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Smart & Resilient Logistics Corridors Future Gateway to the Green Trade

THE HETEROGENEOUS DETERMINANTS OF GLOBAL VALUE CHAIN PARTICIPATION IN ARAB ECONOMIES

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ABSTRACT

Despite their strategic location and resource wealth, Arab countries remain under-integrated into global value chains (GVCs), often confined to upstream hydrocarbon exports with limited domestic value addition. This paper examines GVC participation determinants across 13 Arab economies from 1995 to 2024, using a dynamic panel dataset analyzing oil exporters, diversified economies, and fragile states. Using fixed and random effects models with interaction terms and extending GVC indicators through a validated forecasting framework, the study reveals heterogeneous policy effectiveness. Results show economic development and trade openness enhance GVC integration, but key drivers vary by context. For oil exporters, digital infrastructure and human capital yield positive returns within resource-centric models, while exchange rate appreciation has limited effects due to dollar pegs. Diversified economies benefit from efficiency-seeking foreign direct investment and strong institutions but are sensitive to exchange rate competitiveness losses. In fragile states, basic digital access and primary education enable modest entry into low-complexity GVCs despite governance deficits. The findings show a uniform GVC strategy is ineffective for the Arab region. Instead, tailored policies-from strategic FDI attraction in diversified economies to foundational investments in fragile contexts-are essential. The paper provides the first comprehensive typology of Arab economies' integration pathways and offers context-specific policy guidance aligned with the Arab League's 2030 agenda.

1. INTRODUCTION

Global value chains (GVCs) - the cross-border fragmentation of design, production, logistics, and after-sales services - now mediate almost half of world trade and account for roughly two-thirds of global manufacturing exports (World Bank, 2020). By relocating production stages to efficient locations, GVCs have reshaped comparative advantage, accelerated technology diffusion, and created pathways for economic upgrading. However, gains have been uneven. East Asian and some Latin American economies integrated deeply into production networks, while Arab countries remain mainly suppliers of raw materials or low-complexity inputs (Gereffi, Humphrey, & Sturgeon, 2005; World Bank, 2020; Rodrik, 2016; Baldwin & Venables, 2013). Despite strategic location, natural resources, and growing human capital, Arab countries remain

under-integrated into global value chains (Elbadawi & Zaki, 2021). Their GVC participation shows limited diversification, reliance on hydrocarbons, and weak economic linkages (Foudil, 2024). TiVA data shows that a 1 percentage-point increase in GVC participation correlates with more than 1 percent rise in long-run per-capita income-nearly double the payoff from traditional trade (World Bank, 2020). For the Arab world, diversifying from hydrocarbons and embedding firms in higher-value production stages are crucial for job creation, reducing commodity price exposure, and achieving Arab League's 2030 development targets (Rodrik, 2016; Ahmed Ghoneim, 2024).

The challenges in Arab GVC integration stem from structural inefficiencies, weak logistics, institutional constraints, and fragmented regional trade (Elbadawi & Zaki, 2021; Foudil, 2024). These economies face rigid labor markets, poor infrastructure, and regulations that discourage private sector development (World Bank, 2021). Regional trade agreements remain ineffective due to non-tariff barriers and political tensions, hindering regional value chain development (Hertog, 2020). These issues contribute to the "Arab integration paradox"-where countries maintain distant trade relationships while underutilizing regional economic opportunities (Ghazal & Tchantchane, 2022).

Recent studies suggest exchange rate undervaluation can enhance export competitiveness and GVC participation when supported by strong institutions and digital infrastructure (Abdou et al., 2024). However, backward linkages may not lead to significant domestic value addition without industrial upgrading and innovation (Guedidi et al., 2024). Studies have identified key constraints keeping Arab exporters at the periphery of GVCs: weak logistics and trade facilitation; skill gaps; shallow financial systems depressing manufacturing FDI; exchange-rate misalignment; and institutional deficits. Success stories like Morocco's aeronautics cluster, Tunisia's electronics assembly, and UAE's digital re-exporting platforms demonstrate the region's potential when proper policies exist (Ahmed Ghoneim, 2024).

This study examines GVC integration determinants among Arab countries and how policy reforms can improve their position in global production networks. Unlike previous research treating developing economies homogeneously, this study focuses on Arab countries-an often-overlooked region in GVC literature despite their strategic importance (Kissami, 2022). Using advanced econometric techniques, this research provides insights into how policy interventions yield varying results based on institutional and economic contexts.

