Indian Journal of Agricultural Economics 80: 2 (2025): 335-352
DOI:10.63040/25827510.2025.02.005

# Analysis of the Performance and Determinants of Indian Dairy Exports to Asian Markets

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ABSTRACT

India's dairy exports have surged in recent years despite fluctuating trends, particularly in Asian markets. This study examines the performance and determinants of Indian dairy exports under HS 4/6 codes to 46 Asian countries from 2000 to 2022. Export performance and stability were assessed using Export Market Share, Compound Annual Growth Rate (CAGR), and the Cuddy-Della Valle Index (CDVI). In 2022, India held 8.30 percent of the Asian dairy export market, with processed cheese exhibiting the highest growth (CAGR: 41.57%) and butteroil demonstrating the greatest stability (CDVI: 34.93). The highest growth (15.48%) of Indian dairy exports was recorded in Southeast Asia, while Gulf countries emerged as the most stable market (CDVI-54.39). A gravity model using Poisson Pseudo-Maximum Likelihood (PPML) revealed that GDP, per capita income, unit price, immigration, contiguity, and colonial ties positively influenced exports, while exchange rates and geographical distance had negative impacts. Targeted marketing campaigns and strong distribution networks in countries with large Indian diasporas while also strengthening trade relations with neighboring countries can help to boost dairy exports.

**Keywords: Dairy export, CAGR, CDVI, gravity model, PPML estimator**

**JEL codes: C23, F10, F13, Q17**

## I

## INTRODUCTION

India's position as a rising dairy exporter has gained momentum in recent years with exports reaching 63.7 thousand metric tonnes, valued at over 273 million US dollars in the 2023-24 fiscal year (APEDA, 2024). Globally, milk production is growing at an annual rate of 2 Percent, while India is achieving an impressive growth rate of over 6 Percent, significantly outpacing the global average (PIB, 2024). This rapid increase in milk production offers a significant opportunity for growth in dairy exports. However, the past decade has seen considerable fluctuations in both the volume and value of exports, leading to high instability. Despite these challenges, India has substantial potential to enhance its trade efficiency in dairy products by boosting domestic production and refining its marketing strategies (Kumar, 2010).

The Government of India has initiated various programs aimed at enhancing the potential of dairy exports. In 2016, the Central Government implemented the Merchandise Exports from India Scheme (MEIS) to incentivize the export of notified goods, including dairy products. To strengthen the infrastructure for the production, procurement, processing, and marketing of high-quality milk, the Department of

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Animal Husbandry and Dairying has been implementing the National Programme for Dairy Development (NPDD) since February 2014. For the 2023-24 fiscal year, Rs 345.93 crore has been allocated to this scheme. Additionally, the Dairy Processing & Infrastructure Development Fund (DIDF), with a total project outlay of Rs 11,184 crore from 2018-19 to 2022-23, aims to modernize milk processing facilities. To address quality and safety concerns in the export market, a comprehensive vaccination campaign has been launched to eradicate Foot and Mouth Disease (FMD) by 2025 and achieve FMD-free status by 2030. Furthermore, the Export Promotion Forum (EPF) was established by the Agricultural and Processed Food Products Export Development Authority (APEDA) in 2021 to support exporters of dairy products.

Over the last five years (2019-2023), Asian countries, which account for 27.52 percent of the world's dairy imports, have become key destinations for global dairy exports. Asia is the second-largest dairy-importing region, after Europe (58.31%). The top 10 dairy-importing countries in Asia make up nearly 80 percent of the region's total dairy imports. China leads with a trade value of $37.68 billion, representing 32.10 percent of the market, driven by factors such as rising income levels, urbanization, and dietary shifts towards dairy (Marinova *et al.*, 2022). Japan (7.10%), UAE (5.71%), Philippines (5.42%), and Hong Kong (5.16%) also contribute significantly to this demand, fuelled by population growth and changing dietary preferences.

Asia's growing dairy import market, supported by its proximity to India and favourable trade agreements, offers a strong opportunity for Indian dairy exports. Additionally, lower non-tariff barriers in countries like Singapore and Malaysia present further export growth potential (Kumar, 2021). As competitors like New Zealand face production challenges (Intodia and Zimmerman, 2017), India is well-positioned to expand its presence. Expanding into Asian markets has been identified as a key strategy for enhancing Indian dairy exports on the global stage (Joshi *et al.*, 2018). However, there is limited understanding of the current performance and future potential of Indian dairy exports in Asian markets. Although some studies (Kumar, 2010; Ohlan, 2014; Mondal and Sirohi, 2015) have examined Indian dairy export performance, detailed analyses of major dairy-importing Asian countries are scarce. A thorough assessment of these markets, along with insights from recent trends, can guide strategies to further enhance India's dairy export footprint in the region. This study specifically aims to analyze the performance and key determinants of Indian dairy exports to Asian markets.

## II

## DATABASE AND METHODOLOGY

The study relies on secondary data on 46 Asian countries to which India exported dairy products classified under the Harmonized System (HS) codes (HS-

0401, HS-0402, HS-0403, HS-0404, HS-0405, HS-0406, HS-3501, HS-1702) from 2000 to 2022. The export data was exclusively obtained from UN-COMTRADE database while data on gravity variables was compiled from multiple sources like World Development Indicators, IMF, CEPII, United Nations, and other annual reports. Export share, trend, growth rate, instability, and drivers of export performance were analyzed using the following analytical tools:

*2.1 Export market share and percentage share*

The export market share (EMS) of India in various regions of Asia for different dairy product groups at the HS 4-digit level was calculated by dividing the "export of $i^{th}$ product group from India to $C^{th}$ region of Asia" by "total global exports of $i^{th}$ product group to $C^{th}$ region of Asia".

The percentage share of different Asian regions in Indian dairy exports was calculated by dividing "export of $i^{th}$ product group from India to $C^{th}$ region of Asia" by "total export of $i^{th}$ product group from India to Asia".

