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Assessing the drivers of india's agricultural export growth: Scale, competitive and interaction effects

Averyl Pires[a]
B. P. Sarath Chandran[b]

[a,b]*Goa Business School, Goa University, Taleigao-Goa, India.*
[a]*St. Xavier's College, Mapusa-Goa, India.*

averylpires@gmail.com (Corresponding author)

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ABSTRACT
India's agricultural exports experienced significant growth between 1991 and 2020, and this study analyzes the drivers of that growth using the Constant Market Share (CMS) methodology, which decomposes export performance into scale, competitive, and second-order effects. Most existing CMS studies on India focus on short periods and broad product groups, with limited partner-wise and product-wise detail and little attention to second-order effects. This paper addresses this gap by providing a detailed long-term assessment of India's agricultural export performance. The results show that the scale effect is the principal driver of export growth, accounting for nearly 60 percent of the total increase, largely reflecting favorable international market conditions. Competitive effects vary across product categories, with market share gains in meat, cereals, and tobacco, while sugar, beverages, and vegetable plaiting materials experienced declining competitiveness. The second-order effect, which captures interactions between structural demand shifts and competitiveness, shows a mixed pattern and offsets nearly 20–30 percent of potential gains in several cases, indicating India's limited ability to consistently exploit favorable global demand. Products such as edible fruits and beverages illustrate this mismatch, whereas exports of live animals and sugar benefited from stronger structural alignment. The findings highlight important policy implications, emphasizing product diversification, quality upgrading, improved logistics, and stronger market intelligence to enhance agricultural export competitiveness.

Contribution/Originality: This study contributes to the existing literature by examining three decades of India's agricultural exports through a detailed Constant Market Share analysis. It utilizes product and partner-level breakdowns, highlighting the scale, competitive, and second-order factors driving agricultural export growth, which was previously missing in the literature.

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1. INTRODUCTION

The agricultural sector is the backbone of the Indian economy, making a significant contribution to food security, providing large-scale employment and livelihoods to its population, and earning foreign exchange for the government. From a subsistence economy, India has evolved into a major exporter of agricultural commodities such as cereals, spices, marine products, fruits, vegetables, and processed foods. Despite making rapid progress, the export performance of the Indian agricultural sector remains uneven, characterized by fluctuations in global demand, supply-side constraints, and uncertainties affecting competitiveness. As participation in commodity value chains influences the global share in international trade, it is essential to understand the factors driving agricultural export growth to develop evidence-based policy recommendations.

One of the approaches used to examine whether a country's export performance is driven by favorable global market conditions or by improvements in domestic competitiveness is the Constant Market Share (CMS) analysis. The CMS methodology employed to study the export growth of specific commodities in India is primarily conducted at aggregate product classifications for shorter time periods, without delineating the second-order effects. This paper aims to understand how India's agricultural export competitiveness relative to major partner countries has evolved over the longer period from 1991 to 2020, considering structural changes in global markets. To address this gap in the literature, the study employed the refined CMS methodology developed by Ahmadi-Esfahani (2006). This methodology was applied to India's agricultural exports at a highly disaggregated level (HS-6), covering trade with 20 major partners over the period from 1991 to 2020. The improved approach provides insights into agricultural export growth by analyzing scale effects, competitive effects, and second-order interaction effects, which are crucial for policy formulation aimed at enhancing agricultural export growth in the country. The paper raises several research questions to further explore the research problem, including the impact of global market dynamics, domestic policy measures, and structural changes in the agricultural sector.

1. How has India's agricultural export performance changed in comparison with the overall growth in the global market over the past thirty years?
2. To what extent can this growth be linked to rising global demand (scale), India's own competitive strength, or the combined interaction (second-order) of these factors?
3. How do these patterns differ across major trading partners and various categories of agricultural products over time?
4. What long-term shifts emerge from the analysis, and what policy measures could help enhance India's export position?

2. REVIEW OF LITERATURE

Scholars examining agricultural export performance often rely on the Constant Market Share (CMS) technique to distinguish the impact of structural demand shifts from changes in competitiveness. Broadly, the literature can be categorized into three perspectives: international evidence, commodity- and region-specific applications, and studies focused on India.

2.1. International Evidence on CMS and Agricultural Competitiveness

A substantial body of work applies CMS to understand how different countries adjust to evolving global demand. For example, China's agricultural export gains have been linked to policy reforms and improvements in technology (Zhou & Diao, 2021). The European Union's expansion in high-value agri-food exports has been associated with deeper trade agreements and broader market diversification (Bojnec & Fertő, 2015; Smith, O'Brien, & Martin, 2020). Similar CMS-based assessments for Brazil indicate that export gains in soybeans and poultry were primarily driven by competitiveness (De Souza, Pereira, & Andrade, 2018; Vieira & Veríssimo, 2020). Studies on South Korea and Japan also indicate that product upgrading and market adaptation significantly shaped their agri-food export trajectories (Lee & Kim, 2019; Matsumoto, 2017). Vietnam's strong performance in rice, coffee, and seafood has been supported by improvements in farming practices and enhanced access to international markets (Nguyen, Pham, & Le, 2023), while Turkey's olive oil trade has benefited from product improvements and shifting demand patterns (Kadioglu, Yildiz, & Demir, 2021). In contrast, economies such as Argentina and Egypt have struggled with declining competitiveness due to domestic policy instability and exposure to volatile markets (Diaz-Bonilla, 2015; El-Said & Fawzy, 2020). Together, these studies suggest that agricultural export success depends not only on global demand but also on domestic capabilities, supply-side efficiency, and deeper integration with global markets.

2.2. Commodity and Region-Specific CMS Applications

CMS has also been employed to study competitiveness within individual commodities and regional markets. Research in Spain shows notable shifts in tomato exports driven by improvements in competitiveness (Capobianco-Uriarte, Aparicio, & De Pablo-Valenciano, 2017). Work on ASEAN's tea sector highlights the role of diversification in shaping export outcomes (Oktaviana, Masyhuri, & Hartono, 2017) while Malaysia's fisheries industry has displayed mixed competitiveness trends (Soh, Lim, & Chua, 2021). Further contributions include studies on Sub-Saharan Africa's coffee and cocoa exports, which show varying effects of demand and competitiveness across countries (Abban & Quaicoe, 2020; Ngunyi, 2018). Analysis of Morocco's citrus industry and Kenya's floriculture sector underscores the influence of supply chain efficiency and compliance with quality standards (El-Makhloufi, 2019; Muriithi, 2016). These findings reinforce the importance of detailed, commodity-level assessments, as aggregated data often conceal substantial product-specific dynamics.

