that if all measures are implemented, it is possible to reach almost 10% of trade costs reduction. Following such report, Moïsé & Sorescu (2013) expanded the TFIs to sixteen and estimated, with econometric analysis, the impact on 107 countries when implementing trade facilitation measures that are under negotiation at the WTO. They found that the TFIs named "the availability of trade-related information, the simplification and harmonization of documents, the streamlining of procedures, and the use of automated processes" (Moïsé & Sorescu, 2013) are the indicators that have the greatest impact on trade volume and cost for both import and export. They argued that the combination of such measures has a greater effect, which allows 14.5%, 15.5%, and 13.2% reduction of total trade costs for low-income countries, lower middle-income countries, and upper middle-income countries, respectively. This report also presents which TFI can have the greatest effect on reducing overall trade cost for a specific set of countries. For low-income countries, the harmonization and simplification of documents can potentially reduce trade cost by 3%. After the Bali Conference, Moïsé & Sorescu (2015) expanded their research and found that an increase of 0.100 in the TFIs performance can increase between 1.5 and 3.5% the country's value-added imports and between 1 and 3% the exports.

In the international economics literature, it is common to find research using the structural gravity model to analyze the effect of trade facilitation on trade. The results of the General equilibrium estimations of Beverelli et al. (2023) found that as a result of the TFA implementation agricultural trade increases by 5% worldwide, while total trade increases by 1.17% worldwide. Another study found that the implementation of TFA could increase 12.2% to 15.7% in the number of products exported by destination and an increase of 26.9% to 34.9% in the number of export destinations by product in Sub-Saharan African or Latin America and the Caribbean countries (Beverelli et al., 2015).

Authors such as Huang et al. (2020) used the extended gravity model to showcase that cross-border time reduction has a positive effect on China's agricultural products export, but such effect was weakened by technical trade measures. With gravity model Kim et al. (2022) estimated that when reducing 10% of time at the inbound border of the Central Asia Regional Economic Cooperation (CAREC) Program can increase trade by 1-2% between CAREC countries. A similar study by Nazif & Jenkins (2023) found that reducing trade administration cost can help the Andean Community countries save 0.19% to 0.23% of their gross domestic product. Furthermore, Host et al. (2019) used an augmented gravity model to estimate that the variables of the Logistic Performance Index of the World Bank are highly important to international trade. Yadav (2014) calculated with gravity model the impact of four dimensions of trade facilitation (physical infrastructure, information and communication technology, business environment, and border efficiency) on parts and components and final goods trade.

The results show that border efficiency has the largest impact and that the effect on parts and components is greater compared to final goods trade. Portugal-Perez & Wilson (2009) used a gravity model and found that cutting cost in half has a greater impact than cutting tariff barriers. Fontagné et al. (2020) found

a positive effect from lowering the cost of gathering information on the total exports of all firms; and that measures that reduces uncertainty at the borders can improve export performance for large firms but not for small firms. Hillberry & Zurita (2022) found that the number of Type A trade facilitation commitments indicated by a WTO Members depends on their "level of development, population size, ability to control corruption and foreign aid received to support trade facilitation". Hillberry & Zhang (2018) concluded that country characteristics (like geography, income, and the governance) explains better the variation in customs and logistics performance when compared to measures of trade facilitation policy.

Other methods such as discrete-event simulation, design of experiments, and comparative analysis are also used by researchers to assess the impact of trade facilitation measures on trade. Ferreira et al. (2017) used discrete-event simulation and design of experiments at the largest cargo airport in South America to assess how three trade facilitation measures (use of X-ray equipment for physical inspection; increase of the number of qualified companies in the trade facilitation program; performance targets for customs officials) can have an impact on import flows. They found that all three measures provided "more predictability, cost savings, time reduction, and an increase in security in the international supply chain". Siddiqui & Dung (2019) used comparative analysis and found that the four trade facilitation parameters analyzed in their study (time to export; cost to export; Logistic Performance Index (LPI), and electronic clearance) significantly impact export performance.

Practically all the studies reviewed for this research indicate a positive correlation between the implementation of trade facilitation and diverse trade outcomes, such as an increase in trade, imports, exports, cost reduction, and time reduction. However, to the best of our knowledge, they do not provide a clear guideline on which specific trade facilitation measures a country should invest in to improve their performance in any term. Several OECD reports have come close to quantifying the impact that a country may have if they improved TFI; however, these indicators are composed of several numbers of measures. Therefore, from these reports and other research, it is not possible to have an accurate indication of which trade facilitation measure included in the TFA is necessary but not sufficient for a country to achieve an outcome. In other words, there is no study, to the best of our understanding, on which critical TFA measures can prevent the outcome of achieving a high trading across border performance. So, even if there is an improvement of another TFA measure, if the critical measure is not present, then the outcome is not present either.

The main objective of this research is to precisely identify the TFA measures that must be present if a country wishes to achieve certain trading across border performance. In this sense, the research question that guides this paper is: Which TFA measures are necessary but not sufficient to obtain the highest trading across border performance?