*2.2 Growth and instability of Indian dairy exports*

The exponential growth function of the following form was fitted to work out the Compound Annual Growth Rate (CAGR) of exports (Gujarati, 2007; Kumar *et al.*, 2011; Ohlan, 2014) -

$$Y = ab^t \in \quad \textbf{...(1)}$$

Where, Y= Export Value, a= Constant term, b= Regression coefficient, t= Time variable (1,2,3...), ∈=Error term

The equation was estimated after transforming into: $\log Y = \log a + t \log b + \in$. Compound Annual Growth Rate 'r' was calculated as: r = [Antilog of (b*) - 1] x 100 where, b*= log b

Several statistical methods have been proposed in the literature to calculate the instability index, but there is no consensus on the best approach due to their varying advantages and limitations. A simple technique involves calculating the standard deviation of export or price indices, treating all fluctuations as instability. The coefficient of variation is another common method, but it tends to overestimate instability by ignoring predictable trends. This study adopts the Cuddy-Della Valle approach (Cuddy and Della Valle, 1978), which adjusts for trends in the data, offering a more precise measure of instability. Algebraically,

$$\text{CDVI} = \text{CV} \times \sqrt{(1 - \text{R}^2)} \quad \textbf{...(2)}$$

Where, CDVI= Cuddy-Della Valle instability index, CV = coefficient of variation, $R^2$ = coefficient of multiple determination (adjusted)

A lower value of this index indicates stability in exports from India to destination countries and vice-versa.

*2.3 Determinants of export performance of Indian dairy products*

The gravity model was used to identify various factors influencing the export performance of Indian dairy products. This model is a part of the new trade theory in international trade and was first introduced to economics by Tinbergen (1962), Pöyhönen (1963), and Pulliainen (1963) to investigate the major drivers of international trade. Since then, it has developed into one of the most effective empirical models in international economics (Anderson, 1979). The gravity model of trade theory explains how trade between two nations is directly related to their economic size (GDP) and inversely related to the distance between them (Tinbergen, 1966).

$$y_{ij} = \beta_0 \left(\frac{x_i^{\beta_i} x_j^{\beta_j}}{D_{ij}^{\beta_s}}\right) n_{ij} \quad \text{… (3)}$$

$y_{ij}$= trade flows from country i to country j, $x_i$ & $x_j$ = GDP for countries i and j, $D_{ij}$ = distance from country i to country j, $\beta_0$, $\beta_1$, $\beta_2$= unknown parameters, $n_{ij}$= error term with an expectation, E($n_{ij}$I $x_i, x_j$, $D_{ij}$) of one that is assumed to be statistically independent of the regressors.

However, to estimate this model, traditional approaches in the trade literature start by log-linearizing Equation (3), then estimating the parameters of interest through least squares with Equation (4)

$$\ln(y)_{ij} = \ln\beta_0 + \beta_1 \ln x_i + \beta_2 \ln x_j - \beta_3 \ln D_{ij} + \ln n_{ij} \quad \text{…(4)}$$

This approach is associated with two significant challenges: First, complications may arise when observing the dependent variable in instances where trade values are zero which was very common in our panel dataset. Second, the application of Ordinary Least Squares (OLS) to estimate Equation (4) can yield biased estimators if the var ($n_{ij}$) is correlated with the regressors. Specifically, OLS will only produce unbiased estimates in the unique scenario where the variance of bilateral trade is directly proportional to the square of the trade mean. Conversely, if the trade variance increases with the trade level but does not maintain a proportional relationship to the square of the mean, a correlation will exist between the variance of the error terms ($\ln n_{ij}$) and regressors $x_i, x_j$, $D_{ij}$ in Equation (4). In such instances, the results obtained from OLS will inevitably be biased. Unfortunately, this critical aspect is often overlooked in numerous studies, resulting in biases associated with Jensen's inequality.

Following Silva and Tenreyro (2006), the multiplicative gravity equation can be written as the following exponential function:

$$y_{ij} = exp\left[\ln \beta_0 + \beta_1 \ln x_i + \beta_2 \ln x_j - \beta_3 \ln D_{ij}\right] n_{ij} \quad \text{… (5)}$$

$$Where,\ n_{ij} = \log normal\ random\ variable\ (1, \sigma_i^2)$$

The objective function of the NLS estimator can be formulated as follows:

$$\hat{\beta} = argmin\ \beta \sum_{i=1}^{n} [y_i - \exp(x_i \beta)]^2 \quad \text{… (6)}$$

The FOC derived from this objective function can be written as:

$$\sum_{i=1}^{n} \left[y_i - \exp\left(x_i \exp\left(x_i \hat{\beta}\right)\right)\right] \exp\left(x_i \hat{\beta}\right) = 0 \quad \text{…(7)}$$

Nonlinear Least Squares (NLS) are deemed optimal solely when trade variance remains constant; however, it is highly probable that trade variance increases with the trade level. Consequently, while NLS is asymptotically consistent, it is also inefficient. Silva and Tenreyro,2006 argued for the Poisson Pseudo Maximum Likelihood (PPML) Model that provides a more efficient estimator and consists of dividing the NLS FOC by the conditional variance $\exp\left(x_i \hat{\beta}\right)$, which yields the FOC:

$$\sum_{i=1}^{n} \left[y_i - \exp\left(x_i \exp\left(x_i \hat{\beta}\right)\right)\right] = 0 \quad \text{… (8)}$$

Poisson Pseudo Maximum Likelihood (PPML) estimator has several advantages over other estimators, particularly in the context of gravity models for trade analysis (Gourieroux *et al.*,1984; Silva and Tenreyro, 2006; Babecká *et al.*,2012). Unlike OLS, PPML is robust to heteroscedasticity, which can bias OLS results by creating a correlation between error term variance and regressors. Additionally, PPML naturally accommodates zero trade values, which OLS, FEM, and REM often exclude due to the undefined logarithm of zero, avoiding sample selection bias. PPML remains consistent even when fixed effects, crucial for many gravity models, are included. Moreover, its coefficients can be interpreted similarly to OLS, especially when independent variables are in logarithms, and it doesn't require the dependent variable to be an integer or follow a Poisson distribution, making it flexible for various nonlinear models.

