

Developing Countries and Trade: Strategic Capabilities, Structural Barriers, and Systemic Constraints Shaping Central Asian Economies' Integration into Global Value Chains (GVCs) and Regional Value Chains (RVCs)

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Abstract

Central Asian economies occupy a critical geographic and economic space positioned between Europe and East Asia, offering strategic connectivity and rich natural resource endowments. However, despite these inherent advantages, the region has not effectively transformed these assets into deep participation in Global Value Chains (GVCs) and Regional Value Chains (RVCs). This paper provides a comprehensive analysis of the dynamics of GVC participation among Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, and Tajikistan, examining both backward and forward value-chain linkages. Drawing upon multi-regional input-output data from the EORA database and complementary institutional indicators, the study reveals that Central Asian economies remain predominantly upstream resource exporters with limited value-added capture, minimal technological upgrading, and marginal involvement in multi-stage international production processes. The findings highlight that structural bottlenecks—especially regulatory fragmentation, weak property-rights protection, bureaucratic inertia, logistical inefficiencies, and limited innovation capacity—are primary determinants of shallow GVC integration. In contrast, Southeast Asian economies such as Vietnam and Indonesia have developed robust manufacturing ecosystems by successfully aligning industrial policies with foreign investment attraction and supply-chain integration strategies. This research argues that the Central Asian region requires coordinated policy interventions focusing on harmonizing regional trade standards, fostering competition-driven markets, enhancing institutional transparency, strengthening education and skills development, and incentivizing diversification beyond extractive sectors. Meaningful integration into GVCs requires not just connectivity or geographical positioning, but institutional reliability, adaptive industrial strategy, and the cultivation of distinctive production niches that allow economies to transition from resource dependence toward higher-value activities within global production networks.

Keywords

Central Asia; Kazakhstan; Uzbekistan; Global Value Chains; Regional Value Chains; Value-added trade; Foreign value added; Forward and backward participation; Institutional quality; Trade policy; Industrial diversification; Economic development; Innovation capacity; Investment climate; Supply-chain integration; Transport and logistics; Landlocked economies; Multi-regional input-output analysis; Global production networks

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1. Introduction

The emergence and expansion of Global Value Chains (GVCs) have fundamentally transformed international trade dynamics and the organization of global production (Gereffi et al., 2005; Baldwin, 2013). In the contemporary trading environment, countries no longer simply exchange final goods; instead, production is geographically fragmented, allowing economies to specialize in specific stages of production. Accordingly, both developed and developing countries derive significant advantages from GVC participation. Firms in advanced economies offshore cost-intensive processes to reduce overhead, while developing economies gain access to foreign capital, technology acquisition, managerial know-how, and market learning effects (Slany, 2017; Taglioni & Winkler, 2016).

Prior research has identified multiple determinants of successful GVC integration, including the level of industrial development, tariff and non-tariff regulatory regimes, investor protection frameworks, technological capacity, labor-force quality, institutional stability, and cultural-economic norms (Dunning, 1988; Sturgeon et al., 2008; Coe & Yeung, 2015). However, existing studies often conceptualize GVC dynamics predominantly through bilateral or vertical production linkages between lead firms and suppliers. Methodologies addressing complex multilateral production networks—especially among developing economies—remain limited and under-theorized.

It is widely acknowledged that GVC participation varies significantly both across sectors and across countries. Not all economies are equally integrated into international production systems; indeed, a considerable number remain peripheral or marginal to global manufacturing networks (OECD, 2013). A range of structural impediments—weak property-rights enforcement, insufficient logistics infrastructure, limited technological readiness, and institutional complexity—constrain the ability of developing countries to upgrade from low-value-added export roles into more sophisticated, higher value-added segments of the GVC (UNCTAD, 2020).

In this regard, East and Southeast Asia represent a notable contrast. China's rapid industrial ascent and deepening trade networks catalyzed regional GVC expansion. China's share of global manufacturing output increased from approximately 4% in 2000 to nearly 15% by 2018, fostering both backward and forward linkages with ASEAN and broader Asia-Pacific economies. These regional production networks contributed to robust growth—East Asia's share of global GDP expanded from 20% to 27%, while Southeast Asia doubled its contribution to international production from 2% to 4% over the same period (World Bank, 2019). These trends demonstrate how coordinated regional integration, supported by strong industrial policy, open trade regimes, and high-efficiency logistics systems, can accelerate GVC participation and domestic economic upgrading.

In contrast, the Central Asian region presents a paradox. Despite its strategic geographic location—situated between the European and East Asian markets—and its abundance of natural resources, the region continues to exhibit comparatively low levels of trade diversification and minimal evidence of GVC-driven industrialization (Pomfret & Sourdin, 2014). GDP per capita remains modest, export structures remain heavily resource-dependent, and GVC participation is shallow. Some scholars attribute these outcomes to geographic disadvantages, particularly the landlocked nature of Central Asian states, which amplifies transport costs and weakens trade efficiency (Grigoriou, 2007). Others argue that institutional deficits—rather than geography—constitute the primary impedi-

ment, as governance quality, customs regimes, investment policies, and bureaucratic practices generate hidden trade costs that exceed physical-distance barriers.