To answer the research question, the Necessary Condition Analysis (NCA) method is used. In total, 155 TFA measures are studied; therefore, 155 hypotheses are formulated because each TFA measure is tested separately. The NCA hypotheses are reflected as "No Y without X," a type of formulation that expresses that X is necessary for Y to be present. Thus, in this paper, the 155 hypotheses are expressed as follows: No score of 100 in Trading across Borders performance without [x] measure, where [x] represents each of the 155 separate TFA measures.

This study found that 84 TFA measures, which represents 54.2% of the total analyzed measures, can be considered as necessary but not sufficient to achieve high Trading across Borders performance. Ten out of the 84 TFA measures are considered to have a medium or large effect. These ten measures are: independent or higher-level administrative and/or judicial appeal procedures available for customs decisions; establishment of a national customs website; public consultations between traders and other interested parties and government; possibility to provide online feedback to Customs; information on import and export procedures; average clearance time; time to prepare documents for import; time to prepare documents for export; use of pre-shipment inspections required on Customs matters; targeted stakeholders; international Standards compliance; and release of goods separated from the final determination and payment of Customs duties.

Direct practical implications are present in this research. The findings can help governments prioritize their investment toward those TFA measures that are necessary but not sufficient to reduce cross-border trade cost and time. This is the first time that this type of tool is available for governments. As an example, this paper uses the outcome of the NCA model to analyze the case of Costa Rica and provide guidance on how to achieve the highest Trading across Borders performance.

2. Method

To test the hypotheses, this research chose the emerging quantitative methodology called "Necessary Condition Analysis" (NCA) created by Jan Dul (Dul, 2016). This method differs from regression analysis. With regression analysis, it is possible to identify the determinants that, on average, can contribute to the outcome. Also, with regression analysis, when a determinant is not present, it is possible to compensate for such absence with another determinant. In NCA, the logic is different. When applying NCA, it is possible to identify necessary or critical determinants that can prevent an outcome from occurring.

Critical determinants are those that must be present for achieving an outcome, but their presence is not sufficient to obtain that outcome; it can be considered a bottleneck or a must-have factor. In other words, if the critical determinant is not present, the outcome is not possible either, even if there is an increase in another determinant. However, achieving a critical determinant does not mean automatically that the outcome would be present because the critical determinant might not be sufficient.

As an example of an NCA statement is: The HIV virus is a necessary condition but not sufficient to have AIDS. The HIV virus (the determinant or factor) must always be present to have AIDS (no HIV virus equals no AIDS). However, there are other factors besides the HIV virus for a person to have AIDS, that is why there are persons with the HIV virus but no AIDS.

Another example in the context of public administration: stakeholder engagement is a necessary condition for public policy to be adopted and implemented successfully. Without the engagement of key stakeholders, policies are unlikely to be successfully adopted and implemented, even if they are well-designed and have political support.

NCA is a relatively new method, as of the end of 2023, there are 189 English language articles that use NCA as the sole research method or in combination with Qualitative Comparative Analysis or regression analysis (Dul, 2021). These articles come from diverse areas such as business, innovation, marketing, supply chain, natural sciences, etc. For example, Talib et al.

(2024) found that big data management capabilities are necessary to achieve the highest decision-making performance.

2.1. Data Sources

When using NCA, only two variables can be studied at the time, i.e., one factor variable (X value) and one outcome (Y value). This is because necessary conditions occur in isolation, instead of the traditional regression analysis where each X factor can be contributing together to an outcome. In this sense, each TFA measure (X value) is tested separately against the outcome, which is the Trading across Borders performance indicator (Y value). The data source of the factor variable is the OECD Trade Facilitation Indicators (TFIs). These indicators were launched in 2013 and are updated every two years. The 2019 TFIs register information for 166 countries. In total, they have 11 indicators, each indicator is calculated based on a set of trade facilitation measures. Table 1 shows the indicators listed from A to K and the number of TFA measures associated with each indicator. The TFA measures are identified with a letter linked to the specific indicator and a sequential number from 1 to 155. For each one of the 155 measures, the OECD publishes if each one of the 166 countries has implemented it in full (which assigns a value of 2), implemented partially (which assigns a value of 1), or is not present in the country (which assigns a value of 0). Therefore, the factor variable can have 3 possible scales: absent (0), partial compliance (1), or full compliance (2). For this reason, there are 155 hypotheses that are tested in this research (one per TFA measure). The full list of the TFA measures is shown in the first column of Table 2.

The data source of outcome Y is the Trading across Borders indicator of the Doing Business Report of the World Bank. This Report started in 2003 with data recorded from 133 countries. The last report was presented in 2020 with 190 countries. This indicator records the time and cost (excluding tariffs) of

Table 1.
OECD Trade Facilitation Indicators of 2019 and the number of Trade Facilitation Measures associated to the indicator.