Therefore, the Poisson Pseudo-Maximum Likelihood (PPML) estimator was deemed more appropriate and was subsequently applied. Based on the literature, the study identified 12 explanatory variables, including 4 dummy variables that could influence dairy exports from India (Appendix).

III

RESULTS AND DISCUSSION

*3.1 Export market share and export trend of Indian dairy products in Asia*

The export market share (EMS) of India was calculated by dividing Indian dairy exports by the total global dairy exports to Asian countries (Fig 1). Starting with a 1.47 percent share in 2000, India's market presence increased progressively, reaching 3.53 percent in 2006, 4.52 percent in 2012, 6.69 percent in 2018, and ultimately 8.30 percent in 2022. This reflects a steady rise in India's export footprint in the Asian dairy market over the years.

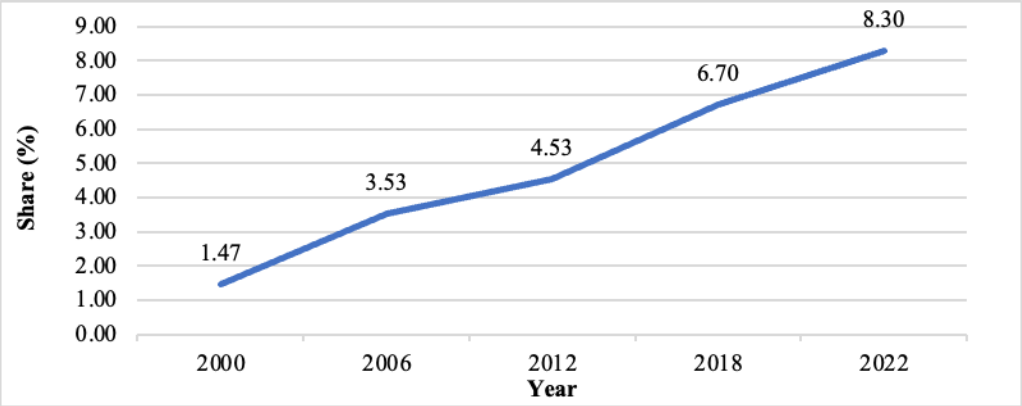


Figure 1. Export Market Share of India in Asian Markets

The trend in the value and volume of Indian dairy exports to Asia, which shows overall positive growth despite fluctuations, is presented in Fig 2. The growth remained steady until 2008, followed by a decline during the global financial crisis and the withdrawal of export benefits by the Indian government. In 2011, dairy exports were temporarily embargoed to curb domestic food inflation, further contributing to the downturn. The embargo was lifted in November 2012, leading to a peak in exports during 2013-14. Post-2020, both export value and volume have risen, likely driven by streamlined supply chains and government initiatives such as the Dairy Processing and Infrastructure Development Fund and the Production Linked Incentive Scheme for dairy products.

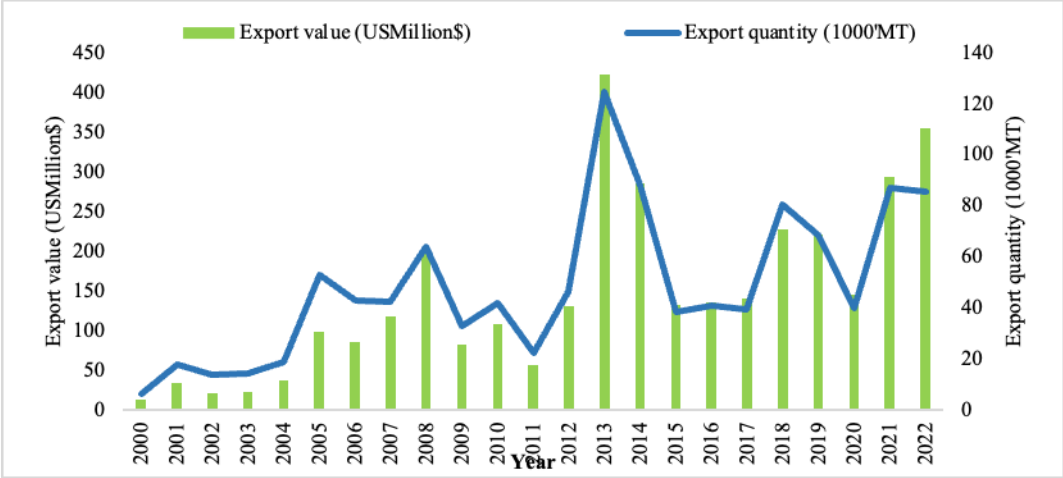


Figure 2. Trends in Indian Dairy Exports in Asian Markets

*3.2 Percentage share of different Asian regions in Indian dairy exports*

The percentage share of different Asian regions in Indian dairy exports is presented in Table 1. South Asia is the top destination for Unconcentrated Milk and Cream (HS-0401), accounting for 47.93 percent of exports. It also leads in Concentrated Milk and Cream (HS-0402) and Yogurt & Buttermilk (HS-0403), with shares of 58.45 percent and 35.97 percent, respectively. East Asia dominates as the primary destination for Whey exports (HS-0404), while the Gulf countries are the largest importers of Indian Butter (HS-0405). The Gulf is also tops in Cheese and Curd (HS-0406) imports, accounting for 46.34 percent. South Asia is the main importer of Lactose sugar (HS-170211) with a 46.34 percent share, while Casein (HS-3501) is primarily exported to Southeast Asia (56.17%). Central Asia's share is under 1 percent across all categories. Overall, South Asia is the largest market for Indian dairy exports at 35.98 percent, followed by the Gulf at 34.82 percent. India has a strong presence in South Asia and the Gulf but has the potential for expansion in Central Asia and East Asia. Strengthening trade relations, improving product quality, and targeting emerging markets in Southeast Asia (Malaysia, Singapore, Philippines, and Thailand) and East Asia (China, Republic of Korea) could further enhance India's competitive edge in the global dairy market.