Consequently, Central Asian countries predominantly export low-value-added commodities with limited domestic processing, resulting in weak integration into intermediate-goods networks and limited insertion into multi-stage production chains. Unlike East Asia, which leveraged China-centric production ecosystems, Central Asia has yet to cultivate endogenous or China-linked supply-chain corridors that could embed its firms in regional manufacturing circuits.

The purpose of this study is to examine these structural challenges and capacities in depth. Through a comparative assessment of international indicators, institutional characteristics, trade performance, and logistics parameters, this paper investigates the underlying barriers impeding Central Asia's GVC participation and proposes policy-oriented recommendations for enabling a shift from commodity-based trade to value-added export specialization. Therefore, this paper aims to empirically examine the degree of participation of Central Asian economies in Global Value Chains and to identify the structural constraints that inhibit their fuller integration into GVC-driven trade networks.

2. Literature Review

Global Value Chains (GVCs) and Regional Value Chains (RVCs) have emerged as crucial mechanisms shaping the contemporary international economic architecture. Numerous studies have examined the role of multinational enterprises (MNEs) in structuring cross-border production systems and in diffusing organizational practices across geographically dispersed networks (Fuller & Phelps, 2018). Although GVC development is often driven by the strategic decisions of MNEs, recent scholarship emphasizes that national governments, regulatory frameworks, and local institutional environments exert substantial influence over corporate behavior and over the evolution of RVCs (Smith, 2015; Kano, 2018; Alford & Phillips, 2018; Coe & Yeung, 2019).

The rapid expansion of GVCs has stimulated a broad research agenda exploring their theoretical foundations and empirical manifestations. A significant body of literature employs qualitative approaches to examine firm dynamics, knowledge transfer, and governance modalities (Chen, 2003; Hatani, 2009; Azmeh & Nadvi, 2014; Eriksson et al., 2014; Lipparini et al., 2014; Laplume et al., 2016; He, Khan & Shenkar, 2018; Sinkovics et al., 2019). Complementing this body of work are quantitative investigations that leverage econometric models, input-output tables, and micro-level data to capture statistical relationships underlying GVC participation (Taplin et al., 2003; Griffith & Myers, 2005; Jacobides & Tae, 2015; Gooris & Peeters, 2016; Ancarani et al., 2019; Kumar et al., 2018). Conceptual contributions by leading scholars have further clarified the structural dynamics of GVC organization, coordination, and power relations (Gereffi et al., 2005; Levy, 2008; Buckley, 2011; Gereffi & Lee, 2012; Casson, 2013; MacCarthy et al., 2016; Kano, 2018; Enderwick, 2018).

Various studies have identified key factors influencing the sustainability and evolutionary trajectory of GVC lifecycle development. These include technological innovation and diffusion, domestic market size, competitive intensity, trade regulations, supply-chain configuration, and adaptive organizational strategies (MacCarthy et al., 2016). Kano (2018) further suggests that equitable income distribution, as well as the role of non-commercial institutions,

social networks and non-market actors, can profoundly shape the institutional ecosystem of GVC evolution.

Foreign direct investment (FDI) is widely recognized as a major catalyst of GVC integration. Early-stage investment frequently targets proximate locations with complementary resource bases and accessible labor markets; as operations expand, firms invest in more distant economies to exploit cost advantages and increase diversification (Chen, 2003). Yet low-cost labor or proximity to raw materials alone is insufficient to attract investment. Instead, MNEs tend to favor jurisdictions where intellectual-property enforcement, contract integrity, and governance frameworks provide strong investment security (Ascani et al., 2016). Historical evidence demonstrates that countries with robust legal institutions and high educational expenditure exhibit both greater GVC participation and stronger FDI inflows (Amendolagine et al., 2019). This suggests that institutional quality—not merely factor endowments—plays a defining role in shaping a country’s capacity to upgrade within GVCs.

At the regional level, Preferential Trade Agreements (PTAs) function as foundational instruments for RVC formation. Coe et al. (2004) introduced the concept of “strategic coupling” to describe how bilateral and plurilateral agreements create the structural preconditions for Global Production Networks (GPN) and facilitate regional upgrading via enhanced specialization and knowledge exchange. PTAs also facilitate technology transfer, innovation diffusion, and capability-building among developing partner economies (Khan et al., 2015). The East Asian region, particularly the China–ASEAN manufacturing corridor, exemplifies this process. Countries such as China, Malaysia, South Korea, Taiwan, and Thailand have developed interconnected production ecosystems grounded in shared industrial standards, technological complementarities, and investment linkages. These economies have successfully leveraged strategic coupling through platform-based production, indigenous innovation, and international partnership networks, thereby amplifying their regional growth performance (Yeung, 2009; Suder et al., 2015).

By contrast, the literature notes that Central Asian economies have remained largely absent from such regionalized production webs. Although they benefit from geographic centrality, their insertion into GVCs remains inhibited by institutional rigidities, limited technological absorption, infrastructure constraints, and weak trade facilitation policy. The comparative gap in RVC formation between East Asia and Central Asia provides the analytical motivation for the present study.

