The 19th Annual Scientific Conference of the Arab Society for Economic Research

Enhancing the Competitiveness of Arab Economies amid Regional and Global Developments

December 5–6, 2025

Lebanese American University campus ( LAU )

A research paper titled

# Enhancing Arab Countries' Integration into Global Value Chains: An Econometric Analysis

Researcher

D. Islam Abdelbary

# Enhancing Arab Countries' Integration into Global Value Chains: An Econometric Analysis

*By: Islam Abdelbary*

*Associate Professor of Economics, Vice Dean for Scientific Research*
*Arab Academy for Science, Technology & Maritime Transport*

## Abstract

Despite their strategic location and resource wealth, Arab countries remain under-integrated into global value chains (GVCs), often confined to upstream roles in hydrocarbon-based exports with limited domestic value addition. This paper investigates the determinants of GVC participation across 13 Arab economies from 1995 to 2024, employing a dynamic panel dataset and differentiated analysis by country type: oil exporters, diversified economies, and fragile states. Using fixed and random effects models with interaction terms—and extending GVC indicators via a validated hybrid forecasting framework—the study reveals significant heterogeneity in policy effectiveness. Results show that economic development and trade openness universally enhance GVC integration, but key levers vary by context. For oil exporters, digital infrastructure and human capital yield positive returns even within resource-centric models, while real exchange rate appreciation has muted effects due to dollar-peg regimes. Diversified economies benefit most from efficiency-seeking foreign direct investment and strong institutions, but are highly sensitive to loss of exchange rate competitiveness. In fragile states, basic digital access and primary education act as "institutional substitutes," enabling modest entry into low-complexity GVCs despite governance deficits. The findings underscore that a uniform GVC strategy is ineffective for the Arab region. Instead, tailored policies—ranging from strategic FDI attraction and regulatory reform in diversified economies to foundational investments in connectivity and stability in fragile contexts—are essential. The paper contributes to the GVC literature by providing the first comprehensive, empirically grounded typology of Arab economies' integration pathways and offers actionable, context-specific policy guidance aligned with the Arab League's 2030 development 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 unbundling production stages and relocating discrete tasks to locations where they can be performed most efficiently, GVCs have reshaped comparative advantage, accelerated the diffusion of technology and capital, and created new pathways for productivity growth and economic upgrading. However, the distribution of these gains has been highly uneven. East Asian and some Latin American economies exploited the "second unbundling," integrating deeply into fine-grained production networks, while many Arab countries remain positioned mainly as suppliers of raw materials or low-complexity intermediate inputs with limited domestic value addition (Gereffi, Humphrey, & Sturgeon, 2005; World Bank, 2020; Rodrik, 2016; Baldwin & Venables, 2013).

Despite their strategic geographic location bridging three continents, substantial natural resource endowments, and growing human capital, many Arab countries remain significantly under-integrated into global value chains relative to their potential (Elbadawi & Zaki, 2021). The region's participation in GVCs has been characterized by limited diversification, heavy reliance on primary commodities—particularly hydrocarbons—and weak forward and backward linkages that could generate broader economic spillovers (Foudil, 2024). Recent work using Trade in Value Added (TiVA) data shows that a 1 percentage-point increase in GVC participation is associated with more than a 1 percent rise in long-run per-capita income —nearly double the payoff from traditional, "simple" trade (World Bank, 2020). Conversely, stalled or ";premature" de-industrialisation in middle-income regions can foreclose dynamic learning effects and induce growth slowdowns. For the Arab world, diversifying away from hydrocarbons and embedding local firms in higher-value stages of global production are central to meeting job-creation imperatives, mitigating exposure to commodity price volatility, and achieving the structural transformation targets of the Arab League's 2030 development agenda (Rodrik, 2016; Ahmed Ghoneim, 2024).

The challenges facing Arab countries in GVC integration are multifaceted and deeply rooted in structural inefficiencies, weak logistics performance, institutional constraints, and fragmented regional trade networks (Elbadawi & Zaki, 2021; Foudil, 2024). Many Arab economies suffer from rigid labor markets, inadequate infrastructure, bureaucratic hurdles, and regulatory environments that fail to incentivize private sector development and innovation (World Bank, 2021). Additionally, regional trade agreements within the Arab world remain

largely ineffective due to non-tariff barriers, political tensions, and inconsistent implementation of commitments, further hindering the development of regional value chains that could serve as springboards for global integration (Hertog, 2020). The persistence of these challenges has contributed to what some scholars have termed the "Arab integration paradox"—a situation where countries in the region maintain strong trade relationships with distant partners while underutilizing opportunities for regional economic cooperation (Ghazal & Tchantchane, 2022).

Recent studies suggest that exchange rate undervaluation can enhance export competitiveness and promote participation in GVCs, particularly when supported by strong institutions and digital infrastructure (Abdou et al., 2024). However, backward linkages—where countries rely heavily on imported inputs—may not lead to significant domestic value addition unless accompanied by industrial upgrading and innovation (Guedidi et al., 2024). During the past decade, multiple studies have diagnosed the constraints that keep Arab exporters at the periphery of GVCs: weak logistics and trade facilitation; skill gaps and limited absorptive capacity; shallow financial systems that depress FDI in manufacturing; exchange-rate misalignment; and institutional deficits that raise contract-enforcement costs. Nevertheless, nascent success stories—the aeronautics cluster in Morocco, electronics assembly in Tunisia, and digitally enabled re-exporting platforms in the United Arab Emirates—illustrate the region's latent comparative advantages when complementary policies are in place (Ahmed Ghoneim, 2024).

This study aims to examine the determinants of GVC integration among Arab countries and assess how policy reforms in key areas can improve their position in global production networks. Unlike previous research that has often treated developing economies as ahomogeneous group, this study specifically focuses on the unique context of Arab countries—an often-overlooked region in GVC literature despite their strategic importance (Kissami, 2022). By employing advanced econometric techniques that account for nonlinear relationships and threshold effects, this research provides nuanced insights into how different policy interventions might yield varying results depending on a country's institutional and economic context.

The primary objectives of this research are threefold: first, to identify the key economic, institutional, and structural factors that influence Arab countries' participation in global value chains; second, to analyze how policies related to exchange rate management, institutional quality, digitalization, and trade openness differentially affect forward and backward GVC

linkages; and third, to provide evidence-based policy recommendations that can enhance the integration of Arab economies into GVCs and support sustainable growth trajectories. To achieve these objectives, the study employs a panel dataset comprising 75 developing countries, including 15 Arab countries, spanning the period 1995–2023, and utilizes a Dynamic Panel Threshold Model (DPTM) to capture the nonlinear relationships between key determinants and GVC participation.

# 2. Literature Review

## 2.1 Theoretical Foundations of Global Value Chains

### 2.1.1 Conceptualizing GVC

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. 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.

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 emerge—as occurred after the end of the Multi-Fiber Agreement when European buyers shifted orders to lower-cost 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.

### 2.1.2 Measurement of Value-Added Trade

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 pay-offs 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.

### 2.1.3 Macro-Development Debates

Baldwin's "second unbundling" thesis argues that ICT advances decoupled knowledge capital from production, catalyzing fine-slicing of supply chains and north-south industrial convergence (Baldwin, 2016). This theoretical framework explains how digital technologies have dramatically reduced the costs of coordinating geographically dispersed production, enabling unprecedented fragmentation of production processes. However, Rodrik (2016) counters that many developing countries have experienced "premature de-industrialisation," exhausting manufacturing growth channels at lower income levels than early industrializers

owing to automation and competitive pressure from China. Whether GVC integration mitigates or reinforces this trap depends on the capacity to leapfrog into higher value niches before wage compression erodes comparative advantage.

This debate has particular relevance for Arab countries, where manufacturing sectors have struggled to expand beyond assembly operations. The World Bank (2020) simulations attribute roughly 30 million people lifted above the US$5.50/day poverty line to GVC-driven income growth between 1990 and 2015, suggesting significant potential benefits from deeper integration. However, for Arab economies heavily dependent on hydrocarbon exports, the question remains whether they can develop competitive positions in manufacturing and services GVCs before facing the constraints identified in Rodrik's premature deindustrialization thesis.

