Sectoral Patterns and Determinants of Global Value Chain Participation: Evidence from India in Comparative Perspective

A Study by:

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SECTORAL PATTERNS AND DETERMINANTS OF GLOBAL VALUE CHAIN PARTICIPATION: EVIDENCE FROM INDIA IN COMPARATIVE PERSPECTIVE

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1. Introduction

In recent decades, international trade and production have become increasingly fragmented, with different stages of the production process located across multiple countries (Feenstra, 1998; Hummels et al., 2001; Baldwin and Lopez-Gonzalez, 2015). Advances in information and communication technologies, trade liberalization, and falling transport costs have enabled firms to unbundle production and organize cross-border production networks. These borderless production systems—commonly referred to as global value chains (GVCs)—are characterized by intermediate goods crossing national borders multiple times before final assembly. As a result, trade in parts and components has grown faster than trade in final goods, and gross trade flows increasingly embody value added originating from multiple countries.

The fragmentation of production has altered not only what countries trade, but how they participate in global production networks. Conventional measures typically classify a country's participation in GVCs as backward or forward. Backward participation reflects the foreign value added embodied in a country's exports, capturing the extent to which domestic production relies on imported intermediate inputs. Forward participation, in contrast, measures the domestic value added embodied in other countries' exports, indicating a country's role as a supplier of intermediate goods and services. Labour-abundant developing economies—often described as "factory economies"—typically exhibit high backward participation, reflecting their specialization in assembly activities dependent on imported inputs. Advanced "headquarter economies," by contrast, concentrate in capital- and knowledge-intensive upstream stages such as design, branding, and high-value component production, resulting in stronger forward linkages.

The experience of China illustrates the dynamic nature of GVC integration. During the 1990s and early 2000s, China's integration was driven largely by backward linkages with advanced economies, reflecting its role as a processing and assembly hub. As wages rose and industrial capabilities deepened, China moved up the value chain: backward participation gradually declined while forward linkages strengthened (Li et al., 2012; Cheng et al., 2019). This transition created opportunities for other labour-abundant economies—such as Vietnam—to expand their participation in manufacturing GVCs (World Bank, 2020).

In contrast, a growing body of research argues that India's integration into global production networks has remained more limited than its factor endowments would predict (Athukorala, 2014; Veeramani and Dhir, 2017). Despite a large labour force and an expansive domestic market, India has yet to consolidate its position as a major manufacturing hub within global value chains (GVCs). This trajectory is reflected in the persistent stagnation of manufacturing's share in GDP, which has hovered between 17 and 19 per cent for several decades (Veeramani and Basu, 2025).

Figure 1. Country-wise Share of Gross Output in Global Production: Total Manufacturing

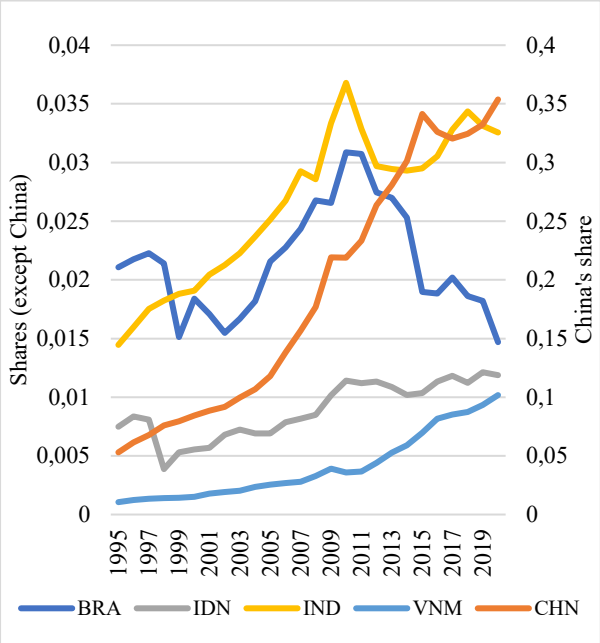
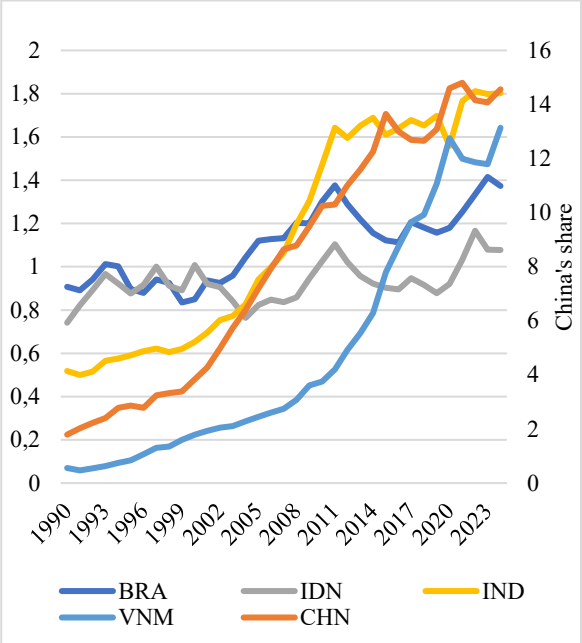


Figure 2. Share in World Merchandise Exports (%)



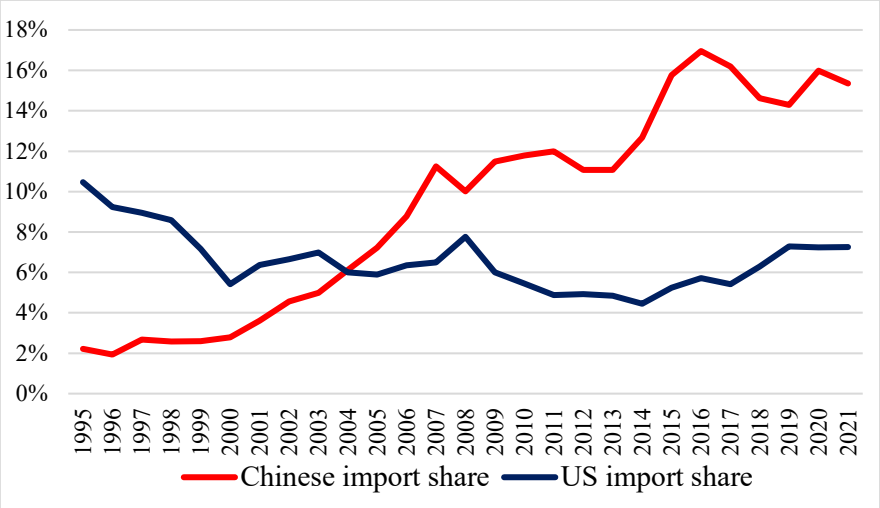
Source: Authors' calculations using data from TIVA (Figure 1) and World Bank (Figure 2)

India's share in global production declined from a peak of 3.7 per cent in 2010 to 2.9 per cent in 2015, before recovering modestly to 3.2 per cent in 2019 (see Figure 1). Even at its peak, India's contribution remained small relative to China, whose share of global output rose steadily to 35 per cent by 2019. A similar pattern is evident in global merchandise exports: India's share remains below 2 per cent as of 2024, while Vietnam—an economy significantly smaller in size—has increased its presence to account for 1.6 per cent of world exports (see Figure 2). Concurrently, on the import side, India's merchandise trade has become increasingly dependent on China (Figure 3), a trend that has raised strategic and geopolitical concerns regarding supply chain resilience and external vulnerability.

A growing empirical literature has analysed India's GVC experience. Banga (2022) discusses the reasons behind India's low GVC participation, especially in labour-intensive industries. Large domestic markets, labour market rigidities and low FDI are among the reasons cited for poor integration. In fact, using OECD's Trade in Value Added (TIVA) Database, Banga (2022) finds that labour intensive industries like textiles have higher forward participation than backward, a contrast to countries like Bangladesh which export ready-made garments and import raw material like yarns and fabrics. Other studies find that stronger backward linkages in India are associated with lower employment for skilled workers, whereas forward linkages stimulate unskilled employment, underscoring the importance of the type of participation for labour market outcomes. Industry-level research further links forward GVC participation to higher innovation performance in Indian manufacturing. Firm-level evidence suggests that

digitalization enhances the likelihood of GVC integration for Indian manufacturing firms, indicating that non-trade factors also shape participation patterns.

Fig 3. China and USA's share (%) in India's merchandise imports



Source: Authors' calculation using WITS (UN COMTRADE) data

However, simple forward–backward measures do not fully capture a country's position within multi-stage production networks. Understanding India's position in global production networks requires moving beyond simple backward–forward participation measures. Recent advances in value-added trade accounting, particularly the three-way decomposition proposed by Borin et al. (2021), allow a more granular assessment of GVC integration. In this framework, overall GVC-related trade comprises three components. First, **Pure forward trade** reflects domestic value added exported and subsequently re-exported by partner countries, capturing upstream participation. **Two-sided trade** combines domestic and imported inputs and is then exported and re-exported, reflecting a central position within the value chain. **Pure backward trade** represents imported intermediates exported to final markets without further re-export, indicating downstream or assembly-type specialization. This decomposition provides a continuous spectrum of GVC participation and allows for precise assessment of whether a country's integration is upstream, central, or downstream.

Against this backdrop, this paper examines the trends and patterns of India's sectoral GVC participation in selected, key industries, while also conducting a comparative analysis with important competitor countries. We employ updated and novel measures of GVC participation developed by Borin et al. (2021), which allow for a detailed sector-by-sector assessment of India's position in the initial, middle-stages and final-stages of global production networks. In addition to trade-based measures, following Borin et al. (2021), we also use output-based measures of GVC participation. This distinction is important: whereas trade-based measures of GVC participation capture only the export dimension, output-based measures consider the

sector's involvement across the entire supply chain, offering a more comprehensive picture of how production in each sector is linked to GVCs, regardless of direct export activity.

Such an assessment is crucial for understanding the implications of GVC participation for productivity growth, technological upgrading, and employment generation in the Indian economy. Apart from recent works like Chawla and Kumar (2023), who undertake an analysis of India's GVC participation using both OECD's Trade in Value Added Database and the Asian Development Bank's Input Output Tables, such a discussion in the Indian context is limited. Additionally, we empirically examine the determinants of GVC participation across Indian industries within a regression framework. In doing so, we assess the role of trade policy variables—particularly tariffs—and macroeconomic factors such as exchange rate movements, while also evaluating the broader influence of industrial policy in shaping the extent and nature of India's integration into global value chains.

The rest of the paper is organized as follows. Section 2 describes the data and presents a comparative analysis of GVC integration across competitor countries. Section 3 discusses the key correlates of GVC participation. Section 4 outlines the empirical strategy and presents the regression results. Section 5 concludes.

2. Data and Descriptive Statistics

We examine India's integration into global production networks using value-added trade data from the OECD's Trade in Value Added (TiVA) database over the period 1995–2020, complemented by the GVC indicators developed by Borin et al. (2021) and compiled in the Asian Development Bank's Key Indicators Database (for the years 2007–2023). The TiVA database enables a decomposition of gross exports into their domestic and foreign value-added components, thereby allowing an assessment of conventional backward and forward participation. The Borin et al. (2021) indicators, in turn, permit a more refined characterization of the nature and positioning of GVC linkages, distinguishing between upstream, central, and downstream forms of integration. Together, these datasets provide a comprehensive value-added perspective on both the extent and the structure of India's GVC participation.

