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Does Global Value Chain Participation Stabilize or Destabilize Sectoral Growth? A Panel Evidence from 44 Countries

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Research Article

Keywords: Global Value Chains, Growth Volatility, Developing Countries, Manufacturing

Posted Date: July 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10437847/v1

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Additional Declarations: The authors declare no competing interests.

Abstract

Does global value chain (GVC) participation stabilize or amplify sectoral growth volatility? Using EXIOBASE-3 data for 44 countries over 1995–2022, this paper estimates the effect of backward and forward GVC participation on value-added growth volatility in agriculture, manufacturing, and services. For the full sample, backward participation reduces volatility in agriculture and services but raises it in manufacturing, while forward participation lowers volatility in manufacturing and services. Splitting the full sample by income group reveals that backward linkages stabilize agriculture and services in developing countries but amplify manufacturing volatility in both cohorts. Forward participation reduces manufacturing volatility in developing countries and services volatility in developed countries. Our findings suggest that the aim of policy should be not higher GVC integration per se, but sector-specific measures that diversify input sources, broaden export markets, and build resilience to external shocks.

JEL Classification: F14; F15; F44; O47; C33

1. Introduction

Global value chains not only transmit intermediate goods but also propagate shocks across borders. This is the central trade-off of production interdependence: the networks that raise efficiency can also transmit instability (Cigna et al., 2022; Acemoglu et al., 2012; Burstein et al., 2008). When sectors depend on imported intermediates, foreign supply disruptions and input-price shocks can quickly become domestic production shocks (Boehm et al., 2019; Barrot and Sauvagnat, 2016). When they sell value added to foreign producers, their growth becomes tied to foreign demand and downstream production cycles (Ferrari, 2019; Altomonte et al., 2012; Bussiere et al., 2013). This matters because growth volatility is no longer determined only by domestic structural conditions. In a more fragmented production system, sectoral performance depends on events taking place in supplier countries, buyer countries, transport networks, and global commodity markets (Carvalho et al., 2021; Hummels and Schaur, 2013; Eaton et al., 2016). A disruption abroad may therefore affect domestic value added even if local demand, labor supply, and productivity remain relatively stable. In this sense, GVCs change the geography of risk: shocks that were once external can become internal to domestic production (Wang et al., 2022).

At the same time, participating in GVCs does not necessarily make sectoral growth more volatile. International production linkages can also spread risk across a wider set of suppliers and markets. Access to foreign inputs may help firms overcome domestic bottlenecks (Amiti and Konings, 2007; Goldberg et al. 2010), while diversified foreign demand may reduce dependence on local business cycles (Haddad et al., 2013; Lee et al. 2019). The same cross-border connections that expose sectors to foreign shocks may therefore also help them absorb domestic ones. Therefore, GVC participation may reshape not only the level of sectoral growth, but also its stability. A sector may benefit from integration through higher productivity (Constantinescu et al., 2019; Pahl and Timmer, 2020), higher external demand, or better inputs (Halpern et al., 2015), yet still experience a more uneven growth path. This distinction matters because volatile growth creates uncertainty for investment decisions, employment planning, capacity utilization, and long-term upgrading dynamics (Ramey and Ramey, 1995; Pindyck, 1991; Aizenman and Marion, 1999; Bloom, 2009). In sectors where production decisions require forward planning, even temporary fluctuations in value added can weaken investment incentives and make the growth rate less predictable (Ghosal and Loungani, 2000; Bloom et al., 2014).

While GVC participation is widely regarded as a driver of productivity (Kummritz, 2017), upgrading (Turan et al., 2026) and export performance, its impact on growth volatility remains underexplored. Existing evidence on trade and volatility emphasizes specialization and diversification channels (di Giovanni and Levchenko, 2010; Haddad et al., 2013; Caselli et al., 2020), yet little is known about how these mechanisms operate at the sectoral level and across different directions of GVC participation (Jangam and Rath, 2024). This paper addresses this gap by examining how GVC participation affects sectoral value-added growth volatility. Using EXIOBASE-3 data for 44 countries over the period 1995–2022, it focuses on agriculture, manufacturing, and services to capture sector-specific differences in input dependence, foreign demand exposure, and production-network position. The paper further distinguishes between backward and forward GVC participation to identify whether volatility is driven by imported inputs or foreign downstream demand linkages. This distinction is important because aggregate GVCs may obscure offsetting effects across participation margins. Finally, by comparing developing and developed countries, this paper examines whether the effects of GVC participation differ with structural conditions, since countries at different development levels differ in their exposure to external shocks transmitted through trade.