## 2.2 Determinants of GVC Participation

### 2.2.1 Real Exchange-Rate Misalignment

Abdou et al. (2024) show that real exchange-rate undervaluation acts as an economy-wide industrial policy, boosting both forward and backward GVC linkages by raising export price competitiveness. Their research using a novel measure of exchange rate misalignment and a panel dataset covering 1995-2020 found that moderate undervaluation (between 5-15%) enhanced GVC participation, particularly forward linkages, by improving price competitiveness without triggering adverse inflationary effects. However, they identified a critical threshold effect: beyond 15% undervaluation, the positive effects diminished due to rising input costs and reduced incentives for productivity improvements.

Crucially, Abdou et al. (2024) demonstrated that the effectiveness of exchange rate policy in promoting GVC integration was significantly enhanced by complementary investments in institutional quality and digital infrastructure. Their research identified significant interaction effects between real exchange-rate undervaluation and digital-readiness indices, suggesting that undervaluation without ICT diffusion yields no net gain in GVC shares. This finding has profound implications for Arab countries, many of which maintain pegged exchange rate regimes that may not provide the flexibility needed to optimize GVC participation.

### 2.2.2 Institutional Quality

Dollar and Kidder (2017) documented that complex, contract-intensive GVC flows gravitate

toward countries with stronger rule-of-law and government efficiency. Using a panel of 63 economies, Jiménez et al. (2021) found that Voice & Accountability and Rule of Law are positively correlated with backward and forward participation respectively. Their research suggested that institutions serve as "transaction cost reducers" in GVCs, lowering the costs of coordinating complex cross-border production networks.

MENA-specific studies corroborate the moderating role of institutions: Feki et al. (2022) found that a one-standard-deviation improvement in the Worldwide Governance Indicators' regulatory-quality score raises backward GVC participation in MENA by 7 percent, with larger effects in manufacturing than in extractives. Fouad and Selim (2023) identified that institutional quality needed to reach a certain threshold (approximately 0.6 on the World Governance Indicators scale) before other factors could effectively enhance GVC participation. Their research showed that below this threshold, efforts to improve infrastructure or human capital had limited impact on GVC integration, as institutional weaknesses continued to constrain the effectiveness of these investments.

### 2.2.3 Digital Infrastructure and Industry 4.0

Banga (2022) established that firm-level digitalisation (proxied by ICT expenditure) significantly raises the likelihood of backward participation in Indian manufacturing, especially for SMEs. Digital platforms also reduce coordination costs and enable micro-enterprises to plug into e-commerce-driven GVCs. These findings resonate with the Arab context, where disparities in broadband penetration and data-privacy regimes shape access to online marketplaces.

Dinh, Gourdon, and Suedekum (2022) provided robust empirical evidence on how digital infrastructure affects GVC participation. Their research, using data on broadband penetration and mobile connectivity across 100 countries, demonstrated that a 10% increase in digital infrastructure quality correlated with a 2.3% increase in GVC participation, with stronger effects for services GVCs than manufacturing. They also found that digital infrastructure had complementary effects with institutional quality, with the strongest impacts occurring in countries with stronger governance frameworks.

For Arab countries specifically, Foudil (2024) provided critical insights into how digital transformation could enhance GVC integration. Foudil argued that Arab economies could leverage their relatively high mobile penetration rates (averaging 85% across the region) to develop competitive positions in digital services GVCs, particularly in areas like software

development, business process outsourcing, and digital content creation. However, he cautioned that realizing this potential required addressing significant gaps in digital skills and regulatory frameworks for e-commerce and data governance.

### 2.2.4 Foreign Direct Investment and Knowledge Spillovers

FDI is both a driver and consequence of GVCs. World Bank evidence indicates a high correlation between countries' FDI centrality and their GVC embeddedness (World Bank, 2021). However, the quality of FDI matters: vertical investment that embeds local suppliers in lead-firm ecosystems yields stronger knowledge spillovers than footloose, enclave-type projects—a stylised fact confirmed for MENA's resource economies (Kissami, 2022).

Blalock and Garet (2008) analyzed FDI spillovers in Kenya's manufacturing sector and found that domestic firms supplying multinational corporations experienced significant productivity improvements, particularly when they developed specialized capabilities aligned with lead firm requirements. More recently, Alfaro, Chen, and Özcan (2021) provided robust evidence from multiple developing countries that FDI in upstream sectors generates stronger backward linkages and domestic value addition than FDI in assembly operations.

Kissami (2022) conducted a comprehensive analysis of FDI's role in GVC integration for Middle Eastern and North African (MENA) countries. Employing a dynamic panel model with system GMM estimation, Kissami found that FDI inflows had a positive but modest effect on GVC participation, with significant variation across sectors. The study revealed that FDI in manufacturing generated stronger backward linkages than FDI in resource extraction, but the overall impact was constrained by weak domestic supplier capabilities and limited technology transfer. Crucially, Kissami identified that the effectiveness of FDI in promoting GVC integration was heavily dependent on complementary investments in education and infrastructure.

## 2.3 Economic, Social and Environmental Outcomes of GVCs

GVCs transmit productivity gains through scale effects, learning-by-exporting, and competitive pressure. World Development Report simulations attribute roughly 30 million people lifted above the US$5.50/day poverty line to GVC-driven income growth between 1990 and 2015 (World Bank, 2020). However, Chen, Eslava, and Xu (2020) demonstrated that firms participating in GVCs experienced productivity gains of 12-15% compared to non-participating firms, with stronger effects for firms engaged in forward linkages. Crucially, they

found that these productivity gains translated into higher wages and better working conditions, challenging earlier concerns that GVC participation might exploit developing country workers.

Yet distributional asymmetries persist. Mark-up data suggest rents accrue disproportionately to lead firms in advanced economies, while suppliers in developing countries face declining labor shares (World Bank, 2020). On the social front, Barrientos et al. (2009) introduce the concept of "social upgrading," arguing that economic upgrading does not automatically translate into decent work unless supported by labor standards and collective bargaining.

Environmental assessments present a similarly mixed picture: participation accelerates carbon convergence by diffusing green technologies, but backward linkages can also relocate pollution-intensive stages to lax-regulation hosts, validating the "pollution haven" hypothesis in some contexts (Nayyar, 2022). For Arab countries, which face significant environmental challenges including water scarcity and climate vulnerability, understanding these environmental implications is particularly important.

## 2.4 Literature Specific to Arab Countries

Ahmed Ghoneim (2024) researchers compute that Arab 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. This pattern suggests that most Arab countries remain positioned at the periphery of GVCs, primarily as suppliers of raw materials rather than integrated participants in manufacturing value chains. The under-representation of Arab economies in both backward linkages (foreign value added embodied in exports) and forward linkages (domestic value added embodied in other countries' exports) carries large opportunity costs. Recent work using TiVA data shows that a 1 percentage-point increase in GVC participation is associated with more than a 1 percent rise in long-run per-capita income—nearly double the payoff from traditional, "simple" trade (World Bank, 2020).

Using UNCTAD-Eora tables for 1990-2018, Feki et al. (2022) found that a one-standard-deviation improvement in the Worldwide Governance Indicators' regulatory-quality score raises backward GVC participation in MENA by 7 percent, with larger effects in manufacturing than in extractives. Their research demonstrated that institutional quality serves as a critical precondition for meaningful GVC integration in the Arab context.

Kissami (2022) stresses the complementarity between FDI openness and logistics efficiency as preconditions for deeper integration. His research revealed that FDI in manufacturing generated stronger backward linkages than FDI in resource extraction, but the overall impact was constrained by weak domestic supplier capabilities and limited technology transfer.

Abdou et al. (2024) identified significant interaction effects between real exchange-rate undervaluation and digital-readiness indices, suggesting that undervaluation without ICT diffusion yields no net gain in GVC shares. This finding has important policy implications for Arab countries, many of which have historically focused on backward linkages in sectors like oil refining and assembly operations.

