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Standards, power, and market access: a political economy analysis of non-tariff measures and Indonesian cinnamon exports

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Indonesia is one of the world's largest producers of cassia cinnamon; however, its export performance remains uneven despite its strong production capacity. This study examines how non-tariff measures—specifically, sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT)—alongside key macroeconomic factors, shape Indonesia's cinnamon exports. Using a political economy framework, the analysis integrates panel data regression with revealed comparative advantage (RCA), export product dynamics (EPD), and X-model assessments across nine major destination markets from 2010 to 2024. The results show that SPS measures exert a significant trade-suppressing effect, functioning as exclusionary regulatory filters, whereas TBT compliance has a modest but positive enabling role. Importing countries' income levels and population are negatively associated with export volume, indicating consumer upgrading to premium alternatives such as Ceylon cinnamon. The exchange rates and distance show limited explanatory power. These findings demonstrate that Indonesia's export performance is shaped less by price competitiveness and more by regulatory power, institutional capacity, and shifting consumer preferences. Therefore, sustaining competitiveness requires a strategic shift from volume-based to value-based exports through quality upgrading, certification, traceability, and branding.

KEYWORDS

agricultural policy, export performance, global value chains, non-tariff barriers, regulatory compliance

1 Introduction

Cinnamon is an important commodity in global agri-food value chains and is widely used in the food, pharmaceutical, and cosmetic industries. Its bioactive compounds, such as cinnamaldehyde, cinnamate, and essential oils, provide aromatic, preservative, and therapeutic properties that are well established in the literature (Elisabeth and Falatehan, 2022). As a spice belonging to the Lauraceae family, cinnamon has long served both culinary and medicinal functions (Kumari and Kumar, 2019), with its key compounds demonstrating antidiabetic, antibacterial, antioxidant, anti-inflammatory, and anticancer properties (Liu et al., 2021; Rao

and Gan, 2014). Recent evidence has further highlighted its potential in the treatment of neurodegenerative disorders, including Parkinson's and Alzheimer's diseases (Rao and Gan, 2014). These diverse attributes underscore the versatility and growing industrial relevance of cinnamon in contemporary global markets (Liu et al., 2021; Rao and Gan, 2014).

In international trade, cassia cinnamon dominates because of its affordability and widespread use as a substitute for premium Ceylon cinnamon (Liu et al., 2021; Supriana et al., 2022). China is currently the world's largest cinnamon producer, while Indonesia is a major producer and exporter of cassia, ranking second in global export value after Sri Lanka, which markets smaller quantities of high-value Ceylon cinnamon (Rochdiani and Wulandari, 2023). Although Indonesia contributes substantially to the global cassia supply and competes strongly in large markets such as the United States (Elisabeth and Falatehan, 2022), its export earnings lag behind those of Sri Lanka. These patterns indicate that Indonesia's competitiveness is shaped not only by the production scale and international demand but also by the degree of quality differentiation, product upgrading, and the continued positioning of cassia as a low-cost alternative (Piyasiri and Wijeratne, 2016).

Indonesia's cinnamon sector continues to face structural constraints that limit its ability to achieve higher export values. Declining production land, limited labor quality, and weak downstream processing capabilities restrict productivity and product upgrading (Elisabeth and Falatehan, 2022). Export performance is also influenced by broader macroeconomic and market conditions, including exchange rates, export volumes, and the GDP of the importing countries (Rochdiani and Wulandari, 2023; Supriana et al., 2022). Despite intensifying competition from China and Vietnam, Indonesia has maintained a positive export trend and a strong comparative advantage in the global market (Supriana et al., 2022). Nevertheless, strengthening productivity and expanding cultivation remain central strategies for securing Indonesia's long-term position in the international cinnamon value chain (Piyasiri and Wijeratne, 2016).

A critical yet underexamined dimension shaping the performance of Indonesia's cinnamon exports is the growing influence of non-tariff measures (NTMs), particularly sanitary and phytosanitary (SPS) regulations and technical barriers to trade (TBT). As global tariff levels have declined through multilateral and bilateral agreements, SPS and TBT requirements have emerged as the dominant instruments for regulating agricultural trade (Gourdon et al., 2020). While these measures are formally designed to protect consumer safety, they also operate as mechanisms of structural power that impose significant compliance costs and reinforce asymmetries between high-income importing countries and developing country exporters. Their effects are especially pronounced in spice commodities such as cinnamon, where contamination risks, maximum residue limits, and traceability requirements are tightly controlled (Riptanti et al., 2018).

The role of NTMs in the Indonesian cinnamon sector is particularly consequential. Major importing countries, including the United States, Canada, Japan, and Thailand, impose extensive SPS and TBT requirements related to laboratory testing, certification, labelling, and documentation (Gourdon et al., 2020; Laursen, 2015). Indonesia's

supply chain, dominated by smallholders and characterized by fragmented production systems, limited processing technology, and inconsistent quality control, faces substantial challenges in meeting these evolving standards (Elisabeth and Falatehan, 2022). Weaknesses in traceability systems, certification pathways, and downstream industry upgrading further constrain Indonesia's ability to access premium markets and capture higher values. These constraints illustrate that Indonesia's competitive position is shaped not only by economic and production factors but also by institutional and regulatory configurations that determine compliance and govern market access.

China is the leading global producer of cinnamon; Indonesia is a major global cinnamon producer and exporter, ranking second in export value behind Sri Lanka (Rochdiani and Wulandari, 2023). The country primarily produces Cassia cinnamon, which, despite its lower market value, is a cheaper alternative to Ceylon cinnamon (Piyasiri and Wijeratne, 2016). Indonesian cinnamon competes strongly in international markets, particularly in the United States (Elisabeth and Falatehan, 2022). However, limited labour quality, decreasing production land, and insufficient downstream industry activities hinder its full potential (Elisabeth and Falatehan, 2022). Factors influencing Indonesian cinnamon exports include exchange rates, export volumes, and importing countries' GDP (Rochdiani and Wulandari, 2023; Supriana et al., 2022). Despite competition from other major producers like China and Vietnam, Indonesia maintains a positive export trend and a strong comparative advantage in the global market (Supriana et al., 2022). To enhance its position, Indonesia must address productivity issues and expand cultivation areas (Piyasiri and Wijeratne, 2016).

A major source of these constraints is the growing prominence of NTMs, particularly SPS regulations and TBT, which now play a central role in shaping agricultural trade. As tariffs have been reduced under multilateral and bilateral agreements, SPS and TBT measures have expanded as the primary instruments governing market access in the agri-food sectors (Gourdon et al., 2020). Although formally intended to ensure safety and protect consumers, these measures also function as mechanisms of structural power that can impose high compliance costs and reinforce asymmetries between high-income importing countries and developing-country exporters of agricultural products. Their effects are especially pronounced in spice commodities, including cinnamon, where contamination risks, maximum residue limits, and traceability requirements are strictly regulated (Riptanti et al., 2018).

In Indonesia's cinnamon sector, the influence of NTMs is particularly important. Importing countries, such as the United States, Canada, Japan, and Thailand, impose extensive SPS and TBT requirements, including laboratory testing, certification, labelling, and documentation protocols (Gourdon et al., 2020; Laursen, 2015). Indonesia's supply chain, dominated by smallholders and characterized by fragmented production systems, limited processing technology, and inconsistent quality control, faces structural challenges in consistently meeting these requirements (Elisabeth and Falatehan, 2022). Weaknesses in traceability, certification pathways, and downstream upgrading further limit Indonesia's ability to enter premium markets and capture greater value. These constraints illustrate that Indonesia's competitive challenges are shaped not only by economic factors but also by the institutional configurations that govern compliance and export.