2.3. CMS Studies on India's Agricultural Exports

Indian researchers have applied the CMS method to a range of agricultural commodities. Earlier studies include evaluations of seafood (Somasekharan, Harilal, & Parameswaran, 2013), rice (Kumar, Choudhary, & Rani, 2019), oilseeds (Arora & Batra, 2019), spices (Bhattacharyya & Batra, 2022), and horticulture produce (Prakash & Pushpangadan, 2011). Most recent work has extended this to tea, sugar, and meat exports, pointing to varied competitiveness patterns across destinations (Alawadhi, Singh, & Mehra, 2021; Goyal & Singh, 2018; Singh & Kaur, 2016). Overall, the evidence presents a mixed picture: some commodities have gained ground due to competitiveness, while others have grown mainly because of favorable global demand. Contemporary analyses (Fayaz & Ahmed, 2020; Fayaz & Kaur, 2022; Kumar, 2022; Kumar, Mishra, & Raju, 2023) continue to highlight the importance of updated CMS approaches and longer time horizons.

Nevertheless, most CMS studies on India continue to rely on short time frames, aggregate product groupings, limited partner-wise analysis, and earlier CMS formulations that do not incorporate second-order effects. These limitations highlight the need for a more detailed, multi-decade examination at finer product levels, which is precisely the approach adopted in the present study.

3. DATA AND METHODOLOGY

3.1. Overview of the CMS Framework

The Constant Market Share (CMS) approach is a long-established method used to break down export growth into its underlying drivers. Rather than estimating behavioral equations or short-run dynamics, CMS examines how much of the change in a country's exports can be linked to broader market expansion, shifts in product mix, or competitiveness. This makes it particularly suitable for examining long-term patterns in trade performance.

Earlier versions of CMS models (e.g., Bowen & Pelzman, 1984; Fagerberg & Sollie, 1987; Leamer & Stern, 1970; Milana, 1988) focused on three broad components: demand, commodity composition, and competitiveness. These early formulations have been criticized for using highly aggregated data and for not separating interaction effects or capturing variations in bilateral demand. The revised framework developed by Ahmadi-Esfahani (2006) addresses these shortcomings by breaking down scale, competitive, and second-order components into more detailed sub-parts. This allows for clearer attribution of export changes to market growth, product structure, and competitive shifts. Additionally, it relies on partner-wise, product-level data, which enhances the interpretation of country-specific and commodity-specific export patterns. Due to these refinements, this version of CMS offers a more transparent and policy-relevant approach to analyzing the evolution of India's agricultural exports over several decades.

3.2. Data Source

The analysis utilizes India's bilateral agricultural export data at the HS-6 level for the period 1991-2020, sourced from UN COMTRADE, a highly credible and widely used international trade database. The dataset employed in the study encompasses 5,612 HS-6 agricultural product lines.

3.3. Trading Partners

The study included India's 20 major agricultural export markets, identified based on their long-term share in India's agricultural shipments. These trade partners include Bangladesh, Nepal, China, Hong Kong, Malaysia, Indonesia, Vietnam, Singapore, Thailand, Japan, Russia, Egypt, the UAE, Iran, Kuwait, Saudi Arabia, the UK, the Netherlands, Germany, and the USA.

3.4. Time Period

To analyze the structural reforms and policy changes in India's agricultural exports, the study utilized data spanning thirty years, from 1991 to 2020. This period was divided into three sub-periods: the early liberalization and market-opening reforms (1991–2000); WTO-related adjustments, including SPS and TBT compliance (2001–2010); and the expansion of high-value exports, FTAs, and shifts in global demand (2011–2020). The R software was employed to decompose agricultural growth across the entire study period and within each sub-period, providing a detailed understanding of the evolving dynamics in India's agricultural export sector. The summary of the data used for the study is outlined in Table 1.

Table 1. Summary of India's bilateral agricultural export dataset.

Component	Description
Product classification	HS-6-digit agricultural commodities
Number of HS-6 products	5612 (Agricultural lines)
Number of partner countries	20
Time period	1991–2020
Total observations	$5612 \times 20 \times 30 = 3{,}367{,}200$
Data source	UN COMTRADE
Unit of measurement	Export value (USD)

Table 2. India's Top 20 Destinations for Agricultural Exports (1991 & 2020).

1991			2020		
Country name	**Trade value (Million) USD**	**Percentage share in India's agricultural exports**	**Country name**	**Trade value (Million) USD**	**Percentage share in India's agricultural exports**
Japan	263.62	8.20	USA	1853.18	5.08
Saudi Arabia	114.49	3.56	Saudi Arabia	1102.70	3.03
USA	83.15	2.59	China	879.21	2.41
Netherlands	72.11	2.24	Iran	876.79	2.41
UK	61.26	1.91	Hong Kong	786.74	2.16
Jordan	53.87	1.68	Singapore	688.44	1.89
Spain	45.07	1.4	Nepal	526.02	1.44
Iran	43.28	1.35	Vietnam	446.82	1.23
Malaysia	42.22	1.31	UAE	419.36	1.15
Singapore	40.39	1.26	Malaysia	388.24	1.07
Germany	37.85	1.18	Japan	379.56	1.04
Czechoslovakia	36.41	1.13	Bangladesh	351.69	0.96
Philippines	34.83	1.08	Egypt	312.29	0.86
Italy	34.22	1.07	Indonesia	278.11	0.76
Belgium	32.20	1.00	Kuwait	197.92	0.54
Indonesia	28.95	0.9	Netherlands	185.81	0.51
UAE	27.83	0.87	Thailand	165.47	0.45
Bangladesh	24.45	0.76	Germany	156.29	0.43
Poland	22.29	0.69	UK	150.87	0.41
France	21.68	0.67	Russia	141.48	0.39
Other countries	2894.69	67.32	Other Countries	26163.32	71.78
Total India's agricultural exports	3213.21		Total India's agricultural exports	36450.29	

Table 2 compares India's top 20 agricultural export markets in 1991 and 2020 demonstrate a significant increase in total shipments, rising sharply from approximately USD 3.21 billion to USD 36.45 billion. This expansion reflects broader global demand and gradual improvements within India's agricultural sector. In 1991, Japan was the dominant market; however, by 2020, its share had diminished as trade patterns shifted, with the United States gaining prominence—its share increasing from 2.59% to 5.08%. Additionally, China, Iran, and Hong Kong emerged as major buyers, indicating changing economic and geopolitical alignments. The share of all other destinations increased from 67.32% to 71.78%, signaling a broader diversification of export markets. Collectively, these patterns illustrate how India's agricultural export profile has broadened over time, emphasizing the importance of strengthening ties with new markets while maintaining long-standing partnerships.

Table 3. Formulas for Decomposition and Definitions of Key Components Driving Export Growth in Constant Market Share Analysis.

