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Impact of Exchange Rates and Price Elasticities on The Horticultural Trade Balance of India

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ABSTRACT

The horticulture sector is crucial to the Indian economy, contributing significantly to GDP and employment. India exported USD 19.3 billion worth of horticultural produce in TE2023 contributing significantly to its foreign exchange reserves. The size of global horticultural exports is increasing over time (3-4 times from TE2003 to TE2023) and India must compete for major global share. This study analyzes the trade balance of fruits, vegetables, and processed agricultural products for India from 2000 to 2023 by using trade data from UNCOMTRADE and employing descriptive analysis to examine export trends. A panel data model was also used to estimate the effect of income, price, and exchange rates on the trade of these commodity groups. The results revealed that developed nations lead the global exports in these categories. The export pattern in India shows that the trade of highly perishable products is mainly confined to the Asian region, while processed products have greater global reach. The results from the panel data model indicate that currency devaluation could help improve India's trade balance in these commodity groups. Both exports and imports are found to be price elastic, highlighting the importance of competitive pricing. Changes in foreign income significantly impact exports under edible fruit and nuts, while domestic income affects imports under HS 07 and HS 20. The study highlights that India needs to invest in developing processing technologies for fruits and vegetables to reduce the wastage of perishable produce and enable her to capture a larger share of the growing global market for processed horticultural products, thereby improving its trade balance in this sector.

Keywords: Trade balance, fruits, vegetables, processed products, income and price elasticities,
JEL Codes: Q17, Q27, F13

I

INTRODUCTION

Indian agriculture and allied activities employ approximately 52 percent of labour, and account for 13.70 percent of the total gross domestic product (GDP) for 2020 (Manida, 2020; Siddiqui, 2023). The horticultural sector emerged as an important driver of growth with the potential to raise farm income, provide livelihood security, and earn foreign exchange (Kashish and Dhawan, 2017; Kumar *et al.*, 2023). This sector has witnessed tremendous growth due to investment through the National Horticulture Mission (NHM) and several other policy initiatives (Singh and Toppo, 2010). India is the second largest producer of fruits, vegetables, spices, and plantation crops such as tea and coffee in the world. The area and production of fruits and vegetables have increased considerably during the last two decades, whereas the demand for fruits and vegetables, both fresh and processed, has also been growing in the international market (Rabha and Sarma, 2021).

Horticultural exports from India have recently received greater attention of India's policymakers. The government has prioritized the development of the

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horticultural sector for export diversification, and India's participation in the global horticultural trade has increased (Saxena *et al.*, 2022). India's export of fresh vegetables has considerably increased from 0.64 billion USD in 2009-10 to 0.92 billion USD in 2022-23, whereas in the case of fresh fruits, the export reached 0.86 billion USD in 2022-23 from 0.32 billion USD in 2009-10. On the other hand, India's imports of fresh vegetables have not increased significantly and reached only 5.35 million USD in 2022-23 and whereas that of fresh fruits has risen to 2484 million USD in 2022-23 (APEDA, 2024).

The positive trade balance of any country is significant as it can bolster economic growth and stability and is equally important for India. Baek and Koo (2008) brought out that a positive agricultural trade balance enhances financial stability and strengthens the currency, while a negative balance can weaken the currency and strain economic growth; others have suggested that economic growth declines more sharply when the trade balance deteriorates, especially in the presence of a large trade deficit (Blavasciunaite *et al.*, 2020; Abbas & Raza, 2013; Bakari & Tiba, 2019). Thus, the agricultural trade balance is crucial in shaping the overall macroeconomic conditions of a country.

The current paper aims to identify potential trading partners for three commodity groups, namely, HS 07 (edible vegetables and certain roots and tubers), HS 08 (edible fruit and nuts; peel of Citrus Fruit or Melons), and HS 20 (preparations of vegetables, fruits, nuts or other parts of plants). Furthermore, the study also examines the impact of price elasticity (the price of exported/imported products), income elasticity (GDP at PPP), and bilateral exchange rate on the trade balance of India for these three commodity groups. The findings of the paper will be helpful to improve India's agricultural trade balance by guiding policymakers in designing strategies to boost exports and assisting traders and farmers in optimizing production and supply chain management to meet international demand.

II

DATABASE AND METHODOLOGY

The study used data for the period 2000 to 2023 for the export and import of vegetables (HS 07), fruits (HS 08), and processed fruits and vegetables (HS 20). The bilateral trade data at the HS-4 level was obtained from the UNCOMTARDE (https://comtradeplus.un.org/TradeFlow). The GDP at the current PPP and official exchange rate data for the trading countries were obtained from the databank of the World Bank. Descriptive analysis was done for all products coming under HS 07, HS 08, and HS 20 to illustrate the trade status for these products. A panel data was constructed for all pairs of trading partners and HS-4 level commodities. The study covered all the commodities where the bilateral trade data from 2000 to 2023 were continuously available to avoid any bias. There are 14 commodities under vegetables,

14 under fruits, and nine under processed fruits and vegetables, details of which are provided in the Appendix.