Abbreviation: NTMs, non-tariff measures; SPS, sanitary and phytosanitary; RCAR, revealed comparative advantage; EPD, export product dynamics; TBT, technical barriers to trade.

Despite the importance of NTMs, empirical research on Indonesian cinnamon trade has focused primarily on production trends, demand conditions, and general export performance (Elisabeth and Falatehan, 2022; Rochdiani and Wulandari, 2023). Very few studies have examined how NTMs affect trade outcomes, and none have integrated a political economy perspective that situates SPS and TBT measures within broader power relations and governance structures. Consequently, the mechanisms through which NTMs influence competitiveness and market access remain poorly understood, representing a significant research gap, particularly given the expanding regulatory environment shaping the global spice trade.

To address this gap, this study applies a political economy framework to analyze how SPS and TBT measures influence the competitiveness and market access of Indonesian cinnamon. In this approach, NTMs are conceptualized not only as regulatory requirements but also as instruments of structural power that may restrict, condition, or enable participation in the global market (Laursen, 2015). SPS measures tend to function as exclusionary filters, whereas TBT compliance can enhance legitimacy, enable differentiation, and facilitate access to regulated high-value markets. By integrating RCA, EPD, and panel regression (Mubarakah, 2020) with an examination of governance arrangements and institutional capacity, the study establishes a comprehensive perspective connecting economic performance with regulatory structures and power dynamics in global cinnamon trade. To address this gap, this study applies a political economy framework to analyze how SPS and TBT measures influence the competitiveness and market access of Indonesian cinnamon. In this framework, NTMs are conceptualized as both regulatory requirements and instruments of structural power that can restrict, condition, or enable participation in global trade. SPS measures often function as exclusionary filters, whereas TBT compliance can create opportunities for legitimacy, product differentiation, and entry into high-value regulated markets. By integrating RCA, EPD, and panel regression with an analysis of governance and institutional arrangements, this study provides a comprehensive perspective that connects economic performance with regulatory structures and power relations.

Accordingly, this study has three aims. First, it evaluates Indonesia's comparative and competitive position in major export destinations. Second, it examines the effects of SPS and TBT on Indonesian cinnamon export volumes. Third, it interprets these trade outcomes through the lens of political economy, highlighting how regulatory power, institutional capacity, and global market governance shape Indonesia's participation in the cinnamon trade. This study contributes to scholarly debates on standards-driven trade regimes and provides evidence of how developing countries navigate increasingly complex regulatory environments.

Overall, this study argues that sustaining and enhancing Indonesia's global position requires a transition from volume-based to value-based export strategies supported by quality upgrading, certification, traceability, branding, and stronger institutional coordination. By showing how SPS and TBT measures operate within the political economy of global trade governance, this study offers insights that can inform policy reforms and capacity-building initiatives aimed at improving Indonesia's market access and competitiveness in the global cinnamon value chain.

2 Methods

2.1 Study design

This study employs a political-economic approach that integrates both quantitative and qualitative perspectives. Traditional economic tools such as the RCA and EPD, and panel regression analysis are used to evaluate Indonesia's competitiveness and export performance in global cinnamon markets. These methods allow for the identification of key economic determinants, including exchange rates, importers' GDP, and trade volumes, which influence Indonesia's position in international trade. However, the application of these methods extends beyond standard econometric assessment. By interpreting SPS and TBT as not only market determinants but also instruments of institutional power, this study connects trade outcomes to broader governance regimes.

To capture these institutional and political dimensions, this study adopts a mixed design that overlays quantitative trade metrics with a political economic framework. In this design, non-tariff measures are treated as both quantifiable barriers affecting trade flows and proxies for institutional arrangements that shape global market access. The framework situates trade indicators, such as the RCA, within a broader analysis of state regulatory capacity, exporters' compliance challenges, and structural asymmetries embedded in global trade governance. This dual approach highlights how developing countries, such as Indonesia, navigate complex regulatory environments, where compliance with standards often determines not only competitiveness but also legitimacy in international markets.

By combining economic modeling with governance analysis, this study aims to generate insights at two levels: first, identifying measurable factors influencing Indonesian cinnamon exports, and second, unpacking how these outcomes are shaped by the institutionalization of global standards and power relations. This design enables a more comprehensive understanding of how trade barriers are operationalized, resisted, and negotiated, ultimately shaping Indonesia's ability to capture value in the global cinnamon industry's value chain.

2.2 Data sources

This study utilized data from secondary sources, specifically existing repositories and publications. The dataset covers a fifteen-year period from 2010 to 2024, comprising yearly time-series data that offers a longitudinal view of the variables under examination. This extensive dataset allows for a comprehensive analysis of trends and patterns over time, contributing to a robust understanding of the factors influencing export volumes. Table 1 presents a detailed summary of the data types collected for this study, providing a thorough reference for the scope and diversity of the information used in the research. This table serves as a key resource, outlining the specific variables and their temporal coverage, thereby supporting the analysis and enhancing the reliability of the study.

To strengthen its analytical framework, this study integrates an extensive range of literature derived from books and scholarly publications over the past 14 years. This broad literature collection underpins the theoretical foundation and empirical findings, establishing a robust platform for exploring critical research questions.

TABLE 1 Data types, sources, and units.

No	Data type	Data source
1.	Indonesia's cinnamon export volume	UN Comtrade
2.	Indonesia's Cinnamon export price	UN Comtrade
3.	Economic distance	Google Maps
4.	Real GDP per capita of the export destination country	World Bank
5.	The real exchange rate of the export destination country	UN Comtrade
6.	Destination country population	World Bank
7.	NTM Indonesia Policy	WTO I-TIP

Moreover, this study incorporates cross-sectional data from nine principal countries that import Indonesian cinnamon: the United States, India, the Netherlands, Germany, Brazil, Canada, Thailand, Japan, and Australia. These countries represent key nodes in Indonesia's cinnamon export network, providing a diverse and comprehensive perspective on the global trade dynamics of this commodity. By merging insights from the literature with detailed cross-sectional data analysis, this study aims to deliver in-depth knowledge of the competitive dynamics and impact of non-tariff measures in Indonesia's cinnamon export industry. This approach not only improves the understanding of export performance but also offers valuable insights into how various factors shape the trade environment for Indonesian cinnamon.

2.3 Data analysis

This study employs a quantitative analytical framework to assess the competitiveness of Indonesian cinnamon exports, with particular attention to the influence of non-tariff measures and other key determinants. Three complementary trade competitiveness indicators, such as RCA, EPD and the X-Model—are used to capture both structural and destination-specific export performance. To further investigate the role of non-tariff measures in shaping market access, this study incorporates panel data regression analysis. The empirical process involved several sequential steps, beginning with the compilation and organization of export data by destination country and year. Data processing and statistical analyses were conducted using Microsoft Excel 2019 and EViews 12, which ensured analytical rigor, accuracy, and reproducibility throughout the study.

The RCA was calculated using the conventional Balassa index, which measures a country's export performance by comparing its share of exports of a particular product to its share of total world exports (Arun Kumar and Dhar, 2023; Balassa, 1965; Laursen, 2015). This product-level indicator is widely used because it captures structural competitiveness across global markets and is relatively stable compared to bilateral or destination-specific measures. Although the RCA can be adapted to examine competitiveness in individual export markets, aggregate RCA indices remain preferred in empirical trade studies, as they minimize volatility from country-specific shocks and facilitate consistent cross-market comparisons (Beno, 2018; Yu et al., 2009). Following this established approach, the RCA in this study measures

Indonesia's cinnamon export share relative to its total exports and benchmarks it against global cinnamon trade patterns, enabling a systematic comparison across all importing countries included in the analysis.