Main effect	Sub effect	Formula	Definition
Scale	Growth	$S^o \Delta X$	Captures the impact on export values resulting from shifts in the overall scale of demand in the importing market.
	Market	$(\Sigma_i\Sigma_j S_{ij}^o \Delta X_{ij} - \Sigma_i S_i^o \Delta X_i)$	Measures changes in export values resulting from variations in demand across different importing regions.
	Commodity	$(\Sigma_i\Sigma_j S_{ij}^o \Delta X_{ij} - \Sigma_j S_j^o \Delta X_j)$	Reflects how export values adjust based on demand changes for specific products within the importing market.
	Interaction	$(\Sigma_i S_i^o \Delta X_i - s^o \Delta X) - (\Sigma_i\Sigma_j S_{ij}o \Delta X_{ij} - \Sigma_j S_j o \Delta X_j)$	Accounts for changes in export value resulting from the combined effects of market fluctuations and shifts in product demand.
	Sub total	$S_{kij} \times \Delta X_{kij}$	Total effect of demand structure changes in the importing market on export values.
Competitive	Pure residual	$\Delta S\ X^o$	Measures of export value changes resulting from shifts in the overall competitiveness, specifically market share, of the exporting country.
	Static residual	$(\Sigma_i\ \Sigma_j\ \Delta S_{ij}\ X_{ij}^o - \Delta S X^o)$	Indicates changes in export values related to adjustments in the exporting country's market share across specific target markets.

Main effect	Sub effect	Formula	Definition
	Sub total	$\Delta S_{kij} \times X^{o}_{kij}$	Total impact of the exporting country's competitiveness changes on export values.
Second order	Pure second order	$(X^{1}/X^{o}-1)\ \Sigma_i\Sigma_j\Delta S_{ij}^{o}\ X_{ij}^{o}$	Tracks export value shifts due to the combined effects of competitiveness and overall import market demand scale changes.
	Dynamic second order	$[\Sigma_i\ \Sigma_j\ \Delta S_{ij}\ \Delta X_{ij}\ -(X^{1}/X^{o}-1)\ \Sigma_i\Sigma_j\ \Delta S_{ij}\ X_{ij}^{o}\ ]$	Captures export value shifts resulting from the interaction between competitiveness changes and structural demand adjustments in the importing market.
	Sub total	$\Delta S_{kij}\times\Delta X_{kij}$	Total impact of interactions between competitiveness and demand scale/structure on export values.
Total (Change in export value)		Δx	Reflects the overall change in export values between countries, covering all components.

3.5. Decomposition of Export Growth in Constant Market Share Analysis

Table 3 outlines the components that influence changes in export values, categorizing them into three primary effects: *Scale*, *Competitive, and Second Order*, along with their sub-components, formulas, and explanations. It comprises four sections: *Growth*, which measures overall changes in global demand; *Market*, reflecting how demand shifts across importing regions; *Commodity*, tracking changes in demand for specific products; and an *Interaction* term that represents the combined influence of regional and product-level demand movements. Collectively, these elements form the structural subtotal, illustrating the cumulative impact of demand-side forces on exports. The *Competitive effect* isolates changes resulting from the exporter's performance relative to competitors. It includes the *Static Residual*, indicating competitiveness changes within individual destination markets, and the *Pure Residual*, capturing broader movements in market share. This subtotal demonstrates how competitive strength or weakness contributed to variations in export values. The *Second Order effect* measures the interaction between competition and demand conditions. The *Pure Second Order* component reflects export changes arising from the interplay between competitiveness and overall demand growth, while the *Dynamic Second Order* shows how shifts in competitiveness combine with structural changes in product- or market-specific demand. Their subtotal presents the aggregated influence of these interactions. The final row of Table 3, Total (Change in Export Value), summarizes the combined effects and provides a comprehensive view of the factors driving variations in export performance.

Taken together, the Ahmadi-Esfahani (2006) version of the CMS model provides a more detailed and actionable framework than traditional formulations. By separating demand-driven, competition-driven, and interaction-driven components of export growth, the approach helps identify whether the key policy needs arise from improving competitiveness, expanding market access, or addressing both simultaneously. This makes the method particularly useful for designing targeted trade strategies, selecting priority products, and identifying promising destination markets, ultimately supporting more informed decisions and strengthening agricultural export performance.

4. RESULTS

This section reports the empirical outcomes of India's agricultural export performance based on the CMS framework, applied at both the product level and across partner countries. The CMS calculations were performed using HS-6 data, but the results are reported at the HS-2 level for ease of presentation. Export growth is broken down into the Scale, Competitive, and Second-Order components for each of the three periods: 1991-2000, 2001-2010, and 2011-2020. The detailed decomposition is presented in Tables 4-8.

Before turning to the results, it is useful to clarify how the CMS coefficients should be interpreted. In some product-partner pairs, especially where export values were initially very low or subject to sharp fluctuations, the CMS decomposition produces unusually large positive or negative figures. These values are not elasticities or percentage changes. Rather, they serve as index-type measures that capture how much each component scale, competitive, or second-order contributed to the overall change in exports. Large coefficients often appear when small baseline export values undergo notable absolute movements, a pattern frequently noted in CMS-based analyses.

CMS is essentially an accounting exercise and not a statistical estimation method; conventional significance testing does not apply. To address concerns about reliability, three robustness checks were conducted. First, the decomposition was recalculated using alternative decade cut-offs to assess period sensitivity. The relative size and direction of the CMS components remained largely unchanged. Second, a partner exclusion test was performed by removing the five largest destination markets. Although this reduced the absolute magnitude of some coefficients, the sign and pattern of effects remained consistent with the baseline. Third, a volatility adjustment was applied by smoothing extremely small and erratic HS-6 export values with a three-year moving average. This helped dampen extreme spikes, such as sharply negative coefficients, without altering the overall structural interpretation. Taken together, these checks demonstrate that the main findings remain stable across partners, products, and time horizons.

To make the results easier to interpret, the study also employs visual tools suited to the nature of each dataset. Heatmaps are used for product-level decomposition to highlight shifts in structural advantage, competitive strength, and decade-wise transitions across commodity groups and for the country-level analysis to present the three CMS components side by side, allowing clear comparison across destination markets. These visualizations help uncover patterns that may not be immediately evident from large numerical tables.

Figure 1 provides the results of decomposition for the 24 HS-2 agricultural commodities for the period 1991-2000.