Trade Facilitation Indicator of the OECD	Number of TFA measures
A. Information availability	21 measures from A.1 to A.21
B. Involvement of the trade community	8 measures from B.22 to B29
C. Advance rulings	11 measures from C.30 to C.40
D. Appeal procedures	13 measures from D.41 to D.53
E. Fees and charges	14 measures from E.54 to E.67
F. Formalities - documents	9 measures from F.68 to F.76
G. Formalities - automation	13 measures from G.77 to G.89
H. Formalities - procedures	35 measures from H.90 to H.124
I. Internal border agency co-operation	11 measures from I.125 to I.135
J. External border agency co-operation	11 measures from J.136 to J.146
K. Governance and impartiality	8 measures from K.147 to K.155

Source: Author

exporting or importing a shipment of goods associated with documentary compliance, border compliance, and domestic transport (World Bank, 2019). The highest score that can be obtained in the Trading across Borders indicator of the Doing Business Report is 100 while 0 is the lowest. Therefore, the outcome Y can range from 0 to 100, the latter being the highest score. For this research, the data set from the year 2019 of the OECD TFIs and the latest report of the year 2020 of Doing Business are used. Even though a more updated version of the OECD TFIs is currently available from the year 2022, this data set is not used because the objective is to compare the impact that the TFA measures have on the cost and time of the cross-border trade transactions during the same period. Therefore, using 2022 data from the OECD TFIs should not be compared to the year 2020 Doing Business indicators.

The Trading across Borders dataset from the Doing Business report is also used even though it has been criticized for irregularities found in the data. It seems that China, Saudi Arabia, the United Arab Emirates, and Azerbaijan have altered the information to improve their ranking (Shalal, 2023). These data are selected because it is the most comprehensive set of information in terms of the number of countries, this allows having a better comparative framework to evaluate certain environments across countries and do benchmark against other countries' performance. The World Bank also publishes the Logistic Performance Index (LPI), however, this ranking is not as fit as the Trading across Borders of the Doing Business because it considers indicators that are not linked to measures implemented by the government such as the ease of arranging competitively priced shipments; competence and quality of logistics services—trucking, forwarding, and customs brokerage; ability to track and trace consignments; and the frequency with which shipments reach consignees within scheduled or expected delivery times. Furthermore, while the overall country rankings of the Doing Business have been criticized, the report includes detailed data on specific areas of business regulation. These sector-specific insights might still provide valuable information for researchers focusing on particular aspects of the business environment, in the case of this paper on the trading across borders sector.

2.2. Population and Sample

Before launching the data analysis process, it is necessary to identify the population and sample. The target population are all WTO Members implementing the TFA measures. A convenient sampling is used. First, the 190 countries of the Doing Business Report database is used as a starting point because it represents the Y outcome. In some countries, the Doing Business Report calculated the Trading across Borders indicator for specific ports. For example, China has three indicators: one for China in general, another one for the port of Shanghai, and the third one for the port of Beijing). In this case, the general indicator is taken into consideration. Second, the researcher excluded those countries that are not in the list of the OECD TFIs database. Third, countries that are part of the OECD TFIs database but not from the Doing Business Report database are also excluded. All possible subjects with available data from both data sources are considered to better represent the population, increase confidence, and generalize results and findings

2.3. NCA Analysis process

For each analyzed WTO Member, the following data is collected: the 2020 Trading across Borders Indicator from the Doing Business Report (score from 0 to 100); the absence (score 0), partial compliance (score 1), or full compliance (score 2) of each of the 155 TF measures in such country. Once the data is collected and cleaned up, the NCA model is performed using the NCA package in R. Six main steps are performed.

First, a scatter plot is created in a traditional cartesian table, factor variable X horizontally and outcome Y vertically, with values increasing to the right and upwards; each country case is a dot.

Second, the ceiling lines are included in the scatter plots, which intend to separate the area with observations from the area without observations. Two ceiling lines are available: CE-FGH and CR-FDH. The first one refers to a ceiling envelopment with a piecewise linear line and the second one a ceiling regression with a continuous linear and straight line (for more information about the ceiling techniques check (Dul, 2016)). The CE-FGH line is chosen because the factor variable X in this analysis is a trichotomous factor.

Third, the "empty space" (also called "ceiling zone") in the XY scatter plot is inspected, the bigger the empty space above the ceiling line in the top left corner, the higher the factor variable is a necessary condition for the outcome Y. There are three possible situations when inspecting the scatter plot: a) upper left corner is clearly an empty area with no cases in it; b) no empty space above the upward ceiling line; and c) there are a few cases present in the empty space, which can represent outliers, exceptions, or anomalies.

Fourth, the effect size is calculated by determining the ceiling. The bigger the effect size, the bigger is the necessity effect of X for outcome Y. This effect is obtained by calculating the scope (area between the minimum and maximum values of X and Y) and the ceiling zone. So, the effect size is the ceiling zone divided by the scope. As a general rule of thumb, an effect size between 0 and 0.10 indicates a small effect, between 0.10 and 0.30 a medium effect, between 0.30 and 0.50 a large effect, and larger than 0.50 a very large effect (Dul, 2016).