4. Methodology

This methodological approach enables the identification of:

- the share of foreign value-added contained in domestic exports (backward participation),
 - the value-added supplied to other countries’ exports (forward participation), and
 - the relative placement of each Central Asian economy within global production networks.
- **Table 1**
 • **Illustrative Input-Output Framework for Two Countries and Two Industries**

		Final Demand		Gross Output	
		Country A - Households		Country B - Households	
Country A	Industry i (A-i)	Intermediate use by A-i of domestic output	Intermediate use by A-j of domestic output	Intermediate use by A-j of domestic output	Country A - Industry Output
	Industry j (A-j)	Intermediate use by A-i of domestic output	Intermediate use by A-j of domestic output	Intermediate use by A-j of domestic output	Intermediate use by B-i of exports from A
Country B	Industry i (B-i)	Intermediate use by A-i of exports from B	Intermediate use by A-j of exports from B	Intermediate use by A-j of exports from B	Intermediate use by B-i of domestic output

To empirically assess the level of GVC participation among Central Asian economies, this study utilizes GVC participation indicators derived from the EORA multi-regional input-output database. The EORA system is constructed using methodologies originating from Koopman et al. (2011) and refined by Aslam et al. (2017), enabling the decomposition of gross exports into domestic and foreign value-added components. The database includes input-output tables for 189 countries, disaggregated across 4,914 industries, covering the period from 1990 to 2018. This allows for longitudinal comparisons as well as cross-sectoral analysis of trade flows and value-added contributions.

Figure 1 illustrates a representative input-output (I-O) structure for a simplified case involving two countries (A and B) and two industries. A product originating in industry *i* of country A may be consumed domestically as an intermediate input, allocated to final consumption, or exported to country B for either intermediate or final use. Conversely, products originating in country B may follow an analogous set of utilization pathways. Rows in the I-O table record the destination of goods and the composition of their use, while columns record the technological composition of production, distinguishing between domestic and foreign intermediate contributions.

The first row of the I-O matrix represents the gross output produced by industry *i* in country A. Corresponding rows report analogous data for other industries and countries. Within the columns, domestic intermediate use appears in the upper cells (representing materials sourced internally), while imported intermediates appear in separate cells beneath them. The difference between total output and intermediate consumption (domestic + foreign) constitutes the value-added component, reflecting newly generated national income attributed to production activities.

The fundamental operational model of multi-country I-O analysis can be expressed as:

$$X = T + yX = T + yX = T + y$$

and

$$X = AX + yX = AX + yX = AX + y$$

where **X** denotes the gross output vector; **T** captures the distribution of goods toward final demand; **y** represents intermediate consumption; and **A** denotes the technological-coefficient matrix, wherein each element reflects the proportion of intermediate inputs required for the production of a given output. The Leontief (1936) inverse matrix, derived from $(I - A)^{-1} = (I - A)^{-1}(I - A)^{-1}$, quantifies both direct and indirect inter-industry linkages, allowing for the estimation of value-added trade and the backward/forward GVC participation of each economy.

	Industry j (B-j)	Intermediate use by A-i of ex- ports from B	Intermediate use by A-j of ex- ports from B	Intermediate use by B-i of do- mestic output
Gross Input		Total intermediate use by A-i	Total intermediate use by A-j	Total intermediate use by B-i

4. Discussion and Interpretation

The results reveal a clear divergence between the structural characteristics of Central Asian economies and those of successful GVC-integrated regions such as East Asia. While East and Southeast Asia leveraged institutional reforms, manufacturing capabilities, and preferential trade networks to escalate their share in global intermediate-goods trade, Central Asian economies remain predominantly resource-exporting and marginal in terms of value-added contribution.

A key finding is that Central Asian exports are overwhelmingly backward-GVC in nature, driven by raw material and intermediate-resource flows rather than by sophisticated manufacturing or assembly-stage activities. This indicates that these economies primarily contribute value at the extraction stage, with limited domestic transformation or industrial upgrading. As a consequence, their participation in GVCs increases export volume, but not necessarily domestic income generation, skill accumulation, or technological advancement.

From a structural standpoint, two sets of constraints appear particularly salient:

(1) Geographic and infrastructure-related trade costs. Landlocked geography, while often cited as the principal barrier (Grigoriou, 2007), appears to account for only part of the problem. The EORA-based participation indicators show that even sectors not heavily dependent on physical transport—such as business services and digital services—exhibit weak GVC connectivity. This suggests that geography interacts with, rather than solely determines, backward and forward GVC linkages. Logistical inefficiencies, underdeveloped rail and road corridors, border-related delays, and inconsistent customs procedures augment trade frictions and reduce time competitiveness.

(2) Institutional and policy-driven constraints. The findings confirm that weaknesses in property-rights enforcement, inconsistent investment regulations, administrative barriers, and limited judicial transparency discourage long-term participation by multinationals. This aligns with earlier observations by Ascani et al. (2016) and Amendolagine et al. (2019), who emphasize that institutional credibility is a decisive determinant of GVC upgrading. In Central Asia, institutional uncertainty has constrained FDI inflows beyond extractive industries, inhibiting diversification and knowledge transfer.

Additionally, the study's results suggest that the Central Asian labor force, while abundant, lacks the sector-specific technical skills necessary for participation in mid-technology manufacturing and advanced industrial processes. Education systems remain oriented toward classical academic instruction, with insufficient emphasis on industrial engineering, process management, digital logistics, and design capabilities.