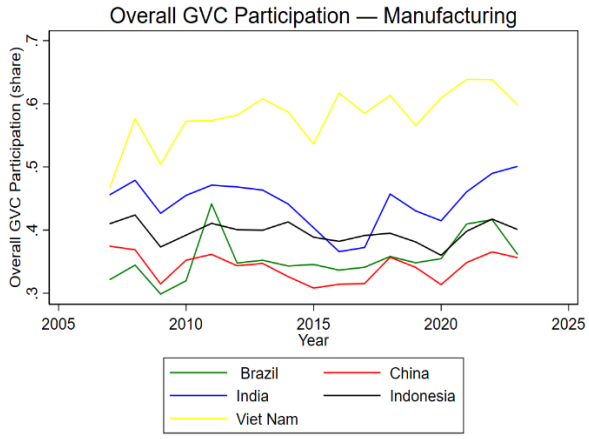
The sectoral descriptive analysis focuses on two groups of industries that are central to debates on structural transformation in developing economies. The first comprises labour-intensive manufacturing sectors—textiles, wearing apparel, and leather and related products—which are traditionally viewed as entry points into export-led industrialization for labour-abundant economies. These industries are typically associated with downstream, assembly-type participation and have historically driven manufacturing-led growth in East and Southeast Asia. The second group consists of "network product" industries (Athukorala, 2011), including computers, electronics and optical products, electrical equipment, machinery, and transport equipment. These sectors are characterized by dense cross-border production fragmentation and complex input–output linkages, making them particularly suitable for analysing deeper forms of GVC integration.

In addition to key manufacturing sectors, we also explore India's GVC participation for services, a sector where India has consistently shown strong export performance. To situate India's performance in a comparative context, we benchmark its GVC participation against selected peer and competitor economies: China (CHN) and Vietnam (VNM), which have successfully integrated into manufacturing GVCs; and Brazil (BRA) and Indonesia (IDN), emerging economies with structural characteristics more comparable to India.

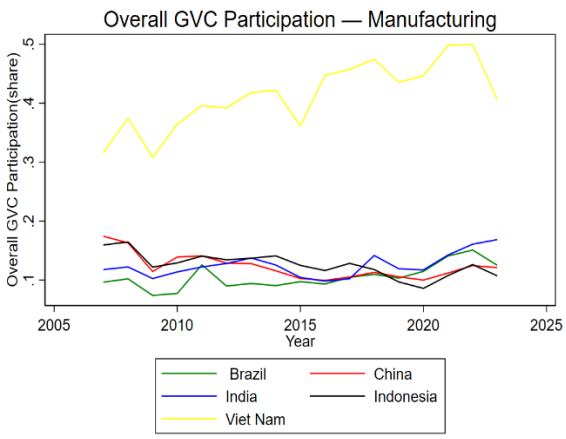
Figure 4 plots the trade-related (Panel A) and output-related (Panel B) GVC share of India and its competitor economies for the years 2007 to 2023. While trade-related GVC measures study backward and forward linkages in the context of exports, Borin et al (2021) extend the analysis to overall output (or production), and not just exports[4]. Overall GVC participation, both trade and output-related, in the manufacturing sector is highest for Vietnam, followed by India. As expected, the values of trade-related GVC participation are higher as compared to those for output-related GVC participation. However, the overall trends remain similar. A decline in the GVC participation share is observed in 2016-17 for both the graphs, followed by an increase in India's GVC participation in the post covid period. Is the rise in overall GVC participation driven by greater downstream linkages or stronger upstream linkages?

Figure 4. Trade-related and Output-related GVC share in manufacturing

Panel A. Trade-related GVC participation



Panel B. Output-related GVC participation



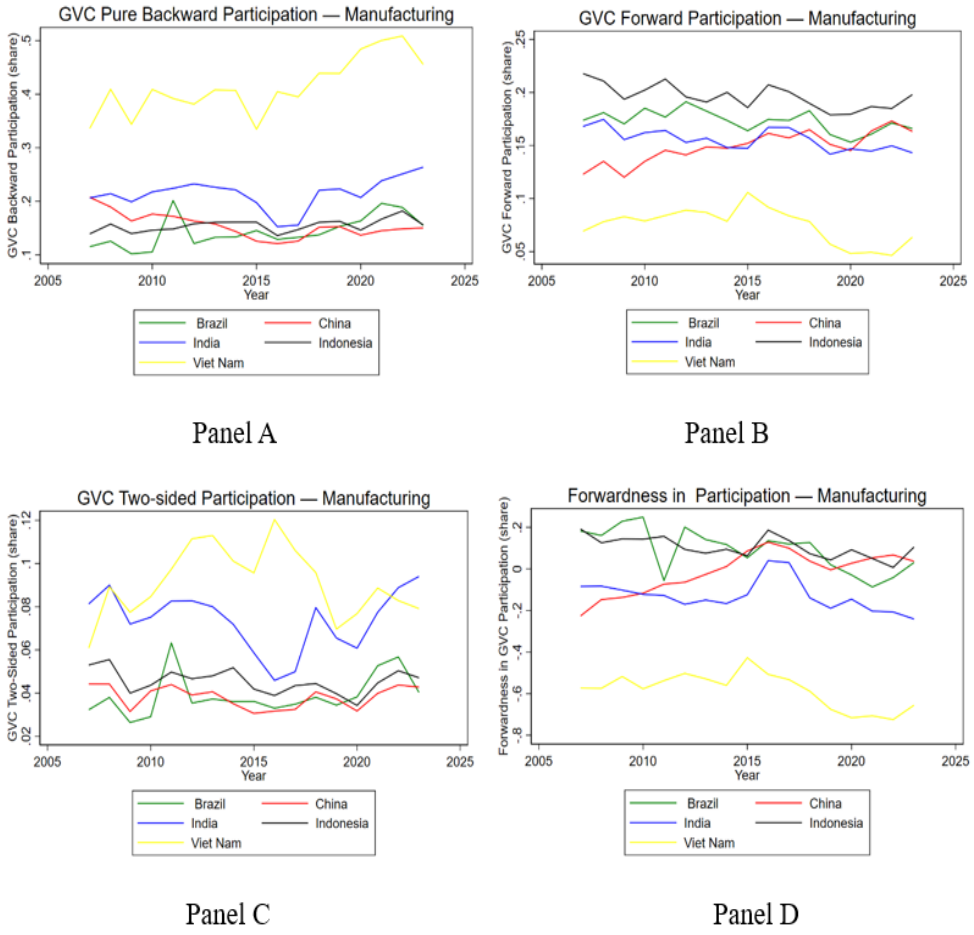
Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

The tripartite decomposition, undertaken by Borin et al (2021), decomposing overall GVC participation into backward, middle and forward linkages is displayed in Figure 5. India's manufacturing sector is characterized by higher backward GVC participation, than forward or two-sided linkages, indicating stronger downstream presence. Pure backward GVC

[4] The GVC participation of sectors which are large but not export intensive, and are not adequately represented in trade-related measures of GVC participation can become more relevant when output is considered. Similarly, smaller export-intensive sectors which may report high GVC shares in trade-related measures, may have smaller GVC participation shares when scaled by overall output instead of exports.

participation (see Figure 5, Panel A), declined from 22% in 2012-13 to 16% in the years 2016-17, and then recovered to reach 25% in the year 2023. This indicates that the rise in overall GVC participation noted in Figure 4, is driven by higher backward linkages. Post covid, there is a sharp increase in India's backward GVC participation. Interestingly, a sharp increase is also observed for India's two-sided GVC participation in the years post 2020 (see Figure 5, Panel C). In the preceding years, two-sided GVC participation was otherwise on a declining trend, falling from 9% in 2008-09 to 5% in 2016-17. It is to be seen whether this reversal of trends post-covid is temporary or whether it is a consequence of schemes like the PLI. Further, is it driven by certain specific sectors like electronics where the PLI has been shown to be successful (Veeramani, 2025) or is it a more broad-based trend?

Figure 5. Tripartite decomposition of trade-related GVC participation for Manufacturing sector



Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

However, such a trend is not observed for forward GVC participation (Panel B, Figure 5), which shows a slight decline from 17% in 2007 to less than 15% in 2023. As a result, the '*forwardness*' measure (Panel D, Fig.5) —defined as the difference between pure forward and

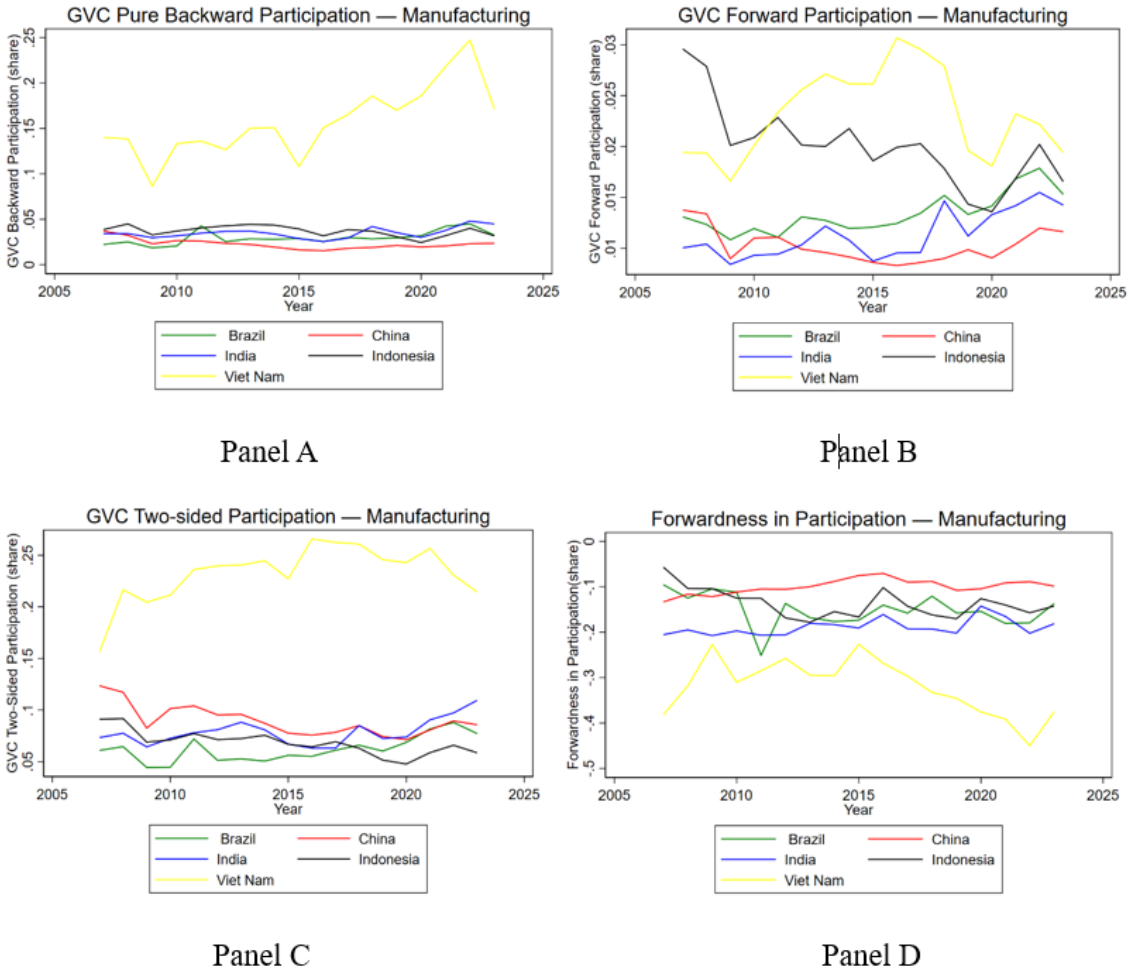
pure backward participation divided by total GVC-related trade[5], exhibits an increasing trend in the years 2016-17- to be attributed to declining backward linkages- and then declines steadily due to declining forward and rising backward linkages.