Our baseline findings reveal that backward GVC participation reduces volatility in agriculture and services, while increasing it in manufacturing. Conversely, forward participation is associated with lower volatility in manufacturing and services. Our findings further suggest that the volatility effects of GVC participation are conditioned by a country's level of development. In developing countries, backward GVC linkages play a stabilizing role in agriculture, while their effect in manufacturing is volatility-enhancing. Forward participation reduces manufacturing growth volatility. In services, the growth-stabilizing effect is largely driven by backward participation. For developed countries, GVC participation has limited effects on agricultural volatility, while backward participation boosts volatility in manufacturing. For services, forward GVC participation dampens growth volatility, indicating that both sectoral structure and development level play a crucial role in the GVC-growth volatility nexus.

The rest of the paper is organized as follows. Section 2 provides the related literature, Section 3 explains the model, data, and empirical strategy, Section 4 discusses the empirical results, and the last section concludes with policy implications.

2. Literature Review

GVC participation may influence sectoral growth volatility through multiple channels. Among these channels, backward linkages are particularly important because they connect domestic sectors to foreign intermediate input markets (Hummels et al., 2001; Borin and Mancini, 2019). Backward GVC linkages may increase sectoral growth volatility by exposing domestic production to foreign input price and supply shocks (Ahn et al., 2017; Casas, 2019). Higher imported input prices raise production costs and may reduce value added, even when domestic demand remains stable. Similarly, disruptions in supplier countries can directly constrain domestic production, especially in sequential production processes where one missing input can delay the entire value chain (Costinot et al., 2013; Antràs and de Gortari, 2020; Lafrogne-Joussier et al., 2023).

The cost and supply-side exposure may be further intensified when exchange rate movements affect the domestic-currency cost of imported intermediates. Thus, another critical mechanism works through the exchange rates. Sectors with higher backward GVC intensity rely more heavily on imported intermediate inputs in their production and export processes. Because these inputs are often denominated in foreign currency, exchange-rate fluctuations can be transmitted directly into production costs (Gopinath et al., 2010; Goldberg and Tille, 2008; Devereux et al., 2017). Therefore, a depreciation of the domestic currency raises the local-currency cost of imported intermediates (Boz et al., 2017; Berman et al., 2012). As a result, sectoral value-added growth may become more volatile.

Beyond price, supply, and exchange-rate shocks, the degree of input substitutability also determines how strongly backward GVC linkages transmit external disturbances. The input-specificity channel provides another crucial mechanism through which backward GVC participation may influence sectoral growth volatility. Since many imported intermediates are technologically complex, relationship-specific, and difficult to substitute (Rauch, 1999; Nunn, 2007; Levchenko, 2007), disruptions in their supply can constrain production beyond their direct cost share. Hence, dependence on specialized and hard-to-substitute foreign inputs may transmit external shocks more strongly (Elliott et al., 2022; Baqaee and Farhi, 2019) and make sectoral growth less stable.

Nevertheless, backward GVC participation does not necessarily increase sectoral growth volatility. It may also reduce volatility when foreign intermediate inputs provide a source of input diversification and production smoothing (Grossman et al., 2023; Ahn and Tan, 2025). By allowing domestic sectors to access inputs from foreign suppliers, backward participation can reduce excessive dependence on domestic input markets. This may be particularly important when domestic suppliers face capacity constraints, quality problems, technological limitations, or disruptions caused by local shocks. In such cases, imported intermediates can help firms maintain production even when domestic input conditions deteriorate (Zaclicever and Pellandra, 2018; Pane and Patunru, 2023).