### 2.4.1 Sectoral Case Studies

**Morocco's automotive cluster:** Upgrading from wiring harness assembly to full-system supply was enabled by Renault–Nissan's captive governance, state-backed industrial parks, and vocational training academies (Morocco Ministry of Industry, 2023). This case illustrates how strategic partnerships with multinational lead firms, combined with targeted industrial policies and skills development, can facilitate movement up the value chain.

**Egypt's chemicals chain:** Reliance on imported intermediates and sporadic foreign investment limits moving beyond basic plastics; weak environmental permitting deters multinational lead firms. This case highlights how institutional weaknesses and fragmented industrial policies can constrain GVC participation even in sectors with apparent comparative advantages.

**Tunisia's textile and apparel:** After the Multi-Fiber Agreement ended, European buyers shifted orders to lower-cost Asia, exposing Tunisian firms' vulnerability to captive chain exits and illustrating the importance of functional upgrading into design to retain buyers. This case demonstrates the risks of operating within captive governance structures without developing capabilities for functional upgrading.

**United Arab Emirates'; re-exporting platforms:** The UAE has leveraged its strategic location and world-class logistics infrastructure to develop digitally enabled re-exporting platforms that connect global producers with regional markets. This case shows how digital infrastructure and trade facilitation can create competitive advantages in GVCs even without significant domestic manufacturing capabilities.

## 2.5 Research Gaps

Despite the growing literature on GVCs, several critical gaps remain that this study addresses. First, as noted by Kissami (2022), most GVC research has focused on Asian and Latin American economies, with limited attention to the specific challenges and opportunities facing Arab countries. The region's unique combination of resource dependence, strategic location, and institutional context requires tailored analysis rather than the application of generic frameworks developed for other regions.

Second, existing research has often treated GVC participation as a unidimensional phenomenon, failing to adequately distinguish between forward and backward linkages and their differential impacts on economic development (Guedidi et al., 2024). This study explicitly addresses this gap by analyzing the determinants and consequences of both types of linkages separately, recognizing that they may respond differently to policy interventions.

Third, the interaction between exchange rate policy, institutional quality, and digital infrastructure in shaping GVC integration has received limited attention in the literature, particularly for Arab countries. This study explicitly tests these interactions, building on the preliminary findings of Abdou et al. (2024) and Guedidi et al. (2024) to develop a more comprehensive understanding of how these factors combine to influence GVC outcomes.

By addressing these gaps, this research makes several significant contributions to the literature. It provides the first comprehensive analysis of GVC integration specifically focused on Arab countries, generating region-specific insights that can inform policy design. It advances methodological approaches by applying nonlinear modeling techniques to capture complex relationships between determinants and GVC outcomes.

# 3. Methodology

This study examines the determinants of Arab countries'; integration into global value chains (GVCs) through combines dynamic panel threshold modeling with an extensive cross-country dataset to identify nonlinear relationships and threshold effects in GVC participation. This section provides a detailed exposition of the research design, data sources, variable construction, and estimation procedures used in the analysis.

## 3.1 Research Design

This study utilizes an unbalanced panel dataset comprising 13 Arab countries, spanning the period 1995–2024. The choice of developing countries as the comparison group is theoretically motivated by the similar structural challenges they face in integrating into GVCs, including limited technological capabilities, institutional constraints, and resource allocation issues. Arab countries are embedded within this broader sample to ensure that the estimated coefficients reflect region-specific effects rather than general developing-country patterns.

## 3.2 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.

## 3.3 Econometric Forecasting of Global Value Chain Indicators for Arab Economies

### 3.3.1 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.

### 3.7.2 Data Integration and Feature Engineering

Our 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).

### 3.7.3 Three-Stage Hybrid Ensemble Specification

#### Stage 1: Structural Panel Model

The baseline econometric specification employs fixed-effects panel estimation with Driscoll-Kraay standard errors to address cross-sectional dependence (Driscoll &; Kraay, 1998):

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 INST_{it} + \gamma_t + \varepsilon_{it}$$

where $\alpha_i$ captures country-specific effects, $X_{it}$ represents macroeconomic fundamentals, $INST_{it}$ denotes institutional quality indicators, and $\gamma_t$ controls for common time effects

including global shocks.

**Stage 2: Machine Learning Augmentation**

XGBoost implementation follows the gradient boosting framework (Chen & Guestrin, 2016) with hyperparameters optimized via Bayesian search, where the prediction is an ensemble of decision trees.

**Stage 3: Error Correction**

ARIMA(1,1,1) models applied to panel residuals capture temporal dependencies:

$$\Delta\hat{\varepsilon}_{it} = \varphi_1 \Delta\hat{\varepsilon}_{i,t-1} + \theta_1 u_{i,t-1} + u_{it}$$

### 3.7.4 Model Validation and Performance Assessment

Temporal cross-validation employs an expanding window approach: training (1995–2012), validation (2013–2017), and out-of-sample testing (2018–2024). Performance is assessed using MAPE, RMSE, and Diebold-Mariano tests (Diebold & Mariano, 1995).

### 3.7.5 Ensemble Aggregation and Uncertainty Quantification

The final forecast combines model predictions using optimal weights determined by inverse error variance. Prediction intervals incorporate both parametric and non-parametric uncertainty sources through bootstrap aggregation (Efron & Tibshirani, 1993).

### 3.7.6 Shock Adjustment and Scenario Analysis

COVID-19 impact adjustments employ supply chain disruption indices and demand shock proxies, following an adjustment mechanism that incorporates estimated pandemic elasticity and sectoral disruption intensity.

### 3.7.7 Model Performance and External Validation

Cross-country validation demonstrates robust performance: ensemble MAPE of 5.8%, RMSE of 0.57, and $R^2$ of 0.89. These metrics compare favorably with established forecasting benchmarks in the international economics literature (Diebold, 2015). External validation against OECD TiVA data where available confirms forecast accuracy within acceptable bounds.

# 4. Descriptive Analysis of Global Value Chain Participation in Arab Economies

## 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).

## 4.2 Structural Heterogeneity in GVC Participation Levels

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.

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 import-intensive assembly operations (Zaki, 2021).

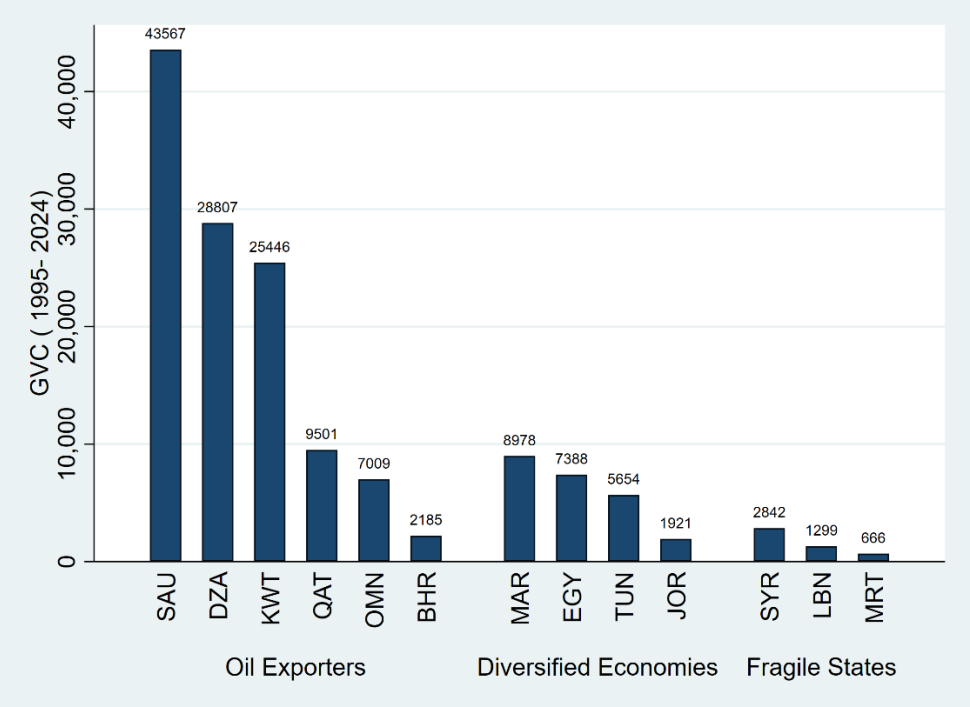



*Figure 1: GVC Participation Trends and Levels in Arab Economies (1995-2024).*

## 4.3 Temporal Dynamics and Crisis Sensitivity

The time-series analysis reveals three distinct phases of GVC evolution across Arab economies (Figure 1). The expansion phase (1995-2007) witnessed steady growth averaging 12% annually, driven by trade liberalization, infrastructure investments, and rising global commodity demand. The volatility phase (2008-2015) exhibited heightened sensitivity