TABLE 1. PERCENTAGE SHARE OF DIFFERENT ASIAN REGIONS IN INDIAN DAIRY EXPORTS (2000-2022)

| Product Group (HS) | East Asia | Central Asia | South Asia | South east Asia | West Asia | Gulf countries | Total |
|---|---|---|---|---|---|---|---|
| 0401 | 3.40 | 0.01 | 47.93 | 35.87 | 0.45 | 12.34 | 100 |
| 0402 | 2.36 | 0.03 | 58.45 | 12.40 | 10.40 | 16.36 | 100 |
| 0403 | 3.66 | 0.01 | 35.97 | 29.16 | 8.10 | 23.10 | 100 |
| 0404 | 63.67 | 0.01 | 7.96 | 7.44 | 1.07 | 19.85 | 100 |
| 0405 | 1.48 | 0.01 | 5.24 | 14.56 | 8.98 | 69.73 | 100 |
| 0406 | 4.00 | 0.01 | 23.18 | 19.22 | 0.90 | 52.59 | 100 |
| 170211 | 6.89 | 0.47 | 46.34 | 31.69 | 3.19 | 11.42 | 100 |
| 3501 | 15.66 | 0.00 | 1.16 | 56.17 | 4.11 | 22.90 | 100 |
| Overall | 3.77 | 0.01 | 35.98 | 17.12 | 8.28 | 34.82 | 100 |

*3.3 Growth and instability of Indian dairy exports in Asian markets*

The Compound Annual Growth Rate (CAGR) of various Indian dairy exports to Asia (Table 2) revealed that processed cheese (HS-040630) had the highest growth at 41.57 percent over the entire period, though it experienced a decline of -6.69 percent in 2018-22 due to stiff competition from major cheese exporters *viz.* European Union, the United States, and New Zealand as well as stringent quality standards during the pandemic. Caseinates (HS-350190) followed with a growth rate of 40.51 percent, while unprocessed cheese (HS-040690), lactose sugar (HS-170211), and butter (HS-040510) grew by 31.48 percent, 24.22 percent, and 24.07 percent, respectively. Conversely, whey powder (HS-040490) faced consistently negative growth, mainly due to stringent non-tariff measures (NTMs) in key markets like China and Vietnam, which imposed multiple barriers that limited export growth (Joshi, 2014).

India's overall dairy export value grew at a Compound Annual Growth Rate (CAGR) of 12.18 percent from 2000 to 2022. However, negative growth occurred during two key periods: 2006-2011, due to the global financial crisis, and 2012-2017, driven by a sharp decline in Skimmed Milk Powder (SMP) exports. The European Union's removal of milk quotas during this time also intensified competition from low-cost dairy producers like Germany and Poland. The highest growth rate, 35.93 percent, was recorded during 2000-2005 which may be fuelled by post-economic reforms, improved market access, and export subsidies. From 2018-2022, the export

value surged by 12.58 percent, reflecting supportive government policies and rising post-pandemic dietary demand.

TABLE 2. COMPOUND ANNUAL GROWTH RATES OF INDIAN DAIRY EXPORTS IN ASIA (%)

| Product code (HS) | 2000-05 | 2006-11 | 2012-17 | 2018-2022 | 2000-22 |
|---|---|---|---|---|---|
| 040110 | -42.43 | 47.82 | 20.96 | -53.84 | 11.44 |
| 040120 | 5191.62 | 9.96 | -7.22 | 30.34 | 17.36 |
| 040130 | - | -9.15 | 0 | 0 | - |
| 040150 | 0.00 | 0.00 | 2.32 | -30.16 | 6.81 |
| 0401 | 128.43 | 10.45 | -3.55 | 6.58 | 19.37 |
| 040210 | 41.72 | -26.75 | -29.08 | 26.97 | 5.86 |
| 040221 | 72.55 | - | - | 124.74 | - |
| 040229 | 36.10 | -12.77 | 53.11 | -14.09 | 5.88 |
| 040291 | 84.34 | 90.78 | 41.30 | 76.28 | 10.68 |
| 040299 | 5.31 | -15.26 | 97.58 | -10.69 | 0.07 |
| 0402 | 40.12 | -26.46 | -25.01 | 19.93 | 6.19 |
| 040310 | - | -8.91 | - | - | - |
| 040390 | 121.24 | -7.38 | 20.85 | 12.64 | 15.97 |
| 0403 | 121.31 | -10.96 | 20.68 | 11.18 | 15.57 |
| 040410 | 215.14 | -28.96 | -40.68 | -34.26 | 0.26 |
| 040490 | -10.11 | -29.56 | -20.86 | -27.10 | -4.09 |
| 0404 | 97.14 | -29.60 | -35.93 | -33.74 | -1.43 |
| 040510 | 22.86 | 25.55 | 13.89 | 16.68 | 24.07 |
| 040590 | 13.12 | 21.64 | 11.33 | 11.27 | 16.02 |
| 0405 | 14.12 | 22.07 | 11.43 | 11.70 | 17.75 |
| 040610 | 135.97 | 23.54 | -4.97 | -15.14 | 22.09 |
| 040620 | - | - | -3.42 | 13.13 | - |
| 040630 | 53.01 | 64.61 | 21.22 | -6.69 | 41.57 |
| 040690 | 21.68 | 29.04 | 26.75 | 10.04 | 31.48 |
| 0406 | 52.12 | 33.55 | 18.35 | 1.73 | 30.49 |
| 350110 | 2.99 | -3.97 | 2.03 | 69.39 | 19.31 |
| 350190 | 64.86 | 5.53 | 57.06 | 54.75 | 40.51 |
| 3501 | 6.70 | -3.29 | 7.11 | 64.34 | 21.27 |
| 170211 | 71.79 | 15.01 | 24.10 | -16.42 | 24.22 |
| Overall | 35.93 | -8.74 | -10.39 | 12.58 | 12.18 |

The Cuddy Della Valle Instability Index (CDVI) was used to assess the instability in Indian dairy exports to Asia (Table 3). Butteroil (HS-040590) was found to be the most stable export, followed by unprocessed cheese (HS-040690) and bulk and pack milk (HS-040120). Other products like whole milk powder (HS-040229) and condensed milk (HS-040291) also exhibited low instability. The highest instability was noted in Yoghurt (HS-040310), followed by milk and cream (HS-040140), whey powder (HS-040490), and blue-veined cheese (HS-040640), particularly during the early phase (2000-2005) when India's dairy industry was adapting to post-reform market conditions. Stability improved by the fourth phase (2018-2022), reflecting a more mature export market. Overall, cheese (HS-0406) was

the most stable product group, while buttermilk and yogurt (HS-0403) were the most unstable, consistent with findings by Das and Singh (2022).