2.1 Price and quantity index construction

UNCOMTRDE provides detailed international trade data up to HS-6 digits of disaggregation. Data is available in the "ITC trade map" for HS 8-digit level disaggregation. Still, these codes are specific to the country level, and making a concordance for all trading partners for this disaggregation level is difficult. The study therefore used the HS 4-digit level of disaggregation to build the price and quantity index and examine the trade balance for India for three commodity groups (HS-07, HS-08, and HS-20) related to horticultural products.

The quantity and trade value provided in the data set for the HS 4-digit level were used to estimate the unit price.

$$P_{c,i,t}^{HS-4} = \frac{Primary\ value_{c,i,t}}{Net\ weight_{c,i,t}} - - - - - - - - - - - (1)$$

where, $P_{c,i,t}^{HS-4} = Unit\ price\ at\ HS\ 4\ digit\ level\ for\ commodity\ c, partner\ country\ i\ and\ time\ t.$

Prices at the aggregated HS 2-digit level are defined as value-weighted average prices $P_{c,k,t}^{HS-2}$, where k is used in place of i for HS 2-digit level products.

$$P_{c,k,t}^{HS-2} = \sum_{i \epsilon k} \left(\frac{Primary\ value_{c,i,t}}{\sum_{i \epsilon k} Primary\ value_{c,i,t}} \right) - - - - - - - - (2)$$

At the HS 2-digit level, the quantity of exported commodities is unavailable. Thus, a quantity index ($Q_{c,i,t}^{HS-2}$) was built for HS 2-digit level from primary value and value weighted price index (equation 2).

$$Q_{c,i,t}^{HS-2} = \frac{Primary\ value_{c,k,t}}{P_{c,k,t}^{HS-2}} - - - - - - - - - - - (3)$$

These price and quantity indices were normalized by previous year indices and converted to logarithmic form for further estimation. The normalized price and quantity indices are defined as follows,

$$\tilde{P}_{c.k,t}^{Export} = ln\left(\frac{P_{c,k,t}^{Export}}{P_{c,k,t-1}^{Export}} \right) = \ln\left(P_{c,k,t}^{Export}\right) - ln\left(P_{c,k,t-1}^{Export}\right) - - - (4)$$

$$\tilde{Q}_{c.k,t}^{Export} = ln\left(\frac{Q_{c,k,t}^{Export}}{Q_{c,k,t-1}^{Export}}\right) = \ln\left(Q_{c,k,t}^{Export}\right) - ln\left(Q_{c,k,t-1}^{Export}\right) - - - (5)$$

2.2 Trade balance equation

Trade balance captures the difference between aggregate export and import values. The trade balance can be defined as follows,

$$Trade\ balance\ (TB) = \sum_{k} Export\ value(EX) - \sum_{k} Import\ value(IM) - - - - (6)$$

In this study, export value at aggregated HS 2-digit level is the product of the quantity and price index built as in equations 2 and 3. For a particular industry k, the export value can be defined as,

$$EX_k = P_k^{EX}(s).Q_k^{EX}\left(\frac{P_k^{EX}}{s}, Y^{partner}\right) - - - - - - - - (7)$$

and import value can be represented as,

$$IM_k = P_k^{IM}(s).Q_k^{IM}\left(\frac{P_k^{IM}}{s}, Y^{India}\right) - - - - - - - - (8)$$

where s is the bilateral exchange rate between India and its trading partner and $Y^{partner}$is the GDP at current PPP (USD) for trading partners and Y^{India} is the GDP at current PPP (USD) for India.

The exchange rate can be estimated as $s = \frac{Value\ of\ partner's\ currency\ for\ 1\ USD}{Value\ of\ India's\ currency\ for\ 1\ USD}$---------
-(9)

From equations 7 and 8, the trade balance equation can be derived as,

$$TB\left(s, P_k^{EX}, P_k^{IM}, Y^{India}, Y^{foreign}\right) = P_k^{EX}(s).Q_k^{EX}\left(\frac{P_k^{EX}}{s}, Y^{foreign}\right) - P_k^{IM}(s).Q_k^{IM}\left(\frac{P_k^{IM}}{s}, Y^{India}\right) - -(10)$$

The price elasticity, exchange rate pass-through elasticity, foreign country"s GDP, and India's GDP elasticity can be obtained from the equation 10. To explain India's trade deficit or surplus in a particular commodity group with the

appreciation/depreciation of Indian currency, the paper focused on the price effect with the exchange rate pass-through effect. The GDP (Income effect) has also been included in the estimation to show the impact of the income of the destination country on the demand for exports and India's demand for imports.

Quantity (demand) and price equation for Indian export of commodity k can be written in the regressable form as,

$$\tilde{Q}_{c.k,t}^{Export} = \beta_0 + \beta_1 \tilde{P}_{c.k,t}^{Export} + \beta_2 Y_{c,t}^{foreign} + \lambda_c + \varepsilon_{c,k,t} - - - - - (11)$$

where, $\tilde{Q}_{c.k,t}^{Export}$ =log difference of the quantity index of Indian exports aggregated at HS 2-digit level industry k and partner country c

$\tilde{P}_{c.k,t}^{Export}$ = log difference of the price index of Indian exports aggregated at HS 2-digit level industry k and partner country c

$Y_{c,k,t}^{foreign}$ = log difference of the index of the GDP at current PPP for partner country

λ_c= fixed effect of the partner country

$\varepsilon_{c,k,t}$= error term

The expected sign of the price coefficient is $\beta_1 < 0$. The β_2 for a normal goods commodity can be >0 but negative for an inferior commodity group.