NTMs, particularly SPS regulations and TTBT, are incorporated into the analysis to capture their role in shaping Indonesia's market access requirements. SPS measures relevant to cinnamon typically include microbiological limits to prevent contamination, such as Salmonella, maximum residue limits (MRLs) for pesticides, and requirements for fumigation or phytosanitary certification to ensure that products are free from mold and harmful pathogens (Gourdon et al., 2020; Riptanti et al., 2018). TBT measures, by contrast, TBT measures involve regulatory requirements that condition market entry through quality-related and administrative standards, such as mandatory labeling (origin, allergen information), moisture and grading specifications, packaging rules, and traceability documentation (Prasada and Dhamira, 2022; Webb et al., 2019). Collectively, SPS and TBT measures impose compliance obligations that require exporters to upgrade their testing capacity, strengthen their documentation systems, and align their supply chain practices with importing country regulations. These obligations can be particularly challenging for Indonesia's cinnamon sector, which is dominated by smallholders and characterized by fragmented production structures and limited downstream processing capabilities (Elisabeth and Falatehan, 2022).

2.3.1 Revealed comparative advantage (RCA)

RCA is employed in this study to assess whether Indonesian cinnamon exports exhibit a competitive advantage in each destination market. The RCA measures a country's export specialization relative to global trade patterns and is widely used to benchmark competitiveness using secondary trade data (Laursen, 2015). Applied to cinnamon, the RCA helps determine Indonesia's relative position among major exporting countries and identifies markets where its competitive strength is most evident (Thomas and Sanil, 2019). If other external factors remain constant, the RCA provides an indication of how closely Indonesia's export performance aligns with its underlying comparative advantages. This measurement supports the first research objective by enabling cross-country comparisons of competitiveness among key cinnamon importing destinations.

$$RCA = \left(\frac{X_{ij} / X_t}{W_{ij} / W_t} \right)$$

Where is:

X_{ij} : Indonesian cinnamon export value to export destination countries,

X_t : Total export value of Indonesian commodities to export destination countries,

W_{ij} : World export value of cinnamon in export destination countries,

W_t : Total export value of world commodities to the export destination countries.

RCA values greater than 1 indicate that Indonesia has a comparative advantage in a given market, whereas values below 1 indicate a disadvantage. This metric establishes a baseline for understanding Indonesia's competitive position before accounting for external regulatory influences such as SPS and TBT measures.

Identifying where Indonesia already demonstrates export strength is essential for determining how its competitive posture can be enhanced or repositioned to respond to evolving market demands.

In this context, the strategic recommendation to shift from a “volume-based” to a “value-based” export approach becomes particularly relevant. While Indonesia may exhibit a comparative advantage in several markets, its continued reliance on bulk, low-priced cassia limits its ability to generate higher returns. A value-based strategy involves upgrading product quality through improved post-harvest handling, stricter moisture and contamination control, enhanced traceability, and greater compliance with SPS and TBT standards, which shape access to premium markets in the EU. Achieving this requires stronger testing capacity, certification systems, and coordination among smallholders to ensure consistent quality. By prioritizing value creation rather than sheer export volume, Indonesia can deepen its presence in high-value segments, reduce its vulnerability to price volatility, and reinforce its long-term competitiveness in a global environment that is increasingly governed by stringent regulatory and quality standards.

2.3.2 Export product dynamic (EPD)

The EPD study approach offers valuable insights into the competitive position of a commodity or product in a particular market. EPD analysis is a method used to assess the competitive advantage of goods that come from a specific country (Abidin et al., 2021). Furthermore, the EPD serves as a metric for assessing the dynamic aspect of a commodity's performance by measuring its increased trajectory. Despite common misconceptions, commodities or goods with relatively low export values might still demonstrate competitiveness (Manalu et al., 2019; Pratita and Budiarto, 2021). The EPD matrix consists of two essential elements: market attractiveness and business strength. We evaluate market attractiveness by analyzing the rate of demand growth for a product in a specific market. However, we determine business strength by examining the growth of a country's market share in the same industry. The classification product's position has four distinct categories: “Rising Star,” “Falling Star,” “Lost Opportunity,” and “Retreat,” based on the combination of these elements (Estherhuizen, 2006). Table 2 provides a clear framework for the EPD technique, known as the competitive position matrix. This matrix allows for a thorough analysis and interpretation of a product's competitive dynamics in a specific market setting.

In world trade, mathematically calculating a country's export share and product market share reveals crucial insights into its economic standing and global competitiveness as follows:

Axis X: Growth in export market share i :

$$\frac{\sum_{t=1}^t \left(\frac{X_t}{W_t} \right) \times 100\% - \sum_{t=1}^t \left(\frac{X_t}{W_t} \right)_{t-1} \times 100\%}{T}$$

TABLE 2 Competitive position matrix in the EPD method.

Share of country's exports in world trade	Share of products in world trade	
	Rising (dynamic)	Falling (stagnant)
Rising (competitive)	Rising Star	Falling Star
Falling (non-competitive)	Lost Opportunity	Retreat

Y-axis: Product market share growth

$$\frac{\sum_{t=1}^t \left(\frac{X_t}{W_t} \right) \times 100\% - \sum_{t=1}^t \left(\frac{X_t}{W_t} \right)_{t-1} \times 100\%}{T}$$

Where:

X_{ij} : The export value of Indonesian cinnamon to the export destination countries.

X_t : Total export value of Indonesian commodities to export destination countries.

W_{ij} : World cinnamon export value in export destination countries.

W_t : The total export value of world commodities to export destination countries.

T : Number of years of analysis.

To improve the precision of assessing a particular product's competitive standing against a country in a specified target market, we can transform Table 2 into Figure 1. This visual representation consists of four separate quadrants that symbolize various competitive positions. We illustrate the combination of market attractiveness and business strength for the analyzed products in each quadrant, calculated using the EPD formula described earlier.

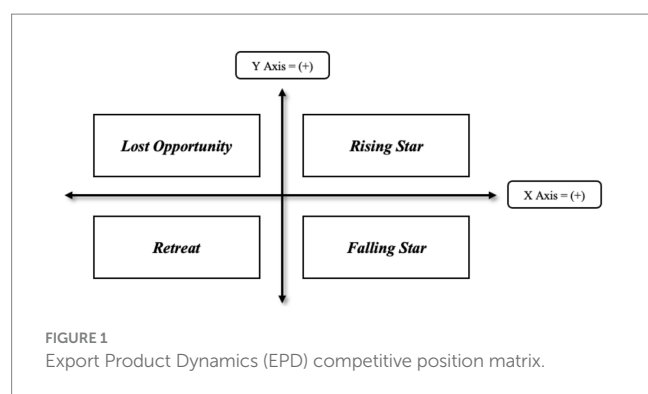
Information:

- The X-axis depicts the increase in business strength or share of the country's exports in a particular destination market
- The Y-axis depicts the increase in market attractiveness or export share of the product in a particular destination market

Market positioning research suggests that the most favorable condition is when both the X- and Y-axis are positive, placing a country in the Rising Star or “bright star” quadrant, which reflects a growing market share in fast-expanding product categories. Conversely, the Lost Opportunity quadrant (negative X-axis and positive Y-axis) is the least desirable, indicating a decline in market share within dynamic product groups. While not ideal, the Falling Star quadrant, with a positive X-axis and negative Y-axis, is still preferable to the Lost Opportunity quadrant, as it shows overall market share growth despite some setbacks. The Retreat quadrant, with negative values on both axes, is generally unfavourable, except in rare instances where transitioning from static to dynamic products proves beneficial (Yulisti et al., 2021).