TABLE 3. INSTABILITY INDEX (CDVI) OF INDIAN DAIRY EXPORTS IN ASIA

| Product code (HS) | 2000-05 | 2006-11 | 2012-17 | 2018-2022 | 2000-22 |
|---|---|---|---|---|---|
| 040110 | 167.85 | 21.36 | 64.57 | 94.16 | 139.61 |
| 040120 | 200.14 | 37.01 | 48.17 | 17.37 | 48.13 |
| 040130 | 194.75 | 51.69 | 207.02 | - | 158.94 |
| 040140 | - | - | 169.12 | 116.39 | 263.16 |
| 040150 | - | - | 72.83 | 56.34 | 134.01 |
| 0401 | 54.68 | 33.98 | 47.41 | 12.94 | 34.79 |
| 040210 | 66.67 | 63.19 | 92.67 | 76.23 | 110.52 |
| 040221 | 171.37 | 122.29 | 173.72 | 28.10 | 161.07 |
| 040229 | - | 121.53 | 90.95 | 19.35 | 69.72 |
| 040291 | 105.64 | 101.15 | 30.37 | 84.07 | 83.57 |
| 040299 | - | 161.43 | 50.66 | 46.70 | 116.79 |
| 0402 | 92.80 | 61.81 | 92.09 | 64.08 | 102.19 |
| 040310 | 207.02 | 268.91 | 97.58 | 68.15 | 349.81 |
| 040390 | 118.58 | 207.05 | 37.71 | 5.30 | 204.17 |
| 0403 | 126.64 | 186.78 | 38.63 | 4.25 | 192.39 |
| 040410 | 114.55 | 96.98 | 109.12 | 105.12 | 162.37 |
| 040490 | 103.26 | 227.60 | 78.11 | 53.17 | 257.39 |
| 0404 | 112.85 | 112.62 | 101.76 | 99.82 | 169.25 |
| 040510 | 13.14 | 57.18 | 20.06 | 79.88 | 130.92 |
| 040520 | 153.46 | 157.48 | 155.58 | 39.18 | 175.30 |
| 040590 | 15.59 | 25.74 | 8.48 | 16.29 | 34.93 |
| 0405 | 16.02 | 32.47 | 8.96 | 36.88 | 59.25 |
| 040610 | 95.17 | 23.79 | 33.09 | 55.00 | 70.88 |
| 040620 | 162.84 | 162.96 | 84.71 | 59.83 | 104.35 |
| 040630 | 119.65 | 41.25 | 29.19 | 10.92 | 53.36 |
| 040640 | 262.00 | 95.68 | 207.01 | 155.41 | 217.05 |
| 040690 | 38.94 | 56.75 | 22.50 | 7.39 | 41.20 |
| 0406 | 26.47 | 25.60 | 9.27 | 8.45 | 27.59 |
| 350110 | 119.76 | 75.73 | 59.43 | 56.11 | 82.30 |
| 350190 | 170.79 | 63.47 | 57.10 | 65.70 | 135.56 |
| 3501 | 79.5 | 74.78 | 57.62 | 57.20 | 82.99 |
| 170211 | 128.83 | 85.56 | 24.04 | 19.26 | 50.47 |
| Overall | 59.98 | 49.86 | 59.08 | 28.00 | 53.91 |

The growth rate and instability of Indian dairy exports were also analyzed for different regions of Asia (Table 4) to identify consistently growing and stable export destinations. Southeast Asia recorded the highest growth rate at 15.84 percent, likely driven by urbanization, rising incomes, and milk shortages in countries like the Philippines and Malaysia (Oliveros, 2019). The Gulf countries followed with 11.84 percent, while South Asia grew by 10.31 percent. East Asia had the lowest growth,

with a CAGR of 1.69 percent. In terms of stability, the Gulf countries were the most stable market with a CDVI of 54.39, supported by strong trade relations and FTA discussions with the GCC since 2004 (Pradhan, 2009). South Asia followed with a CDVI of 63.86, while Southeast Asia had a CDVI of 76.04. West Asia was identified as the most unstable market. These findings suggest that while Southeast Asia offers the fastest growth, the Gulf provides the most stable demand. However, instability in certain regions like West Asia could hinder long-term export success.

TABLE 4. CAGR AND CDVI OF INDIAN DAIRY EXPORTS TO DIFFERENT REGIONS OF ASIA

| | East Asia | Central Asia | South Asia | South East Asia | West Asia | Gulf Countries |
|---|---|---|---|---|---|---|
| CAGR (%) | 1.69 | 3.89 | 10.31 | 15.48 | 5.54 | 11.84 |
| CDVI | 115.03 | 145.89 | 63.86 | 76.04 | 157.25 | 54.39 |

*3.4 Determinants of export performance of Indian dairy products*

The determinants of Indian dairy export performance in Asia were analyzed using a gravity model, estimated with Poisson Pseudo-Maximum Likelihood (PPML) in panel data (Table 5). Results showed that the GDP of destination countries, India's GDP, per capita GDP of destination countries, unit prices, immigration, border sharing, and colonial ties positively impacted export performance. Conversely, distance and exchange rates of destination countries (US$) negatively affected exports.

The GDP of the destination countries had a positive and significant influence on export value indicating that India tends to export more dairy products to countries with larger economies. This finding is backed by the theoretical framework and consistent with similar conclusions in the study done by Kumar (2010) and Ohlan (2014) on drivers of India's dairy exports using the gravity model.