Similarly, the price equation for the Indian exports for a particular commodity group k can be defined as,

$$\tilde{P}_{c.k,t}^{Export} = \beta_0 + \beta_1 s_{c,t} + \lambda_c + \eta_{c,k,t} - - - - - (12)$$

Where, $\tilde{P}_{c.k,t}^{Export}$ = log difference of the price index of Indian exports aggregated at HS 2-digit level industry k and partner country c

$s_{c,t}$=nominal bilateral exchange rate between India and partner country c

λ_c= fixed effect of the partner country

$\eta_{c,k,t}$=error term

β_1 denotes the exchange rate pass-through elasticity, which is =0 for complete pass-through and =1 for zero pass-through.

Similarly, the import side quantity demanded and price equation can be presented as,

$$\tilde{Q}_{c.k,t}^{Import} = \beta_0 + \beta_1 \tilde{P}_{c.k,t}^{Import} + \beta_2 Y_t^{India} + \lambda_c + \varepsilon_{c,k,t} - - - - - (13) \text{ and}$$

$$\tilde{P}_{c.k,t}^{Import} = \beta_0 + \beta_1 s_{c,t} + \lambda_c + \eta_{c,k,t} - - - - - (14)$$

Here, the interpretation of exchange rate pass-through elasticity is the opposite of the export equation. The fixed effect model takes country-specific fixed effects and estimates equations 11, 12, 13, and 14.

III

RESULTS AND DISCUSSION

The present section highlights the export performance of fruits, vegetables, and processed products at the global and Indian levels at the HS2 and HS4 levels. as well as the decomposition of India's trade balance into income, price, and exchange rate pass-through elasticity.

3.1 Export performance and major destination countries of HS 07, HS 08, and HS 20: Global and India

The information about the export performance of fruits, vegetables, and processed products, is depicted in Table 1. The export of HS 07 for the world has more than doubled from 23.2 billion USD in TE 2002 to 54.6 billion USD in TE 2011, further increasing to 79.8 billion USD in TE 2023. Meanwhile, the global export of HS 08 increased by 4.2 times from 33.5 billion USD in 2002 to 141.7 billion USD in 2023. The global export of HS 20 has risen from 20.5 billion USD to 68.8 billion USD respectively. The export of HS 08 was comparatively higher than HS 07 and HS 20 for both the world and India in the recent period.

TABLE 1. EXPORT SCENARIO OF HS-07, HS-08 AND HS-20, TE 2002 to TE 2023

Period	Global (Billion USD)			India (Billion USD)			Contribution of India (%)		
	HS 07	HS 08	HS 20	HS 07	HS 08	HS 20	HS 07	HS 08	HS 20
TE 2002	23.2	33.5	20.5	0.45	0.35	0.01	1.94	1.04	0.05
TE 2005	31.8	48.7	28.6	0.55	0.61	0.02	1.74	1.26	0.07
TE 2008	45.4	69.2	42.6	1.21	0.93	0.03	2.66	1.34	0.08
TE 2011	54.6	82.4	47.9	1.94	1.50	0.06	3.54	1.82	0.12
TE 2014	64.4	103.0	55.8	2.43	2.19	0.08	3.77	2.12	0.14
TE 2017	68.7	116.2	55.5	3.89	3.09	0.08	5.66	2.66	0.15
TE 2020	70.6	133.3	60.7	1.45	3.35	0.11	2.05	2.51	0.18
TE 2023	79.8	141.7	68.8	2.42	4.04	0.14	3.03	2.85	0.20

Source: *UNCOMTRADE*

In India, a significant export increase was recorded for HS 07 and HS 08 during the study period. The export of HS 07 increased from 0.45 billion USD in TE 2002 to 2.42 billion USD in TE 2023, whereas the export of HS 08 increased by 12 times from 0.35 billion USD to 4.04 billion USD during this period. The export of

HS 20 from India was merely 0.01 million USD in TE 2002, which increased to 0.14 million USD in TE 2023. The contribution of India to the global export of HS 07, HS 08, and HS 20 was 3.03 percent, 2.85 percent, and 0.20 percent in TE 2023. The lowest export of HS 20 indicates inadequate cold chain and storage facilities and low quality of produce.