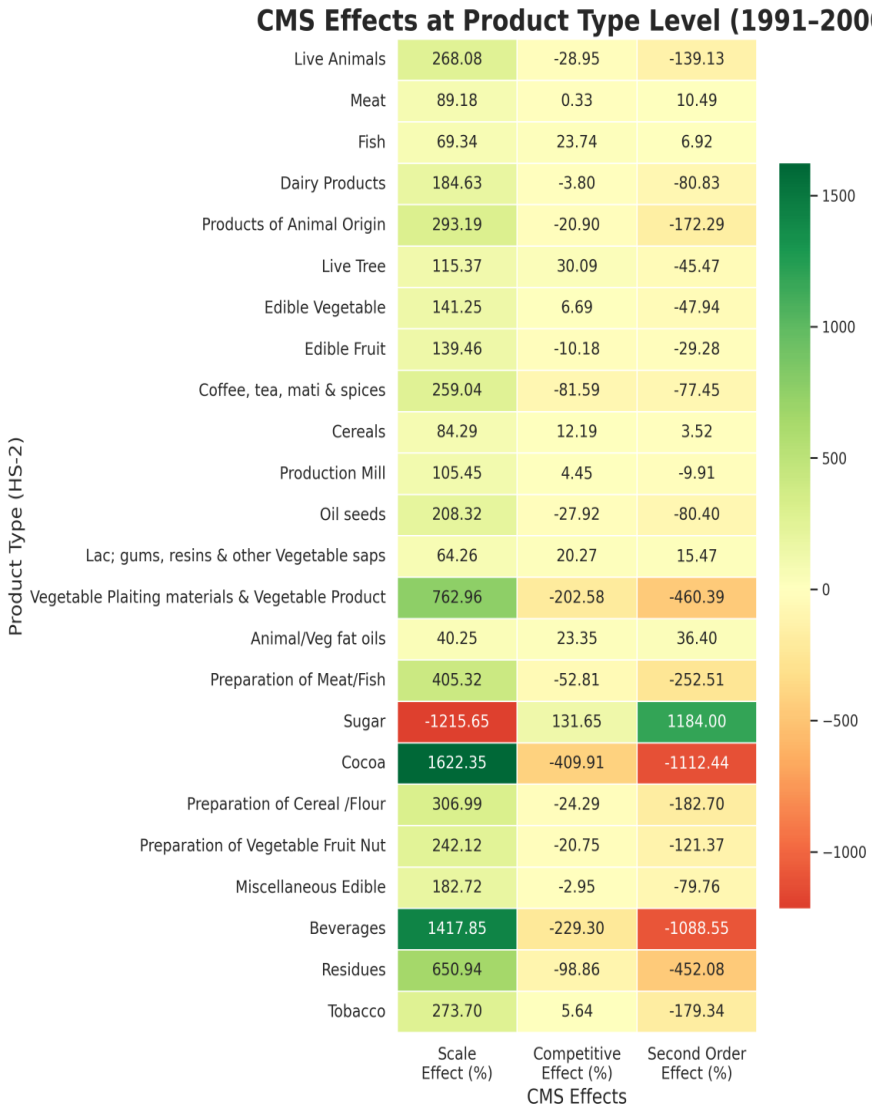

Figure 1. Analysis results at the product type level using CMS (1991-2000).

The Total Scale Effect, which measures the impact of overall market growth, is positive for products such as Live Animals (268.08) and Dairy Products (184.63), indicating they benefited from global demand. Conversely, Sugar (-1215.65) faced significant negative effects. The Total Competitive Effect, reflecting India's ability to compete, shows positive gains for Lac, Gums, Resins & Saps (20.27), Animal/Veg Fat Oils (23.35), and Fish (23.74). Despite its negative scale effect, Sugar (131.65) stands out. On the other hand, Beverages (-229.30) and Vegetable Plaiting Materials (-202.58) recorded major competitive losses. The Total Second Order Effect, which represents the interaction of structural changes and market performance, is negative for most products, suggesting weak responsiveness to demand shifts. However, Sugar (1184) exhibited the highest positive second-order effect, indicating that improvements in competitiveness reinforced favorable market conditions, thereby driving export growth. Animal/Veg Fat Oils (36.40) and Lac, Gums, Resins & Saps (15.47) also showed moderate reinforcement between competitiveness and demand. Overall, while some products benefited from market expansion, competitiveness played a key role in export performance, with second-order effects being largely insignificant except in a few cases.

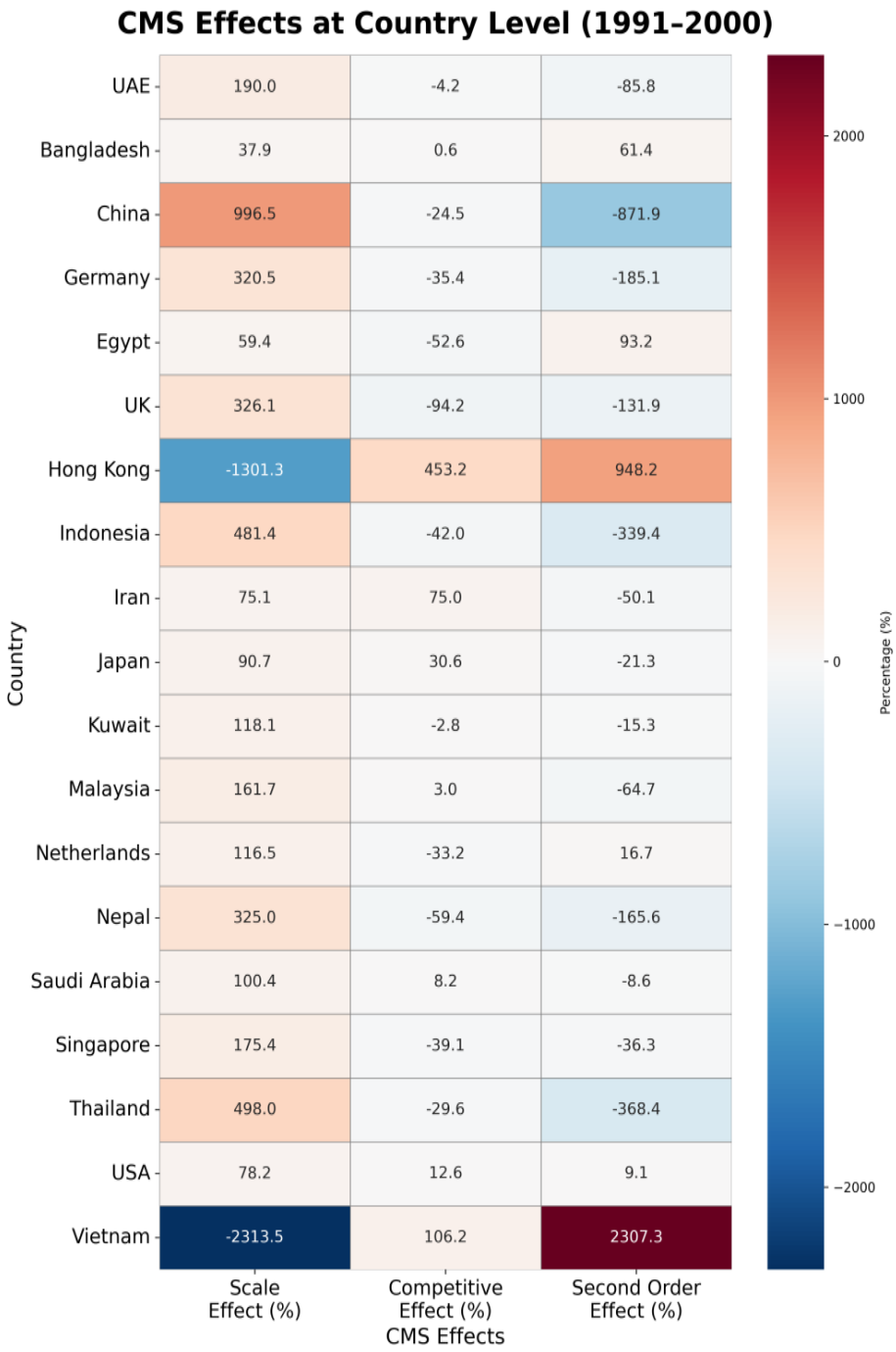

Figure 2. Analysis results at the country level using CMS (1991-2000).