India's GDP had a positive and significant impact on the value of dairy exports, a 1 percent increase in India's GDP was found to result in 1.56 percent increase in dairy exports. This finding aligns with economic theories and is consistent with previous studies on gravity models (Kumar, 2010; Kahouli and Maktouf, 2013; Wang, 2016; Renjini *et al.,* 2017; Kiani *et al.,* 2018; Islam *et al.,* 2024).

The GDP per capita of destination countries also showed a positive and significant relationship with India's dairy exports, indicating that wealthier populations with higher consumption levels drive demand for Indian dairy products. Similar results were also reported by Islam *et al.* (2024) in their study as the coefficient associated with the product of GDP per capita was statistically significant and demonstrated a positive impact on Indian agricultural exports using

the same model. However, this result contrasts sharply with the conclusion reached by Kumar (2010), who reported that GDP per capita in destination countries negatively influenced India's dairy exports. These variations in results may be partially attributed to differences in model specification.

India's GDP per capita, however, exhibited a negative but non-significant relationship with dairy export values. The distance between trading partners had the expected negative sign, suggesting that India is more likely to export dairy products to neighboring countries. As in many gravity model studies, distance is considered a proxy for trade costs (Kea *et al.,* 2019; Shahriar *et al.,* 2019), reflecting the inverse relationship between trade and transportation costs. Increased transportation costs and logistical challenges may reduce the competitiveness of Indian dairy exports in distant markets. This result aligns with the findings of Khorajiya (2018) on the export competitiveness of Indian livestock products. Similar results were reported by Kumar (2010); Renjini *et al.* (2017); Kiani *et al.* (2018); and Islam *et al.* (2024) in their gravity model studies on export drivers.

TABLE 5. DETERMINANTS OF EXPORT PERFORMANCE OF INDIAN DAIRY PRODUCTS IN ASIA: A GRAVITY MODEL ESTIMATION

| | PPML | |
|---|---|---|
| **Dependent variable**: Total trade value | | |
| **Independent variables** | Coefficient | Z statistics |
| Log (GDP of destination country) | 0.180*** (0.044) | 4.10 |
| Log (GDP of India) | 1.560** (0.700) | 2.23 |
| Per capita GDP of destination country | 0.001** (0.001) | 2.06 |
| Per capita GDP of India | -0.001 (0.001) | -1.02 |
| Distance (Km) | -0.001** (0.001) | -2.04 |
| Unit price (USD/Kg) | 0.001*** (0.001) | 7.41 |
| Exchange rate (Per unit USD) | -0.001** (0.001) | -2.35 |
| Immigration | 0.001*** (0.001) | 8.76 |
| Contiguity | 0.966*** (0.185) | 5.22 |
| Common language | -0.824 (0.281) | -2.93 |
| Colonial ties | 0.444** (0.176) | 2.52 |
| Regional Trade Agreements (RTAs) | 0.001 (0.241) | 0.00 |
| Constant | -35.804* (18.475) | -1.94 |
| Observations | 23,925 | |
| Wald $chi^2$ | 554.96*** | |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Unit prices had a positive and significant impact, indicating an association with increased export values. The exchange rate had a significant negative relationship with the value of India's dairy exports, suggesting that Indian dairy exports become more affordable for destination countries when the exchange rate depreciates. This finding contrasts with the study by Ohlan, 2014, which found a positive relationship between exchange rates and export value.

The number of Indian immigrants in destination countries had a positive and significant effect on export value. This effect highlights the importance of diaspora communities in sustaining and expanding international trade for specific goods from their countries of origin.

Contiguity had a positive and statistically significant relationship with export value, underscoring the benefits of trading with neighbouring countries that share a border. The results also indicate that Bangladesh, Bhutan, and Nepal are major export destinations for Indian dairy products, supporting the relationship between proximity and trade growth. This finding aligns with the study of Haq and Ishaq (2008) on the gravity analysis of global dairy trade, as well as study by Kiani *et al.* (2018) on export performance.

Common language had no significant effect on Indian dairy exports to destination countries, a finding consistent with the study on Indian agricultural trade in ASEAN countries by Renjini *et al.* (2017). Colonial ties, however, showed a positive and significant relationship, indicating that countries with a shared colonial history with India are more likely to import Indian dairy products. The presence of Regional Trade Agreements (RTAs) with partner countries has not necessarily led to an increase in dairy exports from India. Joshi *et al.* (2014) also highlighted that, despite the concessions available for Indian dairy products under several RTAs, the Indian dairy sector has largely failed to capitalize on these benefits, indicating an urgent need to reassess India's focus in its FTAs/RTAs, particularly regarding dairy exports.

## IV

## CONCLUSION AND POLICY IMPLICATIONS

Despite fluctuations, India has made significant strides in expanding its dairy export market in Asia. Demand for Indian dairy products has particularly surged in South Asia, the Gulf countries, and Southeast Asia. However, Central and East Asia remain untapped markets with potential for growth. Attempts may be made to increase India’s export market share in these regions through trade negotiations, diversification of dairy product offerings and ensuring quality assurance. Additionally, strategies for stabilizing dairy exports need to be explored. India may also develop tailored marketing campaigns and establish robust distribution networks in countries with large Indian diaspora, especially in Southeast Asia and Gulf countries, to leverage their preference for familiar dairy products. Strengthening trade

relations with neighboring countries and capitalizing on proximity advantages should also be prioritized to further boost Indian dairy exports.

*Received: December2024.* *Revised: April 2025.*

REFERENCES

Anderson, J. (1979). Theoretical foundation for the gravity equation. *American Economic Review*, 69(1), 106–116.

Babecká Kucharčuková, O., Babecký, J., & Raiser, M. (2012). Gravity Approach for Modelling International Trade in South-Eastern Europe and the Commonwealth of Independent States: The Role of Geography, Policy and Institutions. *Open Economies Review*, 23(2), 277-301. DOI: 10.1007/s11079-010-9187-8

Cuddy, J. D., & Valle, P. D. (1978). Measuring the instability of time series data. *Oxford bulletin of economics and statistics*, 40(1): 79-85. Handle: *RePEc:bla:obuest:v:40:y:1978:i:1:p:79-85*

Das, J., & Singh, A. (2022). Export and import of Indian dairy products: An assessment. *Indian Journal of Dairy Science*, 75(6).