Table 2.
Top ten TFA measures with medium and large size effect

TFA measure	Effect size	P-value
D.42. Independent or higher level administrative and/or judicial appeal procedures available for customs decisions	0.350	0.047
A.1. Establishment of a national customs website	0.250	0.001
A.7. Information on import and export procedures	0.130	0.001
H.92. Average clearance time	0.130	0.001
F.75. Time to prepare documents for import (days)	0.120	0.001
F.76. Time to prepare documents for export (days)	0.120	0.001
H.108. Use of pre-shipment inspections required on Customs matters	0.110	0.001
B.25. Targeted stakeholders	0.100	0.001
F.71. International Standards compliance	0.100	0.001
H.99. Release of goods separated from final determination and payment of Customs duties	0.100	0001

Source: Author

Fifth, the substantive and statistical significance is evaluated using the common threshold P-value with a statistical significance of 0.05 (Dul, 2016). For the estimation of the P-value, the number of permutations that is selected is 10,000 samples.

Finally, if a necessity condition is found based on the effect size and p-value, the bottleneck table is calculated. This table specifies for a desired level of the Y outcome, the levels that the conditions are necessary. For very low levels of a desired outcome, most or all of the conditions oftentimes are not necessary (indicated as "NN" in the bottleneck table).

3. Results

Annex 1 shows the effect size (using the CE-FGH ceiling line) and the P-value of the 155 measures. Table 2 shows the ten TFA measures with an effect size above 0.1 and with a P-value below 0.05.

Based on the results, 84 TFA measures, which represent 54.2% of the total analyzed measures, have an effect size of more than 0 and with a P-value below 0.05. This means that all these 84 TFA measures (X values) can be considered necessary but not sufficient to achieve the Y outcome. As of this point, 71 hypotheses are rejected as the effect size is not

Table 3.
Distribution of the TFA measures that have an effect size higher than 0 and a P-value lower than 0.05

Trade Facilitation Indicator (TFI) of the OECD	Number of TFA measures per TFI	Number of TFA measures with effect size > 0 and P-value < 0.05	Percentage of TFA measures with effect size > 0 and P-value < 0.05
A. Information availability	21 measures	12 measures	57.1%
B. Involvement of the trade community	8 measures	5 measures	62.5%
C. Advance rulings	11 measures	10 measures	90.9%
D. Appeal procedures	13 measures	5 measures	38.5%
E. Fees and charges	14 measures	7 measures	50%
F. Formalities - documents	9 measures	6 measures	66.7%
G. Formalities - automation	13 measures	7 measures	53.8%
H. Formalities - procedures	35 measures	13 measures	37.1%
I. Internal border agency co-operation	11 measures	4 measures	36.4%
J. External border agency co-operation	11 measures	9 measures	81.8%
K. Governance and impartiality	8 measures	6 measures	75.0%

Source: Author

big enough or the P-value is too high. Table 3 shows the distribution of the 84 TFA measures according to the TFI classification. Based on these results, all OECD's TFI have necessary measures to achieve a high Trading across Borders performance. When classifying the effect size of these 84 TFA measures, 74 of them are considered as "small effect" because they have an effect size between 0 and 0.100; nine of the TFA measures are considered as "medium effect" with a score between 0.10 and 0.30; and one TFA measure is considered as a large effect as the effect size is above 0.30. For this paper, an explanation of why the top ten TFA measures with a medium or large effect are considered as necessary conditions to have a high Trading across Borders performance.

Figure 1 shows the NCA plot of all the trade facilitation measures that have an effect size bigger than 0.10 and a P-value of less than 0.05, i.e. those with medium and high effect size. Each one of the plots contains the CE-FGH ceiling line (dotted line), the CR-FGH ceiling line (line above the dotted line) and the regression line for reference (lowest line). The bigger the empty space above the CE-FGH ceiling line the bigger is the effect size. Therefore, when visually inspecting these 10 plots, it is easy to identify which one has the highest size effect.

The measure called "D.42. Independent or higher level administrative and/or judicial appeal procedures available for customs decisions" have the biggest empty space with an effect size of 0.35. This is an important measure because it allows business to appeal decisions or omissions of Customs by an authority independent of the Customs administration. This measure can reduce time and cost of trade because inefficient conflict resolution can cause long delays by tidying up goods at borders and increase costs such as storage fees and demurrage charges.

The second highest size effect with a score of 0.25 and P-value of 0.001 is "A.1 Establishment of a national customs website". Having this measure eliminates the need for businesses with different time zones to consult, around the clock, multiple sources or physically visit customs offices for information. With clear published guidelines, it helps businesses understand complex customs procedures which in turn reduces misunderstandings and non-compliance. With information at hand, companies can also plan their shipments more effectively, reducing delays and unexpected costs. This measure is part of the Group A of the TFI called Information availability, which according to Moïsé & Sorescu (2013) this is one of the indicators with the greatest impact on trade volume and cost for both import and export. Also, according to the World Customs Organization (WCO) "[a] website is the most important online tool for a Customs administration. It is a reliable way of providing official information to stakeholders and the public" (World Customs Organization, 2022).