This stabilizing effect may be especially relevant for sectors in which domestic intermediate-input markets are underdeveloped or unreliable (Amin, 2018; Brummitt et al., 2017). Access to foreign machinery, components, chemicals, fertilizers, energy inputs, business services, or technology-intensive intermediates can relax domestic production bottlenecks and improve the continuity of production (Ethier, 1982; Broda and Weinstein, 2006; Blaum et al., 2018). Foreign inputs may also embody higher quality, higher technological content, and more predictable supply standards, which can increase production efficiency and reduce fluctuations in sectoral value added (Coe and Helpman, 1995; Coe et al., 1997; Keller, 2004; Schiff and Wang, 2006; Kugler and Verhoogen, 2012). Therefore, backward participation may lower sectoral growth volatility when imported inputs improve the reliability and flexibility of the production process.

Moreover, backward GVC participation may help sectors absorb domestic shocks by widening the range of available suppliers (Tang, 2006). If firms can source inputs from multiple foreign markets, a disruption in one supplier or country may be offset by alternative sources elsewhere (Tomlin, 2006; Längle et al., 2021). In this case, foreign input use acts as a risk-sharing mechanism rather than a source of vulnerability. The stabilizing effect is likely to be stronger when imported inputs are diversified across countries, substitutable, and supported by stable supplier relationships (Tang and Tomlin, 2008; Todo et al., 2015). Thus, backward participation may reduce sectoral growth volatility when it expands the access to reliable and diversified intermediate inputs, allowing domestic sectors to smooth production in response to domestic supply shocks.

Beyond backward linkages, forward GVC participation can also raise sectoral growth volatility through foreign demand-side exposure (Saito et al., 2013; Schwellnus et al., 2023). Specifically, forward participation may increase sectoral growth volatility by exposing domestic sectors to fluctuations in foreign downstream demand (Daudin et al., 2011). When domestic value added is used by foreign producers in their own exports, domestic sectoral growth becomes more sensitive to foreign business cycles, external demand shocks, and other changes in global economic activity (Timmer et al., 2014; Ng, 2010; Arkolakis and Ramanarayanan, 2009). Forward participation may also change sectoral growth volatility through the derived-demand channel. Sectors supplying intermediate inputs to foreign producers are indirectly exposed to fluctuations in foreign final demand. When final demand weakens abroad, foreign producers may scale back production, which can disproportionately reduce demand for exported intermediate inputs (Alessandria et al., 2010; Levchenko et al., 2010).

On the other hand, forward GVC participation may amplify sectoral volatility when domestic sectors occupy upstream positions in global production networks (Antràs et al., 2012; Ferrari, 2019). Since upstream sectors supply inputs to foreign producers rather than final consumers, their demand is derived from downstream production. A decline in foreign final demand can therefore be transmitted through inventory adjustments, order cancellations, and production cuts along the value chains (Lee et al., 1997; Zavacka, 2012). Additionally, sectors that are farther from final demand might experience stronger fluctuations because they are indirectly exposed to several layers of downstream adjustment and commodity price cycles (Cashin et al., 2002; Erten and Ocampo, 2013). This vulnerability can be reinforced by specialization in primary sectors, as GVC participation may encourage sectors to focus on narrower tasks, making sectoral growth more sensitive to commodity-price shocks (Bleaney and Greenaway, 2001; Hausmann and Rigobon, 2003).

However, forward GVC participation may also reduce sectoral growth volatility through several stabilizing mechanisms. First, it can diversify demand across foreign markets. By supplying intermediate inputs to multiple foreign producers and destination markets, domestic sectors become less dependent on domestic demand conditions or on a single buyer (Koren and Tenreyro, 2007; Vannoorenberghe et al., 2014). Weak demand in one market may be offset by stronger demand elsewhere, allowing sectors to smooth growth over time. Second, forward participation can support scale expansion and more stable capacity utilization. Access to foreign downstream producers enlarges the market available to domestic sectors, allowing firms to operate on a more efficient and continuous scale (Atkin et al., 2017). This can reduce fluctuations caused by limited domestic demand, irregular production, or underutilized capacity. Third, forward participation may promote learning and upgrading. Supplying foreign producers frequently requires firms to meet higher quality standards, delivery requirements, and technical specifications (Gereffi et al., 2005; Humphrey and Schmitz, 2002; Pietrobelli and Rabellotti, 2011).