Figure 2 presents the CMS results at the country level for 1991–2000. The Total Scale Effect, which measures the impact of market and product growth in partner countries, is positive for the UAE (189.99), Bangladesh (37.94), Germany (320.48), the UK (326.11), and Indonesia (481.35), indicating favorable market conditions. However, Vietnam (-2313.49) and Hong Kong (-1301.34) faced significant negative scale effects, likely due to declining demand or market contraction. The Total Competitive Effect, reflecting India's ability to compete, shows notable gains in Hong Kong (453.16), Vietnam (106.15), and Japan (30.59), while Germany (-35.42), Nepal (-59.36), and the Netherlands (-33.19) recorded declines in competitiveness. Vietnam's strong competitive gains helped offset its negative scale effect. The Total Second-Order Effect, which measures structural interactions, highlights Vietnam (2307.34) and Hong Kong (948.17) as markets where favorable shifts supported India's exports, whereas China (-871.94) and Germany (-185.06) faced structural challenges. Minor positive effects in the Netherlands (16.69) and Bangladesh (61.44) suggest modest interaction benefits. While competitiveness and market dynamics improved in Vietnam and Hong Kong, structural and scale-related challenges persisted in countries like Bangladesh, China, and Hong Kong.

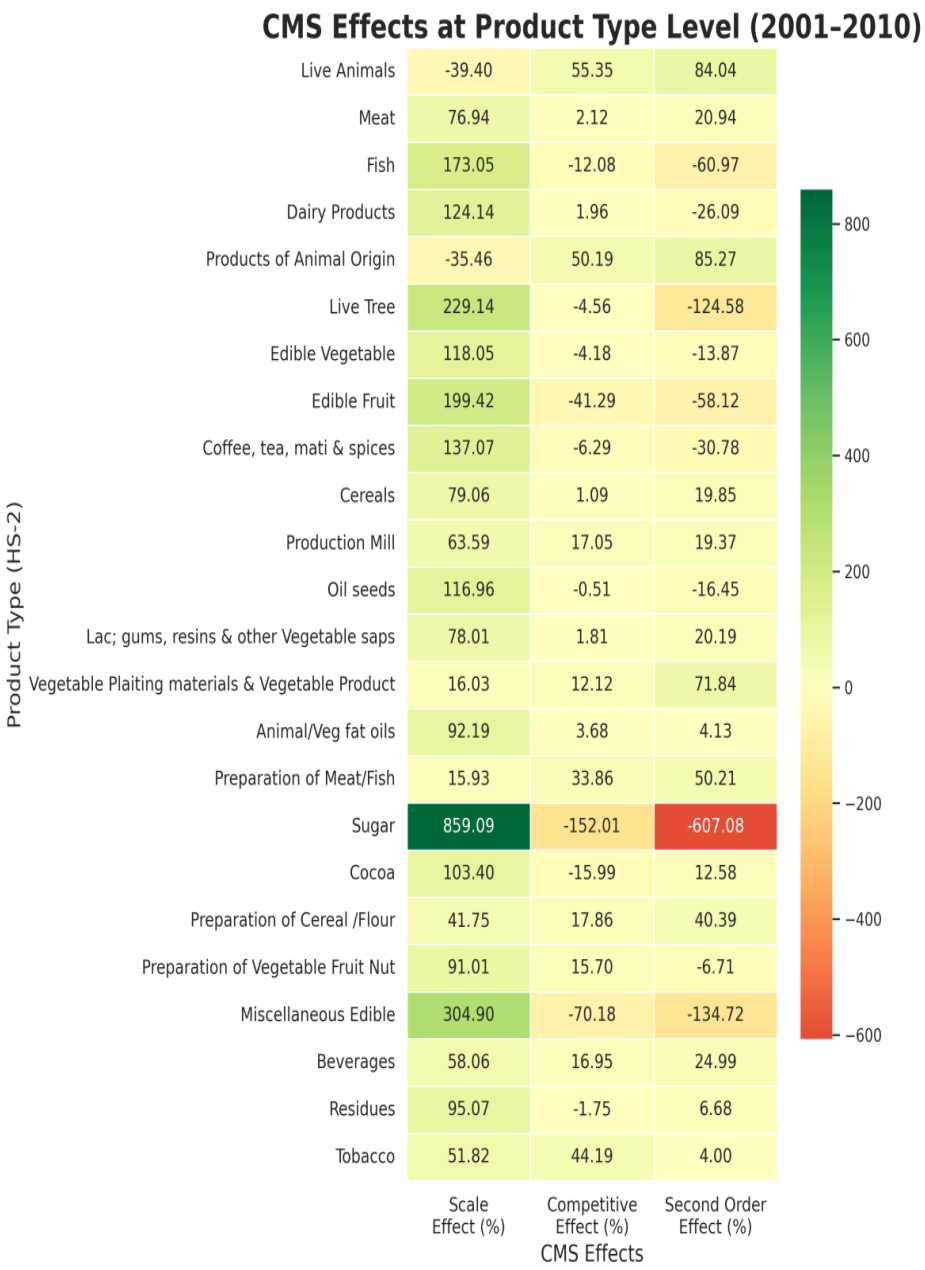

Figure 3. Analysis results at the product type level using CMS (2001-2010).

Figure 3 presents the CMS results at the product level for 2001–2010 indicate that Sugar (859.09) and Cocoa (103.40) maintained positive scale effects despite regional and product-level market contractions. Meanwhile, Miscellaneous Edible Products (304.90) and Live Trees (229.14) benefited from global market growth. However, live animals (-39.40) and products of animal origin (-35.46) faced negative scale effects, indicating unfavorable market conditions. Edible fruits (199.42) and cereals (79.06) reflected strong demand-driven effects despite contractions at the product level. In terms of competitiveness, preparation of cereal/flour (17.86), preparation of meat/fish (33.86), and tobacco (44.19) saw gains, while live animals (55.35) and products of animal origin (50.19) offset scale challenges with strong competitive improvements. Conversely, Sugar (-152.01), Cocoa (-15.99), and Fish (-12.08) experienced declines in competitiveness due to increased competition, while Beverages (16.95) showed moderate gains in competitiveness. The Second-Order Effect indicated structural improvements for Live Animals (84.04) and Products of Animal Origin (85.27), with the Preparation of Meat and Fish (50.21) also benefiting from favorable trade shifts. Meanwhile, Sugar (-607.08) and Fish (-60.97) faced negative interaction effects, suggesting structural challenges within these sectors. Cocoa (12.58) and Residues (6.68) recorded moderate positive effects, whereas Miscellaneous Edible Products (-134.72) experienced significant market losses due to structural issues.