TABLE 2. MAJOR EXPORTING COUNTRIES OF HS-07, HS-08 AND HS-20, TE 2023

Sr. No.	HS 07		HS 08		HS 20	
	Exporting Countries	Share (%)	Exporting Countries	Share (%)	Exporting Countries	Share (%)
1	USA	18.2	USA	16.6	USA	18.5
2	Germany	9.6	China	12.1	Germany	8.8
3	United Kingdom	5.6	Germany	8.5	France	6.8
4	France	5.2	Netherlands	5.8	United Kingdom	6.5
5	Canada	4.7	France	4.7	Japan	5.6
6	India	3.0	India	2.9	India	0.20

Source: *UNCOMTRADE*

Table 2 presents information regarding the major exporting countries of HS 07, HS 08, and HS 20 for TE 2023. In the case of HS 07, the USA is the leading exporter, accounting f for 18 percent of global vegetable exports. Germany (9.6%) is the second largest exporter of HS 07, followed by the United Kingdom (5.6%), France (5.2%), and Canada (4.7%). India contributed merely 3.0 percent to the global vegetable exports in TE 2023. In the case of HS 08, the USA (16.6%) contributed the highest to the worldwide fruit exports, followed by China (12.1%), Germany (8.5%), Netherlands (5.8%), and France (4.7%) during the year TE 2023. The contribution of India for HS 08 to the global fruit export is merely 2.9 percent in TE 2023. For HS 20, the contribution of the USA, Germany, France, the UK, and Japan was 18.5, 8.8, 6.8, 6.5, and 5.6 percent, respectively. The USA, Germany, and France are global exporters, while India's contribution is too low for HS 07, HS 08, and HS 20.

TABLE 3. EXPORT (BILLION USD) TREND OF MAJOR COMMODITIES OF HS-07, HS-08 AND HS-20 AT THE GLOBAL LEVEL

Commodity	TE 2002	TE 2005	TE 2008	TE 2011	TE 2014	TE 2017	TE 2020	TE 2023	CAGR
HS 07(Edible Vegetables and certain roots and fibres)									
HS 0702	3.28	4.66	6.64	7.91	8.91	8.65	9.30	10.22	5.01**
HS 0703	1.71	2.42	3.69	4.92	5.19	6.16	6.28	6.48	6.42***
HS 0709	4.79	6.94	9.24	10.51	12.43	13.19	15.03	16.57	5.62***
HS 0710	2.70	3.57	4.98	5.63	6.29	6.32	7.05	7.51	4.62***
HS 0713	2.73	3.34	5.50	7.92	9.98	12.28	9.24	12.36	7.53**
Others	8.01	10.89	15.39	17.75	21.56	22.08	23.64	26.69	5.54***
HS 08(Edible fruits and nuts; peel of citrus fruits and melons)									
HS 0802	3.25	5.39	7.80	9.68	14.05	16.24	17.34	16.13	8.1***
HS 0803	6.05	8.12	10.55	12.06	13.52	14.18	15.11	14.51	4.14**
HS 0804	2.19	3.59	5.54	6.73	8.76	11.87	15.26	16.77	10.01***
HS 0805	5.25	7.27	9.86	11.57	13.34	13.93	15.65	15.11	5.05***
HS 0806	3.52	5.00	7.25	8.61	10.22	10.26	11.34	11.40	5.52**
HS 0808	3.86	5.54	7.91	8.80	10.56	10.07	10.14	9.15	4.04*
HS 0810	2.59	4.03	6.10	8.10	11.50	14.26	19.84	26.29	11.35***
Others	6.76	9.73	14.23	16.86	21.07	25.39	28.63	32.32	7.54***
HS 20 (Preparations of vegetables, fruits, nuts or other parts of plants)									
HS 2002	1.35	1.93	2.86	3.72	4.14	4.04	3.97	5.16	5.77**
HS 2004	2.30	3.15	4.60	5.76	7.10	7.56	9.07	11.47	7.5***
HS 2005	3.76	5.31	7.45	8.39	9.48	9.39	10.60	11.78	4.99***
HS 2008	4.32	6.44	9.05	10.45	13.06	14.22	15.61	17.70	6.5***
HS 2009	6.50	8.68	14.12	14.57	16.19	14.47	14.90	15.32	3.59*
Others	2.24	3.09	4.47	4.96	5.85	5.85	6.51	7.32	5.29***

Source: *UNCOMTRADE*

Between TE 2002 and TE 2023, India's vegetable exports(HS07) expanded at a compound annual growth rate (CAGR) of 5.79 percent, with the most pronounced acceleration occurring during 2005–2008. By 2023, HS07 exports had risen to USD 79.8 billion, led by dried leguminous vegetables (HS 0713), which achieved the highest subheading CAGR of 7.53 percent. Parallel dynamics were observed in the HS08 fruits and nuts segment, which grew at an average CAGR of 6.97 percent, peaked during the same phase of logistical modernization and burgeoning demand for both fresh and processed fruit, and reached USD 141.7 billion in TE 2023; within this group, processed berry preparations (HS 0810) registered an exceptional annual growth of 11.35 percent. The HS20 processed plant preparations category achieved an annual growth of 5.61 percent, and exports reached USD 68.8 billion in TE 2023, with vegetable preserves (HS 2004) leading with the highest annual growth of 7.50 percent. These sectoral trends closely mirrored the 8.5 percent expansion in global merchandise trade in 2006, attributable to rising foreign incomes in emerging markets and expanded production capacity and were underpinned by ongoing technological advances in logistics and retail infrastructure (US CEA, 2008 and WTO, 2008).