The trend lines of all other countries, except China, also exhibit declining forwardness, indicating that backward linkages are stronger than forward linkages. China exhibits rising forward linkages, indicating that it is moving up the global production chain. Kee and Tang (2016) finds that increase in the domestic value added in Chinese exports is mainly driven by individual processing exporters substituting domestic for imported materials. Further, in recent decades, China has moved from being the world factory for consumer goods towards becoming a technological leader in sectors linked to advanced manufacturing, cloud computing, artificial intelligence, and electric vehicles (Gereffi et al, 2022). On the other hand, Vietnam's rise in the global manufacturing space is characterized by very high and increasing backward linkages and low and declining forward linkages, resulting in the lowest forwardness index as compared to other countries. Crescenzi and Harman (2022) and Jones (2021) also show how Vietnam, primarily driven by low labour costs, and openness to trade and investment, makes a considerable movement towards backward linkages compared to forward linkages, resulting in increase in the tasks for final stage assembly. Compared to India, Brazil and Indonesia exhibit lower backward and two-sided GVC shares and higher forward GVC shares, resulting in higher forwardness in GVC participation than India. Countries that are exporters of natural resources or primary inputs tend to have forward linkages much higher than backward linkages — as in the case of Brazil and Indonesia — resulting in a higher forwardness of GVC participation relative to countries more oriented toward manufacturing assembly (UNIDO, 2018; Banga, 2013).

Figure 6 reveals the same decomposition for GVC-related output. The backward GVC shares for overall output appear to be much depressed as compared to trade-related backward GVC participation. India's output-related backward linkages hover around 5% of total output. The share of forward linkages is even lower, though it seems to be rising post 2016-17. It is interesting to note that two sided GVC participation occupies a significant share in overall manufacturing output, indicating that middle stages seem to be dominant when we consider total output instead of exports. Further, the rise in the two-sided GVC participation share, from less than 10% in 2020 to above 10% post-2020, is also observed in the overall output-related GVC participation (refer to Figure 4, Panel B). Unsurprisingly, China leads in terms of forwardness in GVC participation, reflecting its steady transition to upstream activities.

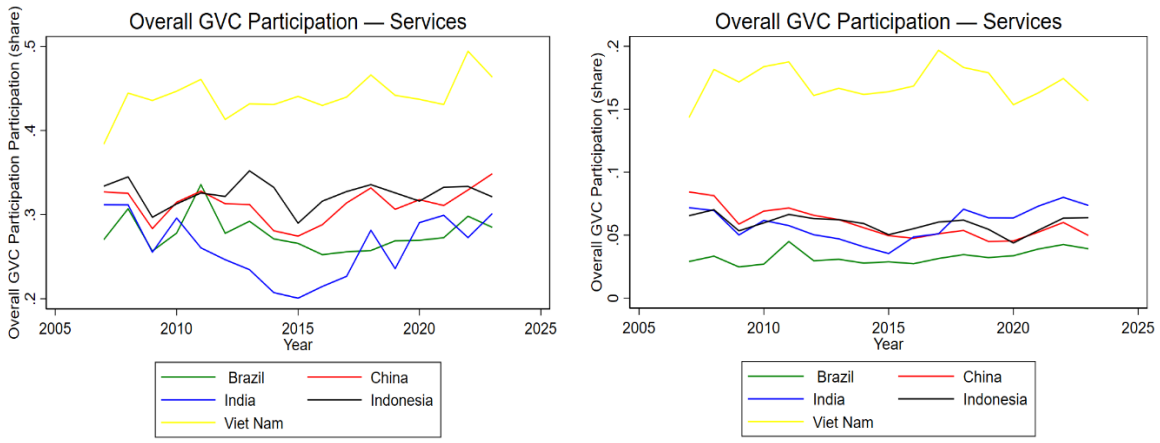
[5] The forwardness measure captures the type of GVC participation and is bounded between -1 and 1.

Figure 6. Tripartite decomposition of output-related GVC participation for Manufacturing sector



Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

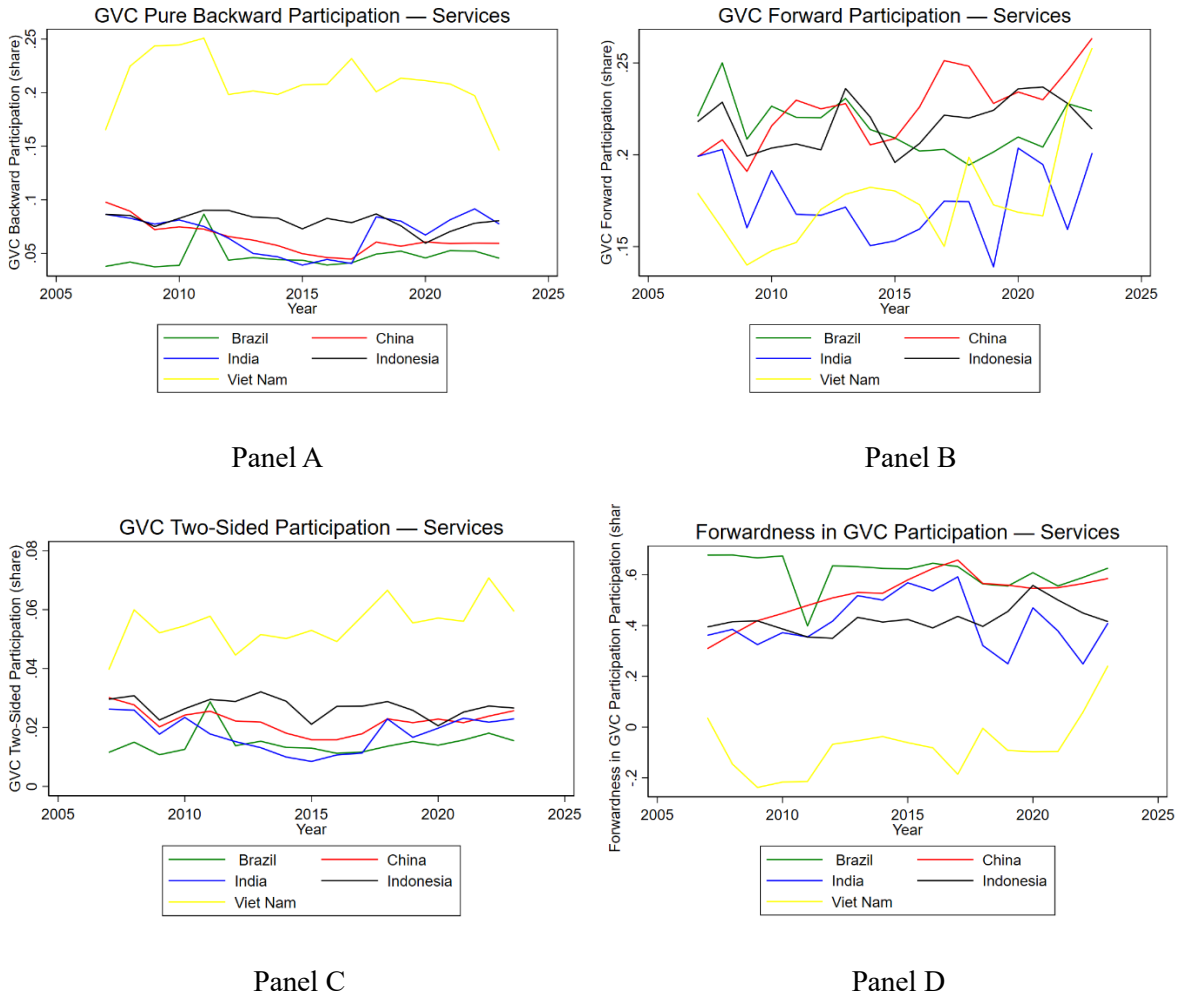
Figure 7. Trade-related and Output-related GVC share in Services



Panel A. Trade-related GVC participation

Panel B. Output-related GVC participation

Figure 8. Trade-related GVC participation measures, Services Sector: India and competitor economies (2007 to 2023)



Panel A

Panel B

Panel C

Panel D

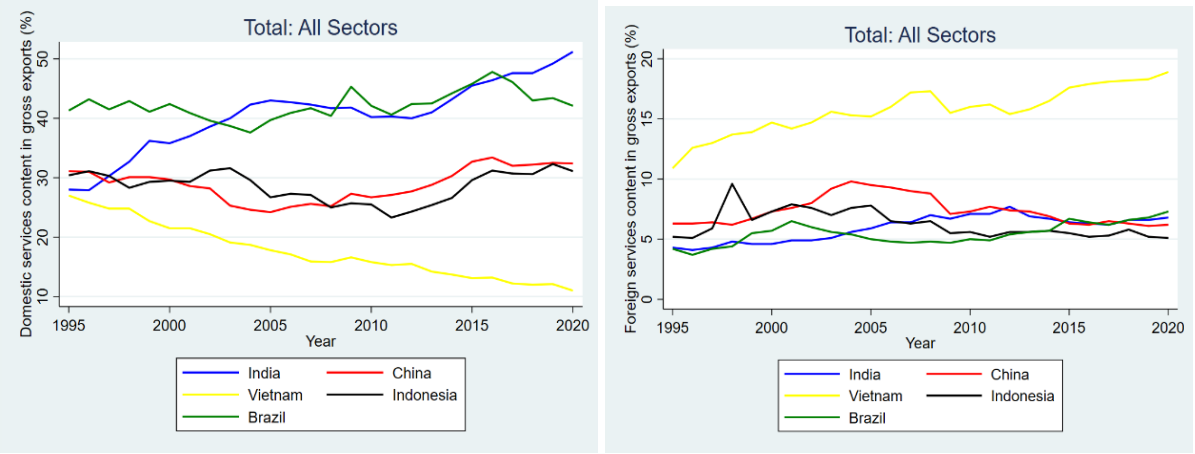
Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

In services, which has long remained a strength of the Indian economy, Figure 7 reveals that compared to the other countries, India has one of the lowest shares in trade-related GVC participation. This trend reverses for output-related GVC participation of services. However, the shares themselves are higher for trade-related participation as opposed to output-related participation, with the former being close to 30% of services exports and the latter being less than 10% of output.

A tripartite decomposition of GVC participation reveals that forward GVC participation (Panel B, Fig 8) forms the bulk of India's services exports with close to 20% of gross service exports comprised of forward linkages as opposed to around 10% of backward linkages (Panel A, Fig 8). Similar to backward linkages, two-sided participation, exhibits a declining trend till 2016-17, followed by a rise till 2023. Fig 9 reflects the increasing importance of services in the Indian economy. Domestic services content in total gross exports has been steadily increasing, starting just below 30% in 1995 to reach ~50% in the year 2020, much higher than the rest of the

economies. Vietnam's share of domestic service content in gross exports, continuously declining since 1995, is lower than the other countries. It is interesting to note however that India's position in services participation, by way of forwardness (Panel D, Fig 8), although on an increase till 2016, has since been mostly on a decline, reflecting declining upstreamness in this sector.