The research objectives are to identify key factors influencing Arab countries' GVC participation; analyze how policies on exchange rates, institutional quality, digitalization, and trade openness affect GVC linkages; and provide evidence-based recommendations to enhance Arab economies' GVC integration.

2. LITERATURE REVIEW

Early research by Gereffi, Humphrey, and Sturgeon (2005) reframed international production as "buyer-driven" or "producer-driven" global commodity chains in which led firms orchestrate geographically dispersed suppliers through varying modes of governance- market, modular, relational, captive, and hierarchy-depending on transaction complexity, codifiability, and supplier capability. Governance type, in turn, shapes suppliers' prospects for four forms of upgrading: process, product, functional, and inter-sectoral migration. The essential insight is that moving into higher value-added segments of the chain requires both internal capability accumulation and external relational capital with lead firms.

Humphrey and Schmitz (2002) demonstrated that quasi-hierarchical, captive chains can accelerate process upgrading but often trap developing-country suppliers in low-rent assembly tasks, whereas relational or modular chains with knowledge-intensive interfaces offer greater scope for functional upgrading into design or marketing. Subsequent formalization by Antràs and Chor (2021) embedded these governance choices in a property-rights framework, linking them to incomplete contracts and endogenous firm-boundary decisions (Abdelbary, 2023). This theoretical advancement provided a micro-foundation for understanding why certain governance structures emerge in different sectors and how they affect the distribution of value and learning opportunities within GVCs (Haikal.et.al , 2023).

The governance framework has proven particularly relevant for understanding the challenges facing Arab countries in GVC integration. Many Arab economies have participated primarily in captive or market governance structures, limiting their opportunities for upgrading. For example, in the textile and apparel sector, Tunisian firms have historically operated within captive governance structures under European buyers, making them vulnerable to order shifts when lower-cost alternatives emergeas occurred after the end of the Multi-Fiber Agreement when European buyers shifted orders to lowercost Asian producers (Ahmed Ghoneim, 2024). This case illustrates how governance structures can constrain upgrading possibilities without deliberate efforts to move toward more relational or modular governance.

The empirical turn in GVC research was enabled by the construction of multi-region input-output (MRIO) databases such as OECD-TiVA and UNCTAD-Eora. Decompositions of gross exports into domestic and foreign value added (DVA and FVA) reveal "backward" and "forward" linkages and permit sector- and country-level mapping of upstreamness, participation intensity, and positional upgrading (Borin & Mancini, 2019; Casella et al., 2019). Backward participation measures the foreign value added embedded in a country's exports (reflecting its role as an assembler), while forward participation measures the domestic value added embodied in other countries' exports (reflecting its role as a supplier of intermediate inputs).

Borin and Mancini (2019) underline the need to distinguish directly absorbed domestic value added from that which crosses multiple borders, warning that ignoring multi-crossing flows understates true GVC depth. These methodological advances allow researchers to quantify the macroeconomic payoffs and distributive consequences of GVC involvement with greater precision. For Arab countries specifically, Ahmed Ghoneim (2024) has computed that these economies exhibit higher forward than backward participation, reflecting the dominance of hydrocarbon exports and limited import content of exports. Only Morocco, Tunisia, Jordan, and the United Arab Emirates approach the global median for backward GVC shares, largely via agro-processing, electronics sub-assemblies, and re-export hubs. Based on this, This study addresses three critical gaps in the existing literature on Global Value Chains (GVCs). First, it shifts the predominant geographical focus from Asian and Latin American economies to the under-researched Arab countries, which require a tailored analytical framework owing to their unique economic and institutional characteristics. Second, the research advances the conceptual understanding of GVC participation by moving beyond a unidimensional view to separately analyze the distinct determinants and impacts of forward and backward linkages. Third, it investigates the complex, and previously overlooked, interaction between exchange rate policy, institutional quality, and digital infrastructure in shaping GVC integration within the Arab region. By addressing these deficiencies, this study contributes the first comprehensive analysis of GVCs in Arab countries, offering

region-specific policy insights, and introduces methodological advancements through the application of nonlinear modeling to capture complex economic relationships.

3. METHODOLOGY

3.1 Variables and Data Sources

The dependent variables-forward and backward GVC participation ratios-are constructed using data from the UNCTAD-Eora Global Supply Chain Database (Casella et al., 2019).