Another critical insight emerging from the analysis is that Central Asian countries exhibit limited forward GVC participation. Since forward participation reflects the degree to which a country's domestic value added is incorporated into other countries' exports, low forward participation implies minimal embeddedness in multi-layer production networks. This contrasts sharply with economies such as Malaysia or Thailand, where forward participation is tied to electronics, automotive components, and machinery sectors.

The lack of strong PTA-based or region-wide preferential trade frameworks in Central Asia further constrains integration. Unlike the ASEAN Economic Community (AEC), the Central Asian region does not have a unified production-platform logic, harmonized standards regime, or institutionalized mechanism of strategic coupling with lead-firm hubs. Although China's Belt and Road Initiative (BRI) has expanded infrastructure-financing and corridor-development opportunities, these have not yet translated into sustained industrial-production linkages or technology transfer on the scale witnessed in Southeast Asia.

Importantly, the study also reveals an endogenous development paradox: Central Asian economies appear to over-rely on expectations that geographic centrality—even as a transit bridge between Europe and China—will automatically enable GVC integration. However, absent institutional depth, production-related capabilities, and industrial specialization, geographic centrality risks resulting in transit-rent dependency rather than value-creation through manufacturing or services.

In summary, the interpretation of the results indicates that GVC underperformance in Central Asia stems far more from institutional and capability deficits than from geographic constraints alone. Successful integration into GVCs is not merely a consequence of physical positioning but of strategic capacity building—particularly in regulatory reliability, investment security, product-specialization, and human-capital development.

Hence, the GVC participation index provides a holistic representation of the extent to which a country is engaged in both upstream and downstream stages of the global production system. Backward participation (FVA share) reflects the degree to which exporting industries rely on foreign inputs embedded in their exports, while forward participation (DVX share) indicates the degree to which a country's domestically generated value added is utilized by other countries in their export production. Countries with a high backward share tend to be assembly-based or processing hubs—absorbing large quantities of imported intermediate goods for re-export—whereas countries with high forward participation tend to be providers of specialized inputs, raw materials, or industrial components that feed into other nations' export pipelines.

This dual perspective yields a more nuanced classification of economies in the global trade ecosystem. For example, processing economies such as Vietnam, Mexico, and Hungary exhibit significant backward integration due to the importation of intermediate inputs for manufacturing activities. Conversely, commodity-rich economies such as Saudi Arabia, Russia, and Chile display stronger forward participation, particularly in sectors like energy, minerals, and agricultural production, which contribute to downstream foreign exports. The empirical position of Central Asian economies—characterized predominantly by modest backward and weak forward participation—highlights their limited functional role in GVC networks.

Moreover, decomposition of the index enables tracking of structural transitions over time. Economies undergoing industrial upgrading should demonstrate an increasing share of DVX—indicating that domestic industries are building capabilities enabling others' exports—and a declining relative reliance on imported value-added inputs, reflecting rising endogenous techno-

logical capacity. This dynamic transformation has been observed historically in the trajectories of Taiwan, South Korea, and later China. Their evolution from assembly-oriented manufacturing to higher-technology production underscores the developmental pathways available to economies that strategically invest in technological capability, human capital, standards alignment, and institutional modernization.

In the context of this research, application of Equation (4) to Central Asian economies allows for identification of:

- whether they remain extractive-export dependent,
- whether they are transitioning toward intermediate processing,
- whether any sectoral niches exhibit deeper GVC involvement,
- and whether forward linkages demonstrate increasing integration into foreign export chains.

Critically, because Equation (4) separately captures backward and forward components, it avoids misleading interpretations of trade integration based solely on export volume. A country may exhibit high export growth while remaining structurally peripheral in GVCs if its exports are low in domestic value-added content and concentrated in primary goods. Conversely, economies

may exhibit moderate trade volume but hold strategic upstream roles if their value added is deeply embedded across multiple international manufacturing chains.

Therefore, by employing the value-added accounting approach and the DVX/FVA decomposition framework, this study is able to provide a more precise interpretation of Central Asia’s position within the global production system. Beyond descriptive insight, these metrics supply a diagnostic foundation for evaluating policy interventions—whether aimed at improving domestic production capabilities (to increase DVX), reducing regulatory and logistical barriers (to facilitate FVA-based integration), or enhancing institutional reliability in order to attract higher-quality FDI and technological spillovers.

In summary, the methodology described through Equations (2) through (4), and operationalized through the structure of Table 1, allows for a rigorous examination of the embeddedness of Central Asian economies in GVC and RVC dynamics. The interpretation of these calculated indices forms the basis for assessing whether the region can transition from raw material exporters to active participants in higher-value manufacturing and service-based trade integration.