Figure 9. Domestic (Panel A) and Foreign (Panel B) Services content (%) in Gross Exports



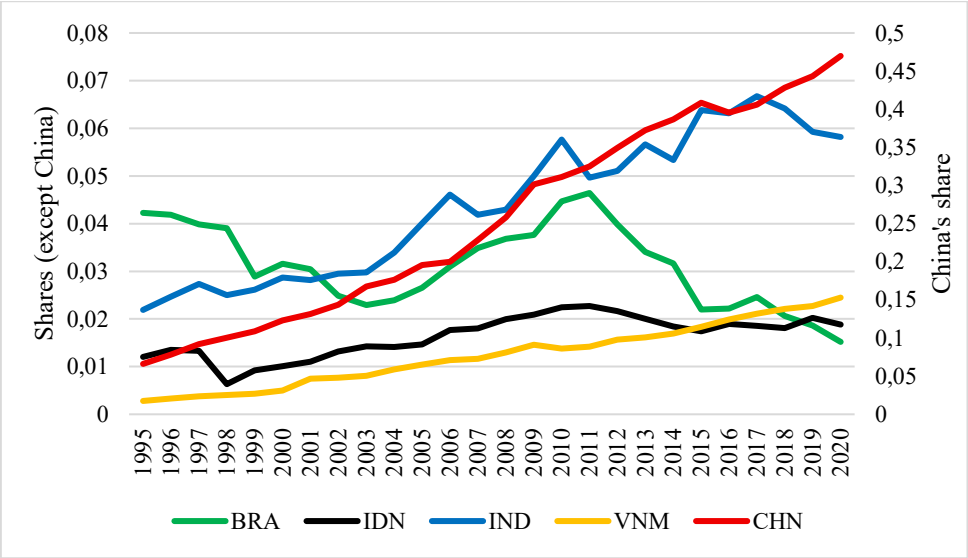
Panel A Panel B

Source: TivA

Next, we turn towards key sectors, first analysing trends in GVC participation for labour-intensive sectors, followed by network product industries. Share of textiles and textile products in India's export basket in the year 2023-24 was around 8%[6]. The relative importance of textiles and leather sector, the two labour-intensive sectors in India, is captured in Figure 10 where we have plotted the economy-wise value-added shares in global value added of the textiles, wearing apparel and leather product sector. India is second to China when we consider its global share in value added. However, India seems to have lost some of its share in recent years when it fell from 6.7% in 2018 to 5.8% in 2020.

[6] Source: Ministry of Textiles, Government of India. (2024). *Annual report 2023–24*. Government of India. https://www.texmin.gov.in/static/uploads/2025/12/c865d599cae0c357c02d247a8a82d24e.pdf

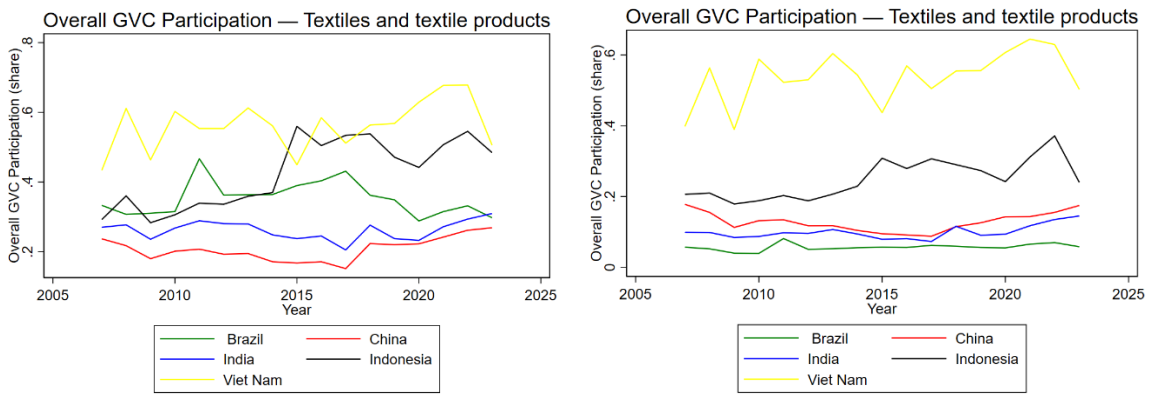
Fig 10. Value Added Shares: Textiles, wearing apparel, leather products



Source: TivA

Figure 11 plots trade-related (Panel A) and output-related (Panel B) GVC participation for India's textile sector. Barring China, for both cases, GVC participation remains lower than other countries. This is expected since India's textile industry is vertically integrated, with upstream stages like production of raw material (yarn, fabric) and downstream stages like manufacture of ready-made garments, both taking place domestically. India's position in GVCs in terms of forwardness in the textiles and textiles products (Figure 12) industry has mostly been positive till the year 2016, followed by a decrease in forwardness, indicating increasing backward linkages in recent years. The decline in forwardness is also accompanied by a decline in India's global share in value-added in this industry (see figure 10). Overall, these trends are in congruence with the trends observed for overall manufacturing in the posit-covid years. In terms of levels, however, Vietnam and Indonesia exhibit the highest backward linkages in this sector.

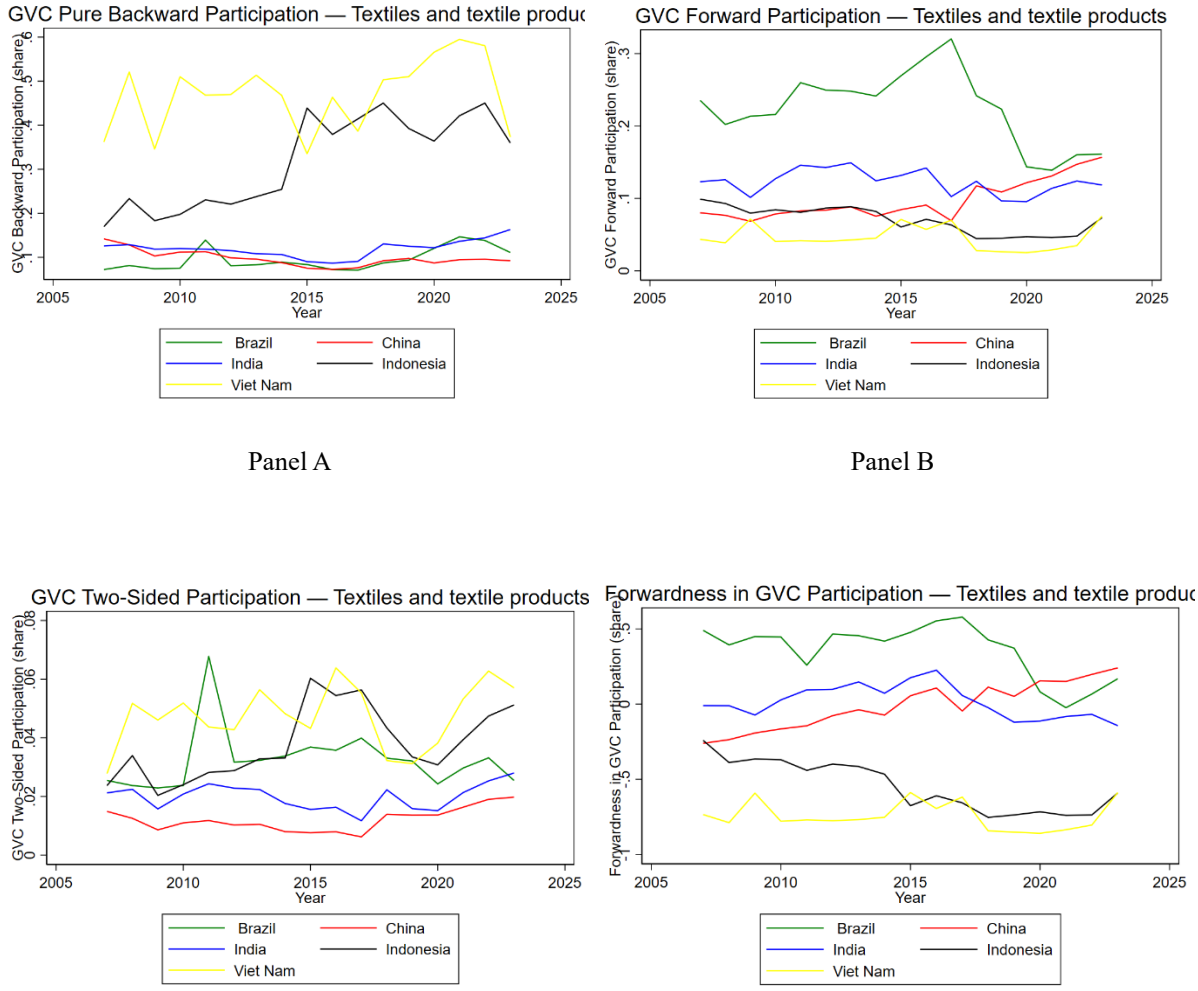
Figure 11. Trade-related and Output-related GVC share in Textile and textile products



Panel A. Trade-related GVC participation

Panel B. Output-related GVC participation

Figure 12. Trade-based GVC participation measures, Textiles and Textile Products: India and competitor economies (2007 to 2023)



Panel A

Panel B

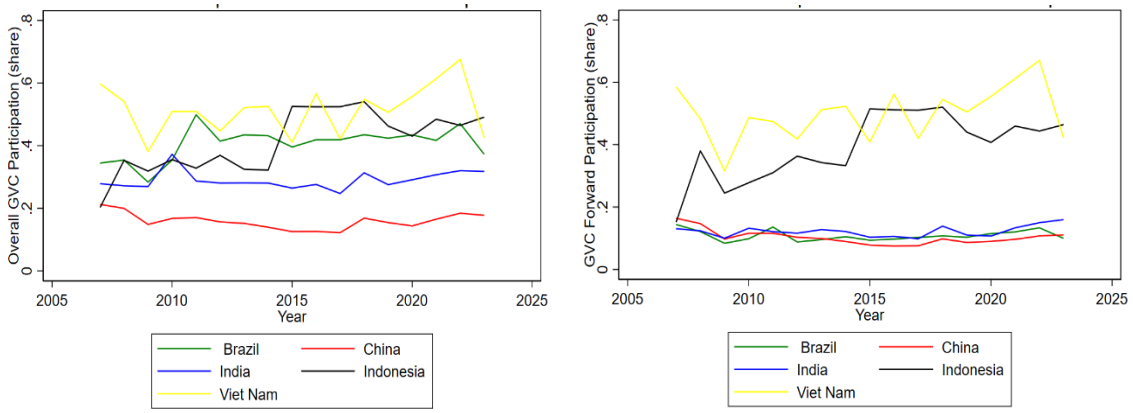
Panel C

Panel D

Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

Figure 13 plots the trade-related (Panel A) and output-related (Panel B) GVC participation shares of leather and leather products. Here too, similar trends are observed with higher shares for trade-related measure and rise in GVC participation observed in the last 5 years of our dataset. From Figure 14, which decomposes the trade-related GVC participation for leather, it is observed that for most years, India is ranked second, after Brazil in terms of forwardness in the sector, only to be overtaken by China in the latest year. For both the textile and leather industries, the extent of two-sided GVC participation for most countries remain modest.