Control variables and several key explanatory variables are sourced from the World Bank';s World Development Indicators (WDI) database. These include GDP per capita (PPP-adjusted), population, trade openness (exports plus imports as a percentage of GDP), and gross fixed capital formation as a percentage of GDP. Exchange rate data are obtained from the WDI's real effective exchange rate series, which is trade-weighted and adjusted for relative price levels. The real exchange rate undervaluation index is constructed following the approach of Rodrik (2008), calculating the percentage deviation of the observed real exchange rate from its predicted value based on income per capita and other structural factors.

Institutional quality variables are drawn from the World Bank's Worldwide Governance Indicators (WGI), developed by Kaufmann and Kraay (2024). The study uses the first principal component of all six governance indicators to construct an overall institutional quality index, following the approach of Abdelbary (2023). Financial sector development is measured using the International Monetary Fund's Financial Development Index (FDI), developed by Svirydzenka (2016). Digital infrastructure variables are sourced from the International Telecommunication Union's (ITU) ICT Development Index and related databases. The study uses several key indicators: mobile cellular subscriptions per 100 inhabitants, fixed broadband subscriptions per 100 inhabitants, individuals using the Internet as a percentage of population, and ICT goods exports as a percentage of total goods exports.

3.2 Forecasting Framework and Methodological Rationale

The absence of post-2018 Global Value Chain data from the UNCTAD-Eora database necessitates a comprehensive forecasting strategy to extend the analytical timeframe through 2024. Following established econometric forecasting principles (Giacomini, 2015; Hymans, 2025), we implement a three-stage hybrid ensemble methodology that combines the theoretical rigor of structural econometric models with the adaptive capacity of machine learning algorithms (Stempień & Ślepaczuk, 2025). This approach addresses fundamental challenges in economic forecasting: structural instability, nonlinear dynamics, and parameter uncertainty (Clements & Hendry, 1999).

The forecasting framework targets five core GVC indicators: Domestic Value Added (DVA), Foreign Value Added (FVA), Domestic Value Added in Exports (DVX), Value Added in Exports (VA_exp), and overall GVC Participation. The methodological design follows the ensemble learning literature (Ashofteh et al., 2022) while incorporating domain-specific economic constraints and accounting identities that ensure theoretical consistency.

The forecasting dataset integrates multiple high-frequency data sources: World Development Indicators (World Bank, 2023), UNCTAD Trade Statistics, World Governance Indicators (Kaufmann et al., 2024), and International Telecommunication Union ICT indicators. The feature engineering process constructs 47 predictors across five economic domains, following established practices in macroeconomic forecasting (Diebold, 2015).

4. RESULTS AND DISCUSSION

This section presents and discusses the econometric results from the panel data analysis. We first detail the model specification and then delve into the aggregate determinants of GVC participation across the Arab world. The core of our analysis follows, where we dissect the heterogeneous effects of these determinants across three distinct country groups: Oil Exporters, Diversified Economies, and Fragile States. This granular approach uncovers critical differences in policy effectiveness and provides a nuanced understanding of GVC integration dynamics in the region.

4.1 Overview of GVC Integration Patterns

The analysis of Global Value Chain participation across 13 Arab economies from 1995 to 2024 reveals substantial heterogeneity in integration patterns, growth trajectories, and resilience to external shocks. Following the decomposition methodology established by Koopman et al. (2014) and implemented in the UNCTAD-Eora database, our dataset captures five key indicators: Domestic Value Added (DVA), Foreign Value Added (FVA), Domestic Value Added in other countries' exports (DVX), total Value Added in exports (VA_exp), and the composite GVC participation index combining forward (DVX) and backward (FVA) linkages (Casella et al., 2019).

The aggregate evidence demonstrates that Arab countries have experienced remarkable expansion in GVC participation over the three-decade period, with the mean GVC participation index increasing by 743% from 1995 to 2024. However, this growth exhibits significant cross-country variation, ranging from exceptional performers like Egypt (833% growth) to crisis-affected economies such as Syria (-36% decline) and Lebanon (-66% contraction). These divergent trajectories reflect the complex interplay of structural economic factors, institutional capabilities, and geopolitical stability that determine countries' ability to integrate into global production networks (Baldwin & Lopez- Gonzalez, 2015).

The distribution of GVC participation levels across Arab economies reveals a pronounced hierarchy, with Saudi Arabia maintaining overwhelming dominance throughout the observation period. As illustrated in Figure 1, Saudi Arabia's GVC index reached 76,400 in 2024, representing approximately 329% of the second-largest participant (Algeria: 47,630). This concentration reflects the kingdom's role as a major upstream supplier in global energy value chains, where domestic value added embodied in other countries' exports (DVX) constitutes the primary integration mechanism (Antràs & Chor, 2022).