The following two TFA measures with the highest score are "A.7 Information on import and export procedures" and "H.92 Average clearance time". They both have an effect size of 0.13. Then, two TFA measures scored 0.12 on its effect size: "F.75 Time to prepare documents for import" and "F.76 Time to prepare documents for export". These four measures are also part of the group of TFIs that, according to Moïsé & Sorescu (2013) can potentially impact the most in terms of trade volume and cost to countries who implement these group of measures. Furthermore Huang et al. (2020) and Kim et al. (2022) analyzed that time reduction can have a positive effect on trade.

The A.7 measure helps to reduce time and cost of trade because it allows businesses to understand the trade requirements which in turn reduce non-compliance, delays, and unexpected costs.

Regarding measure H.92, shorter clearance time is crucial in reducing both the direct and indirect costs and time associated with international trade. Shorter clearance times reduces or eliminates charges such as storage and demurrage. Also, with this measure businesses can have quicker turnaround of the goods and implement strategic supply chain practices like just-in-time.

When the time to prepare documents for trade are shorter (measures F.75 and F.76) businesses have less administrative burdens and labor costs. Employees can allocate their time to more productive tasks rather than spending excessive hours on paperwork.

The TFA measures "H.108 Use of pre-shipment inspections required on Customs matters" have an effect size of 0.11. This TFA measure refers to the prohibition of applying a mandatory third-party review process in the exporting country when related to tariff classification and customs valuation and to discourage the use of this measure in other topics. Pre-shipment inspections (PSIs) usually requires the payment of a fee, which adds to the overall cost of importing or exporting. Other indirect costs of PSI comprise the preparation of the inspection, including documentation and procedural compliance. PSIs can be challenging and time-consuming, particularly for businesses that are new to international trade. PSI can also delay the import or export if the scheduling depends on the availability of inspectors. PSI can also mean duplication of efforts as the goods may undergo multiple inspections by several parties (by the exporter, the importer, and the PSI agency). The establishment of this measure is consistent with the work of Beverelli et al. (2022) where they found that PSI reduces bilateral trade of manufacturing goods.

Lastly, three TFA measures scored 0.10 called "B.25. Targeted stakeholders", "F.71 International Standards compliance" and "H.99. Release of goods separated from final determination and payment of Customs duties".

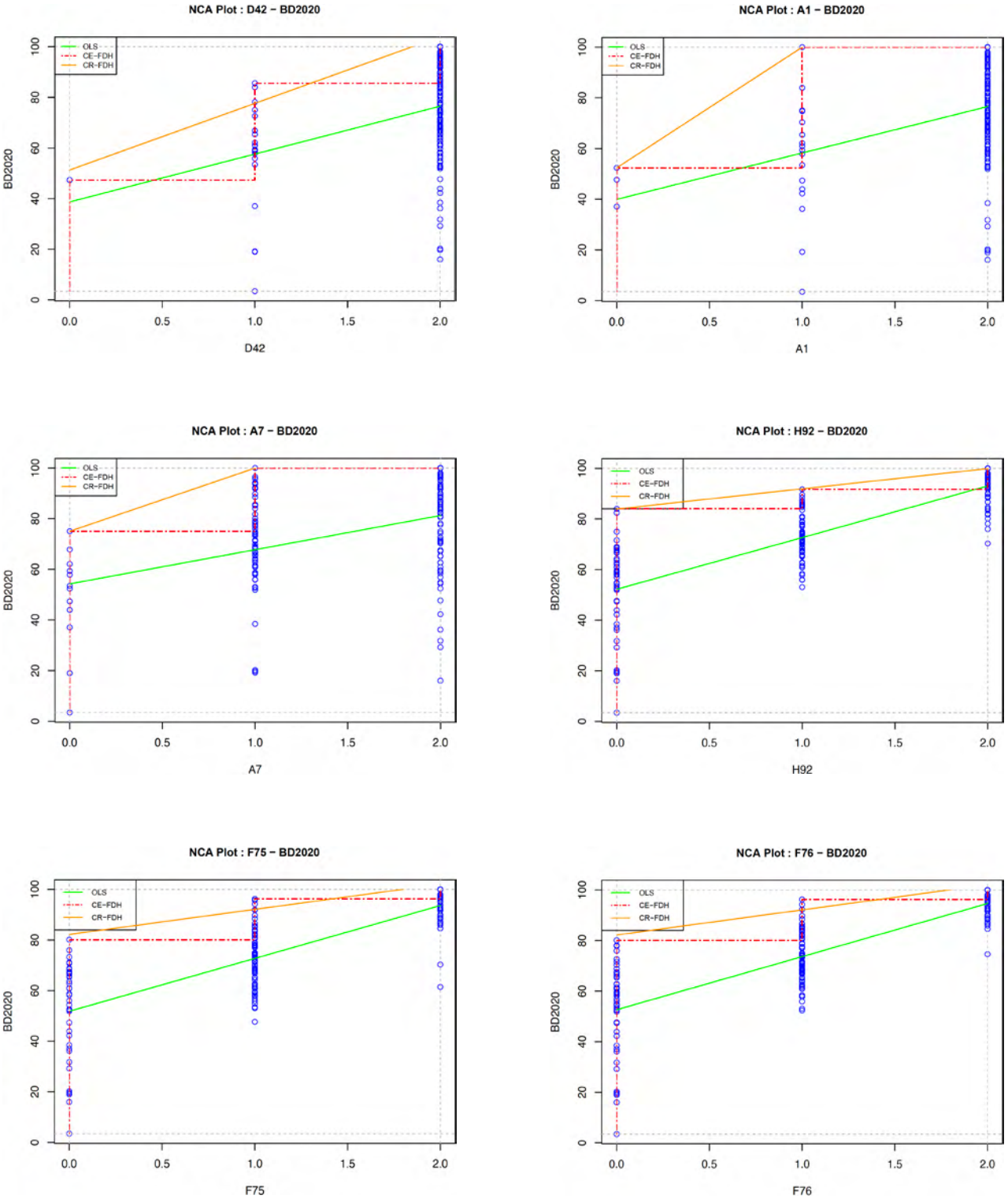
The B.25 measure refers to the number of stakeholders that are consulted when implementing new regulation affecting trade. This measure is relevant because when consulting with key groups or entities, interventions can be more effectively designed and implemented to streamline customs procedures and reduce trade barriers. Engaging with stakeholders allows for direct feedback on bottlenecks faced in the trade process, enabling authorities to make targeted improvements that can significantly reduce delays and associated costs. According to the UNCTAD (2021) this measure can enable "the most efficient and least cumbersome measures to achieve regulatory objectives which in turn leads to higher compliance levels and better trade outcomes".