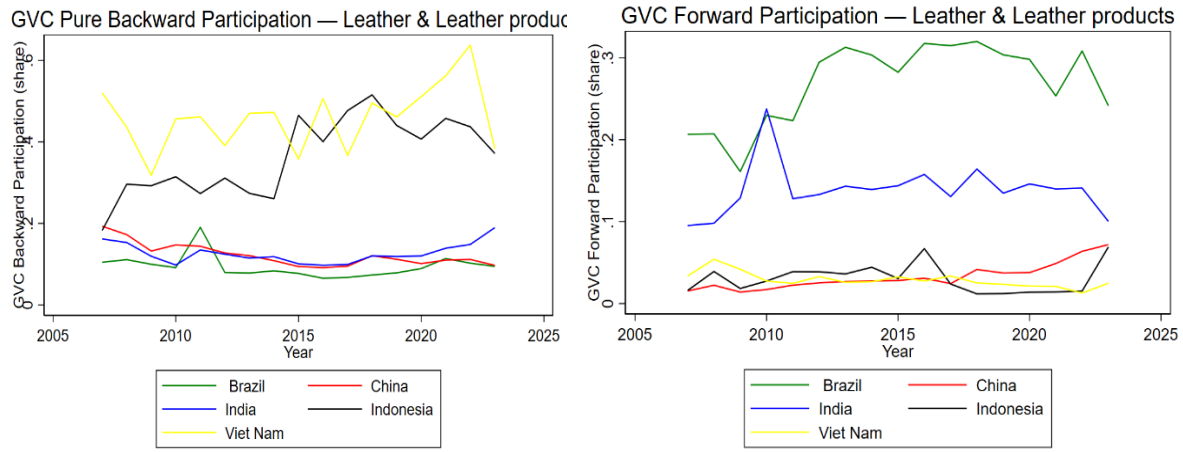
Figure 13. Trade-related and Output-related GVC share in Leather and leather products



Panel A. Trade-related GVC participation

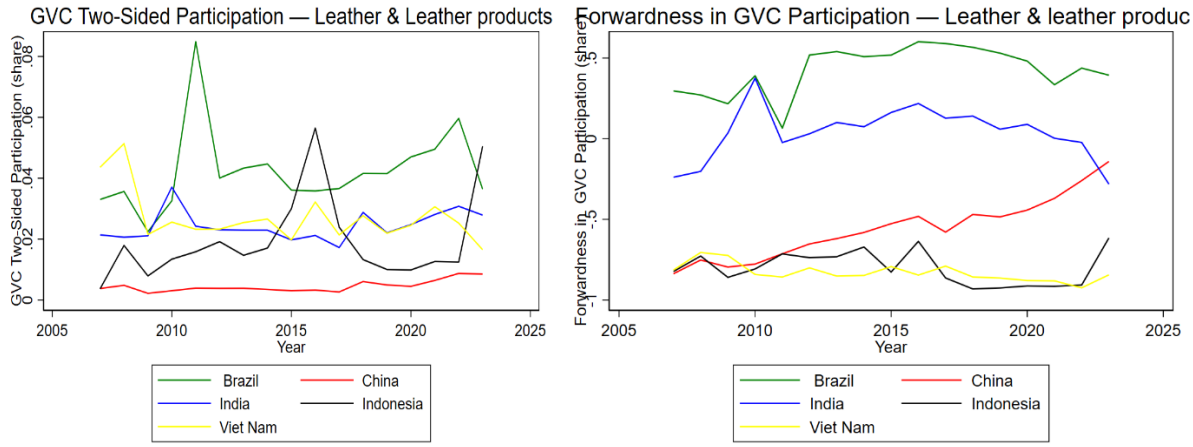
Panel B. Output-related GVC participation

Figure 14. Trade-based GVC participation measures, Leather and Leather Products: India and competitor economies (2007 to 2023)



Panel A

Panel B



Panel C

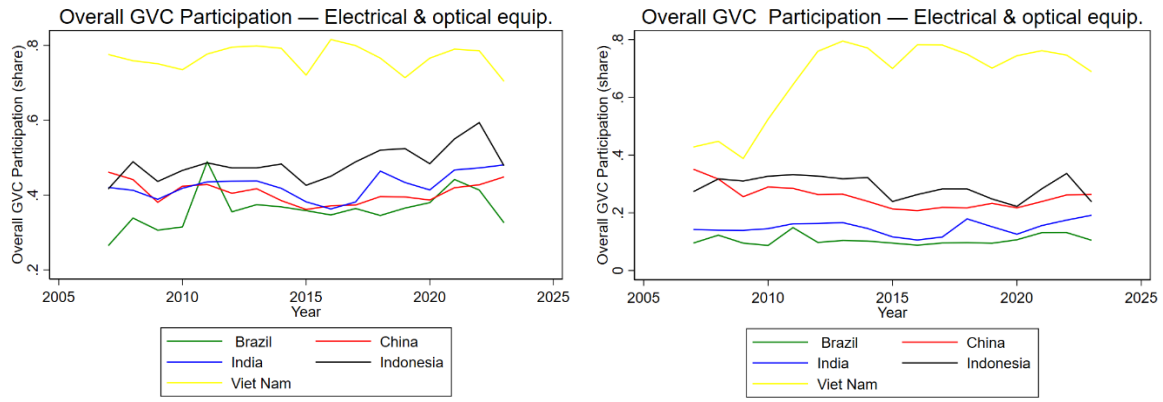
Panel D

Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

Network products, spanning the electrical and optical equipment sector, the machinery sector and manufacturing of transport equipment sector, are characterized by multiple border crossings, and as a result, have higher GVC participation shares than textile and leather products (see Figs 15 to 20). After Vietnam, India's participation in global production networks remains highest in the transport sector, a sector in which it also has significant share in global value-added (3.5%). Both trade-based and output-based GVC participation shares exhibit an increase from the years 2017-18 onwards. To identify whether this is driven by backward, forward or two-stage linkages, decomposition of the trade-based GVC measures suggest that it is mostly an increase in the backward GVC participation that results in higher overall GVC participation for these sectors. The increase post 2017-18 coincides with the implementation of the Make in India Scheme rolled out by the Central government whereas the rise post 2020 coincides with the PLI scheme for many goods in the network product sectors.

Across all network product categories, India ranks second only to Vietnam in the extent of backward linkages, reflecting the growth of downstream activities such as assembly operations. India also surpasses other countries in the forward participation of machinery, suggesting that Indian-made machinery is exported and subsequently re-exported. As expected, China leads in forward participation for most network products, except in electrical and optical products, where Indonesia has advanced rapidly. Notably, India's forwardness in this sector was the highest until 2019. In the transport sector, a sharp rise in two-sided participation is observed for the years post 2020. Interestingly, unlike the other network products, forwardness does not exhibit a strong decline for transport sector, which may be indicative of some evidence of upgrading in this sector.

Figure 15. Trade-related and Output-related GVC share in Electrical and Optical Equipment

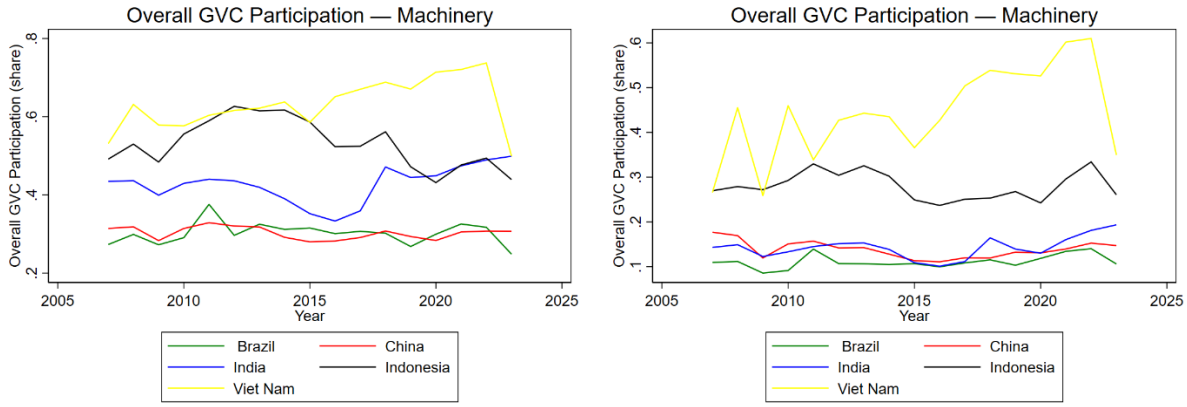


Panel A. Trade-related GVC participation

Panel B. Output-related GVC participation

Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

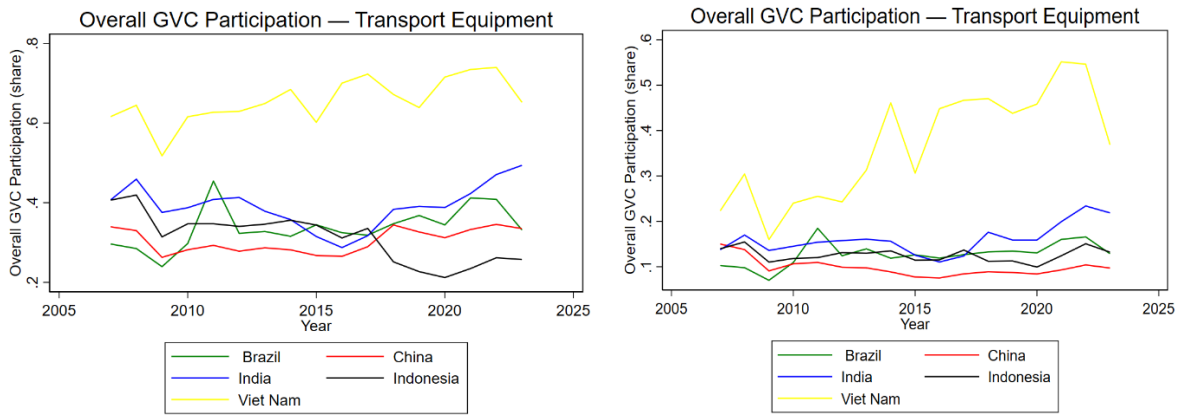
Figure 16. Trade-related and Output-related GVC share in Machinery



Panel A. Trade-related GVC participation Panel B. Output-related GVC participation

Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

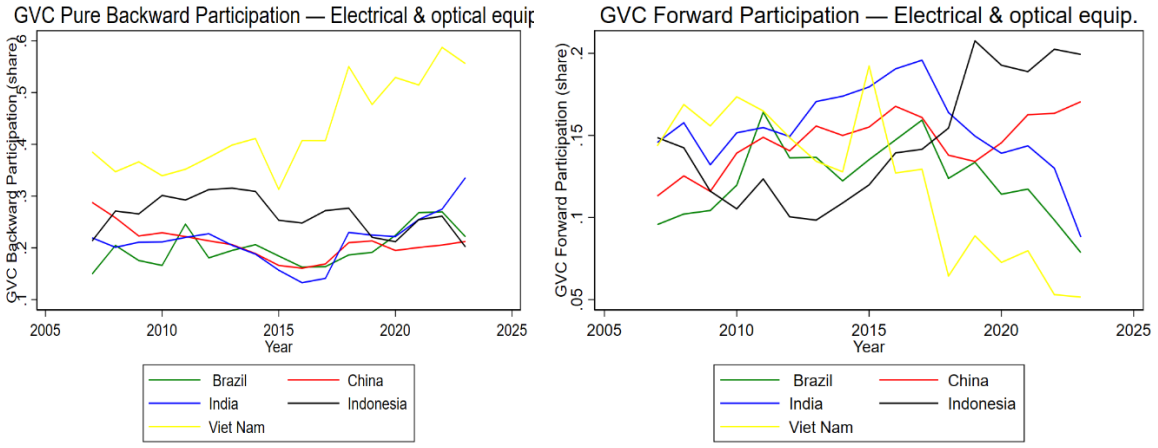
Figure 17. Trade-related and Output-related GVC share in Transport Equipment



Panel A. Trade-related GVC participation Panel B. Output-related GVC participation

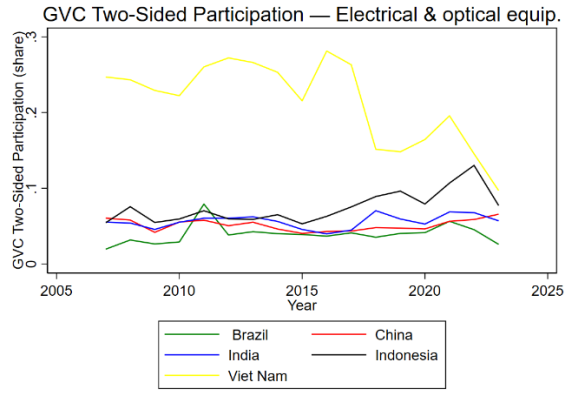
Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

Figure 18. Trade-based GVC participation measures, Electronic and Optical Products: India and competitor economies (2007 to 2023)

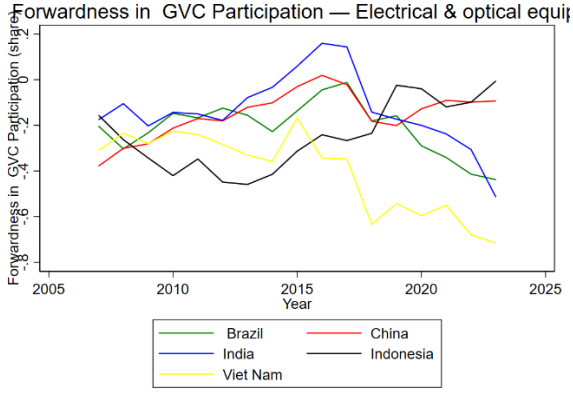


Panel A

Panel B



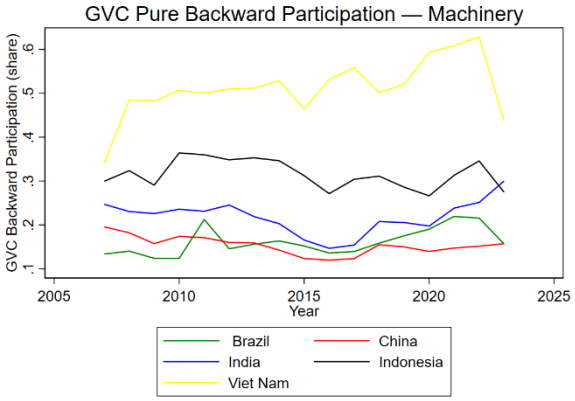
Panel C



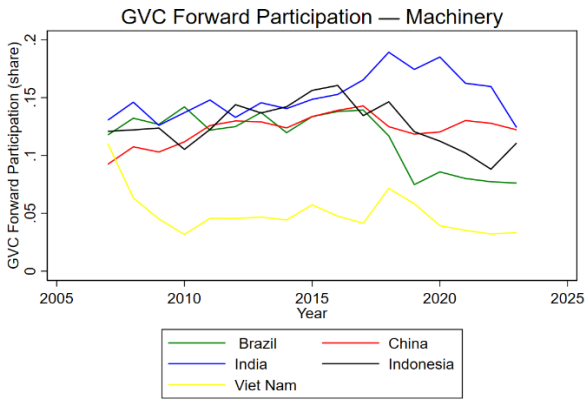
Panel D

Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

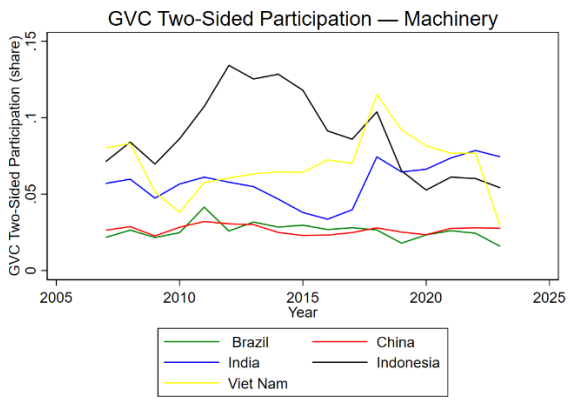
Figure 19. Trade-based GVC participation measures, Machinery: India and competitor economies (2007 to 2023)



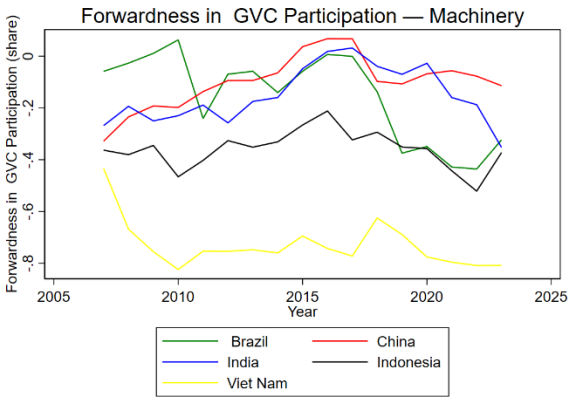
Panel A



Panel B



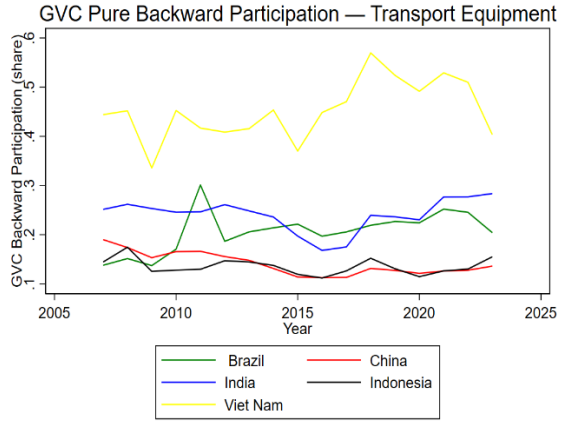
Panel C



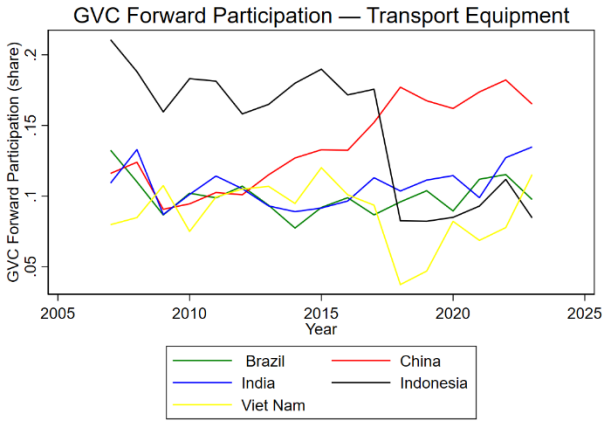
Panel D

Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

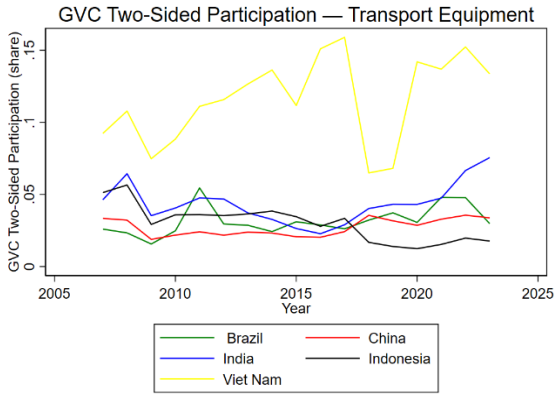
Figure 20. Trade-based GVC participation measures, Transport Equipment: India and competitor economies (2007 to 2023)



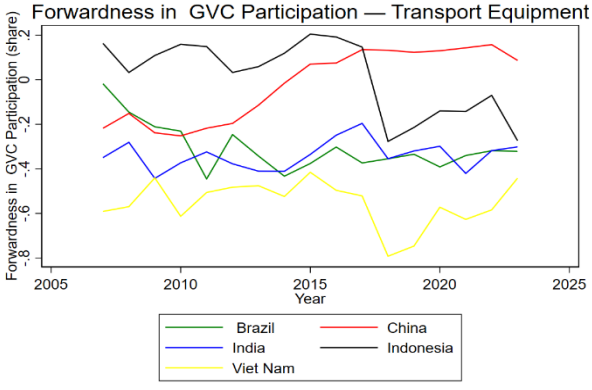
Panel A



Panel B



Panel C



Panel D

Source: Author's calculations using GVC Indicators from ADB Key Indicators Database

Overall, India's GVC participation—both at the aggregate level and across key sectors—remains below its potential. There is limited evidence of upgrading along the value chain, as reflected in largely stagnant or declining forwardness indices. However, in recent years, some sectors—particularly network products—show signs of increasing backward linkage intensity. These patterns raise an important question for future research: to what extent have policy initiatives such as Make in India, the Production-Linked Incentive (PLI) schemes, and efforts to correct the inverted duty structure contributed to strengthening India's backward linkages in these sectors?

3. Correlates of GVC Participation

In this section, we first examine sectoral tariffs and subsequently exchange rates as key correlates of GVC participation. Our empirical focus is on backward GVC participation, which appears to be the more prominent mode of integration for Indian manufacturing industries.

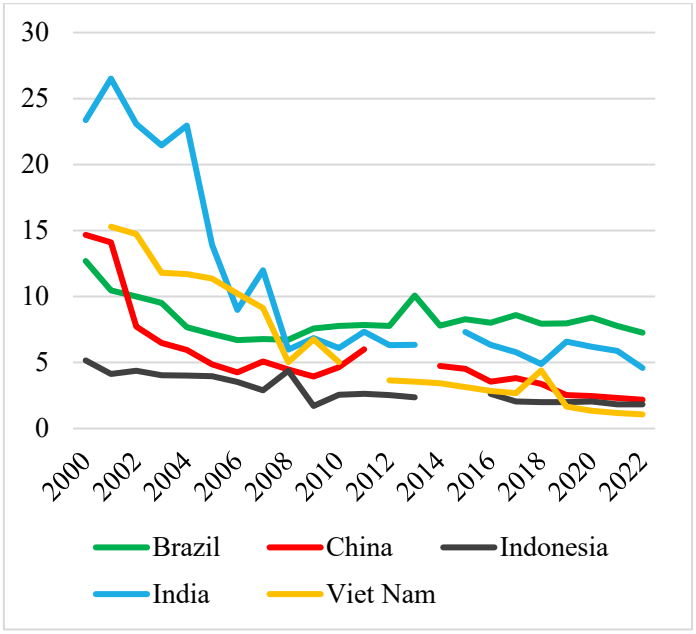
3.1 GVC Participation and Sectoral Tariffs

Trade policy is an important determinant of trade participation. In this section, we assess the role of tariffs in shaping GVC participation across Indian manufacturing industries. Although India's average tariff rates remain higher than those of most comparator countries, there is evidence of a recent recalibration of the tariff structure (see Figure 21). In particular, weighted average applied tariffs declined from around 7 percent in 2019 to 4.6 percent in 2022, indicating a degree of post-pandemic liberalization.