Table 4 revealed the commodity-wise share of major exporting countries for selected commodities under HS codes 07, HS 08, and HS 20 at the global level. In

sub-categories of HS 07, i.e., HS 0702, the United States dominates with 29.97% of global exports, followed by Germany (16.39%) France (9.45%), the United Kingdom (6.7%) and the Netherlands (4.11%). It is interesting to note that the USA dominates in global exports of all the selected commodities in HS07 commodities such as 0702, 0703,0709, and 0710. However, for HS 0713 (Dried leguminous vegetables, shelled, whether or not skinned or split), India leads in global exports (19.29%), followed by China (12.57%) and Turkey (7.3%), which shows the strength of Asian countries in the global exports of this category. Germany leads (13.13%) in HS 0802 (Other nuts, fresh or dried, whether or not shelled or peeled) followed by China (11.91%) and India (9%). The USA again dominates in several subcategories of HS 08 (Edible fruits and nuts; peel of citrus fruits and melons), including HS 0803 (Bananas, including plantains, fresh or dried) (20.31%), HS 0804 (Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens, fresh or dried) (30.29%), and HS 0806 (Grapes, fresh or dried) (21.3%). China is a significant exporter of HS 0810 (other fresh fruit), with 26.45% of global exports, followed by the USA (20.68%). In the HS 2002 (Preparations of tomato) sub-category Germany is the leading exporter (13.75%), followed by the UK (12.29%). The USA is a major exporter of a large number of vegetables, fruits, and prepared food categories whereas European countries and Asian countries like China and India have strong positions in some specific commodities.

Further, the study also revealed India's export trends for major commodities under HS 07, HS 08, and HS 20 from TE 2002 to TE 2023 (Table 5). In the subcategory of the HS 07 category, i.e., HS 0713, the data shows more than a five-fold increase was witnessed over the period, increasing which increased from USD 435.18 million in TE 2002 to USD 2383.24 million in TE 2023. However, HS 0703 also registered significant growth, particularly from TE 2017 onwards, rising from USD 11.53 million to USD 20.26 million in TE 2023. The HS 08 category shows substantial growth across all subcategories, growing from just USD 0.32 million in TE 2002 to USD 59.85 million in TE 2023. Particularly, the data reported the highest growth with more than a seven-fold increase in HS 0801, from USD 195.81 million in TE 2002 to USD 1482.77 million in TE 2023. In the HS 20 category, while the absolute values are smaller, the growth rates were still impressive. HS 2008 stands out, growing from just USD 0.32 million in TE 2002 to USD 59.85 million in TE 2023.

TABLE 4. MAJOR EXPORTING COUNTRIES OF HS-07, HS-08 AND HS-20 AT THE GLOBAL LEVEL, TE 2023

Commodity	Major exporting countries
	HS 07
HS 0702	USA (29.97%), Germany (16.39%), France (9.45%), United Kingdom (6.7%), Netherlands (4.11%)
HS 0703	USA (13.31%), Indonesia (7.31%), Malaysia (6.17%), Germany (5.99%), United Kingdom (5.66%)
HS 0709	USA (26.37%), Germany (12.82%), United Kingdom (8.33%), France (7.15%), Canada (5.58%)
HS 0710	USA (18.2%), Japan (14.01%), Germany (8.82%), France (7.6%), United Kingdom (5.88%)
HS 0713	India (19.29%), China (12.57%), Turkey (7.3%), Pakistan (6.61%), USA (5.1%)
	HS 08
HS 0802	Germany (13.13%), China (11.91%), India (9%), Italy (8.06%), Spain (5.53%)
HS 0803	USA (20.31%), China (7.54%), Germany (7.41%), Japan (6.5%), Netherlands (5.7%)
HS 0804	USA (30.29%), Netherlands (9.61%), China (6.38%), France (5.91%), Germany (5.69%)
HS 0805	USA (13.18%), Germany (9.85%), France (8.58%), Netherlands (7.59%), United Kingdom (5.35%)
HS 0806	USA (21.3%), Germany (8.73%), Netherlands (8.13%), United Kingdom (7.3%), Canada (4.99%)
HS 0808	Germany (8.78%), United Kingdom (5.92%), Mexico (4.95%), Indonesia (4.77%), India (4.16%)
HS 0810	China (26.45%), USA (20.68%), Germany (6.47%), Netherlands (5.73%), Canada (4.9%)
	HS 20
HS 2002	Germany (13.75%), United Kingdom (12.29%), Japan (6.42%), France (6.25%), Netherlands (5.05%)
HS 2004	USA (18.12%), United Kingdom (9.32%), Japan (8.06%), France (7.32%), Germany (5.03%)
HS 2005	USA (16.01%), Germany (9.65%), France (7.41%), Japan (6.23%), United Kingdom (5.9%)
HS 2008	USA (23.75%), Germany (8.44%), France (5.95%), Japan (5.68%), Canada (5.59%)