2.3.3 X-model potential export product

The X-model potential export product is a strong framework that combines the results of the RCA and Export Product Domestic (EPD) methods. This makes the competitiveness analysis of Indonesian cinnamon goods more in-depth and comprehensive. By concurrently evaluating the perspectives of RCA and EPD, this model delivers a holistic view of market dynamics, offering valuable insights into the potential of various export products (Mubarakah, 2020). This combined approach allows for a nuanced understanding of export opportunities, facilitating the implementation of targeted regional strategies for product development. The primary objective is to strategically categorise products based on their trade market potential, enabling efficient resource allocation and fostering sustainable growth within the cinnamon sector (Nurhayati et al., 2019).



The framework of global trade, shaped by tariff boundaries set forth by WTO member nations, has led to a notable rise in NTMs aimed at safeguarding domestic industries and consumers from substandard goods. In agriculture, particularly in commodities such as cinnamon, the most prevalent NTMs include SPS measures and TBT measures. Countries heavily reliant on cinnamon exports, including Indonesia, face substantial obstacles owing to the pervasive application of NTMs. Addressing these challenges effectively requires vigilant governmental oversight, with a primary emphasis on managing SPS and TBT measures that directly impact product quality and safety standards. These regulatory aspects wield a significant influence over the dynamics of international trade, underscoring their critical role in global commerce (see Table 3).

In this study, the SPS and TBT variables are expressed as *coverage ratios*, which indicate the proportion of tariff lines or product categories within the cinnamon HS code that are subject to each type of non-tariff measure in each importing country. These ratios range from 0 to 1, where values closer to 1 reflect a broader application of SPS or TBT measures across product categories. Therefore, they do not represent binary indicators but instead capture the *intensity* or *extent* of the regulatory requirements imposed on cinnamon imports. Using coverage ratios provides a more nuanced measure of the regulatory environment than a simple 0–1 dummy variable, as it reflects differences in the regulatory scope across countries and over time. This approach aligns with the established practices in NTM analysis and strengthens the empirical interpretation of the regression results.

In this study, shifting from a “volume-based” to a “value-based” export strategy refers to moving Indonesia’s cinnamon sector away from reliance on bulk, low-priced cassia toward higher-quality, differentiated, and certified products with premium market appeal. A value-based approach prioritizes improved post-harvest handling, moisture and contamination control, traceability, and compliance with SPS and TBT standards, which directly influences access to high-income markets. It also requires stronger domestic testing capacity, certification systems, and coordination among smallholders to ensure consistent product quality. Pursuing value creation rather than volume maximization would enable Indonesia to participate in premium segments, reduce exposure to price volatility, and strengthen long-term competitiveness in an increasingly standards-driven global trading environment.

2.3.4 Panel data regression analysis

To explain the strategic implications of Indonesia’s changing trade conditions, this study focuses on two key ideas: agility and data-driven

TABLE 3 Analysis clustering X-model potential export product.

RCA	EPD	X-Model
>1	Rising Star	Optimistic Market Development
	Lost Opportunity	Potential Market Development
	Falling Star	Potential Market Development
	Retreat	Less Potential Market Development
<1	Rising Star	Optimistic Market Development
	Lost Opportunity	Potential Market Development
	Falling Star	Potential Market Development
	Retreat	Less Potential Market Development

strategies. Being agile means that Indonesia can quickly respond to shifts in global demand, stricter SPS and TBT requirements, and stronger competition—especially from China in bulk cassia and Sri Lanka in premium cinnamon. Agility involves regularly monitoring market trends, anticipating regulatory changes, and shifting exports toward better opportunities when needed. Data-driven strategies refer to the use of trade statistics, inspection results, and NTM monitoring tools to support export decisions. When combined, these flexible and evidence-based approaches help Indonesia compete more effectively in a market environment that is increasingly shaped by standards, as shown in the EPD results.

To empirically assess these dynamics, this study employs a panel data regression approach to analyze how NTMs—specifically sanitary and phytosanitary (SPS) measures and TBT—shape Indonesia’s cinnamon export volumes across destination markets. Panel regression is well-suited for this investigation because it integrates both cross-sectional (across countries) and time-series (across years) variations, allowing for a richer understanding of the structural and temporal factors influencing trade performance. The dependent variable in this model is Indonesia’s cinnamon export volume, while the independent variables include the importing country’s real GDP, economic distance, the real exchange rate between Indonesia and its trading partners, and the presence of SPS and TBT regulations in each destination market.

By incorporating these variables simultaneously, the model captures the direct effects of NTMs and the broader economic context that shapes trade outcomes. This structure allows researchers to disentangle the relative importance of market size, exchange rate movements, distance-related trade frictions, and regulatory constraints, thereby providing a comprehensive assessment of the determinants of Indonesia’s cinnamon export. The choice of panel data regression strengthens the analytical framework by enabling control for unobserved heterogeneity across countries and over time, offering more precise and policy-relevant insights into how NTMs influence export performance.

The panel regression model can be calculated using the following formula:

$$\ln VEX_{ijt} = \beta_0 + \beta_1 \ln PDB_{jt} + \beta_2 \ln HE_{ijt} + \beta_3 \ln NTR_{ijt} + \beta_4 \ln JE_{ijt} + \beta_5 \ln POP_{ijt} + \beta_6 CS_{ijt} + \beta_7 CTBT_{ijt} + \varepsilon_{ijt}$$

Information:

VEX_{ijt} : Volume of Indonesian cinnamon exports to export destination country j on year t (tons),

PDB_{jt} : Real GDP of export destination country j in year t (Million US\$),

HE_{ijt} : Export price of Indonesian cinnamon to destination country j (US\$/ton),

NTR_{ijt} : Indonesia's real exchange rate against the currency of the export destination country j in year t (Rp/LCU),

JE_{ijt} : Economic distance between Indonesia and the destination country (US\$/Km),

POP_{jt} : Population of export destination country j in year t (people),

$CSPS_{ijt}$: Coverage ratio SPS of export destination country j for cinnamon Indonesia in year t ,

$CTBT_{ijt}$: Coverage ratio TBT export destination country j for cinnamon Indonesia in year t ,

i : Country exporter (Indonesia),

j : Country main export destinations (United States, India, Netherlands, Brazil, Germany, Canada, Thailand, Japan and Australia),

t : Year.

This study deliberately selected panel data because of its significant relevance to the research objectives and its ability to provide precise insights into the impact of NTMsSP on Indonesian cinnamon export dynamics. Panel data analysis provides a robust framework for investigating the complex interplay of various factors affecting export performance across countries and over time. Using panel data, this study effectively accounts for unique country-specific variables and temporal fluctuations, enhancing the quality and reliability of its conclusions. This approach allows for a detailed exploration of the nuanced effects of NTM policies on cinnamon exports, facilitating a deeper understanding of the core mechanisms that drive trade patterns and policy outcomes.

3 Results

3.1 Competitiveness of Indonesian cinnamon in export destination countries

Indonesia's competitiveness in the global cinnamon market varies considerably across destination countries, with some markets consistently exhibiting strong demand for Indonesian products, while others reveal weaker or less stable competitive positions. These differences provide valuable insights into the structure of Indonesia's export performance, illustrating where the country maintains a clear advantage and where it faces greater competition. By comparing competitiveness across markets, the analysis helps identify which destinations serve as core drivers of Indonesia's cinnamon exports and which ones may constrain overall performance because of limited or fluctuating demand. This understanding is essential for guiding market prioritization and developing strategies to strengthen Indonesia's position in international trade.