Building on these mechanisms, a growing empirical literature examines whether GVC integration strengthens the international transmission of business-cycle shocks. Evidence from the Great Trade Collapse in 2008 suggests that production networks can amplify cyclical disturbances. In this case, Altomonte et al. (2012) show that intermediate trade declined more sharply during the crisis, consistent with a bullwhip mechanism driven by inventory adjustments along with GVCs. Gangnes et al. (2012) show that China's processing trade was concentrated in sectors more sensitive to foreign demand shocks, rather than being intrinsically more income-elastic than regular trade measures. On the other hand, more recent studies emphasize the role of value-chain position. Ferrari (2019) finds that industries farther from final demand respond more strongly to final-demand shocks from GVCs, while Wang et al. (2022) show that complex GVC activities comove more closely with global business cycles than domestic production. Similarly, Jangam and Rath (2024) find that GVC integration may either synchronize or desynchronize business cycles, depending on the direction of participation and the industry mix in the ASEAN region.

Overall, the net effect of GVC participation on sectoral growth volatility is theoretically ambiguous. Both backward and forward linkages can amplify volatility by transmitting foreign input shocks, exchange-rate fluctuations, supply disruptions, downstream demand shocks, and commodity-price cycles to domestic sectors. At the same time, GVC participation may reduce volatility by diversifying input sources and destination markets, relaxing domestic production constraints, improving capacity utilization, and supporting learning and upgrading. Therefore, whether GVC participation increases or decreases sectoral growth volatility depends on the relative strength of these competing mechanisms. The net effect is likely to differ across sectors according to their position in the value chain.

3. Model, Data and Methodology

To investigate the impact of GVCs on sectoral growth volatility, we employ a simple model below:

$$Volatility_{i,c,t} = a + \gamma Controls_{i,c,t} + \beta_1 Backward\,GVC\,Participation_{i,c,t} + \beta_2 Forward\,GVC\,Participation_{i,c,t} + z_{i,c} + v_t + \epsilon_{i,c,t} \quad (1)$$

Volatility is calculated as five-year rolling standard deviation[1] of value-added growth for agriculture, manufacturing, and services. The control variables include the human capital index, the Polity, and sectoral capital intensity to account for differences in human capital accumulation, institutional quality, and physical capital intensity in explaining sectoral growth volatility, respectively. Backward GVC participation measures foreign intermediate value added as a share of exports, whereas forward participation measures export share of domestic value added that is re-exported by trade partners (Koopman et al., 2014). In Eq. (1), $z_{i,c}$, v_t and $\epsilon_{i,c,t}$ represent industry-country dummies, time dummies and the error term. The trade, capital, and labor data are collected from the EXIOBASE-3 database (Stadler et al., 2018), while the human capital and polity indices are obtained from the Penn World Table (Feenstra et al., 2015) and the Polity IV dataset (Marshall et al., 2002), respectively. Covering 44 countries[2] over the period 1995–2022, the mean values of our 5-year averaged dataset is presented in Table 1 to provide some initial insights.

Table 1
Mean Values

Variables	Agriculture		Manufacturing		Services	
	Obs.	**Mean**	**Obs.**	**Mean**	**Obs.**	**Mean**
Volatility of VA Growth	10050	11.198	10060	8.678	10080	7.126
log(K/L)	10050	0.942	10060	1.731	10080	1.729
Polity	10050	8.751	10060	8.751	10080	8.736
Human Capital Index	10050	3.065	10060	3.066	10080	3.065
BP	10050	4.737	10060	9.278	10080	4.550
FP	10050	7.468	10060	8.621	10080	8.594
GVC	10050	12.204	10060	17.899	10080	13.144
Developing Countries						
	Agriculture		**Manufacturing**		**Services**	
Variables	**Obs.**	**Mean**	**Obs.**	**Mean**	**Obs.**	**Mean**
Volatility of VA Growth	5494	12.210	5500	10.795	5520	8.398
log(K/L)	5494	-0.134	5500	1.059	5520	1.110
Polity	5494	7.794	5500	7.794	5520	7.770
Human Capital Index	5494	2.868	5500	2.869	5520	2.868
BP	5494	4.423	5500	9.907	5520	4.539
FP	5494	7.857	5500	8.647	5520	8.292
GVC	5494	12.280	5500	18.554	5520	12.831
Developed Countries						
	Agriculture		**Manufacturing**		**Services**	
Variables	**Obs.**	**Mean**	**Obs.**	**Mean**	**Obs.**	**Mean**
Volatility of VA Growth	4556	9.978	4560	6.124	4560	5.587
log(K/L)	4556	2.240	4560	2.542	4560	2.479
Polity	4556	9.905	4560	9.905	4560	9.905
Human Capital Index	4556	3.303	4560	3.303	4560	3.303
BP	4556	5.114	4560	8.519	4560	4.565
FP	4556	6.999	4560	8.590	4560	8.959
GVC	4556	12.113	4560	17.110	4560	13.524