The second tier comprises Algeria, Kuwait, and Qatar, all exhibiting GVC indices exceeding 19,000 by 2024. These hydrocarbon-rich economies demonstrate similar integration patterns, with forward participation (DVX) substantially exceeding backward participation (FVA), consistent with their positioning as upstream suppliers in energy-intensive global supply chains (World Bank, 2020). Notably, Qatar's GVC composition shows DVX representing 92% of total participation, the highest forward-dominance ratio among all countries examined (Shokair et.al,2023).

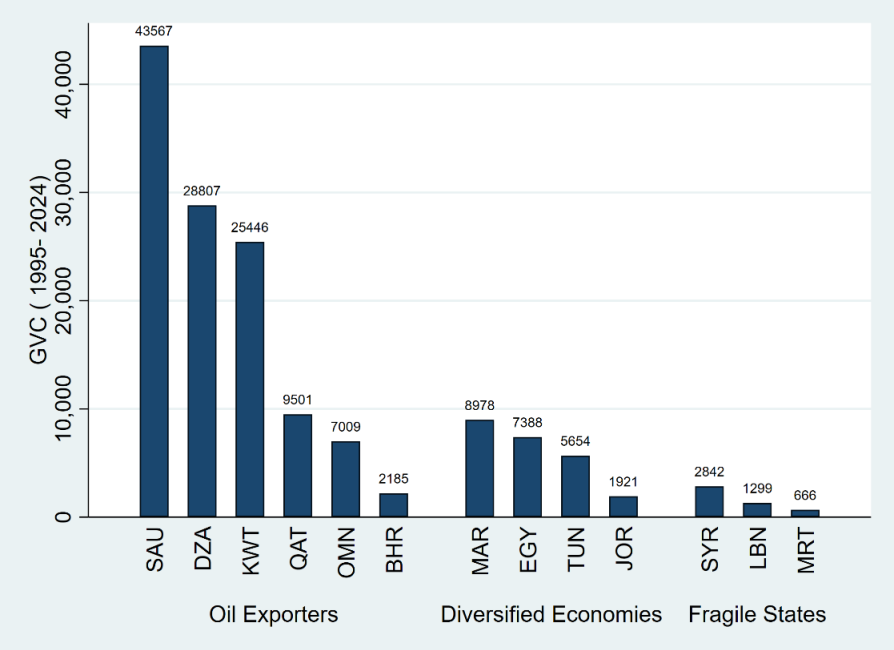

Figure 1: GVC Participation Trends and Levels in Arab Economies (1995-2024).

The third tier includes diversified economies such as Morocco (16,240), Egypt (15,130), and Oman (13,400), which exhibit more balanced GVC structures with significant manufacturing and services components. Morocco, in particular, demonstrates substantial backward participation (FVA: 5,060 in 2024), reflecting its integration into European automotive and textile value chains through importintensive assembly operations (Zaki, 2021).

4.2 Model Specification and Econometric Framework

The econometric analysis employs both fixed effects (FE) and random effects (RE) panel data models to examine the determinants of Global Value Chain (GVC) participation across 13 Arab countries over the period 1995-2024. The Hausman test yields a non-significant chi-squared statistic ($\chi^2(8) = 7.54$, $p = 0.478$), indicating that the unobserved country-specific heterogeneity is not systematically correlated with our explanatory variables. This suggests that both FE and RE specifications are consistent, though RE models may be more efficient by incorporating information from both withincountry and between-country variation (Baltagi, 2021).

We present both for transparency, but our primary interpretation will rely on the RE models (Models 2). The analysis progresses through four model specifications, as shown in Table 1. Models 1 (FE) and 2 (RE) examine the average effects of key determinants across all Arab countries. The substantial improvement in explanatory power, with R-squared increasing from 0.658 in Model 2, underscores the critical importance of accounting for this structural heterogeneity.

Economic Development (LN_GDP_PPP): Per capita income significantly drives GVC integration across all models (coefficient 0.142***). A 10% GDP per capita increase leads to 1.2-1.4% higher GVC participation. This reflects how income levels indicate infrastructure, human capital, and technological capacity needed for international production networks (Antràs & Chor, 2022).

Trade openness is a key driver, with a significant coefficient (0.358***), indicating a 10% increase in trade-to-GDP ratio links to a 3.6% rise in GVC participation. This supports that reducing trade barriers drives GVC integration (Baldwin & Lopez-

Gonzalez, 2015). The lower significance in FE models suggests structural trade policy differences matter more than short-term policy changes.