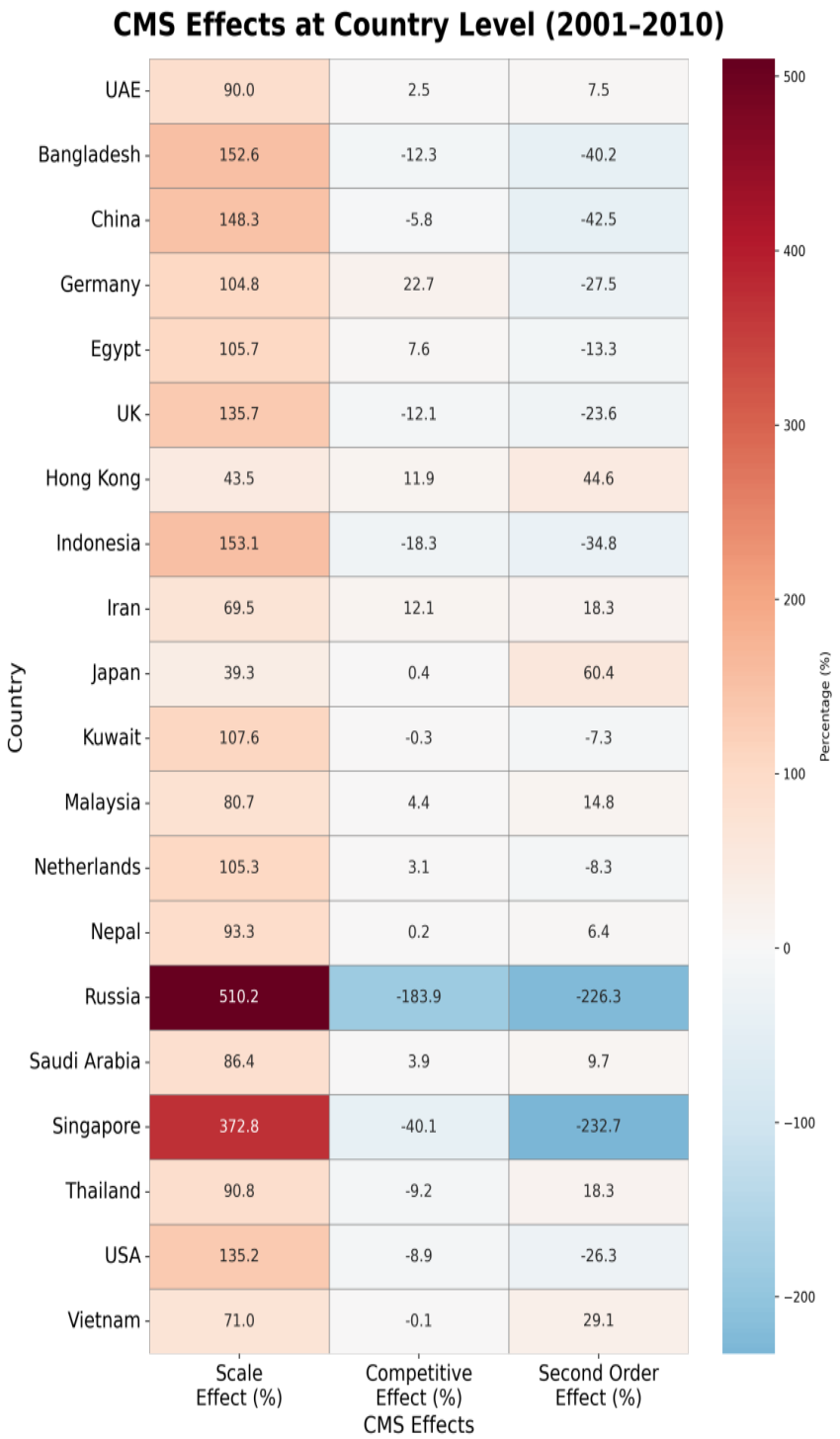

Figure 4. Analysis results at the country level using CMS (2001-2010).

Figure 4 presents the CMS results at the country level for 2001–2010 indicate varied market dynamics across different nations. Singapore (372.79), the UAE (89.97), and Russia (510.16) recorded high-scale effects due to strong market growth. Conversely, the USA (135.20), Indonesia (153.07), and Bangladesh (152.57) benefited from demand-driven scale effects. Nepal (93.32) and Kuwait (107.59) showed moderate positive scale effects, reflecting favorable demand growth. Germany (104.78) and the Netherlands (105.27) maintained positive effects despite experiencing contractions at the product level. In terms of competitiveness, Singapore (-40.14), Russia (-183.88), and the USA (-8.87) experienced significant declines, suggesting increased competition from other suppliers. Meanwhile, the UAE (2.54), Malaysia (4.43), and Nepal (0.25) demonstrated minor competitive gains. Hong Kong (11.90), Iran (12.14), and Saudi Arabia (3.91) displayed small positive effects, indicating improved market performance. Japan (0.36) saw negligible change. The Second-Order Effect revealed positive structural shifts in Hong Kong (44.63), Japan (60.38), and Vietnam (29.14). Malaysia (14.85) and Saudi Arabia (9.73) experienced moderate gains. However, Russia (-226.28), Singapore (-232.65), and Germany (-27.52) faced structural challenges affecting exports. The USA (-26.33) and Indonesia (-34.76) also experienced negative second-order effects, reflecting unfavorable market dynamics.