Table 4 presents a summary of Indonesia's RCA for cinnamon across major export destinations over the 2010–2024 period. The table provides an overview of how Indonesia's competitiveness varies from market to market, highlighting the countries that consistently demonstrate strong import demand and where Indonesia's export position remains weak or unstable. This comparison offers important insights into the structure of Indonesia's export competitiveness and identifies key markets that drive or constrain the country's performance in the global cinnamon trade.

3.2 Dynamics of Indonesian cinnamon export in export destination countries

The EPD analysis provides an overview of how Indonesia's cinnamon export performance has shifted across destination markets over time. By examining changes in both export market share and product market share, the table identifies whether Indonesia is gaining or losing competitiveness in each market segment. This diagnostic perspective helps distinguish markets with expanding opportunities from those where competitive pressures or weakening demand are limiting Indonesia's export growth. As such, the EPD results offer a valuable basis for understanding the strategic position of Indonesian cinnamon in global trade and for guiding market-specific export strategies.

Table 5 illustrates the dynamic position of Indonesian cinnamon in major export destinations using the EPD framework. The results reveal that Indonesia occupies a Rising Star position in the United States, indicating simultaneous growth in both export market share and product market share—an indication of strong competitiveness and expanding demand. In contrast, Brazil and the Netherlands fall into the Falling Star category, where export market share grows but product share declines, suggesting weakening competitiveness despite market expansion. India and Canada are classified as Lost Opportunity, reflecting positive product growth but declining export market share, which signals that Indonesia has not fully capitalized on expanding demand in these markets. Most other destinations—including Germany, Thailand, Japan, and Australia—are positioned in Retreat, where both export and product market shares contract, highlighting structural challenges and declining competitiveness. Overall, these findings suggest that Indonesia's strongest growth potential lies in the U.S. market, while several traditional markets require strategic interventions to reverse declining performance.

3.3 Export potential of Indonesian cinnamon in export destination countries

The combined RCA and EPD results presented through the X-Model reveal clear differences in the competitiveness and market potential of Indonesian cinnamon across export destinations. The United States stands out as the most promising market, demonstrating both strong competitive performance and favorable conditions for future growth. Other markets, such as Brazil, the Netherlands, India, and Canada, also show potential, although their competitiveness indicators are more mixed. In contrast, Germany, Thailand, Australia, and, particularly, Japan display limited or declining potential, reflecting structural constraints that hinder market expansion. Overall, the results indicate that Indonesia's future export growth will depend on strengthening its position in high-potential markets while adopting more targeted strategies in destinations where responsiveness is weak.

Table 6 integrates the RCA and EPD indicators through the X-Model framework to assess both the competitiveness and market development potential of Indonesian cinnamon across destination countries. The findings show that the United States remains the most promising market, classified as a Rising Star with Optimistic Development Potential, indicating strong competitiveness and expanding market opportunities. Several other markets—including Brazil, the Netherlands, India, and Canada—are categorized as having potential despite being positioned as Falling Stars or Lost Opportunities in the EPD analysis. These markets may still offer

TABLE 4 Revealed comparative advantage of Indonesia's cinnamon exports by destination market (2010–2024).

Country	RCA pattern (2010–2024)	Overall trend	Interpretation
Brazil	Extremely high RCA values, with peaks above 3,000 and large fluctuations across years.	Highly volatile but consistently strong comparative advantage.	Brazil is a dominant market for Indonesian cinnamon, although export performance is unstable.
Germany	RCA consistently high, mostly between 170 and 550, with moderate fluctuations.	Stable and strong comparative advantage.	Germany represents a reliable, sustained market with consistent competitiveness.
India	RCA values low (mostly below 20), with occasional increases but generally weak.	Persistent weak comparative advantage.	Indonesia faces stronger competition or lower demand relative to competitors in India.
Netherlands	Moderate RCA values (50–167), showing periodic strengthening and weakening.	Moderate comparative advantage with fluctuations.	The Dutch market offers opportunities but with less consistent competitiveness.
United States	RCA mostly low to moderate, with isolated increases; values generally below 100.	Weak to moderate comparative advantage.	The U.S. market is competitive, requiring stronger differentiation or compliance efforts.
Canada	RCA varies widely (17–348), showing strong peaks but also very low years.	Highly volatile comparative advantage.	Export competitiveness is inconsistent, suggesting sensitivity to market or supply factors.
Thailand	RCA moderate but decreasing over time, mostly between 17 and 47.	Gradual weakening of comparative advantage.	Indonesia's position is declining, possibly due to increasing competition or changing demand.
Japan	RCA extremely low (mostly near zero) with almost no improvement.	No significant comparative advantage.	Japan is a marginal market for Indonesian cinnamon with very weak competitiveness.
Australia	Low to moderate RCA (0–21), with occasional increases but generally weak.	Consistently weak comparative advantage.	Australia presents limited competitive strength for Indonesian cinnamon exports.

growth opportunities if strategic improvements in their competitiveness are pursued. In contrast, Germany, Thailand, Australia, and especially Japan, fall under less potential or no potential, reflecting weak or declining competitiveness combined with limited prospects for market expansion. Overall, the results highlight a concentration of high-potential opportunities in a few key markets, while others require targeted strategies to overcome structural constraints or a decline in performance.

3.4 Scope of NTM application on Indonesian Cinnamon Commodities to export destination countries

The results of the analysis show that differences in economic conditions, market characteristics, and regulatory requirements across destination countries play an important role in shaping Indonesia's cinnamon-export performance. Income levels in importing markets and export pricing emerge as key drivers influencing demand, while the presence of sanitary and phytosanitary measures contributes to variations in export flows. In contrast, factors such as exchange rate movements, population size, distance, and technical trade barriers do not appear to exert a meaningful influence in this context. Overall, the findings highlight that market demand conditions and regulatory compliance are more decisive determinants of export outcomes than broader macroeconomic and geographical factors.

Table 7 highlights the clear differences in SPS and TBT environments across Indonesia's key cinnamon export destinations. Mature markets, such as the United States, Canada, and Thailand, consistently enforce SPS and TBT measures, reflecting stable and stringent regulatory regimes. Brazil and India show a progressive tightening of requirements, with SPS and TBT measures introduced only in the latter part of the period, indicating a shift toward more regulated import standards. Germany and the Netherlands apply

minimal SPS measures, although the Netherlands maintains consistent TBT requirements. Japan enforced SPS and TBT standards in most years, with only a brief relaxation in 2018. Australia demonstrated the most gradual shift, adopting TBT measures in 2019 and SPS measures in 2022. Overall, the table illustrates that Indonesian cinnamon exporters face diverse regulatory conditions, with stricter and more predictable standards in advanced economies, while emerging markets exhibit a more incremental approach to regulatory enforcement.

3.5 The influence of cinnamon export prices on export volume of Indonesian cinnamon

The regression results highlight several important factors influencing Indonesian cinnamon exports. While destination countries' economic growth and population size are associated with lower demand, export prices, regulatory engagement, exchange rates, and technical trade measures contribute positively to export performance. The findings also show that sanitary and phytosanitary measures hinder exports, whereas meeting technical standards can support market acceptance. Overall, the results underscore the complexity of global trade dynamics and the importance of aligning export strategies with market conditions to enhance the competitiveness of Indonesian cinnamon.