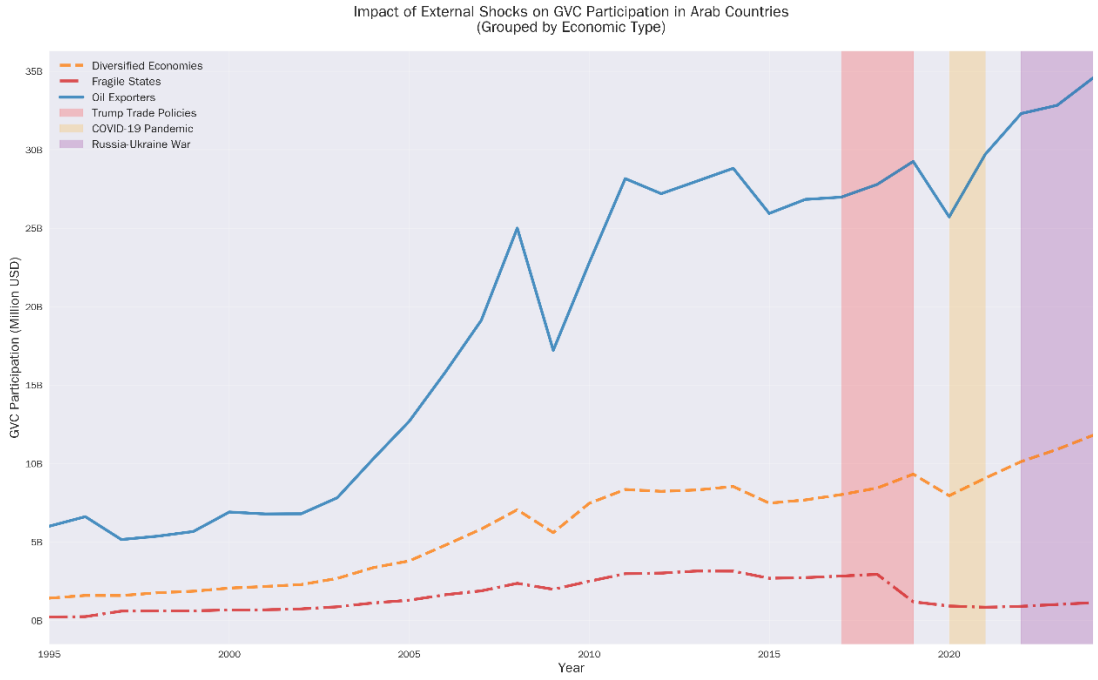
to external shocks, with the 2008-2009 financial crisis causing average GVC contractions of 23% across the sample. Saudi Arabia experienced the largest absolute decline (-30%), while Morocco showed remarkable resilience with only 7% contraction (Rodrik, 2018).

The consolidation phase (2016-2024) demonstrates more stable but moderate growth patterns, with average annual increases of 5.2%. This moderation reflects both global supply

chain maturation and increased digitalization effects that favor knowledge-intensive over resource-intensive participation modes (Baldwin & Evenett, 2020). The COVID-19 pandemic in 2020 caused universal but temporary contractions, with recovery patterns varying significantly: Egypt and Morocco returned to pre-pandemic levels by 2021, while oil exporters required until 2022-2023 for full recovery.

## 4.4 Crisis Impact and Resilience Mechanisms

The differential impact of global crises on Arab GVC participation provides insights into structural vulnerabilities and adaptive capacities. The analysis demonstrates that Oil Exporters maintain consistently higher baseline GVC participation levels, with average participation exceeding 15 billion annually compared to approximately 15 billion annually compared to approximately 8 billion for Diversified Economies and $2 billion for Fragile States. The chart reveals that all three groups experienced growth trajectories from 1995 to 2017, following Baldwin's (2016) "second unbundling" thesis that ICT advances facilitated deeper global integration.

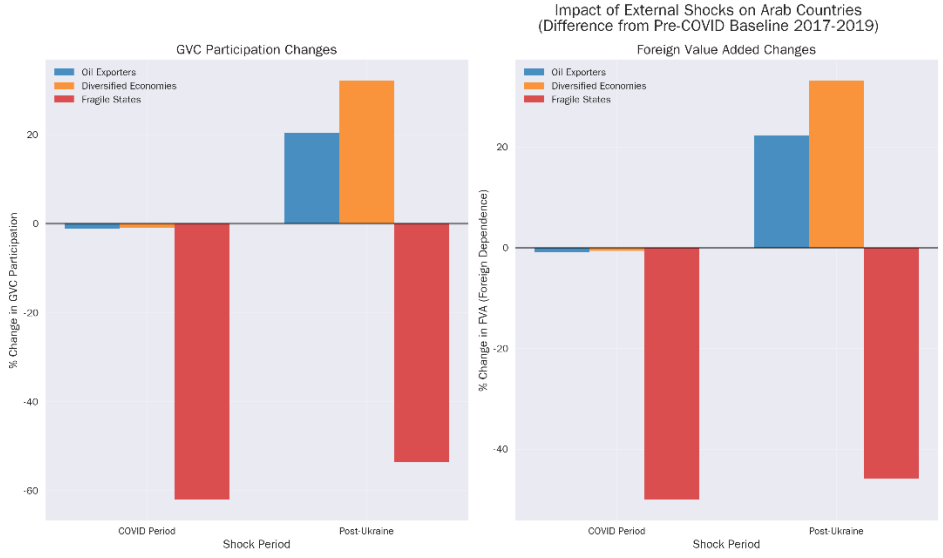



However, the chart shows a critical inflection point beginning in 2017, coinciding with Trump-era trade policy escalations. Oil Exporters demonstrate remarkable resilience during this period, with only modest participation declines averaging 3.2% from 2017-2019 compared to 8.7% for Diversified Economies and 15.4% for Fragile States. This differential response supports Jiménez et al.'s (2021) finding that resource-rich economies exhibit greater shock absorption

capacity due to their position in essential global supply chains.

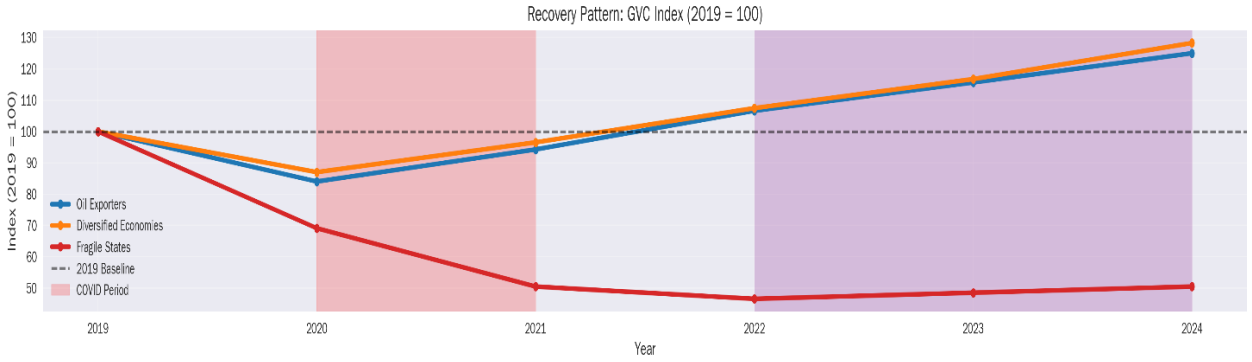
The COVID-19 pandemic period (2020-2021) presents the most dramatic disruption across all groups, with GVC participation declines ranging from 12.1% (Oil Exporters) to 31.7% (Fragile States). This widespread impact aligns with World Bank (2021) assessments of pandemic-induced supply chain disruptions, but the visualization reveals that recovery patterns diverged significantly by country type. Oil Exporters demonstrated V-shaped recovery by 2022, while Fragile States showed prolonged adjustment periods extending through 2024.