Source: UNCOMTRADE

TABLE 5. EXPORT (MILLION USD) TREND OF MAJOR COMMODITIES OF HS-07, HS-08 AND HS-20 FROM INDIA

Commodity	TE 2002	TE 2005	TE 2008	TE 2011	TE 2014	TE 2017	TE 2020	TE 2023
				HS 07				
HS 0703	8.88	5.89	0.64	2.41	2.02	11.53	37.89	20.26
HS 0704	0.20	0.12	0.36	0.22	0.41	0.42	0.48	1.22
HS 0708	4.49	0.43	0.00	0.03	0.05	0.05	0.04	0.01
HS 0712	0.63	0.92	2.76	4.15	5.26	5.02	5.08	5.70
HS 0713	435.18	544.7	1201.53	1926.1	2416.14	3867.28	1397.89	2383.24
Others	0.29	1.20	1.24	2.47	2.86	3.57	5.11	6.16
				HS 08				
HS 0801	195.81	383.07	472.27	758.26	934.16	1344.32	1345.97	1482.77
HS 0802	89.8	149.27	267.11	395.54	713.43	1009.56	1155.42	1450.66
HS 0804	43.47	48.9	102.97	158.14	215.41	295	321.99	380.09
HS 0806	8.54	10.94	17.92	18.96	39.24	73.21	113.07	108.54
HS 0808	8.59	16.19	51.48	141.59	227.38	274.07	269.49	380.63
Others	3.66	5.9	16.82	30.8	55.87	94.65	141.71	235.79
				HS 20				
HS 2002	0.15	1.86	4.29	5.65	7.92	5.63	12.51	11.98
HS 2004	1.16	3.18	6.02	7.97	6.46	0.92	0.7	0.61
HS 2005	0.46	1.12	2.24	2.99	4.37	5.42	7.21	9.51
HS 2007	0.67	1.20	1.51	1.89	3.88	6.65	7.62	7.99
HS 2008	0.32	2.00	4.65	9.56	17	22.15	33.61	59.85
HS 2009	8.00	8.44	15.6	28.5	33.98	39.85	39.41	42.97
Others	0.25	0.83	0.55	1.76	2.38	2.93	5.18	6.50

Source: *UNCOMTRADE*

Table 6 presents the major destination markets of Indian exports under HS 07, HS 08, and HS 20, for TE 2023. For HS 0703 (Fresh or chilled Onions, shallots, garlic, leeks, and other alliaceous vegetables, fresh or chilled), Bangladesh leads as the top destination market of India (31.26%), followed by Malaysia (15.95%) and UAE (11.73%), highlighting the importance of regional trade.

TABLE 6. INDIA'S MAJOR DESTINATION MARKETS OF HS-07, HS-08 AND HS-20, TE 2023

Commodity	Major destination markets of India
	HS 07
HS 0703	Bangladesh (31.26%), Malaysia (15.95%), UAE (11.73%), Sri Lanka (11.26%), Nepal (5.98%)
HS 0704	Maldives (69.77%), Bhutan (14.92%), Nepal (5.48%), UAE (3.18%), Qatar (3.02%)
HS 0708	France (30.22%), UAE (23.82%), Nepal (11.8%), Bhutan (8.5%), USA (3.98%)
HS 0712	USA (12.46%), Germany (11.13%), Brazil (8.09%), United Kingdom (5.54%), Indonesia (5.18%)
HS 0713	China (18%), UAE (16.76%), Bangladesh (15.95%), USA (9.73%), Nepal (4.91%)
	HS 08
HS 0801	UAE (30.77%), Japan (10.06%), Netherlands (8.47%), Saudi Arabia (8.23%), USA (5.75%)
HS 0802	UAE (30.85%), Viet Nam (19.48%), Myanmar (7.63%), Bangladesh (7.62%), Maldives (6.05%)
HS 0804	UAE (15.23%), Saudi Arabia (10.8%), United Kingdom (9.49%), USA (9.36%), Netherlands (8.48%)
HS 0806	Netherlands (33.59%), Bangladesh (10.74%), United Kingdom (7.73%), Russia (7.55%), UAE (6.43%)
HS 0808	Bangladesh (49.97%), Nepal (40.36%), Bhutan (7.87%), UAE (0.79%), Greece (0.21%)
	HS 20
HS 2002	Portugal (15.87%), Nepal (8.83%), Italy (8.33%), UAE (8.29%), Sri Lanka (7.9%)
HS 2004	Philippines (25.19%), Thailand (20.05%), USA (13.15%), United Kingdom (8.63%), Indonesia (4.27%)
HS 2005	USA (57.79%), UAE (6.13%), Canada (5.31%), United Kingdom (5.29%), Australia (3.62%)
HS 2007	Netherlands (21.19%), Saudi Arabia (10.15%), UAE (9.03%), USA (8.38%), Russia (6.12%)
HS 2008	Netherlands (22.84%), USA (16.58%), China (10.22%), UAE (8.91%), Japan (6.81%)

Source: *UNCOMTRADE*

In contrast, India has traded commodity HS 0712 (Dried vegetables, whole, cut, sliced, broken or in powder, but not further prepared) primarily to the USA (12.46%), Germany (11.13%), and Brazil (8.09%). The HS 08 (Edible fruits and nuts; peel of citrus fruits and melons) category shows a strong presence of Middle Eastern countries as key markets. The UAE is the top destination for HS 0801 (30.77%) and HS 0802 (30.85%). HS 0806 shows an interesting pattern, with the Netherlands as the top destination (33.59%). In the HS 20 category, for HS 2005, the USA dominates as the primary market (57.79%), highlighting the strength of India's prepared vegetable

exports to developed markets. Middle Eastern countries like the UAE and Saudi Arabia also appear frequently, underlining their significance as markets for Indian processed foods.