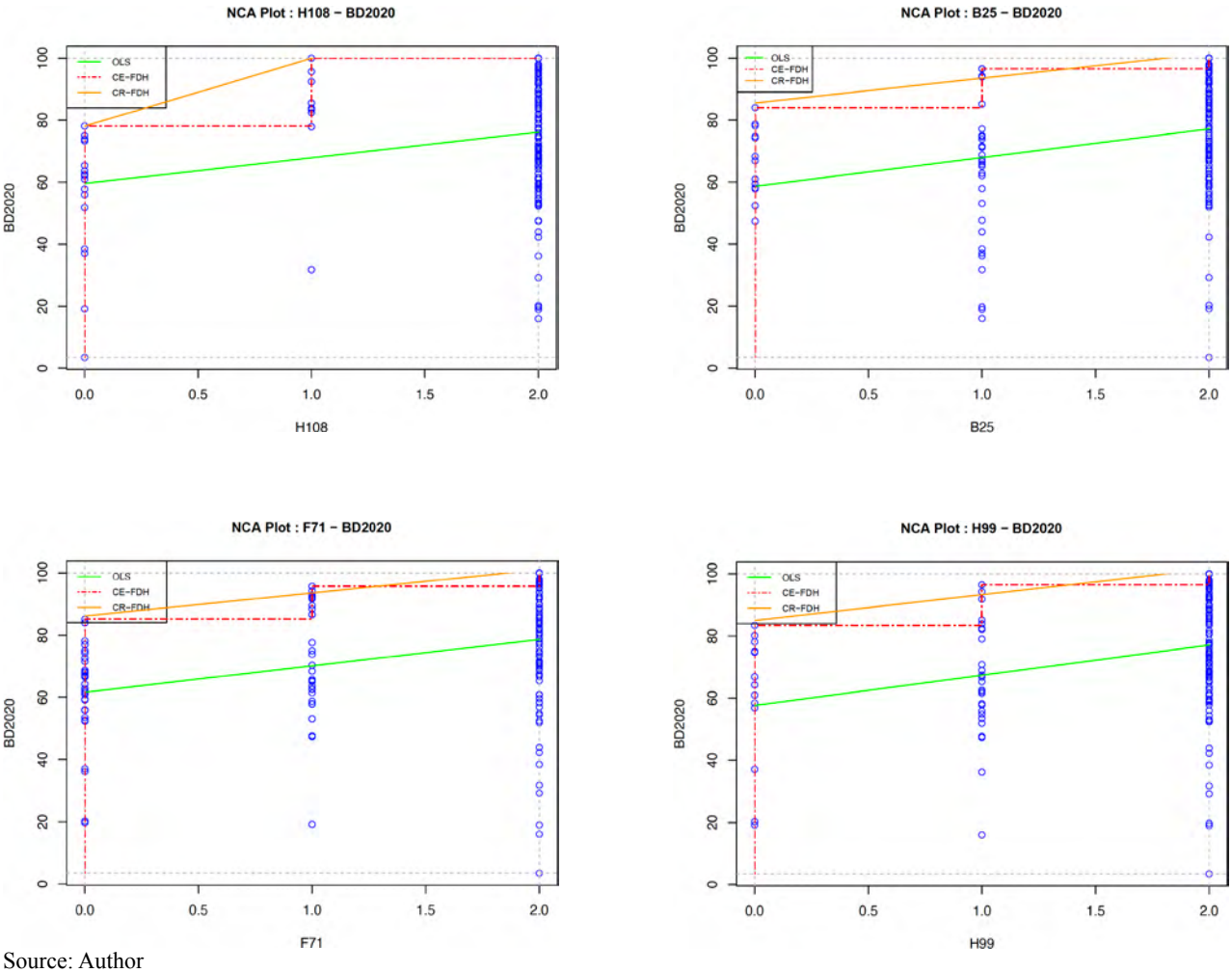
The F.71 measure refers to the alignment of national trade regulations, procedures, and standards with international norms and standards, such as those set by WTO, WCO, and other relevant international bodies. Compliance with international standards increases predictability and transparency in trade, helping businesses to better plan their operations and reduce the risks and costs of non-compliance. International standards often embody best practices for streamlining and simplifying trade procedures, reducing the time required for customs processing and clearance.