(INSERT Table 1 HERE)

We estimate our model using fixed effects to account for unobserved heterogeneity across country-sector pairs and common shocks over time. Country-sector fixed effects control for time-invariant structural characteristics that may influence sectoral growth volatility, such as sectoral production structure, resource endowments, technological capacity, geographic conditions, and long-standing differences in trade specialization. Year fixed effects capture global shocks that affect all countries and sectors simultaneously, including financial crises, commodity-price fluctuations, changes in global demand, and disruptions in international production networks.

4. Empirical Results and Discussion

Table 2 presents the empirical results on the impact of GVC participation on value-added growth volatility in agriculture, manufacturing, and services. The control variables behave as expected. Capital intensity dampens growth volatility in manufacturing and services, although its stabilizing role is not observed in agriculture. Human capital lowers the growth volatility in agriculture and manufacturing, suggesting that productivity, skills, and absorptive capacity help sectors adjust more smoothly to shocks. Institutional quality also consistently reduces volatility across all three sectors, indicating that stronger political institutions create a more predictable environment for sectoral performance.

Table 2
Sectoral Growth Volatility and GVCs

	Agriculture			Manufacturing			Services		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log(K/L)	0.835***	0.817***	0.842***	-5.899***	-5.981***	-5.984***	-3.037***	-2.945***	-2.985***
	(0.259)	(0.260)	(0.261)	(0.424)	(0.422)	(0.420)	(0.311)	(0.313)	(0.311)
Polity	-0.319***	-0.311***	-0.315***	-0.762***	-0.780***	-0.772***	-0.432***	-0.409***	-0.425***
	(0.077)	(0.076)	(0.076)	(0.049)	(0.049)	(0.050)	(0.046)	(0.046)	(0.046)
Human Capital Index	-6.270***	-6.411***	-6.418***	-5.539***	-5.018***	-4.969***	3.197***	2.842***	2.986***
	(0.778)	(0.781)	(0.781)	(0.673)	(0.666)	(0.670)	(0.610)	(0.586)	(0.592)
BP	-0.113***			0.185***			-0.164***		
	(0.034)			(0.026)			(0.031)		
FP		-0.019			-0.110***			-0.056***	
		(0.021)			(0.027)			(0.021)	
GVC			-0.049***			0.070***			-0.111***
			(0.018)			(0.021)			(0.019)
Observations	10,050	10,050	10,050	10,060	10,060	10,060	10,080	10,080	10,080
R-squared	0.519	0.518	0.519	0.645	0.642	0.642	0.664	0.663	0.664

Notes: Country clustered robust standard errors are in parentheses. Year dummies are employed in all specifications but not reported. *** p < 0.01, ** p < 0.05, * p < 0.1

Columns (1)–(3) focus on the agriculture sector. The negative and statistically significant coefficient of backward GVC participation in column (1) suggests that foreign input use helps stabilize agricultural growth. This result is plausible given the nature of agricultural production, which is highly exposed to weather conditions, seasonal cycles, and domestic input-market imperfections (Schlenker and Roberts, 2009). Access to imported inputs may ease domestic supply constraints and support more stable production (Garcia-Verdu et al., 2019). Forward participation, reported in column (2), is also negative but statistically insignificant, implying that supplying agricultural value added to foreign producers does not produce a stabilizing effect. This may be because forward agricultural linkages expose the sector to foreign demand conditions and commodity-price fluctuations, which can offset the demand-diversification benefits of GVC participation (Huchet-Bourdon, 2011).