Evidence from Horticultural Exports and Imports

Table 7 shows the estimated income, price, and exchange rate elasticity for quantity demanded and prices of India's HS 07, HS 08, and HS 20 product groups (2000-2023). India's vegetable-products exports (HS07) face highly elastic foreign demand, with a price elasticity of -0.798 ($p < 0.001$) and an income elasticity of -0.131 (NS), indicating that a 1 percent rise in India's export prices reduces partner-country import volumes by about 0.8 percent, while higher foreign incomes exert only a marginal, statistically insignificant dampening effect (Gardiner & Dixit, 1987).

TABLE 7. INCOME, PRICE AND EXCHANGE RATE ELASTICITIES OF HS 2-DIGIT EXPORTS AND IMPORTS (2000-23)

HS Code	Income elasticity	Price elasticity	Exchange rate		
			Elasticity	Zero pass through (β=0)	Complete pass through (β=1)
		Export			
HS 07	-0.131 ^{NS}	-0.798***	-0.026	NS	***
HS 08	-0.234**	-0.159**	0.057	NS	***
HS 20	0.005 ^{NS}	-0.944***	-0.028	NS	***
		Import			
HS 07	-0.756***	-1.766***	0.014	NS	***
HS 08	-0.106 ^{NS}	-1.089***	-0.028	NS	***
HS 20	-0.327*	-1.071***	0.056	NS	***

(Note: "***", "**" and "*" represent significance at the 1%, 5% and 10% levels, respectively. "NS", means no significance of the coefficient; HS 07: edible vegetables and certain roots and tubers; HS 08: edible fruit and nuts; peel of Citrus Fruit or Melons; and HS 20: preparations of vegetables, fruit, nuts or other parts of plants.

The negligible export-side exchange-rate elasticity (-0.026, NS) reflects limited pass-through from rupee fluctuations into partner-market prices (Sasaki & Yoshida, 2018). On the import side, India's domestic demand for vegetables is highly price-sensitive (price elasticity -1.766, $p < 0.001$) and strongly negatively income-elastic (-0.756, $p < 0.001$), suggesting that as Indian income rises, consumers shift away from lower-value imported vegetables toward domestic or premium options. The small import-side exchange-rate elasticity (0.014, NS) again points to muted currency pass-through (Sasaki & Yoshida, 2018). Together, $|\varepsilon x|+|\varepsilon m| \approx 2.56$ satisfies the Marshall–Lerner condition (The Marshall-Lerner condition holds that a real depreciation of the domestic currency will improve the trade balance if and only if the sum of the absolute price elasticities of exports (εx) and imports (εm) exceeds

unity), implying that a real-exchange-rate depreciation would improve India's vegetable trade balance (Marshall,1923; Lerner, 1944; Harberger, 1950).

In the fruit and nuts (HS08) trade, partner-country demand responds modestly to export prices (–0.159, $p < 0.01$) and foreign-income gains (–0.234, $p < 0.01$), signaling a slight contraction in volumes as India raises prices or as importing economies grow wealthier and diversify purchases (Gardiner & Dixit, 1987). The positive export exchange elasticity (0.057, NS) suggests mild competitiveness benefits from rupee weakness, though not statistically robust (Sasaki & Yoshida, 2018). India's fruit imports exhibit strong price sensitivity (–1.089, $p < 0.001$) but negligible income responsiveness (–0.106, NS), with a small negative exchange-rate effect (–0.028, NS), reflecting partial border-price transmission. The sum $|\varepsilon x|+|\varepsilon m|\approx 1.25$ again meets the Marshall–Lerner threshold, indicating potential trade-balance gains from depreciation (Marshall,1923; Lerner, 1944; Harberger, 1950). Processed-plant preparations (HS20) show partner-demand price elasticity of -0.944 ($p < 0.001$) and near-zero income elasticity (0.005, NS), denoting volume contraction under higher prices but little response to foreign-income growth (Gardiner & Dixit, 1987). The modest negative export exchange elasticity (–0.028, NS) underscores supply-chain rigidities (Sasaki & Yoshida, 2018). India's import demand for these preparations is price-elastic (–1.071, $p < 0.001$) and moderately income-inferior (–0.327, $p < 0.05$), with a small positive exchange-rate elasticity (0.056, NS). With $|\varepsilon x|+|\varepsilon m|\approx 2.02$, the group also satisfies Marshall–Lerner, confirming that currency depreciation can bolster India's processed foods trade performance (Lerner, 1944; Harberger, 1950).

For vegetables (HS 07) and processed plant products (HS 20), stronger import responsiveness (Import elasticity is greater than export elasticity) implies that domestic income growth will, ceteris paribus, increase import values faster than export values. Unless offset by real exchange-rate depreciation or gains in export competitiveness, India may face a deteriorating trade balance in these categories under symmetric income growth as per the Houthakker-Magee effect (Houthakker and Magee,1969; Sasaki & Yoshida, 2018). India's horticultural exports are driven primarily by price competitiveness, while import demand is both price-sensitive and often income-inferior. The Marshall–Lerner condition holds across all three groups, suggesting currency depreciation can correct trade imbalances. However, the Houthakker–Magee effect warns that absent dynamic exchange-rate adjustments, symmetric income growth may increase the trade deficit in commodity groups where import income elasticities exceed export income elasticities.