Measure H.99 is critical when certain requirements are pending and might take some time to resolve. By allowing the deferment of duty payments until a final assessment is made, businesses can use or sell goods before duty payment and therefore enhance operational flexibility and financial efficiency. For instance, businesses have better cash flow, frees up

Figure 1.

NCA plot for the trade facilitation measure with an effect size bigger than 0.10 and a P-value of less than 0.05





Source: Author

capital for other uses, goods spend less time in ports or holding facilities that generates unnecessary costs. According to the UNCTAD (2021), this measure "allows traders to avoid costly delays" and when reducing the bottlenecks at the border it "[…] will enable a higher number of trade transactions to take place, increase customs revenues and lead to a more productive use of human and financial resources".

Now that it has been determined the top 10 TFA measures that are necessary to have a high level of Trading across Borders performance, the next step is to understand the level of the TFA measure (X factor) that needs to be satisfied to achieve a desired level of the Trading across Borders indicator (Y outcome).

Table 4 presents the bottleneck analysis of the 10 TFA measures identified as necessary but not sufficient to obtain the Y outcome with a medium and high effect. This table is important because it allows understanding the combination of the TFA measures that are necessary, but not sufficient, to achieve levels of the outcome. For this analysis, the Costa Rican example is used.

In the 2020 Trading across Borders indicator, Costa Rica scored 77.604. The first column of Table 4 has the potential level of the Y outcome, the next columns are the bottleneck data for each TFA measure at each level of the Y outcome. The "NN" in the table means "not necessary". The last row of such a table

shows the score obtained by Costa Rica in each of the analyzed TFA measures.

Based on the Table 3 bottleneck data, for Costa Rica to obtain a score of 80.690 or more (their score in the 2020 report is 77.604), it is necessary for them to obtain a minimum score of 1.00 in the following measures: A.1. Establishment of a national customs website; A.7. Information on import and export procedures; F.75. Time to prepare documents for import; F.76. Time to prepare documents for export; and H.108. Use of pre-shipment inspections required on Customs matters. When verifying the scores of Costa Rica, it is clear that this country already has the necessary conditions to obtain 80.690 or even 90.345, but it is still not sufficient, that is why the Costa Rican score is less than 80.690.

If Costa Rica wishes to get a score of 100.00, in the year 2019 (year inspected for the 2020 Trading across Borders indicator) it is necessary for them to have had fully implemented the following measures: H.92, F.75, F.76, and F.71. In those four measures, Costa Rica only partially implemented them (they got a score of 1.00), therefore, the highest level of compliance of these four measures are a necessary condition for the highest Trading across Borders indicator.

4. Discussion and Conclusions

This research found necessary conditions that need to be achieved if a country wishes to obtain a high Trading across Borders performance score. It found 10 TFA measures with a medium and large size effect and 74 with a small size effect. This finding is important because without these conditions the desired outcome cannot materialize. Even though not all the TFA Measures are regarded as "necessary", it does not mean that they are not important because they can still contribute to the outcome, it is just that

Table 4.

Bottleneck analysis for TFA measures A.1, A.7, H.29, F.75, F.76, H.108, B.25, F.71, and H.99

Y	D.42	A.1	A.7	H.92	F.75	F.76	H.108	B.25	F.71	H.99
3.452	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
13.107	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
22.762	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
32.416	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
42.071	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
51.726	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
61.381	NN	1.00	NN	NN	NN	NN	NN	NN	NN	NN
71.036	NN	1.00	NN	NN	NN	NN	NN	NN	NN	NN
80.690	NN	1.00	1.00	NN	1.00	1.00	1.00	NN	NN	NN
90.345	NN	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100.000	2.00	1.00	1.00	2.00	2.00	2.00	1.00	2.00	2.00	2.00
Costa Rica	2.00	2.00	2.00	1.00	1.00	1.00	2.00	2.00	1.00	2.00

Source: Author

NCA analysis suggests that they are not essential for the outcome. Therefore, if one of those measures are absent or partially fulfilled, it can be compensated by other measures. This reasoning is validated with the example of the Costa Rican Trading across Borders performance. Costa Rica has all the necessary conditions to get a score of 90.345, however, such outcome is absent.