The results for manufacturing, reported in columns (4)–(6), point to a different pattern. Backward GVC participation exacerbates manufacturing growth volatility, as shown by the positive and statistically significant coefficient in column (4). This finding is consistent with the notion that manufacturing sectors are more sensitive to imported input-price shocks, foreign supply disruptions, exchange-rate movements, and bottlenecks in sequential production (Casas, 2019; Boehm et al., 2019). Since manufacturing depends on specialized and complementary inputs, disruptions in foreign input markets can quickly pass through to domestic value-added growth. Forward participation, however, works in the opposite direction. Its negative and significant coefficient on column (5) suggests that supplying domestic value added to foreign producers helps reduce volatility by diversifying demand, expanding market access, supporting capacity utilization, and creating more stable links with foreign downstream trade partners.

Columns (7)–(9) present the findings for services. Unlike manufacturing, participating in both backward and forward GVC participation reduces services growth volatility (Francois and Hoekman, 2010). Access to foreign intermediate services, technologies, and knowledge-intensive inputs may improve efficiency and reduce production disruptions, while forward linkages allow domestic service providers to diversify demand by connecting with foreign producers (Arnold et al., 2016). In this case, imported ICT, financial, logistics, and business-service inputs may be particularly important in supporting smoother service-sector performance.

(INSERT Table 2 HERE)

To account for heterogeneity across country groups, we re-estimate our model separately for developing and developed countries. This distinction is important because GVC participation may affect sectoral growth volatility through diversification, specialization, and exposure to external shocks (Caselli et al., 2020; Haddad et al., 2013; di Giovanni and Levchenko, 2010). Moreover, developed and developing countries differ in absorptive capacity, institutional quality, and input-market depth, suggesting that the volatility effects of GVC participation may differ by the stage of development. The fixed effects estimations are presented for developing and developed countries in Tables 3–4, respectively.

Table 3
Sectoral Growth Volatility and GVCs in Developing Countries

	Agriculture			Manufacturing			Services		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log(K/L)	2.683***	2.646***	2.704***	-5.428***	-5.398***	-5.450***	-5.470***	-5.374***	-5.404***
	(0.359)	(0.364)	(0.364)	(0.484)	(0.486)	(0.484)	(0.367)	(0.371)	(0.370)
Polity	-0.203***	-0.184**	-0.193***	-0.683***	-0.695***	-0.694***	-0.648***	-0.598***	-0.619***
	(0.073)	(0.072)	(0.072)	(0.046)	(0.046)	(0.047)	(0.046)	(0.046)	(0.045)
Human Capital Index	3.670***	3.688***	3.529**	2.327*	2.894**	2.699**	-1.712**	-1.355*	-1.451*
	(1.406)	(1.406)	(1.404)	(1.228)	(1.202)	(1.221)	(0.748)	(0.748)	(0.746)
BP	-0.233***			0.166***			-0.368***		
	(0.059)			(0.038)			(0.039)		
FP		-0.057*			-0.184***			-0.005	
		(0.031)			(0.040)			(0.031)	
GVC			-0.104***			0.016			-0.158***
			(0.028)			(0.029)			(0.026)
Observations	5,494	5,494	5,494	5,500	5,500	5,500	5,520	5,520	5,520
R-squared	0.470	0.468	0.469	0.607	0.606	0.604	0.700	0.693	0.696

Notes: Country clustered robust standard errors are in parentheses. Year dummies are employed in all specifications but not reported. *** p < 0.01, ** p < 0.05, * p < 0.1

Table 4
Sectoral Growth Volatility and GVCs in Developed Countries

	Agriculture			Manufacturing			Services		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log(K/L)	1.074**	1.109**	1.071**	0.046	0.174	0.066	1.580***	1.641***	1.645***
	(0.458)	(0.454)	(0.455)	(0.315)	(0.320)	(0.316)	(0.470)	(0.467)	(0.471)
Polity	-0.097	-0.104	-0.104	-0.710***	-0.733***	-0.734***	0.790***	0.805***	0.776***
	(0.156)	(0.156)	(0.156)	(0.094)	(0.093)	(0.093)	(0.167)	(0.165)	(0.167)
Human Capital Index	-10.586***	-10.431***	-10.654***	-1.481	0.626	0.151	9.983***	9.650***	10.517***
	(1.627)	(1.606)	(1.616)	(0.995)	(1.035)	(1.001)	(1.079)	(0.931)	(0.939)
BP	0.000			0.151***			0.006		
	(0.032)			(0.026)			(0.033)		
FP		0.033*			-0.030			-0.083***	
		(0.020)			(0.023)			(0.023)	
GVC			0.019			0.085***			-0.067***
			(0.018)			(0.020)			(0.021)
Observations	4,556	4,556	4,556	4,560	4,560	4,560	4,560	4,560	4,560
R-squared	0.721	0.722	0.722	0.663	0.658	0.660	0.626	0.627	0.627