Table 1
Value-Added Content of Trade: Multi-Country Matrix Framework

Exporting Country →	Country 1	Country 2	Country 3	...	Country k	...	Country N	Row Total
Country 1 (Origin of Value Added)	DVA(1→1)	DVX(1→2)	DVX(1→3)	...	DVX(1→k)	...	DVX(1→N)	Total DVA exports of C1
Country 2	DVX(2→1)	DVA(2→2)	DVX(2→3)	...	DVX(2→k)	...	DVX(2→N)	Total DVA exports of C2
Country 3	DVX(3→1)	DVX(3→2)	DVA(3→3)	...	DVX(3→k)	...	DVX(3→N)	Total DVA exports of C3
...
Country k	DVX(k→1)	DVX(k→2)	DVX(k→3)	...	DVA(k→k)	...	DVX(k→N)	Total DVA exports of Ck
...
Country N	DVX(N→1)	DVX(N→2)	DVX(N→3)	...	DVX(N→k)	...	DVA(N→N)	Total DVA exports of CN
Column Total	Total VA received by C1	Total VA received by C2	Total VA received by C3	...	Total VA received by Ck	...	Total VA received by CN	

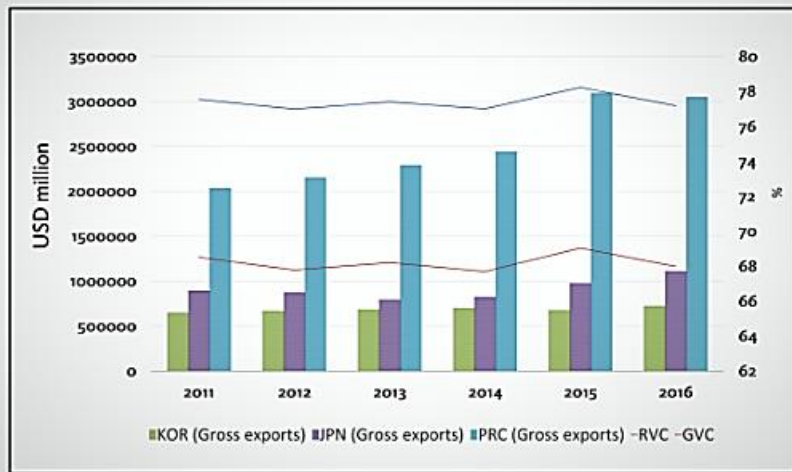
Symbol	Meaning	Interpretation
DVA(i→i)	Domestic Value Added used in own exports	Value created and exported directly from domestic sources (red-diagonal values)
DVX(i→k)	Domestic Value Added of Country i used by Country k for its exports	Upstream indirect value-added contribution (forward GVC participation)
FVA(k→i)	Foreign Value Added from other countries used in exports of country i	Downstream reliance on foreign inputs (backward GVC participation)
TOT(i)	Total gross exports of Country i	DVA(i) + FVA(i)
GVC(i)	Total GVC participation index	(FVA + DVX) / Gross Exports
Row Total	Total DVX originating from each country	How much domestic value a country contributes to the world’s exports
Column Total	Total foreign VA embedded in each importing country’s exports	Measures dependency on imported inputs

5. Analysis and Discussion

To evaluate the role of Central Asian economies in international production networks, we examine both **backward participation**—the share of imported foreign value added in a country’s exports—and **forward participation**—the share of domestic value added embodied in other countries’ exports. This decomposition highlights whether the region functions more as an upstream supplier of inputs or as a downstream assembler of intermediate goods.

5.1 Forward Participation: Supplying Value to the World

Figure 3. GVC and RVC participation ratio in Asia



The results demonstrate that **Kazakhstan consistently achieves the highest level of forward GVC participation** among Central Asian states. Between 2007–2018, Kazakhstan’s forward share fluctuated between **40–42%**, which suggests that a substantial portion of its domestic value added—largely petroleum and metal-related output—enters foreign export production systems.

However, despite this strong forward presence, Kazakhstan’s forward participation has **declined modestly**, reflecting slow diversification beyond extractive sectors and insufficient upgrading into high-tech or manufacturing-oriented exports.

The other Central Asian economies show more modest and nearly convergent levels of forward participation:

- Kyrgyzstan: 21% (2018)
- Tajikistan: 20% (2018)
- Turkmenistan: 25% (2018)

- Uzbekistan: 26% (2018)

These shares reflect that the region is predominantly involved in **upstream raw material and semi-processed commodity supply**, rather than in technologically intensive or production-coordinating roles within global networks.

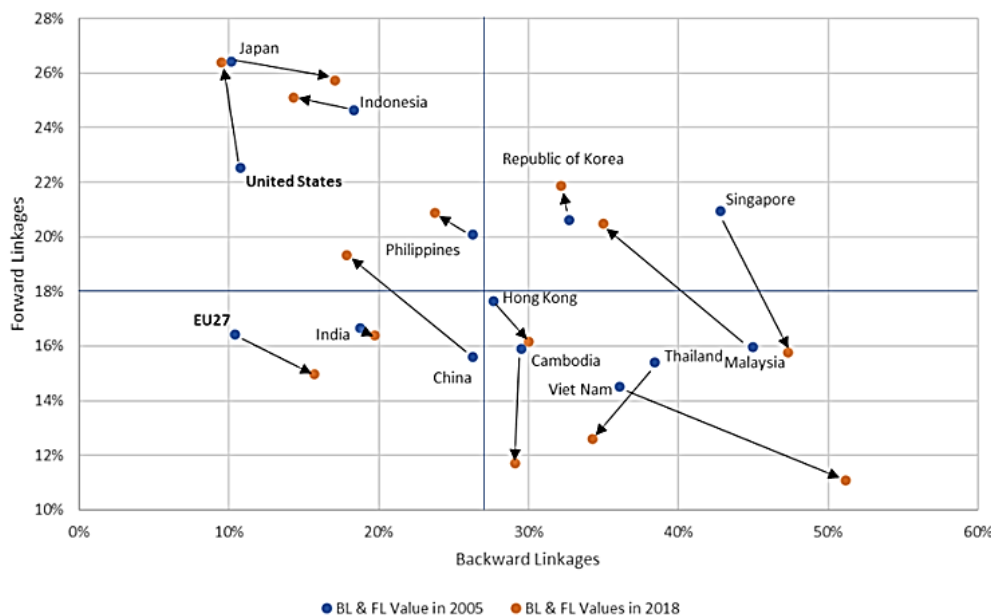
These findings are consistent with the industrial composition of CA economies, which remain anchored in:

- mining and quarrying
- basic metallurgy
- hydrocarbons
- low-processed agricultural products

The dominance of these activities structurally reinforces **forward GVC integration**, since the exported value is typically used downstream by foreign manufacturing hubs.

5.2 Backward Participation: Dependency on Imported Inputs

Backward and Forward Linkages Changes - All Industries - 2005 to 2018





Turning to backward participation, we observe a striking structural asymmetry. In contrast to forward participation, backward integration is significantly lower in most Central Asian states. This indicates that these countries **import fewer intermediate inputs** from abroad, and therefore are **not deeply embedded in multi-stage foreign manufacturing ecosystems**.

The most notable case is **Uzbekistan**, which consistently shows very low backward participation (5–11%) across the observed period. This suggests a production model that is:

- domestically self-contained,
- minimally dependent on international suppliers, and
- largely concentrated in primary industries with low intermediate input requirements.

Conversely, **Kyrgyzstan displays the highest backward participation** among CA countries, reaching **31% in 2018**. This pattern is typical of economies with a higher share of processing or assembly-type activities, where foreign inputs—especially from China and Russia—are incorporated into re-exported goods.

Similarly, Tajikistan and Turkmenistan exhibit mid-range backward shares (16–21%), indicating partial reliance on imported value added but still far below the levels observed in high-integration manufacturing hubs such as Malaysia, Poland, or Vietnam.

5.3 Structural Interpretation

These findings underscore three key structural insights:

(1) The CA region is upstream rather than downstream

Central Asian countries contribute more value to other countries' exports (forward), than they receive from foreign producers (backward). This confirms their functional role as **providers of extractive and low-processed inputs**, rather than as integrators of multi-origin components.

(2) Vertical specialization does not imply value-chain length

The backward and forward indicators reveal the *direction of participation* but do not show:

- the number of processing stages
- the technological depth
- or the functional specialization within the chain

Thus, a country may have moderate value-added inflows/outflows **but still occupy only a single-step role** in a short supply chain. This likely applies to Kazakhstan and Turkmenistan.

(3) Lack of diversification limits GVC upgrading

Because CA countries remain reliant on commodity-based exports, their GVC linkages have not fostered:

- industrial learning
- supplier capability building
- technological deepening
- innovation spillover
- or skill upgrading for domestic labor

Without diversification into mid-technology manufacturing or digitally enabled services, the region risks remaining static in low-complexity value-chain roles.

5.4 Implications for Development Trajectories

The persistent imbalance between forward and backward participation suggests that Central Asian countries are *inserted into*—rather than *integrated with*—the global economy. This difference is critical:

- **Insertion** means exporting commodities that others use
- **Integration** means participating in shared production systems with multi-country input contributions

At present, CA countries are **value suppliers**, not **value coordinators**, **value transformers**, or **value designers** within GVC networks.