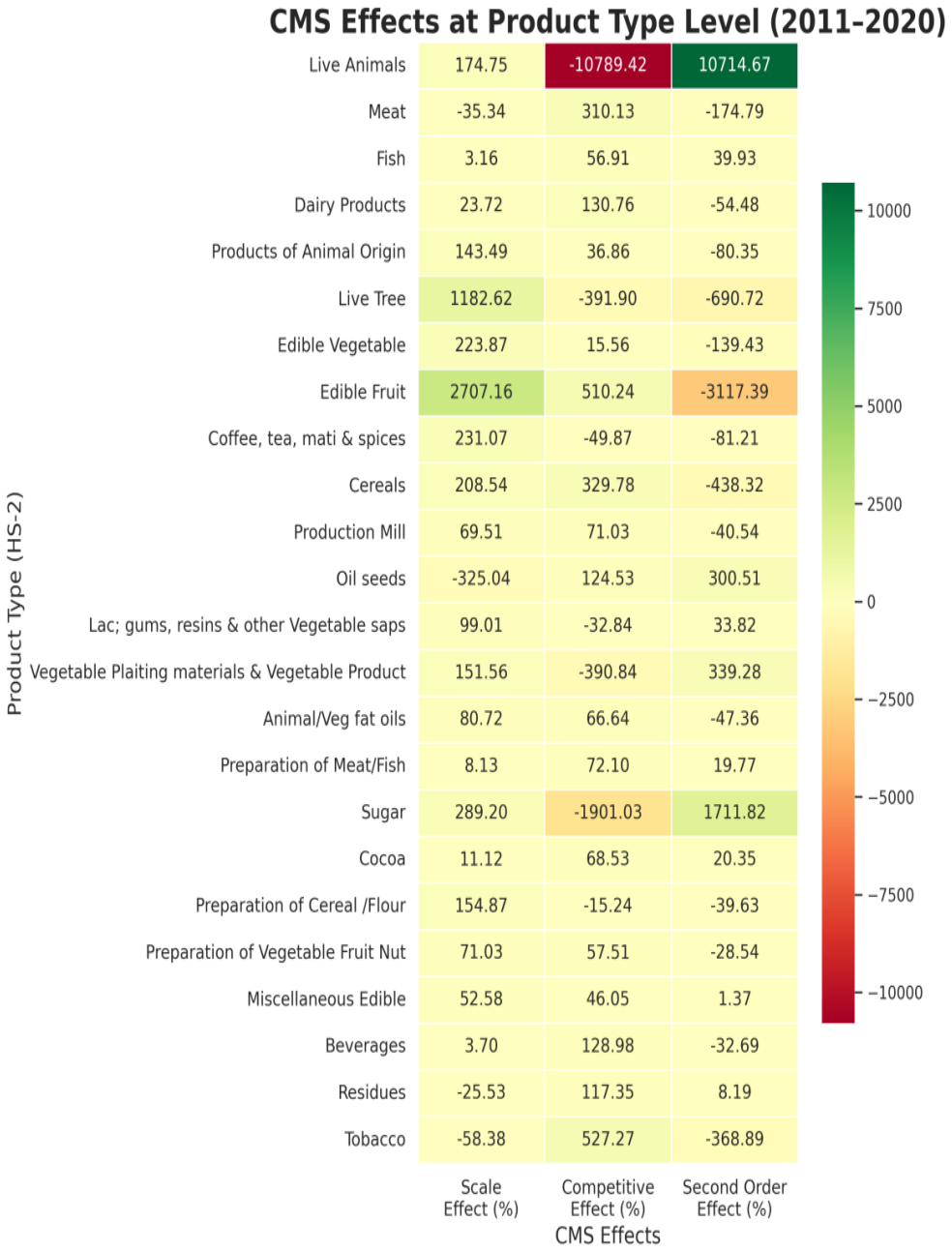

Figure 5. Analysis results at the product type level using CMS (2011-2020).

Figure 5 presents the CMS results at the product level for 2011–2020 indicate varied performance across different commodities. Edible Fruit (2707.16), Sugar (289.20), and Live Trees (1182.62) experienced strong demand-driven growth despite facing product-specific challenges, suggesting significant opportunities in the global market. Additionally, Cereals (208.54) and Edible Vegetables (223.87) also benefited from favorable demand conditions, reflecting positive market trends in these sectors. Conversely, Live Animals (174.75) and Meat (-35.34) showed weak or marginal demand-driven effects, indicating limited growth potential in these categories. Oil Seeds (-325.04) and Tobacco (-58.38) faced negative scale effects due to unfavorable global demand, which impacted their export performance negatively. In terms of competitiveness, Live Animals (-10789.42) and Sugar (-1901.03) suffered substantial losses, highlighting significant competitive disadvantages. However, Tobacco (527.27) was an exception, demonstrating notable gains in competitiveness. Beverages (128.98), Oil Seeds (124.53), Cocoa (68.53), and Preparation of Meat/Fish (72.10) showed moderate improvements within niche markets, reflecting steady growth in specialized segments. The Second-Order Effect analysis revealed strong positive structural changes for Sugar (1711.82), Vegetable Plaiting Materials (339.28), and Live Animals (10714.67), indicating robust interaction effects despite weak competitiveness. Oil Seeds (300.51) also benefited from positive structural shifts. Conversely, Edible Fruit (-3117.39), Preparation of Cereal/Flour (-39.63), and Tobacco (-368.89) faced structural challenges that constrained their export performance, underscoring the need for strategic adjustments to improve market outcomes.

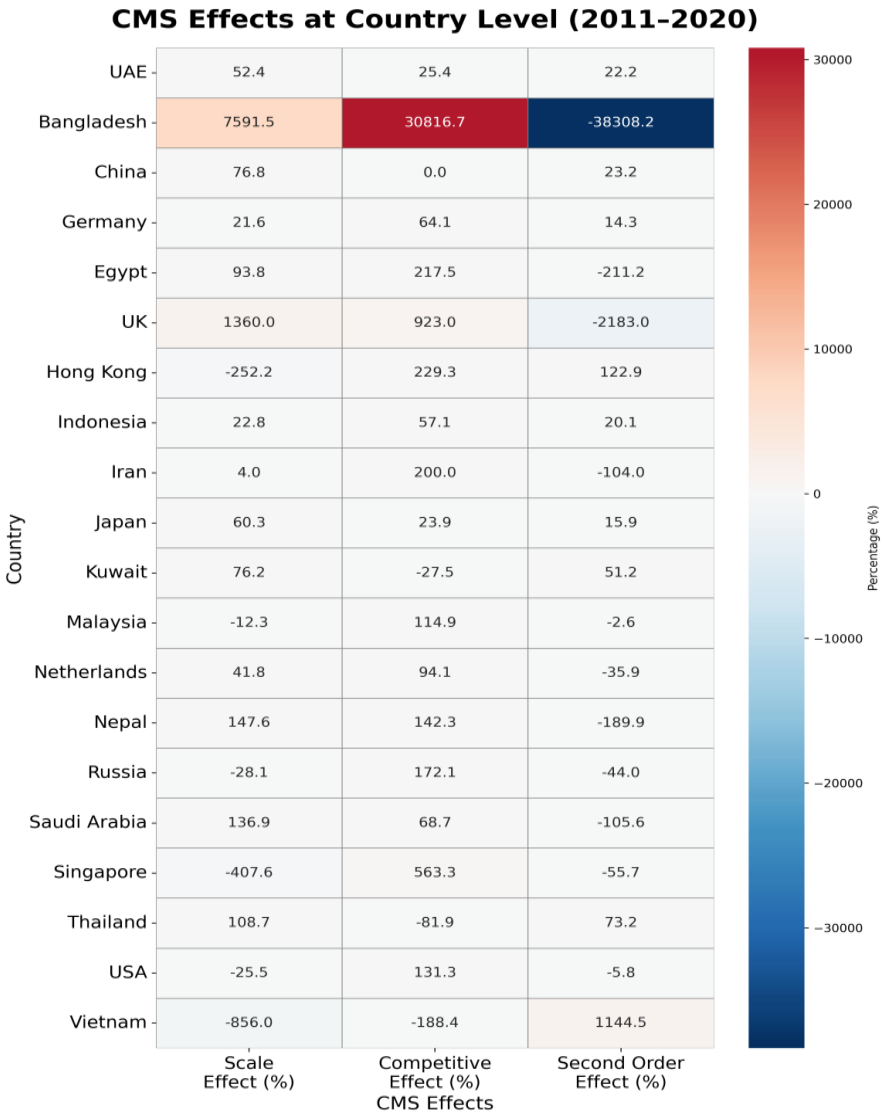

Figure 6. Analysis results at the country level using CMS (2011-2020).