Gourieroux, C., Monfort, A., Trognon, A., 1984. Pseudo maximum likelihood methods: theory. *Econometrica*, 52 (3), 681–700. https://doi.org/0012-9682(198405)52:3%3C681:PMLMT%3E2.0.CO;2-N

Gujarati DN. 2007. Basic Econometrics (4th Edition). New York, NY: The McGraw-Hill.

Haq, Z., & Ishaq, M. (2008). A gravity analysis of global dairy products trade. *Sarhad Journal of Agriculture*, 24(4), 719-729. https://doi.org/10.1007/978-981-16-3260-0_3

Intodia, V., & Zimmerman, J. (2017). Dairy and products annual: India. *USDA Foreign Agricultural Service*. https://www.fas.usda.gov/data/india-dairy-and-products- annual-3

Islam, M. K., Mudasir Rajab, M., & Ahmed, M. (2024). An empirical analysis of factors affecting Indian agriculture exports with SAARC economies: A gravity model approach. *Res. Jr. Agril. Sci*, 15(2), 409-414.

Joshi, R. M. (2014). *India's dairy exports: Opportunities, challenges and strategies*. In Invited Article. National Seminar on "Indian Dairy Industry—Opportunities and Challenges". AAU Anand.

Joshi, R. M., Symss, J. & Rana, A. (2018). *Roadmap and Strategies to Promote Export of Dairy Products for the Organized Dairy Sector*. National Dairy Development Board. https://www.nddb.coop/sites/default/files/pdfs/baseline/ 16_Roadmap_&_strategies_to_promote_dairy_products.pdf

Kahouli, B., & Maktouf, S. (2013). Regional trade agreements in Mediterranean area: Econometric analysis by static gravity model. *Journal of East-West Business*, 19(4), 237-259. https://doi.org/10.1080/10669868.2013.794380

Kea, S., Li, H., Shahriar, S., Abdullahi, N. M., Phoak, S., & Touch, T. (2019). Factors influencing Cambodian rice exports: An application of the dynamic panel gravity model. *Emerging Markets Finance and Trade*, 55(15), 3631-3652. DOI: 10.1080/1540496X.2019.1673724

Khorajiya, M., Shiyani, R. L., Ardeshna, N. J., Swaminathan, B., & Meena, M. (2018). Export Competitiveness and Performance of Indian Livestock Export-A Balance Panel Data Analysis. *International Journal of Livestock Research*, 8(3), 141-155. DOI: 10.5455/ijlr.20170828011840

Kiani, A., H. Muhammad and A.Siddique. (2018). Determinants of Agricultural Exports of Pakistan : An Application of Gravity Model. *The Dialogu*,8(4), 467-478.

Kumar, A. (2010). Exports of Livestock Products from India: Performance, Competitiveness and Determinants. *Agricultural Economics Research Review*, 23, 57-67.

Kumar, A., Rai, D. C., & Ram Chaudhary, K. (2011). Prospects and opportunities for exports of dairy products from India. *Indian Journal of Animal Sciences*, 81(2), 188.

Kumar, C. N. (2021). Non-tariff measures on India's agri-food exports: Is ease of doing business reform distractive? *The Routledge Handbook of Post-Reform Indian Economy*, 221-236.

Marinova, D., Bogueva, D., Wu, Y., & Guo, X. (2022). China and changing food trends: A sustainability transition perspective. *Ukrainian Food Journal*, 11(1), 126-147. https://doi.org/10.24263/2304-974X-2022-11-1-13

Mondal, B., & Sirohi, S. (2015). Capitalizing Gains from Dairy Trade: Excavating the Market Potential. Economic Affairs, 60(4): 637-646.

Ohlan, R. (2014). Competitiveness and trade performance of India's dairy industry. *Asian Journal of Agriculture and Development*, 11(2), 17-37. DOI: 10.2139/ssrn.2797978

Oliveros, M. C. R. (2019). The dairy industry in southeast asia: perspective, challenges and opportunities. In *IOP Conference Series: Earth and Environmental Science*. 372 (1): 012068). IOP Publishing. doi:10.1088/1755-1315/372/1/012068

Pöyhönen, P. (1963). A tentative model for the volume of trade between countries. *Weltwirtschaftliches archiv*, 93-100. http://www.jstor.org/stable/40436776

Pradhan, S. R. (2009). India's export potential to the Gulf Cooperation Council: A gravity model exploration. *IUP Journal of Applied Economics*, *8*(3/4), 48-71.

Press Information Bureau. (2024, May 31). *World Milk Day (June 01).* [Press Release]. https://pib.gov.in/PressNoteDetails.aspx?NoteId=151889&ModuleId=3

Pulliainen, K. (1963). A World Trade Study: An Econometric Model of the Pattern of the Commodity Flows of International Trade in 1948-60. *Economiska Sanmfundets Tidskrift*. 16(1), 78-91.

Renjini, V. R., Kar, A., Jha, G. K., Kumar, P., Burman, R. R., & Praveen, K. V. (2017). Agricultural trade potential between India and ASEAN: An application of gravity model. *Agricultural Economics Research Review*, 30(1), 105-112. 10.5958/0974-0279.2017.00009.X

Shahriar, S., L. Qian, and S. Kea. 2019. Determinants of Exports in China's Meat Indus try: A Gravity Model Analysis. *Emerging Markets Finance and Trade*, 55 (11), 2544–2565. https://doi.org/10.1080/1540496X.2019.1578647.

Silva, J. M. C. S., and S. Tenreyro. 2006. "The Log of Gravity." *The Review of Economics and Statistics*, 88(4), 641–658. https://doi.org/10.1162/rest.88.4.641.