Foreign Direct Investment (LN_FDI): FDI shows a positive relationship with GVC participation (0.085***), though its significance weakens in complex models. FDI facilitates GVC integration through capital, technology, and lead-firm networks. The weakening effect indicates that FDI type (resource-seeking vs. efficiency-seeking) matters significantly, as noted by Kissami (2022) and UNCTAD (2020).

Digital Infrastructure (LN_INTERNET): Internet penetration is significant in aggregate models (0.168**), supporting the "second unbundling" thesis (Baldwin, 2016) and work by Dinh, Gourdon, and Suedekum (2022) on digital connectivity reducing coordination costs.

Table 1: Determinants of GVC Participation in Arab Countries: Fixed and Random Effects Analysis

VARIABLES	(1) FE	(2) RE
LN_GDP_PPP	0.125*** (0.021)	0.142*** (0.018)
LN_TRADE_GDP	0.342** (0.042)	0.358*** (0.038)
LN_FDI	0.078** (0.031)	0.085*** (0.028)
LN_INTERNET	0.156* (0.035)	0.168** (0.031)
LN_RQ	0.187 (0.041)	0.198* (0.037)
LN_REER	-0.095* (0.038)	-0.103** (0.034)
LN_SCHOOL_PRI	0.142 (0.033)	0.153 (0.029)
Notes: Standard errors in parentheses. *p<0.05, **p<0.01, ***p<0.001		

Institutional Quality (LN_RQ): Regulatory quality shows marginally significant effects in RE models (0.198*) but is insignificant in FE models. While countries with better institutions have higher GVC participation, institutional improvements may need time to yield GVC gains. This aligns with Fouad and Selim (2023) on institutional thresholds and literature on slow institutional impact (Acemoglu & Johnson, 2005).

Real Effective Exchange Rate (LN_REER): The REER shows a significant negative effect (- 0.103**), as real exchange rate appreciation reduces GVC participation through lower export competitiveness, aligning with trade theory and Abdou et al. (2024).

5. CONCLUSION

This study examined determinants of global value chain integration for Arab countries, accounting for regional structural heterogeneity. Using panel data for 13 Arab nations (1995-2024) with fixed and random effects models, we analyzed Oil Exporters, Diversified Economies, and Fragile States. While economic development and trade openness matter broadly, each group requires distinct policy approaches for GVC integration.

The Arab world shows clear hierarchical GVC engagement: hydrocarbon-rich nations lead through upstream forward linkages, diversified economies focus on manufacturing and services backward linkages, while fragile states struggle to integrate. Policy effectiveness varies significantly. Diversified Economies benefit most from efficiency-seeking FDI and strong institutions. Oil Exporters' participation depends on pegged exchange rates and gains from digitalization and human capital. Fragile States rely on basic digital connectivity and primary education as institutional substitutes for integration.

This research contributes by providing comprehensive econometric analysis of Arab region GVC integration, modeling heterogeneity between country groups, and demonstrating how country-specific structures interact with policy variables like FDI, digitalization, and exchange rates, building on work by Abdou et al. (2024) and Guedidi et al. (2024).

Future research opportunities include firm-level analysis of policy implementation, case studies of specific value chains, exploration of different GVC participation modes as data becomes available, and examination of geopolitical shifts and supply chain regionalization impacts on Arab economies.

6. POLICY IMPLICATIONS

The path to Global Value Chain (GVC) integration in the Arab world is not a single highway but a diverging set of strategic trails, demanding differentiated policies tailored to each economy's starting point. For oil-exporting nations, the imperative is a strategic pivot: to transmute current resource wealth into durable, knowledge-based advantages by investing in the digital infrastructure and high-skilled human capital that will power downstream diversification. In contrast, for the region's diversified economies, the challenge is one of sharpening their competitive edge. Their success hinges on forging a world-class investment climate through institutional reform and aggressively pursuing vertical FDI, all while vigilantly maintaining exchange rate competitiveness to win in price-sensitive global markets.

For fragile states, the policy focus must be foundational, seeking to build economic lifelines where formal institutions are weak. Here, investments in digital connectivity and basic education can act as "institutional substitutes," enabling participation in low-complexity GVCs and creating islands of excellence even amidst instability. Ultimately, none of these national strategies can reach their full potential in isolation. Overcoming the "Arab integration paradox" requires a concerted regional effort to develop intra-Arab value chains and invest in cross-border infrastructure, turning regional cooperation into a collective springboard for global integration.

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