Table 8 reports the estimated coefficients from the random effects model (REM) explaining Indonesia's cinnamon export volume. Importing country income (Ln_PDB_{ijt}) has a positive and statistically significant effect, indicating that economic growth in destination markets supports higher export volume. In contrast, Indonesia's export price (Ln_HE_{ijt}) is negative and significant, confirming that demand for Indonesian cassia remains price-sensitive within its current low- to mid-value market segment. Trade openness (Ln_NTRI_{ijt}), exchange rates (Ln_JE_{ijt}), and population size (Ln_POP_{ijt}) are statistically insignificant, suggesting that

TABLE 5 EPD estimation results for Indonesian cinnamon in destination countries for the 2010–2024 period.

Export destination country	EPD value		EPD position
	Export market share growth (%)	Product market share growth (%)	
Brazil	0.382	−0.012	Falling Star
German	−6.934	−0.008	Retreat
India	−1.941	0.006	Lost Opportunity
Dutch	0.475	−0.006	Falling Star
America	1.281	0.005	Rising Star
Canada	−1.664	0.006	Lost Opportunity
Thailand	−2.833	−0.004	Retreat
Japan	−0.049	−0.066	Retreat
Australia	−0.802	−0.031	Retreat

UN Comtrade, 2025 (processed).

conventional macroeconomic and scale variables play a limited role once regulatory and structural factors are considered. The SPS coverage ratio ($CSPSijt$) shows a negative, trade-restricting effect, while the TBT coverage ratio ($CTBTijt$) is positive but weak, indicating its limited enabling role at current compliance levels.

The R -squared value of 0.2004 indicates that approximately 20.04% of the variation in Indonesia's cinnamon export volume is explained by the model, while the remaining 79.96% is influenced by external factors such as global political conditions, non-tariff barriers, demand fluctuations and domestic policies. Although modest, this R^2 is typical in international trade research and suggests that export performance is shaped by complex and often unobservable forces. The overall statistical significance of the model confirms that the selected variables provide meaningful explanatory insights into Indonesia's cinnamon export performance.

To verify the stability of the regression results, a pairwise correlation analysis was conducted for all explanatory variables. The correlation matrix shows that the simple bivariate relationships for GDP per capita, population, exchange rates, and export prices generally align with the directions observed in the regression estimates. Differences in coefficient signs emerge once the model simultaneously controls for diverse structural and regulatory characteristics across importing countries, which is common in trade models involving heterogeneous markets and overlapping policy measures (Gourdon et al., 2020; Webb et al., 2019). This diagnostic check confirmed that the multivariate regression results reflected conditional effects rather than inconsistencies in the underlying data.

Interpreting the coefficient magnitudes further clarifies their economic meaning: tighter SPS standards significantly suppress export volumes, while stronger TBT compliance supports trade once standards are met; rising incomes favor premium cinnamon over cassia; and large populations alone do not guarantee higher demand. Together, these results confirm that Indonesia's cinnamon export performance is shaped by the interaction of market attributes, regulatory environments, and price dynamics rather than by production capacity or global price trends alone.

TABLE 6 X-model estimation results for Indonesian cinnamon in destination countries for the 2010–2024 period.

Export destination country	RCA average	EPD position	Market development potential
Brazil	560.3	Falling Star	Potential
German	233.2	Retreat	Less Potential
India	7.4	Lost Opportunity	Potential
Dutch	94.9	Falling Star	Potential
America	38.1	Rising Star	Optimist
Canada	110.3	Lost Opportunity	Potential
Thailand	31.5	Retreat	Less Potential
Japan	0.3	Retreat	Not Potential
Australia	6.9	Retreat	Less Potential

UN Comtrade, 2025 (processed). Optimist: Positive expectations about growth, success, or improvement.

4 Discussion

4.1 Structural economic conditions and their influence on export outcomes

The findings of this study show that the structural economic conditions in importing countries play a decisive role in shaping Indonesia's cinnamon export performance. While conventional trade theory assumes that rising income and expanding markets increase commodity demand, the results of this study reveal a more nuanced relationship. The negative effects of GDP per capita and population size on Indonesia's export volume indicate that economic expansion does not automatically translate into higher demand for Indonesian Cassia. Instead, these indicators reflect broader structural shifts in consumer preferences, market segmentation, and quality differentiation, patterns increasingly observed in recent spice and high-value agricultural trade literature (Beghin et al., 2015; Crivelli and Groeschl, 2016). As high-income countries upgrade their food safety regimes and shift toward premium varieties such as Ceylon cinnamon, Indonesia's role as a bulk cassia supplier becomes progressively less aligned with the preferences of wealthier consumers.

This pattern contrasts with earlier studies that reported positive GDP effects on cinnamon demand in the United States (Elisabeth and Falatehan, 2022) and positive population effects on agricultural export volumes in broader commodity contexts (Rochdiani and Wulandari, 2023). In contrast, the present study shows that even large and affluent markets do not necessarily generate income-elastic demand for cassia. Instead, demand is shaped by structural repositioning toward higher-value substitutes and increasingly stringent regulatory environments that impose greater compliance. This confirms a central argument in the standards literature: market access is no longer determined by economic size alone but by the interaction between wealth, consumption norms, and evolving governance architectures of food quality and safety (Botterill and Daugbjerg, 2015; Macdonald et al., 2024). Export prices also significantly influence Indonesia's cinnamon export outcomes. The positive relationship between price and export

TABLE 7 Summary of SPS and TBT coverage ratios for Indonesia's cinnamon export destinations, 2010–2024.

Country	SPS implementation pattern (2010–2024)	TBT implementation pattern (2010–2024)	Interpretation summary
Brazil	Introduced SPS in 2016; fully applied thereafter (2016–2024: 1)	Fully applied throughout entire period (2010–2024: 1)	Brazil consistently applies TBT; SPS became binding after 2016.
Germany	No SPS measures observed (all years: 0)	No TBT measures observed (all years: 0)	Germany imposes neither SPS nor TBT for cinnamon imports.
India	SPS introduced in 2020 and applied continuously thereafter (2020–2024: 1)	TBT applied from 2017 onward (2017–2024: 1)	India tightened SPS and TBT regulations in the later years.
Netherlands	No SPS measures observed (all years: 0)	TBT fully applied (all years: 1)	Dutch market applies TBT but not SPS requirements.
United States	SPS fully applied (all years: 1)	TBT fully applied (all years: 1)	The U.S. maintains the strictest regulatory regime across all years.
Canada	SPS fully applied (all years: 1)	TBT fully applied (all years: 1)	Similar to the U.S., Canada consistently applies full regulatory measures.
Thailand	SPS fully applied (all years: 1)	TBT fully applied (all years: 1)	Thailand consistently implements both measures.
Japan	SPS fully applied except 2018 (one-year gap)	TBT fully applied except 2018	Regulatory relaxation occurred only in 2018; otherwise consistently applied.
Australia	SPS implemented beginning in 2022 (2022–2024: 1)	TBT implemented from 2019 onward (2019–2024: 1)	Australia gradually tightened its regulatory measures over time.

SPS = 1, SPS regulation exists, or = 0, No SPS regulation.

TBT = 1, Active technical barriers, or = 0, No active technical barriers.

TABLE 8 Estimated coefficients of factors influencing Indonesia's cinnamon export volume.