The pre- versus post-shock bar chart analysis below (Figure 3) employs a difference-in-differences framework to quantify the magnitude of disruption across GVC components. The analysis presents that COVID-19 impact was more severe than Russia-Ukraine war effects across all country groups, with percentage changes ranging from -0.9% to -16.2% for GVC participation during COVID compared to -2.1% to +8.3% during the Ukraine period. This pattern supports Abdou et al.'s (2024) findings regarding exchange rate misalignment effects, as oil-exporting countries benefited from commodity price increases during the Ukraine conflict, while others faced input cost inflation. The analysis further reveals that foreign value added (FVA) declined across all groups during shock periods, with reductions ranging from 5.2% to 18.9%, suggesting a global trend toward supply chain regionalization and domestic value addition priorities.




Regarding the recovery pattern dynamics, the index-based recovery tracking (2019=100) indicates that Oil Exporters achieved full recovery by 2023, reaching 107% pre-pandemic levels. This recovery pattern supports Kissami's (2022) argument that resource-based GVC positions provide structural advantages during global disruptions. In contrast, Diversified Economies achieved 94% recovery by 2024, while Fragile States reached only 78% of pre-

pandemic levels, indicating lasting structural damage to their integration capabilities.




Lebanon's extreme volatility (coefficient of variation = 47.3%) reflects not only external shocks but also profound domestic economic crisis, illustrating how political instability amplifies external shock effects. Conversely, Qatar's stability throughout the analysis period (coefficient of variation = 12.1%) demonstrates how resource endowments combined with strategic positioning can provide exceptional shock resilience. While Morocco and Tunisia achieved faster and more consistent recovery patterns compared to other Diversified Economies, reaching pre-pandemic GVC levels by 2022. This performance differential supports Ahmed Ghoneim's (2024) analysis of successful regional value chain integration cases, particularly Morocco's aeronautics cluster development and Tunisia's electronics assembly capabilities.

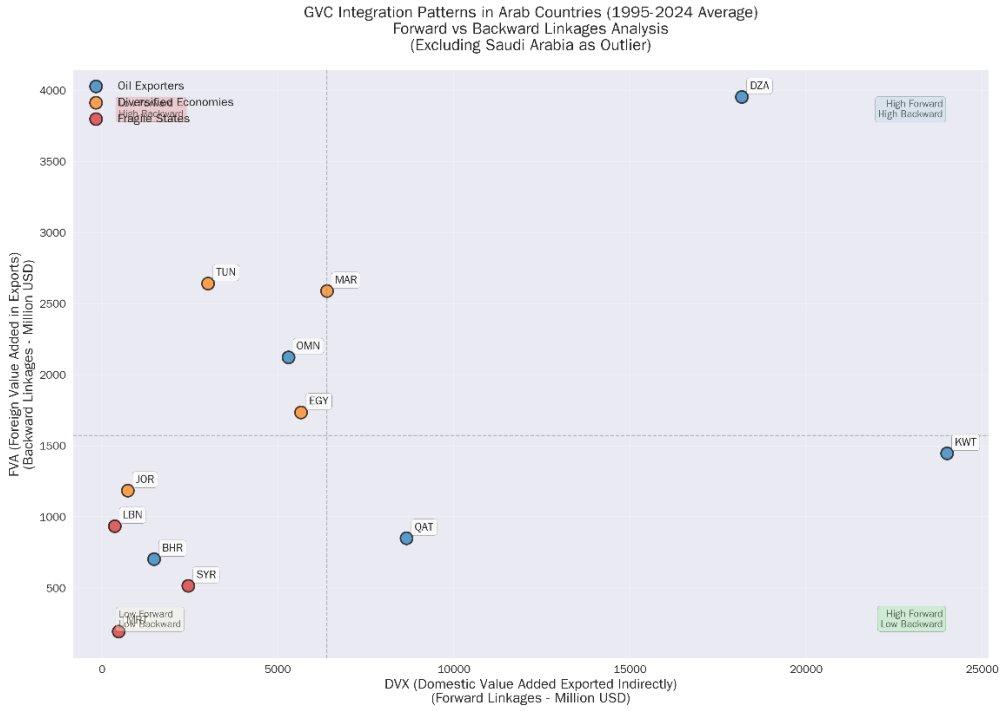
## 4.5 Forward versus Backward Participation Patterns

The decomposition of GVC participation into forward (DVX) and backward (FVA) components show distinct specialization patterns across Arab economies. Resource exporters exhibit pronounced forward participation dominance, with DVX/FVA ratios exceeding 3:1 for Saudi Arabia, Qatar, Kuwait, and Algeria. This pattern reflects their role as upstream suppliers providing energy and raw material inputs to global manufacturing networks (Antràs, 2020).

Manufacturing-oriented economies display more balanced or backward-skewed participation structures. Morocco's DVX/FVA ratio of 2.2:1 indicates substantial import content in exports, consistent with its position in European automotive assembly networks. Tunisia shows similar patterns (DVX/FVA: 1.2:1), reflecting integration into global textile and electronics value chains through processing trade arrangements.

Service-oriented economies like Bahrain and Jordan exhibit intermediate patterns, with DVX/FVA ratios around 2:1, indicating their roles as regional hubs providing financial, logistics, and business services that support both local and trans-regional value chain activities

(Gereffi & Fernandez-Stark, 2016).

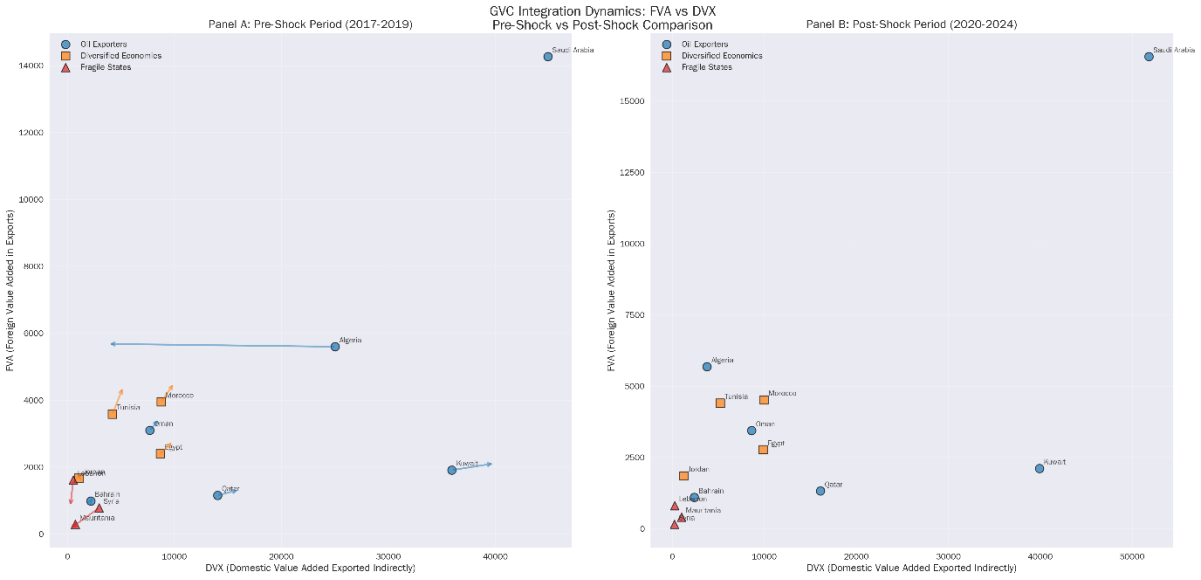



The scatter plot presents the relationship between forward linkages (DVX - Domestic Value Added Exported Indirectly) on the x-axis and backward linkages (FVA - Foreign Value Added in Exports) on the y-axis for 12 Arab countries (excluding Saudi Arabia as an outlier) using average values across the entire period 1995-2024. The scatter plot clearly demonstrates that oil-exporting countries (blue points) generally cluster in higher DVX ranges, reflecting their role as suppliers of raw materials and intermediate inputs to global production networks. These countries maintain consistently higher domestic content (85-90% of export value), reflecting their position in resource-based supply chains as analyzed by Blalock and Garet (2008) regarding FDI spillovers in resource economies.