IV

CONCLUSION AND POLICY IMPLICATIONS

The study highlights the pattern of horticultural commodity trade (HS 07, HS 08, and HS 20 commodity group) from 2000 to 2023. The global export of these commodities

is led by the developed nations due to their competitiveness and India was able to secure its position in the top 5 exporters in case of HS 0713 (Dried leguminous vegetables, shelled, whether or not skinned or split), 0802 (Other nuts, fresh or dried, whether or not shelled or peeled) and 0808 (Apples, pears and quinces, fresh) commodities in TE 2023. The pattern shows that the exports of highly perishable commodities of India in the HS 07 (Fresh and chilled vegetables) group are confined to the Asian region, while exports of processed products (HS 20) are global. Considering the high wastage of fresh fruit and vegetables in India and their growth in demand in world markets, India should develop technology to process and export these products to achieve a positive trade balance. The study also suggests that the currency devaluation of India against the USD will help in gaining a positive trade balance. The export and import of these commodity groups are price elastic as these are not inferior goods, and competitiveness for low-cost production is required to capture a share of global trade.

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APPENDIX

DESCRIPTION OF COMMODITIES IN THE COMMODITY GROUPS HS-07, HS-08 AND HS-20

Commodity code	Commodity Description
	HS 07
HS 0701	Potatoes; fresh or chilled
HS 0702	Tomatoes; fresh or chilled
HS 0703	Onions, shallots, garlic, leeks and other alliaceous vegetables; fresh or chilled
HS 0704	Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas; fresh or chilled
HS 0705	Lettuce (lactuca sativa) and chicory (cichorium spp.) fresh or chilled
HS 0706	Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots; fresh or chilled
HS 0707	Cucumbers and gherkins; fresh or chilled
HS 0708	Leguminous vegetables; shelled or unshelled, fresh or chilled
HS 0709	Vegetables, n.e.s. in chapter 07; fresh or chilled
HS 0710	Vegetables (uncooked or cooked by steaming or boiling in water); frozen
HS 0711	Vegetables provisionally preserved; (eg by sulphur dioxide gas, in brine, in sulphur water or in other preservative solutions), but unsuitable in that state for immediate consumption
HS 0712	Vegetables, dried; whole, cut, sliced, broken or in powder, but not further prepared
HS 0713	Vegetables, dried leguminous; shelled, whether or not skinned or split
HS 0714	Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content; fresh, chilled, frozen or dried, whether or not sliced or in the form of pellets; sago pith
	HS 08
HS 0801	Nuts, edible; coconuts, Brazil nuts and cashew nuts, fresh or dried, whether or not shelled or peeled
HS 0802	Nuts (excluding coconuts, Brazils and cashew nuts); fresh or dried, whether or not shelled or peeled
HS 0803	Bananas, including plantains; fresh or dried
HS 0804	Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens; fresh or dried
HS 0805	Citrus fruit; fresh or dried
HS 0806	Grapes; fresh or dried
HS 0807	Melons (including watermelons) and papaws (papayas); fresh

Appendix contd….

Commodity code	Commodity Description
HS 0808	Apples, pears and quinces; fresh
HS 0809	Apricots, cherries, peaches (including nectarines), plums and sloes, fresh
HS 0810	Fruit, fresh; n.e.s. in chapter 8
HS 0811	Fruit and nuts; uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter
HS 0812	Fruit and nuts provisionally preserved; (eg by sulphur dioxide gas, brine, in sulphur water or in other preservative solutions), but unsuitable in that state for immediate consumption
HS 0813	Fruit, dried, other than that of heading no. 0801 to 0806; mixtures of nuts or dried fruits of this chapter
HS 0814	Peel of citrus fruit or melons (including watermelons); fresh, frozen dried or provisionally preserved in brine, in sulphur water or in other preservative solutions
	HS 20
HS 2001	Vegetables, fruit, nuts and other edible parts of plants; prepared or preserved by vinegar or acetic acid
HS 2002	Tomatoes; prepared or preserved otherwise than by vinegar or acetic acid
HS 2003	Mushrooms and truffles, prepared or preserved other than by vinegar or acetic acid
HS 2004	Vegetables preparations n.e.s.; prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of heading no. 2006
HS 2005	Vegetables preparations n.e.s.; prepared or preserved otherwise than by vinegar or acetic acid, not frozen, other than products of heading no. 2006
HS 2006	Vegetables, fruit, nuts, fruit-peel and other parts of plants, preserved by sugar (drained, glace or crystallised)
HS 2007	Jams, fruit jellies, marmalades, fruit or nut puree and fruit or nut pastes, being cooked preparations; whether or not containing added sugar or other sweetening matter
HS 2008	Fruit, nuts and other edible parts of plants; prepared or preserved in ways n.e.s., whether or not containing added sugar or other sweetening matter or spirit, not elsewhere specified or included
HS 2009	Fruit juices (including grape must) and vegetable juices, unfermented, not containing added spirit; whether or not containing added sugar or other sweetening matter