Variables	Coefficient	Prob.
Constant	24.3955	0.0614
Ln_PDBjt (PDB-gross domestic products)	0.0008	0.0003
Ln_HEijt (Export price)	−0.3999	0.0107
Ln_NTRijt (IDR exchange rate)	−3.92E−10	0.7779
Ln_JEijt (Distance to destination country)	−2.16E−09	0.9708
Ln_POPijt (Population destination country)	−0.7123	0.1514
$CSPSijt$ (Coverage ratio SPS of export destination)	−0.0875	0.0665
$CTBTijt$ (Coverage ratio TBT export destination country)	0.0448	0.3849
Weighted statistics		
R-squared		0.2004
Adjusted R-squared		0.0996
Prob. (F-statistic)		1.9884
F-statistic		0.0214

volume diverges from conventional price–demand expectations but is consistent with the behavior of bulk commodity buyers in global spice value chains. Similar patterns are observed in India's spice export sector, where cassia is treated as a low-cost input with a relatively inelastic demand, particularly among industrial processors and re-exporting hubs (Thomas and Sanil, 2019). This suggests that Indonesian cassia occupies a stable market segment in which price increases do not immediately suppress demand because buyers prioritize volume availability and supply reliability over marginal price

fluctuations. This positioning differs sharply from premium Ceylon cinnamon, where demand is highly quality-elastic and closely tied to certification and grading (Hewavitharana et al., 2022).

Exchange rate movements, population size, and distance do not significantly affect Indonesian cinnamon exports, reinforcing the argument that institutional conditions matter more than traditional macroeconomic factors in regulated value chains. Similar findings have been reported in studies of coffee, nutmeg, and rubber exports in Southeast Asia, where macroeconomic determinants lose their explanatory power once NTMs and supply chain quality issues are considered (Abidin et al., 2021; Ahmad et al., 2020). This indicates that Indonesian cassia competes in markets where logistical distance and exchange rate fluctuations are overshadowed by regulatory alignment, supply consistency, and quality conformity.

4.2 Wealth, consumer behavior, and the repositioning of Indonesian cinnamon

The negative association between importing countries' GDP per capita and Indonesia's cinnamon export volume indicates that rising income is linked to a gradual shift away from bulk cassia toward more differentiated and higher-value products and substitutes. Rather than signalling a decline in cinnamon consumption, this pattern reflects how wealthier consumers in high-income markets increasingly prioritise quality, provenance, and perceived health attributes in their spice purchases. Similar trends are documented in the broader spice and high-value crop literature, where income growth is accompanied by a move from generic bulk products to certified, origin-linked, or “premium” varieties (Hewavitharana et al., 2022; Thomas and Sanil, 2019). In the cinnamon sector, Sri Lanka has capitalized on changing preferences by positioning Ceylon cinnamon as a premium “true

cinnamon” with superior sensory and health attributes, enabling it to capture a disproportionate share of value relative to volume (Hewavitharana et al., 2022; Piyasiri and Wijeratne, 2016). Against this backdrop, Indonesia’s continued specialization in bulk cassia increasingly confines it to the lower-value segment of an income-segmented, global market.

These findings refine existing studies on Indonesian cinnamon exports, which have mainly emphasized supply-side and macroeconomic factors without explicitly linking them to shifts in consumer behavior. Earlier studies underscore the role of production constraints, exchange rates, and demand trends in shaping exports (Iskandar et al., 2012; Rochdiani and Wulandari, 2023; Supriana et al., 2022), while export-demand research highlights the influence of relative prices and global market conditions (Tanjung et al., 2024). However, these studies usually treat destination markets as homogeneous and do not systematically explore how rising incomes and evolving quality norms reconfigure the competition between cassia and Ceylon cinnamon. In contrast, this study shows that as GDP per capita increases, consumer upgrading away from bulk cassia becomes visible in the trade data, indicating that Indonesia’s competitiveness is increasingly constrained by product positioning rather than by production volume alone.

The interaction between wealth and consumer behavior is further mediated by food safety and quality standards. As consumers in higher-income markets become more attentive to health risks, contamination, and residues, they increasingly reward products that signal compliance through certification, labelling, and traceability (Fontagné et al., 2015; Umali-Deininger and Sur, 2007). This shift reinforces the structural power of public and private standards in shaping demand, particularly for spices used in processed foods and nutraceutical product (Beghin et al., 2015; Jaffee, 2012). The regression results in this study are consistent with the literature: while sanitary and phytosanitary (SPS) measures suppress trade, technical barriers to trade (TBT) become trade-enabling once exporters can credibly signal compliance. In wealthier markets, consumer preferences increasingly favor suppliers that meet strict quality, labelling, and traceability requirements, under which Indonesia’s fragmented, smallholder-based cassia supply chain is structurally disadvantaged (Elisabeth and Falatehan, 2022).

Relative to the latest empirical work on Indonesian cinnamon competitiveness, this study advances the debate in two key ways. First, it shows that the demand-side effects of wealth are conditional on product positioning: rising incomes in destination markets systematically benefit suppliers of premium, standard-intensive cinnamon more than bulk cassia, reinforcing Sri Lanka’s dominance in value capture while constraining Indonesia’s upgrading prospects (Hewavitharana et al., 2022; Sa’diyah and Darwanto, 2020). Second, by integrating political economy perspectives on standards with consumer behavior, the analysis demonstrates that Indonesian cassia is being “repositioned by default” as a lower-tier product suited to price-sensitive or less regulated segments unless deliberate strategies are adopted to move into higher-value, standards-intensive markets. This positions the present study at the intersection of trade competitiveness, standards-based governance, and consumer upgrading, extending earlier work that largely treated standards as exogenous constraints rather than as mechanisms through which wealth and consumer behavior actively reshape the global cinnamon demand.

4.3 Currency movements and the limits of Price-based competitiveness

The regression results show that exchange rate movements (IDR against partner country currencies) do not have a statistically significant effect on Indonesia’s cinnamon export volume. This contrasts with a large body of trade literature that identifies currency depreciation as a key driver of export performance, particularly for aggregate exports and the manufacturing sector (Ahmad et al., 2020; Taningco, 2012). In several agricultural export studies, including rice in Tanzania and Indonesian seaweed and rubber, real exchange rate changes affect export volumes by altering relative prices and profitability (Luhwago et al., 2023; Prasada and Dhamira, 2022). The absence of a similar effect here suggests that, for a highly specific and standards-sensitive commodity such as cinnamon, exchange rate-based price competitiveness is insufficient to overcome structural and institutional constraints in destination markets.

This result reflects the organization of Indonesia’s cinnamon trade through long-term buyer–seller relationships and contract arrangements that limit the short-run pass-through of exchange rate fluctuations. Large industrial buyers typically negotiate contracts in major currencies, such as the US dollar, with prices adjusted infrequently, and with quality, reliability, and regulatory compliance taking precedence over short-term price movements (Beghin et al., 2015). Under these conditions, currency depreciation may improve exporters’ local currency margins but does not automatically raise export volumes when access is constrained by SPS requirements, TBT regulations, and reputational risks (Crivelli and Groeschl, 2016; Gourdon et al., 2020). This aligns with broader evidence that non-tariff measures increasingly dominate agricultural trade outcomes and can offset price-based advantages (Munadi and Saputri, 2019; Murina and Nicita, 2017; Nasution and Hurulaini, 2023).

The negative and significant coefficient on export prices confirms that the demand for Indonesian cassia remains price-sensitive within its low- to mid-value market segment. However, this does not imply that devaluation or price reductions offer a sustainable competitive strategy. In markets where SPS and TBT measures are stringent, regulatory compliance and perceived quality function as entry conditions, and prices influence traded volumes only after these requirements are fulfilled (Fontagné et al., 2015; Ha et al., 2023; Webb et al., 2019). Relative to earlier studies that emphasize macroeconomic and price factors (Iskandar et al., 2012; Rochdiani and Wulandari, 2023; Supriana et al., 2022) this study shows that in a standards-driven global spice market, sustained competitiveness for Indonesian cinnamon depends less on exchange rate dynamics and more on restructuring the sector toward value-based, standards-compliant exports (Edra et al., 2025; Jaffee, 2012; Mubarakah, 2020; Rindayati and Kristriana, 2018; Yulisti et al., 2021).