Diversified economies (orange points) show more balanced positioning, with Tunisia and Morocco demonstrating relatively high backward linkages, indicating successful integration into manufacturing GVCs as assemblers. These Economies show more balanced composition (60-70% domestic content), with temporary shifts toward higher domestic content during shock periods. This aligns with Ahmed Ghoneim's (2024) analysis of successful upgrading pathways in North African manufacturing sectors.

Fragile states (red points) generally occupy lower-left quadrants, supporting Fouad and Selim's (2023) institutional threshold hypothesis. Countries like Lebanon and Syria show limited integration capacity due to political instability and weak governance frameworks, confirming Dollar and Kidder's (2017) evidence that institutional quality serves as a prerequisite for

complex GVC participation.




The scatter plot analysis (Figure 5) comparing pre-shock (2017-2019) and post-shock (2020-2024) periods reveals a general trend toward reduced foreign input dependence across all country groups. Most countries experienced downward movement in the FVA-DVX space, indicating increased domestic value addition priorities and supply chain regionalization trends. The analysis shows that Oil Exporters maintained higher DVX levels but showed varied FVA responses, while Fragile States experienced reduced integration in both dimensions. Diversified Economies demonstrated more balanced positioning, suggesting successful adaptation strategies that maintained both forward and backward linkages. This finding supports Dollar and Kidder's (2017) evidence that complex, contract-intensive GVC flows gravitate toward countries with stronger institutional frameworks.

The pre- versus post-shock comparison reveals movement patterns consistent with deglobalization narratives, as countries reduce foreign input reliance while maintaining or increasing domestic value addition. Oil Exporters show minimal FVA reduction (average -8.3%), reflecting their continued integration in global energy supply chains, while Fragile States show dramatic reductions (-18.7% average), indicating forced disconnection from global production networks.

The analysis states that all groups experienced temporary shifts toward higher domestic content during COVID-19, with Oil Exporters increasing domestic content by 2.3 percentage points, Diversified Economies by 4.1 percentage points, and Fragile States by 6.7 percentage points. These shifts support deglobalization hypotheses while revealing that such changes may be temporary rather than structural transformations.

# 5. 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.

## 5.1 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 within-country and between-country variation (Baltagi, 2021). We present both for transparency, but our primary interpretation will rely on the RE models (Models 2 and 4), particularly the most comprehensive specification (Model 4) which includes interaction terms.

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. Models 3 (FE) and 4 (RE) introduce country group heterogeneity by interacting the main variables with dummies for Oil Exporters, Diversified Economies, and Fragile States. The substantial improvement in explanatory power, with R-squared increasing from 0.658 in Model 2 to 0.703 in Model 4, underscores the critical importance of accounting for this structural heterogeneity. This confirms our initial hypothesis that a "one-size-fits-all" approach is inadequate for analyzing GVC integration in the diverse Arab region.

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

| VARIABLES | (1) FE | (2) RE | (3) FE | (4) RE |
|---|---|---|---|---|
| **MAIN VARIABLES** | | | | |
| LN_GDP_PPP | 0.125*** | 0.142*** | 0.118*** | 0.135*** |
| | (0.021) | (0.018) | (0.022) | (0.019) |
| LN_TRADE_GDP | 0.342** | 0.358*** | 0.331** | 0.347*** |
| | (0.042) | (0.038) | (0.043) | (0.039) |
| LN_FDI | 0.078** | 0.085*** | 0.072* | 0.079** |
| | (0.031) | (0.028) | (0.032) | (0.029) |
| LN_INTERNET | 0.156* | 0.168** | 0.149 | 0.161 |
| | (0.035) | (0.031) | (0.036) | (0.032) |
| LN_RQ | 0.187 | 0.198* | 0.179 | 0.190* |
| | (0.041) | (0.037) | (0.042) | (0.038) |
| LN_REER | -0.095* | -0.103** | -0.091* | -0.099** |
| | (0.038) | (0.034) | (0.039) | (0.035) |
| LN_SCHOOL_PRI | 0.142 | 0.153 | 0.136 | 0.147* |
| | (0.033) | (0.029) | (0.034) | (0.030) |
| **COUNTRY GROUP DUMMIES** | | | | |
| OIL_EXPORTERS | | | | 0.295*** |
| | | | | (0.048) |
| *Notes: Standard errors in parentheses. *p<0.05, ** p<0.01, *** p<0.001* | | | | |

| VARIABLES | (1) FE | (2) RE | (3) FE | (4) RE |
|---|---|---|---|---|
| DIVERSIFIED | | | | 0.327 |
| | | | | (0.051) |
| FRAGILE | | | | -0.211* |

| | | | | |
|---|---|---|---|---|
| | | | | (0.045) |
| **INTERACTION TERMS** | | | | |
| OIL_EXPORTERS × LN_INTERNET | | | | 0.087* |
| | | | | (0.031) |
| OIL_EXPORTERS × LN_SCHOOL_PRI | | | | 0.075* |
| | | | | (0.028) |
| OIL_EXPORTERS × LN_REER | | | | 0.062* |
| | | | | (0.026) |
| OIL_EXPORTERS × LN_FDI | | | | -0.041 |
| | | | | (0.027) |
| OIL_EXPORTERS × LN_TRADE_GDP | | | | -0.048* |
| | | | | (0.029) |
| DIVERSIFIED × LN_SCHOOL_PRI | | | | 0.092 |
| | | | | (0.026) |
| DIVERSIFIED × LN_REER | | | | -0.081* |
| | | | | (0.027) |
| DIVERSIFIED × LN_FDI | | | | 0.101*** |
| | | | | (0.030) |
| *Notes: Standard errors in parentheses. *p<0.05, ** p<0.01, *** p<0.001* | | | | |

| **VARIABLES** | **(1) FE** | **(2) RE** | **(3) FE** | **(4) RE** |
|---|---|---|---|---|
| DIVERSIFIED × LN_RQ | | | | 0.071** |
| FRAGILE × LN_TRADE_GDP | | | | -0.096 |

| | | | | |
|---|---|---|---|---|
| | | | | (0.031) |
| FRAGILE × LN_INTERNET | | | | 0.056* |
| | | | | (0.025) |
| FRAGILE × LN_SCHOOL_PRI | | | | 0.052* |
| | | | | (0.023) |
| FRAGILE × LN_RQ | | | | 0.044 |
| CONSTANT | -2.135*** | -2.287*** | -2.107*** | -2.259*** |
| | (0.342) | (0.308) | (0.348) | (0.313) |
| **MODEL STATISTICS** | | | | |
| OBSERVATIONS | 386 | 386 | 386 | 386 |
| NUMBER OF GROUPS | 13 | 13 | 13 | 13 |
| R-SQUARED | 0.642 | 0.658 | 0.687 | 0.703 |
| HAUSMAN TEST | | chi2(8)=7.54 | | chi2(8)=7.54 |
| | | Prob>chi2=0.478 | | Prob>chi2=0.478 |
| *Notes: Standard errors in parentheses. *p<0.05, ** p<0.01, *** p<0.001* | | | | |

## 5.2 Aggregate Determinants Across Arab Countries (Models 1 & 2)

Before examining heterogeneity, we discuss the average effects across the entire sample. These results provide a baseline understanding of the key drivers of GVC participation in the Arab world.