To examine the association between tariffs and backward GVC participation, we analyse their relationship for aggregate manufacturing (Figure 22) and across major sectors (Figure 23). The scatter plots reveal a broadly negative relationship in most industries: countries with lower final tariffs tend to exhibit higher backward linkages. This pattern aligns with the logic of production fragmentation, whereby lower tariffs reduce the cost of imported intermediates, enhance firms' access to foreign inputs, and thereby facilitate deeper integration into cross-border value chains. It is also consistent with the GVC literature, which emphasizes that tariffs can magnify along the value chain (Yi, 2003): when intermediate goods cross borders multiple times, even modest tariffs compound, raising cumulative trade costs and discouraging participation in vertically fragmented production processes.

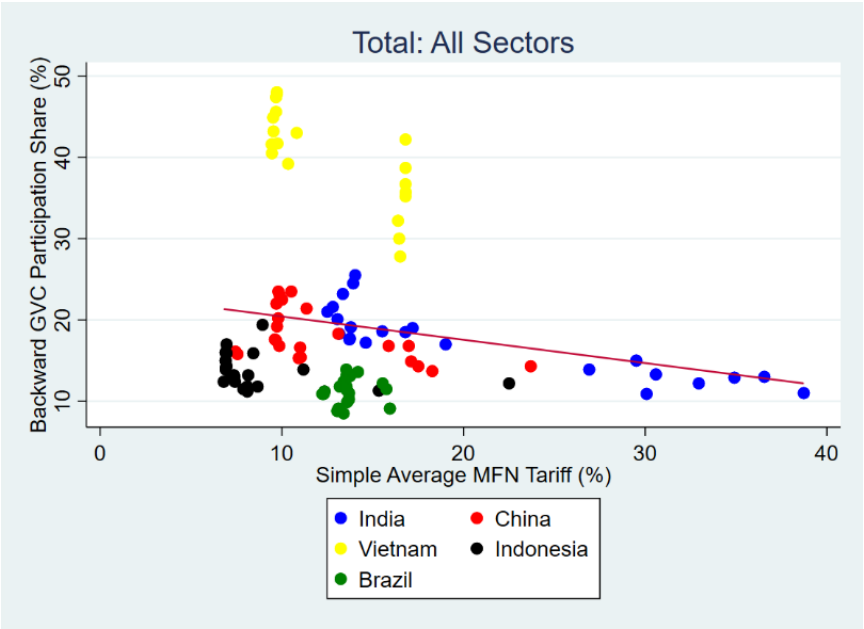
India's tariff rates remain relatively high in cross-country comparison, as reflected by the blue markers clustered toward the right side of the figures. This positioning suggests that tariff protection may have acted as a constraint on deeper integration, particularly in sectors reliant on imported inputs. However, the recent decline in applied tariffs coincides with a noticeable increase in backward GVC participation. While this temporal co-movement does not establish causality, it reinforces the cross-sectional evidence that input tariff liberalization is closely associated with stronger downstream integration in global production networks.

Figure 21. Tariff rate, applied, weighted mean, all products (%)



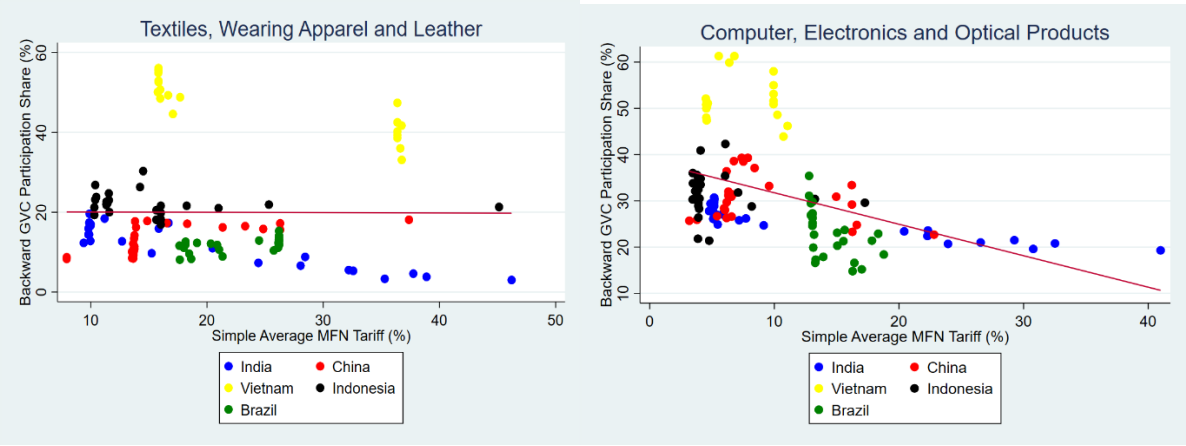
Source: World Bank

Figure 22. Correlations (Scatter-plots) between Average Tariffs and (Backward) GVC Participation in the Manufacturing Sector



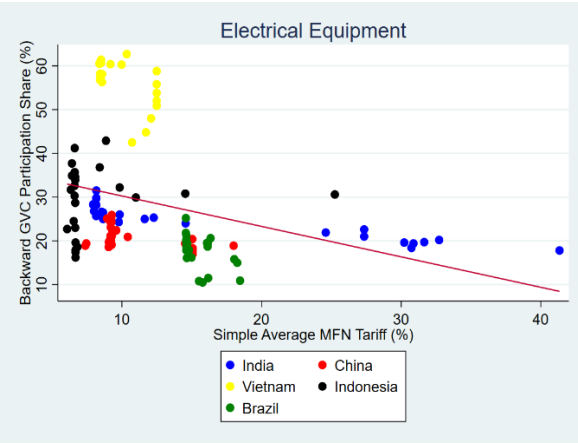
Source: TivA

Figure 23. Sector-wise Correlations (Scatter-plots) between Average Sectoral Tariffs and (Backward) GVC Participation

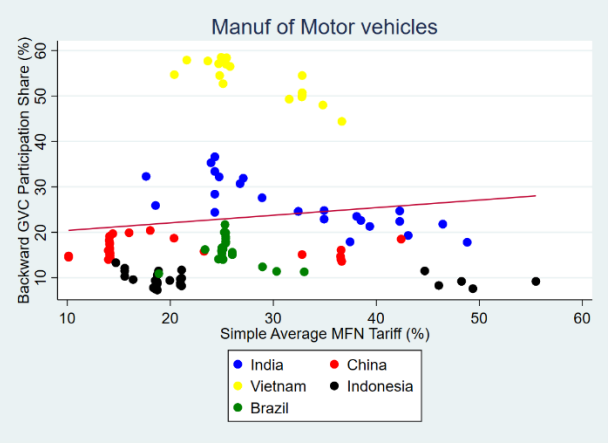


Panel A

Panel B



Panel C



Panel D

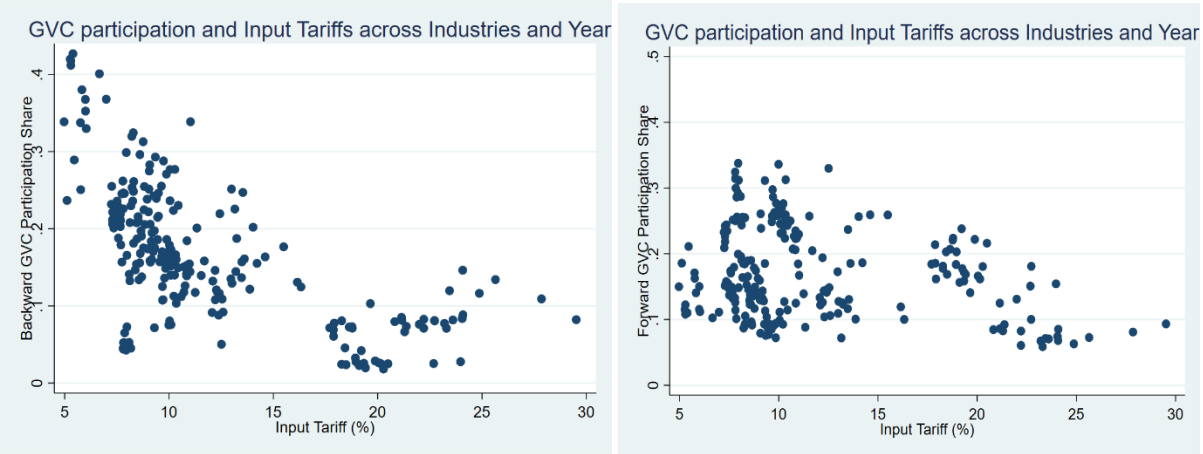
Source: TivA

***Note for Figures 22 and 23**: The y-axis measures backward GVC participation (share of foreign value added in Gross exports), sourced from TIVA database. The x-axis measures the simple average sectoral tariff rate, obtained from the WITS (World Bank) database. Each point in the graph corresponds to a particular country (varying by colour) in a particular year. The red line represents the line of best fit.*

Next, we use sectoral input shares from the ADB Input-Output Tables combined with tariff data from UNCTAD TRAINS to construct industry-level input tariffs for India. Examining the relationship between these input tariffs and GVC participation, we observe a clear negative association (Figure 24). Notably, the inverse relationship is more pronounced for backward GVC participation (Panel A, Figure 24) than for forward GVC participation (Panel B, Figure 24). This pattern is consistent with economic intuition: higher tariffs on intermediate inputs increase the cost of sourcing foreign components, thereby reducing the extent to which domestic industries integrate imported inputs into their production processes. Forward GVC participation, which reflects the extent to which domestic value is embedded in exports of other

countries, appears less sensitive to input tariffs, as it is primarily driven by the domestic supply of intermediates rather than their import cost. These results align with prior empirical findings suggesting that input trade barriers are an important constraint on backward GVC integration, reinforcing the role of trade policy in shaping global production linkages.

Figure 24. Scatterplot of backward (Panel A) and forward GVC participation shares (Panel B) of Indian industries over the years with sectoral Input Tariffs (%)



Panel A Panel B

Source: Authors' calculations using data from UNCTAD TRAINS (WITS) and ADB Input Output Tables

Note: Broad Economic Categories (BEC) and SNA classification are used to identify HS six-digit level intermediate inputs. Then, using sectoral input shares from ADB IO tables and tariff data for intermediate inputs from UNCTAD TRAINS, sectoral-level input tariffs for all the years and industries are constructed by taking weighted averages.