Figure 6 presents the CMS results at the country level for 2010-2020 indicate varied export performance across different nations. While exports to Vietnam (-856.00), Singapore (-407.65), and Hong Kong (-252.18) faced unfavorable demand conditions, the USA (-25.48) and Russia (-28.10) experienced only marginally negative scale effects, reflecting limited demand growth. Bangladesh (7591.48) emerged as the top-performing destination in terms of total scale effects, driven by strong global demand, followed by the UK (1360.03), Nepal (147.64), and Saudi Arabia (136.95). India gained the most in Bangladesh (30816.69) in terms of competitiveness, significantly expanding its market share. Although the USA (131.29) and Nepal (142.31) showed modest increases despite negative scale effects, Hong Kong (229.32), Singapore (563.34), and the UAE (25.38) exhibited moderate competitive gains despite occasional weaker demand. However, substantial demand-driven scale effects were offset by notable competitive losses for Vietnam (-188.45). The Netherlands (94.08) and Russia (172.05) also demonstrated slight increases in competitiveness. Regarding second-order effects, despite challenges with competition, Vietnam (1144.45) showed significant positive structural changes, whereas Nepal (-189.95), Hong Kong (122.86), and Kuwait (51.23) underwent structural adjustments that somewhat supported export growth. Conversely, Bangladesh (-38308.17) faced major structural issues that limited export gains despite its size and competitive advantages. Positive competitiveness was counterbalanced by structural restrictions in the UK (-2183.03) and Singapore (-55.69), while Germany (14.29) exhibited only slight structural effects.

5. DISCUSSION

The CMS results for India's agricultural exports from 1991 to 2020 indicate a gradual but clear shift in the factors driving export performance over time. During the 1990s, most of the growth was driven by demand conditions abroad, as evidenced by the strong Scale effect across a wide range of commodities. India benefited from favorable global consumption trends; however, its own export capacity was not yet sufficiently developed to fully capitalize on these opportunities. Several traditional export items, such as tea, spices, and dairy products, recorded weak or even negative Competitive effects, suggesting that production capabilities, quality standards, and supply responsiveness had not kept pace with global expectations. The Second-Order effect was also relatively small during this period, indicating that

improvements in market demand and India's competitive position were not mutually reinforcing. Variations across markets were also notable: India achieved competitive gains in regions like Vietnam and Hong Kong, even when demand was weak, but continued to face challenges in advanced economies such as Germany and the UK. These observations align with earlier studies, including (Kumar, 2022; Singh, 2014), which suggest that India's early export gains were primarily driven by global demand rather than competitiveness.

The period from 2001 to 2010 reflects the beginning of a transition. India still benefited from global demand for several products, but improvements in the competitive and second-order effects became visible in a number of agricultural categories, especially in livestock-related items and processed foods. The decade marked a phase where supply chains became somewhat more efficient. Even so, competitiveness did not improve uniformly. Sectors such as sugar and fish, despite experiencing high global demand, showed declining competitive strength, pointing to uneven structural adjustments. On the destination front, India's growing presence in emerging markets like Malaysia, Iran, and Hong Kong suggests a strategic shift towards new centers of demand. These patterns are broadly in line with the arguments made by Chaoudhari (2024) and Singh (2019), who emphasize how trade reforms and deeper integration with emerging markets reshaped India's export orientation during this period.

The decade from 2011 to 2020 exhibits the most significant structural changes throughout the entire study period. The competitive effect became the primary driver of export growth, indicating that India had made notable progress in areas such as efficiency, quality, and market penetration. Gains were particularly evident in commodities like meat, cereals, and tobacco. Simultaneously, the scale effect played a smaller role compared to earlier decades, suggesting that India's export expansion was driven more by its own capabilities than by favorable demand conditions abroad. However, improvements were not uniform across all sectors. The second-order effect remained volatile and showed little consistent pattern. A notable example is Bangladesh, where very large positive scale and competitive effects were entirely offset by a substantial negative second-order effect, pointing to unresolved structural mismatches or market-specific constraints. Other destinations, including Singapore, the UK, and Hong Kong, demonstrated steady but moderate competitive improvements, indicating the emergence of promising export niches. These trends correspond with the findings of Kumar (2022) and Singh (2019), who argue that India has made progress in competitiveness, though several challenges persist.

Across the three decades, the overall picture suggests a movement from demand-led growth in the 1990s to partial structural adjustments in the 2000s, and finally towards competitiveness-driven expansion in the most recent decade. Yet, the uneven progress across products and destinations indicates that deeper productivity gains, stronger quality and safety standards, and more focused market strategies are still required if India intends to translate competitive improvements into sustained and stable export growth.

6. CONCLUSION

The decomposition of India's agricultural exports over a thirty-year period reveals that the forces influencing export performance have changed significantly across different decades. In the initial years, export growth was primarily driven by the Scale effect, indicating that India benefited more from favorable external demand than from improvements in domestic competitiveness. However, over time, there has been a noticeable structural shift in export growth dynamics. Between 2011 and 2020, the Competitive effect became more prominent, reflecting advancements in product quality, processing capabilities, market outreach, and cost structures. The Second-Order effect, which measures how competitiveness interacts with global demand patterns, remained inconsistent across various commodities and destinations, highlighting structural bottlenecks and market-specific vulnerabilities.

At the product level, some commodities consistently rode on global demand growth, while others struggled due to domestic supply constraints, inconsistent quality, or volatile international prices. The partner-country results revealed an interesting pattern; while India built competitive strength in a few markets, it continued to face structural disadvantages in several others. The visual representation of the findings, through product heatmaps and country-wise charts, highlighted the major conclusion of the study: India's export performance aligns with global market shifts, but mismatches persist.

The overall findings emphasize the need for a comprehensive export strategy that does not rely solely on favorable demand cycles but incorporates multiple approaches for various products and markets. Strengthening logistics and supply chains, enhancing adherence to international standards, and expanding value-added processing will be essential for building sustainable competitiveness. Market-specific strategies, increased trade engagement, and incentive systems linked to quality and sustainability can further support India's efforts to establish a stable position in global agricultural markets. As the global trading system becomes increasingly standards-driven and technology-intensive, investing in digital trade facilitation, traceability, and climate-resilient agricultural practices will also be crucial for achieving and maintaining high agricultural export growth.

6.1. Limitations of the Study

Although this study provides valuable insights into India's agricultural export performance, it faces certain limitations, including issues with product aggregation within HS-6 classifications, potential inconsistencies in COMTRADE data, and the inherent limitations of the CMS framework. The framework explains export growth mechanically without capturing deeper structural factors or market shocks. Additionally, the decade-wise analysis overlooks short-term fluctuations, and the absence of firm-level or microeconomic evidence limits the depth of competitiveness assessment. Future research can address these gaps by employing finer product classifications, utilizing improved data sources, and incorporating micro-level or dynamic analytical approaches.

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