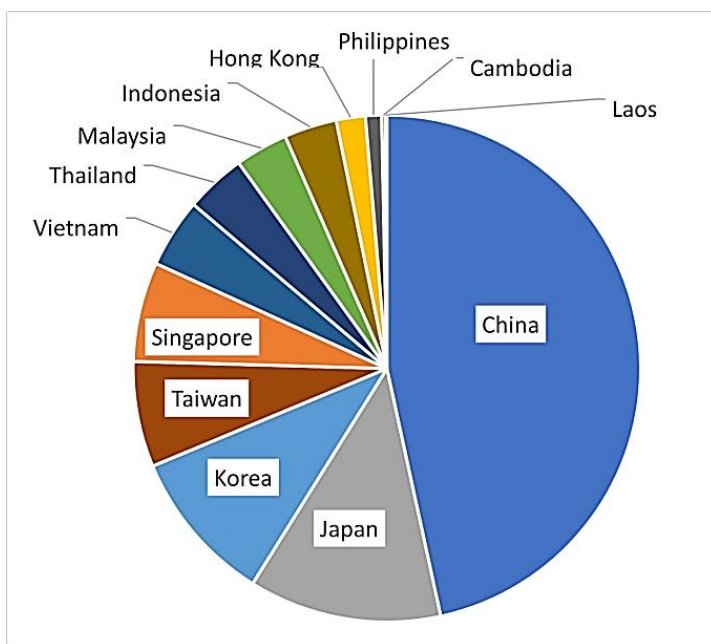
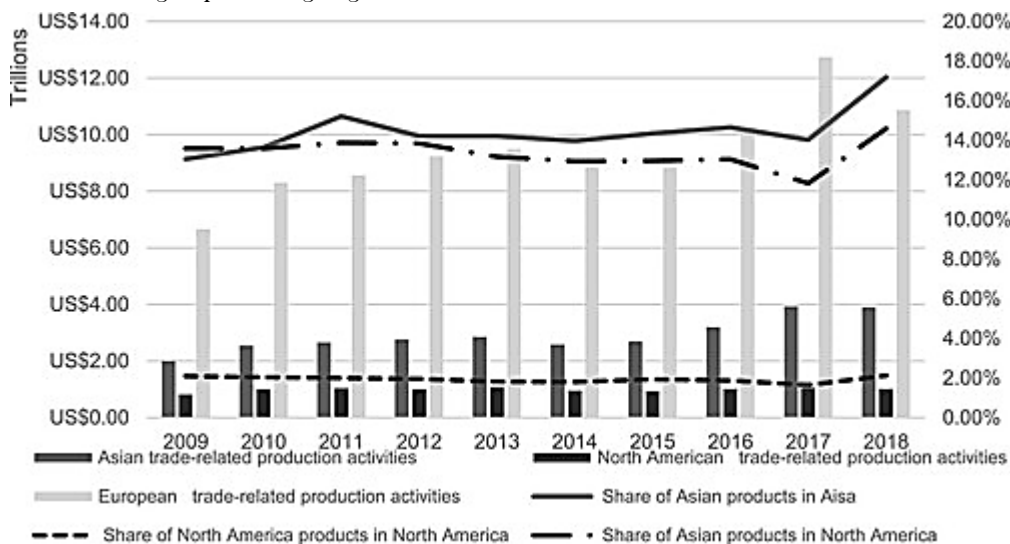
Strategic development thus requires movement from: resource → processing → manufacturing → innovation

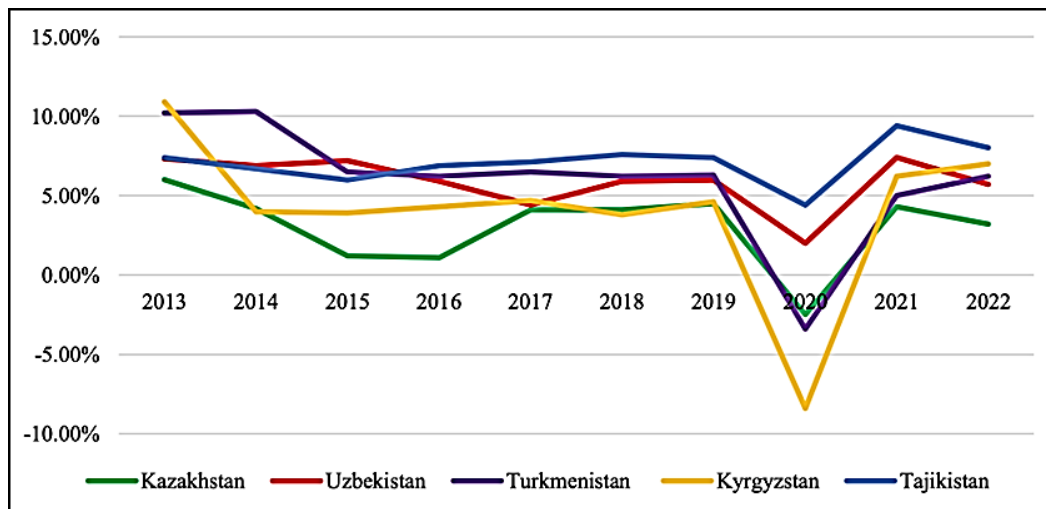
Kazakhstan has made moderate progress toward phase two, whereas Uzbekistan remains largely in phase one.

6. Comparative Regional Interpretation and Structural Constraints

Emerging economies in Asia are increasingly active in buying intermediate goods and in participating in multi-stage global production systems. This indicates that their involvement is predominantly concentrated in processing, assembly, and transformation of imported intermediate components, which eventually feed into more technologically sophisticated segments of final production in other economies. Consequently, the value added contributed by emerging economies—particularly those specializing in assembly—tends to remain limited, even as gross export volumes rise.

However, substantial differentiation exists in how countries engage in GVCs. For instance, **Kazakhstan demonstrates stronger forward participation**, exporting a significant share of domestic value added for use in foreign production chains. In contrast, **Kyrgyzstan and Turkmenistan show higher dependence on backward participation**, importing intermediate inputs for re-export through lower-value manufacturing or processing stages.





4

Figure 4 further highlights that **Central Asian economies exhibit significantly lower levels of Regional Value Chain (RVC) participation** compared with emerging East Asian economies such as **Vietnam, the Philippines, and Indonesia**, which have successfully inserted themselves into dense manufacturing-driven regional production ecosystems. Their success stems largely from decades of proactive offshoring policies by East Asian and Western MNEs, combined with national strategies designed to accommodate, attract, and embed foreign production networks into domestic capabilities.