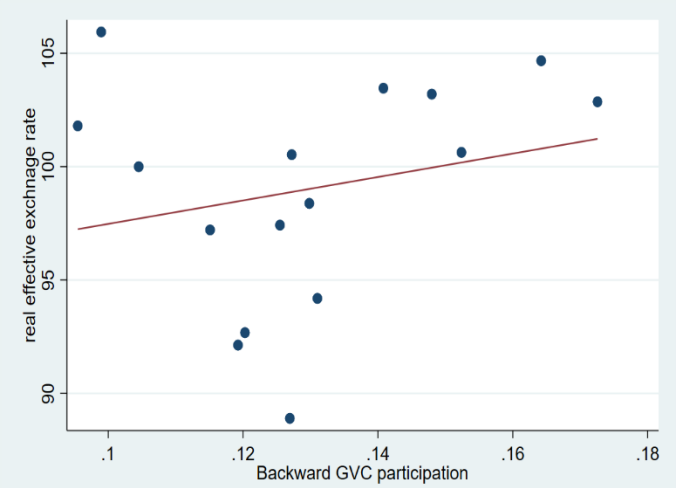
3.2 GVC Participation and Exchange Rates

A recurrent theme in the international trade literature is that India's tariff rates remain relatively high by global standards—a point corroborated by the evidence presented above. However, focusing exclusively on tariffs may provide an incomplete picture of effective protection. Macroeconomic policy has contributed to episodes of real exchange rate appreciation for much of the post-2000 period, which can partly offset the restrictive effects of high nominal tariffs. A striking illustration is India's bilateral trade with China in the most recent year, where total trade reached approximately USD 113 billion, with a trade deficit of nearly USD 100 billion. This suggests that despite relatively elevated tariffs, currency movements and underlying demand conditions have played an important role in shaping trade outcomes.

Preliminary evidence from a simple scatter plot in Figure 25 indicates a positive association between the real effective exchange rate (REER) and backward GVC participation, implying that depreciation (i.e., a lower REER) is associated with stronger backward linkages. One possible interpretation is that the scale effect—whereby depreciation stimulates export expansion and thus increases demand for imported intermediates—may dominate the cost

effect arising from more expensive foreign inputs. In this sense, exchange rate movements can interact with trade policy to influence GVC integration.

Figure 25. Correlations (Scatter-plots) between Real Effective Exchnage Rate and (Backward) GVC Participation in the Manufacturing Sector for India



4. Regression Analysis

To empirically examine the determinants of GVC participation at the sectoral level in India, we estimate the following panel regression model:

$$GVC\ share_{i,t} = \alpha + \beta_1(VA\ Share)_{i,t} + \beta_2(K-intensity)_{i,t} + \beta_3(Labour\ Productivity)_{i,t} + \beta_4(Final\ Tariff)_{i,t} + \beta_5(Input\ Tariff)_{i,t} + \beta_6(Import\ Intensity)_{i,t} + \beta_7(Export\ Intensity)_{i,t} + \beta_6(X_{i,t} * REER_t) + \gamma_i + \delta_t + \varepsilon_{i,t}$$

where subscripts *i* and *t* index sectors and years, respectively. The dependent variable, $GVC\ share_{i,t}$, obtained from the ADB GVC Indicators Database, represents the overall or backward GVC participation of sector *i* in year *t*.

Explanatory variables, sourced from INDIA KLEMS (RBI) Database, capturing sectoral characteristics include: i) sectoral value-added as a share of total economy-wide value added (VA share), capturing relative sectoral scale, ii) Capital intensity (K_intensity), i.e., the capital stock relative to gross output, and iii) Labour productivity measuring the value added per employee. Policy-related variables, sourced from UNCTAD Trains/WITS and RBI Databases, include: i) Final Tariff, i.e., the sectoral weighted average output tariff, ii) Input Tariff i.e., the average tariffs on inputs (weighted by sectoral value-added share in total inputs), iii) Import intensity capturing the sector's imports as a share of output; iv) Export Intensity i.e, the sector's

exports as a share of output; and v) to capture the effect of exchange rate, we also include interactions of the policy variables with the REER: the real effective exchange rate.

The model includes sector fixed effects (γ_i) and year fixed effects (δ_t) to control for unobserved heterogeneity across industries and over time. The estimation is performed using a panel fixed effects approach. The dataset spans 27 two-digit sectors, including 13 manufacturing industries, over the period 2007–2022.

The selection of variables in the model is grounded in the existing literature. The role of capital in promoting GVC participation, particularly backward GVC participation, has been highlighted in Fernandes et al. (2022). Similarly, Pahl et al. (2022) show that expansion in GVCs is positively correlated with labor productivity across countries, underscoring the importance of productive capacity in integrating into global production networks. Beyond output tariffs, input tariffs are especially relevant for GVC trade, as intermediate goods often cross borders multiple times; higher tariffs on such inputs are therefore expected to deter backward GVC participation (World Bank, 2020). In this context, distinguishing between input and output/final tariffs is crucial: while input tariffs directly influence the cost of imported intermediates, final tariffs serve as a proxy for the level of foreign competition faced by domestic producers. To account for the overall openness of a sector, we also include export and import intensity as controls, capturing the extent of traditional trade activity. Finally, the influence of exchange rate movements on GVC participation has been explored in studies such as Guedidi and Baghdadi (2023) and Cheng et al. (2018), suggesting that currency fluctuations may interact with trade costs and input sourcing to affect GVC integration.

Table 1 reports the empirical results. The first three columns present estimates for the full sample of industries, including both manufacturing and services, whereas Columns (4) and (5) restrict the analysis to tradable sectors by excluding services.

In Columns (1) and (2), the dependent variable is overall sectoral GVC participation. The results indicate that sectors with higher import intensity exhibit significantly greater GVC participation, suggesting that greater reliance on imported inputs is associated with deeper integration into cross-border production networks. However, the interaction between Import Intensity and the real exchange rate (REER) is negative and statistically significant. This implies that the positive association between import openness and GVC participation weakens when the domestic currency depreciates, as depreciation raises the cost of imported intermediates and may constrain the ability of firms to source foreign inputs that are essential for participation in fragmented production processes.

Table 1. Determinants of GVC participation for Indian industries:

Sectoral-level Analysis using Panel Fixed Effects Estimation

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Overall GVC share; All Industries	Overall GVC share; All Industries	Backward GVC share; All Industries	Backward GVC share; Manuf Industries only	Backward GVC share; Manuf Industries only
Value added Share	-0.709	-0.530	0.178	-0.302	-0.136
	(0.454)	(0.316)	(0.112)	(0.330)	(0.191)
K-intensity	0.001	0.001	0.007***	0.000	0.004*
	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)
Labour Productivity	0.008***	0.007**	0.005***	0.005***	0.005***
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)
Final Tariff				-0.004	
				(0.004)	
Input Tariff				-0.012***	-0.006**
				(0.004)	(0.003)
Import Intensity	0.482***	2.181***	0.565***		-0.124
	(0.074)	(0.669)	(0.085)		(0.422)
Export Intensity	-0.062		0.050		
	(0.109)		(0.042)		
Input Tariff*REER				0.000**	0.000**
				(0.000)	(0.000)
Final Tariff*REER				0.000	
				(0.000)	
Import Intensity *		-0.017**			0.006
REER		(0.007)			(0.005)
Constant	0.320***	0.303***	0.034**	0.174***	0.065

VARIABLES	(1) Overall GVC share; All Industries	(2) Overall GVC share; All Industries	(3) Backward GVC share; All Industries	(4) Backward GVC share; Manuf Industries only	(5) Backward GVC share; Manuf Industries only
	(0.041)	(0.031)	(0.014)	(0.058)	(0.038)
Observations	430	430	430	240	240
R-squared	0.338	0.354	0.819	0.517	0.838
Number of industries	27	27	27	15	15
Industry FE	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Column (3) focuses on backward GVC participation. The estimated relationships largely mirror those obtained for overall GVC participation. Import intensity continues to be positively associated with GVC integration, and the interaction with REER remains negative and significant. An additional result in this specification is that capital intensity is positive and weakly significant (at the 10 percent level), suggesting that sectors with higher capital–labour ratios may be better positioned to engage in internationally fragmented production (Fernandes et al, 2022), possibly due to greater technological capabilities or greater investment associated with GVC participation. Across all specifications, labour productivity is positive and statistically significant, indicating that more productive sectors are systematically more integrated into global production networks[7]. This is in line with the theoretical model developed by Antras and Helpman (2004) where higher productivity firms self-select into backward-GVC participation. In contrast, sectoral value added—capturing the relative size of the sector in the domestic economy—does not exhibit a statistically significant relationship with GVC participation.

Columns (4) and (5) introduce trade policy variables and focus exclusively on tradable sectors. In particular, we include tariffs on intermediate inputs (Input Tariffs) and tariffs on final goods (Final Tariffs). Input tariffs capture the cost of importing intermediate goods used in production, whereas final tariffs proxy the degree of foreign competitive pressure faced by

[7] To address potential endogeneity concerns related to labor productivity, we re-estimated the regression specifications after excluding this variable. The overall conclusions remain unchanged, indicating that the main results are robust.

domestic producers. We also include interaction terms between these tariffs and the REER to examine whether exchange rate movements moderate the impact of trade policy.

The results indicate that higher input tariffs significantly reduce backward GVC participation, consistent with the notion that protection on intermediate inputs raises production costs and discourages participation in international production networks that rely on imported components. Interestingly, the interaction between Input Tariffs and the REER is positive and statistically significant, suggesting that currency depreciation partially offsets the negative impact of input tariffs. One possible interpretation is that depreciation enhances export competitiveness, thereby mitigating some of the adverse effects of higher input costs on firms participating in export-oriented value chains.

By contrast, tariffs on final goods do not appear to have a statistically significant effect on backward GVC participation. Their interaction with the exchange rate is also insignificant, indicating that protection against foreign final goods competition does not materially influence the extent to which sectors rely on imported intermediates. In Column (5), we replace Final Tariffs with Import Intensity as an alternative measure of foreign competitive exposure. Import intensity and its interaction with the REER remain statistically insignificant in this specification, while the negative and significant effect of Input Tariffs persists. This pattern underscores the central role of intermediate input costs—rather than protection from final goods competition—in shaping sectoral participation in backward GVC linkages.

Conclusion

In conclusion, this paper shows that India's participation in global value chains—both overall and across key sectors—remains below its potential, with limited evidence of upgrading as reflected in largely stagnant or declining forwardness indices. That said, recent years point to emerging shifts, particularly in network product sectors, where backward linkage intensity has strengthened.

The tripartite decomposition of GVC participation highlights important structural patterns. In manufacturing, India's integration is predominantly downstream, with higher backward participation relative to forward and two-sided linkages. The recovery in pure backward participation—from 16% in 2016–17 to 25% in 2023—suggests that recent gains in overall GVC participation are primarily driven by deeper reliance on imported intermediates. In contrast, the services sector exhibits a markedly different profile, with forward linkages dominating. A substantial and rising share of domestic services value added in exports—reaching nearly half of gross exports—underscores India's relatively stronger position in upstream service activities.

At the sectoral level, India's prominence in network products is particularly notable, ranking just behind Vietnam in backward linkages, consistent with the expansion of downstream assembly operations since 2017–18. Finally, the regression results provide clear policy-relevant insights: higher input tariffs significantly dampen backward GVC participation, whereas tariffs on final goods do not exert a statistically significant effect. Taken together, the findings point to the importance of reducing barriers on intermediate inputs and fostering conditions that support both deeper integration and eventual upgrading within global value chains.

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