To get a score of 100 in the Trading across Borders performance, Costa Rica needs to fully implement the following four measures: H.92, F.75, F.76 F.71. To have a score of 2 in the H.92 measure, the average clearance time should be below 10 hours based on the TFI. To achieve this objective, Costa Rica needs to implement a Business Process Analysis, or a Time Release Study where they can clearly identify the bottlenecks of the process. This type of analysis is complex and costly as they involve the collection of data of multiple steps and for at least one weeks of all the cases of import/export. However, without a clear understanding of the bottleneck, it is not possible to truly identify the deficiencies of the process. One is as fast as the slowest process.

To have a score of 2 in the F.75 and F.76 measure, the time that takes to prepare documents must be below four hours based on the TFI. The government should undertake a careful analysis with key stakeholders of the required documentation that is solicited in each border post. Based on the recollected information, the customs authority should analyze if the requested documents are aligned with the current legislation or if some should be eliminated. Also, for a continuous improvement of processes, the customs authority should periodically study if the current documentation can be eliminated (even if the legislation requests it), automated or replaced.

Regarding the measure of F.71 about International Standards compliance, to have a score of 2 it is necessary to have ratified at least 4 relevant international Conventions according to the TFI. Costa Rica still has to ratify the Convention (1990) on the Temporary Admission of Goods (Istanbul Convention), and the General Annex of the International Convention (1999) on the Simplification and Harmonisation of Customs procedures (Revised Kyoto Convention). To have these ratified, the government should have sufficient political will and prioritize this matter. The Revised Kyoto Convention has been analyzed in Costa Rica by key stakeholders. They gave a positive assessment on November 2023, but it hasn't move forward for ratification.

The result of this study also provides theoretical contributions to the work performed by other authors. For example, Moïsé & Sorescu (2013) found that the TFIs from group A (information availability), Group F (Formalities-Documents), and Group H (Formalities-procedures) are the indicators that have the greatest impact on trade volume and cost for both import and export. Eight out of the ten TFA measures with medium-high effect that this study found to be necessary are measures that are part of Group A, F, and H of the TFI. This study advances the OECD reports by Moïsé & Sorescu, (2013, 2015) because it clearly identifies the exact measures that a government should look at to have an impact on cost and time of import and export and therefore improve the Trading across Borders performance.

Practical contributions are also clear in this research. Government and national and multinational financial organizations can directly benefit from the results of this research. It can guide governments on which factors they should focus their limited resources to achieve a desired outcome because those are the measures that if they are not in place the outcome cannot exist. Similarly, it can guide national and multinational financial institutions that lend money to certain governments to achieve certain policies.

So, this kind of research can also guide managerial decision-making towards the factors that need to be acted upon and therefore investment should be allocated to them. In other words, if the right level of a necessary condition is not satisfied, it is a waste of effort/investment to act on other factors than the necessary factor as this will not influence the outcome. Of course, having only the critical factors does not guarantee the Y outcome, but it is a step forward to avoid failure in the achievement of the outcome.

This study uses a novel research method called NCA. As any other approach, it has its strengths and weaknesses. A clear strength of using this method is that it allows applying a different logic and data analysis to an existing data set. In this case, the TFIs of the OECD and the Trading across Borders indicator of the World Bank are used. As a result, it is possible to provide a different view of knowledge and enhance and advance existing theory and provide targeted practical implications to different actors as mentioned in the previous paragraphs. Another benefit of using NCA in this research is that the results can almost perfectly predict the absence of the outcome. In the case of this research, it predicts the absence of a certain level of Trading across Borders performance. This is also a reason why the results of the NCA method can provide such clear and useful practical advice to practitioners.

Although NCA can predict the absence of the outcome, this method has the limitation that it does not predict the presence of the outcome. For instance, in this research, we found that Costa Rica has the necessary conditions to obtain a Trading across Borders score higher than 77.604 but the outcome is absent. For it to be present, some other conditions must be met, and these are not clear in this study using NCA. In this sense, future research can complement the present study by using an additional research method such as regression analysis to determine the contributing factors. Furthermore, NCA is not designed to address concerns of endogeneity. Therefore, the reciprocal causation of trade facilitation and trade performance or other sources of endogeneity such as omitted variables or measurement errors cannot be tackled with NCA.

Finally, this research also provides a methodological contribution because an emerging methodology is being applied to an existing field of research.

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Does not include.

Declaration of conflict of interests

No conflict declared.

Supplementary documents

Available at: https://www.kerwa.ucr.ac.cr/workflowitems/21872/view

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