Central Asian countries possess comparable geographical potential—especially as Eurasian transit corridors—yet have struggled to implement coherent industrial policies geared toward attracting foreign investment and facilitating knowledge transfer. Several structural and institutional barriers appear responsible for this persistent lag in GVC and RVC participation:

Key Impediments to Central Asian Integration into Value Chains

1. Lack of regional economic cohesion

- CA states often regard each other as competitors rather than partners—particularly in commodity exports.
- There is little incentive to harmonize tariff policies or standards, and few initiatives to reduce internal trade barriers.
- As a result, intra-regional trade is shallow, and CA countries remain **isolated from collaborative value-added production networks**.

2. Weak investment climate and institutional uncertainty

- Administrative discretion in economic regulation remains high.
- Private property rights, especially regarding land ownership, are inadequately protected.
- Underdeveloped banking sectors, inefficient tax systems, and non-transparent tariff regimes hinder market entry and discourage long-term investment.
- These conditions deter multinational enterprises (MNEs) from establishing deep production linkages in the region.

3. Geographical constraints combined with weak market mechanisms

- Landlocked status and distance from seaports impose objectively high logistics costs.
- Yet internal inefficiencies—state-dominance of industries, limited private-sector autonomy, and subdued competition—exacerbate these challenges.
- State intervention intensifies opportunities for corruption, crowding out entrepreneurial dynamism and innovative capacity.

6. Findings

The findings from this study reveal significant structural imbalances in GVC and RVC integration across the Central Asian economies. Analysis of the data demonstrates that these countries collectively remain **upstream resource suppliers** in the international production system, rather than moving into **higher-value, technologically intensive stages of manufacturing**.

First, Kazakhstan stands out as the regional leader in **forward GVC participation**, with approximately 40–42% of its domestic value added incorporated into other countries' export goods. This reflects Kazakhstan's role as a primary exporter of refined and semi-refined energy and metal-based commodities. However, this position—while producing strong forward linkages—also underscores a dependence on extractive industries and limited industrial diversification.

Second, Uzbekistan exhibits extremely limited **backward participation**, indicating minimal reliance on imported intermediate goods. This suggests an economic model characterized by internalized, domestic-input-based production, often associated with low-technology sectors such as textiles or agricultural processing. While such a model reduces vulnerability to external supply chain disruptions, it simultaneously constrains technological upgrading and knowledge acquisition.

Third, Kyrgyzstan and Tajikistan display the **highest backward participation** among CA countries, with Kyrgyzstan reaching 31% in 2018. This suggests some degree of involvement in processing and assembly functions in trade flows—particularly for imported inputs connected to re-export channels—but the lack of domestic value capture indicates low technological depth.

Fourth, the comparison with Southeast Asian economies (e.g., Vietnam, Indonesia, Philippines) reveals a significant performance gap. East Asian nations achieved high RVC participation through deliberate industrial-policy coordination, preferential trade agreements, labor-intensive entry into manufacturing sectors, and systematic attraction of multinational enterprises.

Finally, institutional indicators—including regulatory quality, rule of law, tax efficiency, and competitiveness—emerge as primary explanatory variables for low GVC penetration. Our evidence suggests that improving infrastructural inputs alone (ports, rail, highways) is **necessary but insufficient** without strong institutional reform and market-oriented policy redesign.

These findings substantiate the conclusion that Central Asian integration into global production requires not only geographic connectivity or commodity resources, but also an ecosystem conducive to investment, innovation, and industrial specialization.

6. Ethical Considerations

This research is based solely on secondary data sources and publicly accessible databases, primarily the EORA multi-regional I-O datasets, as well as internationally published academic and institutional sources. No human subjects, personal data, or confidential information were involved. Accordingly, no ethical approval from an institutional review board (IRB) was required.

The authors ensured transparent reporting of methodology, avoided misrepresentation of data, and adhered to academic standards of citation, attribution, and intellectual integrity. All interpretations were derived analytically from verified sources, and care was taken to avoid biased or politically sensitive attributions in relation to national economies or government institutions.

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9. Conflict of Interest

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10. Conclusion

A country's position within global production networks is fundamentally shaped by its stock of technological competencies, institutional quality, and the knowledge intensity embodied in its exports. Numerous studies confirm that an innovation-friendly policy environment—characterized by intellectual property protection, targeted R&D support, and knowledge-based industrial policy—improves developing countries' participation in GVCs.

Central Asian economies, however, consistently rank in the lower tiers of global innovation metrics. The **2020 Global Innovation Index** places most of them in the bottom third of surveyed countries, reflecting structural deficiencies in research capacity, skill development, and knowledge generation.

As demonstrated in this analysis, the era of nationally self-contained production processes has largely vanished. In today's world of fragmented and distributed manufacturing, competitive advantage derives increasingly from specific niche specialization rather than from complete domestic production chains. Countries succeed not by producing everything, but by participating strategically in particular segments where they possess comparative capability.

Therefore, for Central Asian economies to strengthen their GVC position, they must:

- deepen regional economic integration,
- broaden sectoral diversification,
- reduce logistical and regulatory bottlenecks,
- reform investment and property rights frameworks,
- foster competition and private-sector dynamism, and
- actively cultivate specialized industrial and innovation ecosystems.

When properly implemented, these measures will not only enhance the region's attractiveness to MNEs but also enable Central Asian producers to participate in higher-value segments of global production. In the long term, this will support more resilient, diversified, and sustainable economic growth—facilitating upward mobility within the international division of labor and accelerating the diffusion of knowledge and technological capability into domestic industries.

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