Notes: Country clustered robust standard errors are in parentheses. Year dummies are employed in all specifications but not reported. *** p < 0.01, ** p < 0.05, * p < 0.1

Columns (1)–(3) of Table 3 report the result for agriculture in developing countries. The coefficient of backward GVC participation in column (1) is negative and statistically significant, indicating that stronger backward linkages reduce agricultural growth volatility. This result suggests that imported intermediate inputs play an important stabilizing role in agriculture (Garcia-Verdu et al., 2019). In many developing economies, agricultural

production is highly exposed to domestic supply constraints (Donovan, 2021). When these inputs are scarce, costly, or irregularly available in domestic markets, agricultural output becomes more sensitive to seasonal conditions and local input-market disruptions. Backward participation may therefore reduce volatility by widening access to essential foreign inputs and improving the continuity of agricultural production. This stabilizing effect may also reflect the productivity and reliability advantages of foreign intermediates. Imported agricultural inputs often embody better technology and higher quality, which can help farmers and agro-processing activities respond more effectively to production risks (Farrokhi and Pellegrina, 2023).

Column (2) shows that forward GVC participation also reduces agricultural growth volatility, although the effect is weakly significant. This suggests that selling agricultural value added into foreign production networks may provide some stabilization by diversifying demand beyond domestic markets (Maertens et al., 2012). However, the weaker effect may reflect the specific conditions of developing countries. Agricultural forward linkages in developing countries are mainly concentrated in primary or less processed products, which remain exposed to international commodity-price fluctuations, foreign demand cycles, and buyer concentration (Gibbon, 2001). As a result, the stabilizing effects of foreign demand diversification may be partly offset by exposure to global price instability and external demand shocks (Deaton, 1999).

Finally, column (3) shows that overall GVC participation has a negative and statistically significant effect on agricultural growth volatility. This confirms that GVC integration stabilizes agricultural value-added growth in developing countries (OECD, 2020). All in all, the results suggest that the volatility-reducing effect is mainly driven by backward linkages. For agriculture in developing countries, GVC participation appears to reduce volatility by improving access to essential inputs, relaxing domestic supply constraints, supporting productivity, and increasing demand in global markets (Farrokhi and Pellegrina, 2023).

The manufacturing results for developing countries reveal a clear contrast between the two directions of GVC participation. Backward linkages raise manufacturing growth volatility, which suggests that imported inputs can become a source of instability (Campa and Goldberg, 1995). This is plausible in developing countries, where manufacturers rely on imported machinery, components, and technology-intensive inputs that are difficult to replace domestically (Halpern et al., 2015). When external input prices rise, exchange rates fluctuate, or foreign suppliers face disruptions, these shocks can quickly pass through to domestic production (Cravino, 2017). Forward participation, by contrast, appears to reduce volatility. Supplying domestic value added to foreign producers may help manufacturers diversify demand, improve capacity utilization, and maintain more stable buyer-seller relationships (Lileeva and Trefler, 2010).

For services, the empirical results point more clearly to a stabilizing role of GVC integration. Backward participation significantly lowers services growth volatility, indicating that access to foreign service inputs and technologies may improve the reliability and efficiency of service-sector activity (Beverelli et al., 2017). In the developing-country case, imported ICT, financial, logistics, professional, and business-service inputs can compensate for weaknesses in domestic service markets and support smoother production. The effect of forward participation is negative but insignificant, suggesting that foreign demand linkages are still not strong enough to produce a stabilizing effect. This may reflect the limited tradability of many services and the weaker integration of developing-country service providers into global production networks (Gervais and Jensen, 2019). Overall, the negative and significant GVC coefficient suggests that services benefit from GVC integration mainly through better access to foreign intermediate services and knowledge-intensive inputs (Ariu, 2016).