Tinbergen, J. (1962). An analysis of world trade flows. Shaping the world economy: 1- 117.

Tinbergen, J. (1966). Shaping the World Economy; Suggestions for an International Economic Policy. *Economic Journal* ,76 (301), 92–95. https://doi.org/10.2307/2229041.

Wang, X., & Badman, R. P. (2016). A multifaceted panel data gravity model analysis of Peru's foreign trade. arXiv preprint arXiv:1612.01155.

APPENDIX

TABLE A. HS-6 DIGIT DAIRY PRODUCT CODES WITH DESCRIPTION

| Product Code (HS) | Product Name | Description |
|---|---|---|
| 040110 | Bulk & Pack Milk | Milk and cream, not concentrated nor containing added sugar or other sweetening matter: Of a fat content, by weight, not exceeding 1 % |
| 040120 | Bulk & Pack Milk | Milk and cream, not concentrated nor containing added sugar or other sweetening matter: Of a fat content, by weight, exceeding 1 % but not exceeding 6 % |
| 040130 | Bulk & Pack Milk | Milk and cream, not concentrated or sweetened, fat content, by weight >6% |
| 040140 | Cream | Milk and cream, not concentrated nor containing added sugar or other sweetening matter: Of a fat content, by weight, exceeding 6 % but not exceeding 10 % |
| 040150 | Cream | Milk and cream, not concentrated nor containing added sugar or other sweetening matter: Of a fat content, by weight, exceeding 10 % |
| 040210 | SMP | Milk and cream, concentrated or containing added sugar or other sweetening matter: In powder, granules or other, solid forms, of a fat content, by weight, not exceeding 1.5 % |
| 040221 | WMP | Milk and cream, concentrated or containing added sugar or other sweetening matter: In powder, granules or other solid forms, of a fat content, by weight, exceeding 1,5 %: Not containing added sugar or other sweetening matter |
| 040229 | WMP | Milk and cream, concentrated or containing added sugar or other sweetening matter: In powder, granules or other solid forms, of a fat content, by weight, exceeding 1,5 %: Other |
| 040291 | Condensed Milk | Milk and cream, concentrated or containing added sugar or other sweetening matter: Other: Not containing added sugar or other sweetening matter |
| 040299 | Condensed Milk | Milk and cream, concentrated or containing added sugar or other sweetening matter: Other: Other |
| 040310 | Yoghurt | Buttermilk, curdled milk and cream, Yoghurt, kephir and other fermented or acidified milk and cream, whether or not concentrated or containing added sugar or other sweetening matter or flavoured or containing added fruit, nuts or cocoa: Yoghurt |
| 040390 | Yoghurt | Buttermilk, curdled milk and cream, Yoghurt, kephir and other fermented or acidified milk and cream, whether or not concentrated or containing added sugar or other sweetening matter or flavoured or containing added fruit, nuts or cocoa: Other |
| 040410 | Whey | Whey, whether or not concentrated or containing added |

| | | |
|---|---|---|
| | Powder | sugar or other sweetening matter; products consisting of natural milk constituents, whether or not containing added sugar or other sweetening matter, not elsewhere specified or included: Whey and modified whey, whether or not concentrated or containing added sugar or other sweetening matter |
| 040490 | Whey Powder | Whey, whether or not concentrated or containing added sugar or other sweetening matter; products consisting of natural milk constituents, whether or not containing added sugar or other sweetening matter, not elsewhere specified or included: Other |
| 040510 | Butter | Butter and other fats and oils derived from milk; dairy spreads: Butter |
| 040520 | Butter | Butter and other fats and oils derived from milk; dairy spreads: Dairy spreads |
| 040590 | Butter | Butter and other fats and oils derived from milk; dairy spreads: Other |
| 040610 | Cheese | Cheese and curd: Fresh (unripened or uncured) cheese, including whey cheese, and curd |
| 040620 | Cheese | Cheese and curd: Grated or powdered cheese, of all kinds |
| 040630 | Cheese | Cheese and curd: Processed cheese, not grated or powdered |
| 040640 | Cheese | Cheese and curd: Blueveined cheese and other cheese containing veins produced by Penicillium roqueforti |
| 040690 | Cheese | Cheese and curd: Other cheese |
| 350110 | Casein | Casein, caseinates and other casein derivatives; casein glues: Casein |
| 350190 | Caseinates | Casein, caseinates and other casein derivatives; casein glues: Other |
| 170211 | Lactose | Sugars; lactose and lactose syrup, containing by weight 99 % or lactose, expressed as anhydrous lactose, calculated on the dry matter |

TABLE B. DESCRIPTION OF VARIABLES USED IN GRAVITY MODEL

| Variables | Unit | Source | Expected sign |
|---|---|---|---|
| Y is the exports from $j^{th}$ (India) country to $i^{th}$ (destination) country at time t | US$ | UN-COMTRADE | |
| Gross Domestic Product of the destination country at time t | US$ | World Development Indicators | + |
| GDP of the exporter country (India) at time t | US$ | World Development Indicators | + |
| GDP per capita of the destination country at time t | US$ | World Development Indicators | +/- |
| GDP per capita of the exporter country (India) | US$ | World Development Indicators | +/- |
| Geographical distance between India and the destination country | Kilometers | CEPII | - |
| Export unit value of Indian dairy product in the destination country at t | Per unit USD | Author's Calculation | - |
| Exchange rate of destination country with respect to USD at time t | Per unit USD | IMF | - |
| Number of Indian migrants living in the destination country at time t | Population size | United Nations, Our world in data | + |
| Dummy variable for contiguity, 1 if the destination country shares a border with India, otherwise 0. | Binary | CEPII | + |
| Dummy variable for common language, 1 if India and the destination country share a common language, otherwise 0. | Binary | CEPII | + |
| Dummy variable representing the colonial relationship between India and the destination country, 1 if had, otherwise 0. | Binary | CEPII | + |
| Dummy variable representing the Regional Trade Agreement between India and the destination country, 1 if RTA exists, otherwise 0 at time t | Binary | CEPII/ Joshi *et al.*,2018 | + |