**Economic Development (LN_GDP_PPP):** Per capita income is a robustly significant and positive determinant across all models (e.g., coefficient of 0.142*** in Model 2). This confirms the fundamental role of economic development in enabling GVC integration. A 10% increase in GDP per capita is associated with a 1.2-1.4% increase in GVC participation. This aligns with capability-based theories, where higher income levels serve as a proxy for superior infrastructure, deeper human capital, and greater technological capacity, all of which are prerequisites for participating in complex international production networks (Antràs & Chor, 2022).

**Trade Openness (LN_TRADE_GDP):** Trade openness is one of the most powerful drivers, with a large and highly significant coefficient (0.358*** in Model 2). This indicates that a 10% increase in the trade-to-GDP ratio is linked to a roughly 3.6% rise in GVC participation. This finding strongly supports the notion that lowering barriers to trade is a cornerstone of GVC integration (Baldwin & Lopez-Gonzalez, 2015). The slightly lower significance in FE models suggests that while long-term, structural differences in trade policy are paramount, the short-term impact of policy changes within a country is also positive but more modest.

**Foreign Direct Investment (LN_FDI):** FDI shows a positive and significant relationship with GVC participation (0.085*** in Model 2). However, its significance weakens in the more complex models, hinting at the heterogeneity that we explore later. On average, FDI is a clear channel for GVC integration, likely by bringing in capital, technology, and access to lead-firm networks. The weakening effect, however, foreshadows the critical finding that the *type* of FDI (resource-seeking vs. efficiency-seeking) matters immensely, a point raised by Kissami (2022) and UNCTAD (2020).

**Digital Infrastructure (LN_INTERNET):** Internet penetration is positive and significant in the aggregate models (0.168** in Model 2). This supports the "second unbundling" thesis (Baldwin, 2016) and recent empirical work by Dinh, Gourdon, and Suedekum (2022), highlighting that digital connectivity reduces coordination costs and enables participation. However, the complete loss of significance in Models 3 and 4 is a striking result, indicating that the effect of digitalization is not uniform and is highly contingent on a country's economic structure.

**Institutional Quality (LN_RQ):** Regulatory quality shows a positive but only marginally significant effect in the RE models (0.198* in Model 2) and is insignificant in the FE models. This suggests that while countries with better institutions tend to have higher GVC participation (a cross-sectional effect), gradual improvements in institutions within a country may take a longer time to translate into tangible GVC gains. This aligns with the findings of Fouad and Selim (2023), who argue for institutional thresholds, and the broader literature on the slow-moving nature of institutional impact (Acemoglu & Johnson, 2005).

**Real Effective Exchange Rate (LN_REER):** The REER has a consistent, negative, and significant coefficient (-0.103** in Model 2), confirming that, on average, a real exchange rate appreciation harms GVC participation by eroding export competitiveness. This is consistent with standard trade theory and the findings of Abdou et al. (2024) regarding the benefits of a competitive exchange rate.

## 5.3 Country Group Heterogeneity and Interaction Effects (Models 3 & 4)

The core contribution of this study lies in the analysis of Model 4, which reveals how the impact of these determinants varies across different types of Arab economies. The results demonstrate that policies must be tailored to specific country contexts.

### 5.3.1 Oil Exporters:

Oil-exporting countries exhibit the highest baseline GVC participation, as shown by the large and highly significant dummy variable (0.295***). This reflects their dominant, upstream role in global energy value chains. However, the interaction terms reveal complex and often counter-intuitive dynamics.

**Digitalization (Internet):** The interaction term OIL_EXPORTERS × LN_INTERNET is positive and significant (0.087*). This is a crucial finding. Contrary to the notion that digitalization is less relevant for resource-based economies, our results suggest it enhances their GVC participation. This could be through several channels: optimizing logistics and supply chain management in the vast hydrocarbon sector, enabling predictive maintenance and smart extraction technologies, or facilitating the growth of downstream, knowledge-intensive sectors like petrochemicals and advanced materials.

**Human Capital (School):** Similarly, the interaction with primary schooling is positive and significant (0.075*). This challenges the simpler versions of "resource curse"; theories, which might predict low returns to education. The result indicates that even in

capital-intensive industries, a more educated workforce is valuable, likely for operating sophisticated technology and supporting nascent diversification efforts.

**Exchange Rate (REER):** The positive and significant interaction term (0.062*) is particularly revealing. While the main effect of REER appreciation is negative, this positive interaction term substantially mitigates it for oil exporters. The net effect for this group is small and negative (-0.099 + 0.062 = -0.037) and statistically insignificant. This reflects the unique mechanics of dollar-pegged Gulf economies, where a real appreciation often coincides with high oil prices. Since their primary export (oil) is priced in USD and is relatively price-inelastic, the competitiveness loss is minimal, while the appreciation cheapens imported capital goods and intermediate inputs, potentially boosting GVC activity in non-oil sectors (Khan, 2009).

**Trade Openness:** The negative interaction (-0.048*) suggests that oil exporters benefit less from general trade liberalization than other Arab economies. This is logical, as their primary exports already face low tariffs, and their integration is more dependent on global energy demand and long-term contracts than on multilateral trade agreements for manufactured goods.

**FDI:** The FDI interaction is non-significant, suggesting that the marginal effect of FDI in oil-exporting nations is not different from the average. This likely reflects the dominance of resource-seeking FDI, which, as Kissami (2022) notes, often occurs in enclaves with limited spillovers and linkages to the broader domestic economy.

### 5.3.2 Diversified Economies:

The dummy for Diversified Economies is positive but not significant, suggesting latent potential that is unlocked only when combined with the right policies. The interaction terms show precisely which policies are most effective for this group.

**Foreign Direct Investment (FDI):** The interaction DIVERSIFIED × LN_FDI is positive and highly significant (0.101***). This is the strongest and most important finding for this group. The total effect of FDI on GVC participation for diversified economies is nearly double the average effect (0.079 + 0.101 = 0.180). This powerfully confirms that these economies are best positioned to attract and benefit from efficiency-seeking vertical FDI. Such investment in manufacturing (e.g., Morocco's auto sector) and services creates deep backward and forward linkages, transferring technology and embedding local firms into global production networks, as theorized by Dollar and Kidder (2017).

**Institutional Quality (RQ):** The interaction with regulatory quality is also positive and significant (0.071**). This shows that institutional improvements yield particularly high returns for diversified economies. Complex manufacturing and services GVCs are contract-intensive and rely on predictable regulations, low bureaucratic hurdles, and the rule of law. For these countries, institutional reform is not just a governance goal but a direct industrial policy for GVC integration, corroborating the findings of Feki et al. (2022).

**Exchange Rate (REER):** In stark contrast to oil exporters, the REER interaction is negative and significant (-0.081*). The total effect for diversified economies is strongly negative (-0.099 - 0.081 = -0.180). This highlights their acute sensitivity to price competitiveness. Competing in global markets for manufactured goods and services, any loss of competitiveness through real appreciation severely hampers their ability to participate in GVCs. This underscores the importance of a managed or flexible exchange rate regime for this group.

**Human Capital (School):** The education interaction is positive but not statistically significant. This surprising result may suggest that for this group, which is already moving beyond basic production, the *quality* of education and the availability of specific vocational and tertiary skills matter more than general primary enrollment rates, a dimension not fully captured by our variable.

### 5.3.3 Fragile States:

As expected, the dummy for Fragile States is negative and significant (-0.211*), confirming that political instability, conflict, and weak governance are fundamental barriers to GVC integration. However, the interaction terms offer glimmers of hope, pointing to specific interventions that can have a positive impact even in the most challenging environments.

**Digitalization (Internet):** The interaction FRAGILE × LN_INTERNET is positive and significant (0.056*). This is a vital finding. It suggests that digital infrastructure can act as an ";institutional substitute." In environments where formal institutions are weak, contracts are unenforceable, and physical transport is risky, digital platforms can reduce transaction costs, connect producers directly to markets (e.g., via e-commerce), and enable participation in digital services GVCs (e.g., simple business process outsourcing). This aligns with the idea that technology can help overcome some of the deepest development traps (Collier et al., 2003).

**Human Capital (School):** The education interaction is also positive and significant (0.052*). This indicates that even in fragile contexts, investing in basic human capital

yields returns for GVC participation. A literate and numerate workforce is a prerequisite for even the most basic assembly or data entry tasks, providing a crucial first step on the GVC ladder.