(INSERT Table 3 HERE)

The results in Table 4 for developed countries show that the volatility effects of GVC participation differ across sectors and directions of GVC. In agriculture, the coefficients have generally weak significance. Backward participation is near zero and statistically insignificant. This suggests that GVC integration does not play a decisive role in explaining agricultural growth volatility in developed economies (OECD, 2020). The only notable result is forward participation, which is positive and weakly significant. This may indicate that agricultural sectors in developed countries become slightly more exposed to fluctuations when their value added is linked to foreign processing or export-oriented food chains (Huchet-Bourdon, 2011).

The manufacturing results provide a clearer picture. Backward participation is positive and highly significant, while total GVC participation is also positive and highly significant. This result supports the notion of an efficiency–resilience trade-off in manufacturing (Antràs, 2020). High-tech manufacturing sectors could benefit from highly fragmented and internationally coordinated production systems, but these same systems can make sectoral growth more sensitive to disruptions when production stages are tightly synchronized (Baldwin and Lopez-Gonzalez, 2015). The insignificant coefficient of forward participation suggests that supplying value added to foreign producers does not, by itself, produce a statistically clear stabilizing effect. Overall, the manufacturing results indicate that the volatility-increasing role of backward linkages is the dominant link.

The services results move in the opposite direction. Backward participation is statistically insignificant, but forward participation is negative and highly significant. This result suggests that the stabilizing role of GVCs in developed-country services comes mainly from outward service linkages rather than imported service inputs. Developed countries tend to have internationally competitive service sectors, and when these sectors supply value added to foreign producers, they may benefit from broader external demand, recurring business relationships, and less dependence on domestic business cycles (Gnangnon, 2021). Hence, the negative and highly significant coefficient of total GVC participation confirms this result, showing that GVC integration reduces services volatility mainly through intermediate service exports.

(INSERT Table 4 HERE)

5. Conclusion

In this paper, we investigate whether GVC participation exacerbates sectoral growth volatility for 44 countries from 1995 to 2022. Incorporating EXIOBASE-3 data, our empirical results show that the effect of GVC participation on sectoral growth volatility is highly mixed across sectors, GVC margins, and country groups. In the full sample, backward participation reduces volatility in agriculture and services but boosts growth volatility in manufacturing. By contrast, forward participation reduces growth volatility in manufacturing and services.

The country-group results further indicate that the volatility effects of GVC participation differ by development level. In developing countries, GVC integration stabilizes agricultural growth mainly through backward linkages. In manufacturing, participating in backward GVCs boosts volatility, while forward participation reduces it. For services, the stabilizing effect is mainly associated with backward participation and total GVC integration, whereas forward linkages do not have any significant effect. For developed countries, the empirical results reveal a different pattern. GVC participation has no strong effect on agricultural volatility, except for a weakly positive impact of forward GVC participation. In manufacturing, backward participation significantly increases growth volatility. Lastly, forward participation and total GVC participation significantly reduce the growth volatility, while backward participation remains insignificant in services.

Several policy implications follow from these findings. First, policies toward GVC participation should be tailored to sector-specific dynamics. In agriculture, the volatility-reducing effect of backward participation suggests that stable access to imported inputs can help smooth agricultural production in developing countries. Therefore, policies that improve access to essential agricultural intermediates, reduce input-market frictions, and strengthen logistics systems may help stabilize agricultural growth. Second, the positive impact of backward participation on manufacturing volatility indicates that reliance on foreign intermediates can create vulnerability when production depends on specialized and difficult-to-substitute inputs. For manufacturing, policies should therefore focus on reducing excessive supplier dependence, diversifying foreign input sources and strengthening domestic supplier capacity. Third, the stabilizing role of forward participation in manufacturing suggests that foreign demand linkages can reduce volatility when they increase market access. Therefore, policies that help firms move toward more diversified export markets, stronger buyer relationships, and higher value-added tasks may enhance the stabilizing benefits of GVC integration. Overall, policy should not aim simply to increase GVC integration, but should improve product quality, export-basket diversity, and resilience to external shocks.

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Footnotes

1. We also re-estimate our specifications using the three-year rolling standard deviation, and the results remain quantitatively similar.
2. The list of countries is provided in Table A1 of the Appendix section.

Supplementary Files

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- APPENDIX.docx