4.4 Population dynamics and the political economy of demand

The regression results show that the population of importing countries has a negative, though statistically insignificant, association with Indonesia’s cinnamon export volume. While this coefficient does not support strong causal claims, its sign is informative when interpreted alongside competitiveness indicators (RCA, EPD, and X-Model). Rather than larger populations automatically generating greater demand for

Indonesian cassia, evidence indicates that demand is shaped by how cinnamon is embedded within specific consumption niches, such as industrial processing, ethnic cuisines, and herbal products. In large, high-income markets such as Germany and Japan, where population size is substantial but Indonesian cinnamon falls in the Retreat quadrant and exhibits very low RCA values, market scale does not translate into stronger import performance. Instead, these markets are characterised by strict quality expectations, intense competition from Ceylon cinnamon, and consumer preferences for premium, certified products (Hewavitharana et al., 2022; Piyasiri and Wijeratne, 2016).

This pattern contrasts with many aggregate export studies in which population typically emerges as a positive driver of demand by proxying for market size. For example, analyses of Indonesian agricultural exports and other primary commodities often show that larger populations increase imports by expanding food and raw material requirements (Iskandar et al., 2012; Luhwago et al., 2023; Tombolotutu et al., 2019). Likewise, studies on spices and high-value crops frequently treat the population as a straightforward indicator of demand potential (Abidin et al., 2021; Edra et al., 2025). In contrast, this study shows that for a highly specialized and standards-sensitive product such as cassia cinnamon, population alone is a weak predictor of export performance once regulatory regimes, income levels, and competitiveness are considered. This supports the argument that market “size” in standards-driven value chains must be understood not only demographically, but also through quality norms, purchasing power, and governance structures that shape actual import demand (Beghin et al., 2015; Jaffee, 2012).

Accordingly, the political economy of demand for Indonesian cinnamon is less about how many people reside in a country and more about who purchases the product and the institutional conditions. In markets with stringent SPS and TBT regimes, demand is concentrated among buyers who require credible compliance, traceability, and reputation assurance (Fontagné et al., 2015; Umali-Deininger and Sur, 2007). Where Indonesian cassia cannot consistently meet these requirements due to fragmented supply and weak certification systems, demand may remain constrained even in populous economies (Elisabeth and Falatehan, 2022). In contrast, the United States illustrates how a large population can sustain a Rising Star position when cassia is embedded in stable industrial uses and compliance is credibly signalled (Macdonald et al., 2024).

4.5 The double-edged role of standards: exclusion and enablement in global trade governance

The regression results reveal the dual character of global standards regimes in shaping Indonesia's cinnamon exports. SPS measures have a negative and economically meaningful effect on export volumes, whereas TBT show a positive, albeit more modest, relationship with trade performance. This confirms that standards operate as a double-edged governance instrument: they restrict market access through exclusionary effects while simultaneously enabling entry into regulated, higher-value markets by conferring legitimacy to firms. This duality reflects a growing consensus in the political economy of trade standards that contemporary non-tariff measures function as differentiated tools of market selection and value chain governance rather than as hidden protectionism (Beghin et al., 2015; Botterill and Daugbjerg, 2015; Gourdon et al., 2020).

The negative impact of SPS measures confirms that SPS regimes continue to operate as instruments of exclusion for exporters with weak institutional and compliance capacities in developing countries. Although justified as health-protective regulations, SPS measures impose substantial compliance costs related to laboratory testing, pesticide residue control, fumigation, certification, and traceability, which disproportionately burden smallholder-based supply chains, such as Indonesia's cassia sector (Crivelli and Groeschl, 2016; Jaffee, 2012; Murina and Nicita, 2017). As Elisabeth and Falatehan (2022) note, Indonesia's cinnamon supply chain is characterized by fragmented production, weak traceability, and limited downstream upgrading. Similar trade-suppressing effects of SPS regimes have been documented in Indonesian tuna, rubber, and pulp and paper exports (Nasution and Hurulaini, 2023; Prasada and Dhamira, 2022; Rindayati and Kristriana, 2018), illustrating how SPS functions as a form of structural power that reshapes production practices in the Global South (Beghin et al., 2015; Macdonald et al., 2024).

In contrast, the positive association between TBT measures and Indonesia's export volume highlights the enabling role of technical standards once compliance is credibly achieved. TBT regulations covering labelling, packaging, grading, documentation, and product information impose adjustment costs but also allow exporters to signal quality consistency and regulatory conformity to downstream buyers (Beghin et al., 2015; Fontagné et al., 2015). Evidence from Vietnam's rice and coffee exports and Indonesian rubber and tuna exports shows that TBT compliance can expand exports and facilitate access to premium segments when institutional support is available (Ha et al., 2023; Munadi and Saputri, 2019; Rindayati and Kristriana, 2018). Relative to earlier studies that treat NTMs as homogeneous constraints (Iskandar et al., 2012; Rochdiani and Wulandari, 2023; Supriana et al., 2022), this study shows that Indonesia's future competitiveness depends not on avoiding standards but on navigating their double-edged nature through SPS upgrading and strategic TBT engagement to reposition cassia into higher-value markets (Jaffee, 2012; Macdonald et al., 2024).

5 Conclusion and policy recommendation

This study shows that Indonesia's cinnamon export performance is shaped less by price and scale advantages than by the interaction of regulatory power, consumer upgrading, and institutional capacity. The negative impact of SPS regimes confirms their exclusionary effects on smallholder-based exporters with weak compliance systems, while the positive role of TBT measures highlights how technical standards can function as pathways to market legitimacy and value upgrading. These results imply that future export growth cannot rely on cost-based competition or exchange rate movements alone but must be grounded in structural value chain reforms. Therefore, policy priorities should focus on strengthening the national SPS infrastructure, coordinating smallholder upgrading for traceability and compliance readiness, and strategically using TBT instruments such as labelling, grading, packaging, and

origin branding to reposition Indonesian cassia in higher-value market segments. Without these interventions, Indonesia risks being locked into low-value export pathways, despite its strong production capacity.

5.1 Limitation of the study

This study relies exclusively on secondary panel data from international databases, which limits our ability to capture firm-level compliance costs, traceability practices, and informal trade, which may also shape Indonesia's cinnamon export. The SPS and TBT variables are measured using coverage ratios, which reflect the presence and scope of regulations but do not capture differences in enforcement intensity, inspection frequency, or compliance costs across countries. In addition, the model explains a modest share of export variation, indicating that unobserved factors such as private standards, buyer–seller contracts, logistics disruptions, and domestic institutional capacity are not fully captured. Finally, while the analysis identifies strong regulatory and demand-side effects at the macro level, it does not directly observe micro-level upgrading processes among smallholders and export firms in the study area. Future research should integrate primary data and firm-level evidence to deepen our understanding of compliance dynamics.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

LZ: Conceptualization, Software, Methodology, Resources, Data curation, Formal analysis, Project administration, Writing – original draft. NK: Validation, Supervision, Writing – review & editing. HA: Validation, Supervision, Writing – review & editing. BN: Writing – review & editing, Validation, Supervision. AT: Conceptualization, Methodology, Writing – original draft, Funding acquisition. AA: Data curation, Writing – original draft, Formal analysis, Investigation, Resources, Visualization, Project administration. SS: Resources, Project administration, Visualization, Formal analysis, Writing – original draft, Software, Data curation, Investigation. RD: Supervision, Conceptualization, Writing – review & editing.

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