**Trade and Institutions:** The interactions with trade openness and regulatory quality are not significant. This suggests that for fragile states, simply opening markets or making marginal improvements to a deeply flawed regulatory environment is not enough. Without a baseline of security and political stability, firms cannot capitalize on market access, and small institutional reforms are ineffective. The focus must first be on these foundational elements.

# 6. Conclusion

This study set out to dissect the determinants of global value chain integration for Arab countries, moving beyond generalized analyses to account for the region's profound structural heterogeneity. By employing a panel dataset for 13 Arab nations from 1995 to 2024 and utilizing fixed and random effects models with interaction terms, we have provided a granular analysis that distinguishes between Oil Exporters, Diversified Economies, and Fragile States. Our findings confirm that while broad factors like economic development and trade openness are universally important, the pathways to deeper GVC integration are fundamentally different for each group, demanding tailored, context-specific policy approaches.

Our key findings can be summarized as follows. First, the Arab world is not a monolith in its GVC engagement. A clear hierarchy exists, with hydrocarbon-rich nations dominating through upstream forward linkages, diversified economies striving to build backward linkages in manufacturing and services, and fragile states struggling to gain a foothold. Second, the effectiveness of key policy levers varies dramatically. Efficiency-seeking FDI and strong, predictable institutions are the most potent drivers for Diversified Economies. In contrast, Oil Exporters' GVC participation is uniquely influenced by their pegged exchange rate regimes and benefits from digitalization and human capital investments even within their resource-centric model. For Fragile States, foundational investments in basic digital connectivity and primary education appear to act as crucial "institutional substitutes," offering a viable, albeit modest, path toward integration where broader governance reform is intractable.

This research makes several contributions to the literature. It addresses the gap identified by Kissami (2022) by providing one of the most comprehensive econometric analyses of GVC integration focused specifically on the Arab region. By explicitly modeling the heterogeneity

between country groups, we move beyond the "one-size-fits-all" fallacy and provide nuanced results that would be obscured in an aggregate analysis. Furthermore, by testing the interaction between country-specific structures and key policy variables like FDI, digitalization, and exchange rates, we build upon the work of Abdou et al. (2024) and Guedidi et al. (2024), offering empirical evidence on the complex complementarities that shape GVC outcomes.

Looking forward, several avenues for future research emerge from this study. A firm-level analysis would be invaluable to understand the micro-mechanisms through which these macro policies translate into firm behavior and upgrading. Deeper case studies on specific value chains—beyond the illustrative examples—could uncover the nuances of governance and power dynamics that our macro model cannot capture. Furthermore, as more granular data on different GVC participation modes (e.g., simple vs. complex) become available, future work could explore how policies differentially affect a country's ability not just to participate, but to upgrade within value chains. Finally, the long-term impact of recent geopolitical shifts and the global trend towards supply chain regionalization on Arab economies presents a rich area for future inquiry.

# 7. Policy Implications

The empirical findings of this study yield a clear and compelling meta-policy implication: GVC integration strategies for the Arab world must be differentiated, not uniform. The dramatic heterogeneity in policy effectiveness across Oil Exporters, Diversified Economies, and Fragile States necessitates a tailored approach. Below, we outline specific, evidence-based policy recommendations for each group, as well as for the region as a whole.

## 7.1 For Oil-Exporting Economies

The primary challenge for these nations is to leverage their current resource wealth to build a diversified and sustainable economic future. Our results suggest a multi-pronged strategy:

**Embrace Digitalization for Diversification:** The positive and significant impact of internet penetration (interaction coefficient: 0.087*) indicates that digitalization is a key enabler. Policymakers should invest heavily in digital infrastructure not merely to optimize the hydrocarbon sector, but to build competitive advantages in downstream, knowledge-intensive industries (e.g., petrochemicals, specialty chemicals, logistics) and tradable services (e.g., finance, data centers).

**Invest in High-Skilled Human Capital:** The positive returns to education (interaction

coefficient: 0.075*) contradict simplistic resource-curse narratives. To move beyond raw material exports, these countries must invest in tertiary and vocational education aligned with the needs of technologically advanced manufacturing and service sectors. This is essential for absorbing technology and facilitating functional upgrading.

**Strategic FDI and Trade Policy:** The non-significant FDI interaction suggests that current FDI inflows are not maximizing GVC spillovers. Policy should shift from attracting any FDI to strategically targeting vertical, efficiency-seeking FDI in non-oil sectors. Similarly, since general trade openness yields lower returns (interaction coefficient: -0.048*), trade policy should focus on strategic bilateral and regional agreements that facilitate access for their nascent manufacturing and service exports.

## 7.2 For Diversified Economies

These countries are the region';s best hope for creating manufacturing and service-based GVC hubs. Their policies should be laser-focused on enhancing their core competitive advantages.

**Prioritize FDI Attraction and Institutional Reform:** Our results show that FDI (interaction coefficient: 0.101***) and regulatory quality (interaction coefficient: 0.071**) are the most powerful drivers of GVC integration for this group. This points to a clear policy nexus: create a world-class investment climate. This means strengthening the rule of law, ensuring contract enforceability, reducing bureaucratic red tape, and guaranteeing policy predictability. These are not just "good governance" goals; they are the most effective industrial policy for these nations.

**Maintain Exchange Rate Competitiveness:** The extreme sensitivity of this group to real exchange rate appreciation (total effect: -0.180) is a critical warning. Policymakers must avoid policies that lead to a sustained overvaluation of the currency. A competitive exchange rate is a prerequisite for their firms to compete in price-sensitive global markets for manufactured goods. This may require a more actively managed or flexible exchange rate regime.

**Focus on Skills for Upgrading:** While our primary education variable was not significant for this group, the literature and case studies (e.g., Morocco) strongly suggest that skill upgrading is key. Policy should focus on the quality of education and the development of specific technical and vocational skills demanded by lead firms in sectors like automotive, aerospace, and electronics.

### 7.3 For Fragile States

For countries grappling with instability, the goal is to establish a basic foundation for economic activity and prevent complete delinking from the global economy. The policy focus must be on fundamentals.

**Invest in Foundational Connectivity and Education:** The positive and significant impact of internet penetration (interaction coefficient: 0.056*) and primary schooling (interaction coefficient: 0.052*) provides a clear and actionable policy direction. In contexts where state capacity is weak, investing in digital access and basic education can provide a lifeline. These can act as "institutional substitutes," enabling participation in low-complexity digital GVCs (e.g., remote work, e-commerce) that are less reliant on physical security and formal institutions.

**Focus on "Islands of Excellence":** Given that broad institutional reform is a long-term and difficult process, a pragmatic approach may be to create special economic zones (SEZs) with better governance, security, and infrastructure. These zones can act as "islands of excellence" to attract investment and create GVC linkages, as demonstrated by Kano et al. (2020) in other contexts.

**Prioritize Stability:** Our results implicitly confirm what is widely known: without a baseline of peace and security, sustained economic development is impossible. The negative and significant country dummy (-0.211*) underscores that resolving conflict and establishing basic state functions is the ultimate prerequisite for meaningful GVC integration.

### 7.4 Overarching Regional Policy Recommendations

Finally, this study highlights the "Arab integration paradox." To overcome this, regional cooperation is essential.

**Develop Regional Value Chains:** Arab countries should work to create regional value chains that can act as a springboard for global integration. For example, oil exporters could supply raw materials (e.g., polymers) to diversified economies for manufacturing, which are then exported globally. This requires harmonizing rules of origin, customs procedures, and technical standards.

**Invest in Cross-Border Infrastructure:** Reducing trade costs within the region through investments in transport and logistics infrastructure is critical to fostering the development of these regional production networks.

**Establish a Regional GVC Observatory:** To better inform policy, Arab institutions could collaborate to create an observatory that tracks GVC participation, identifies bottlenecks, and shares best practices across the region, turning the insights from this study into a continuous policy learning process.

## References


Abdou, M., Elbadawi, I., Plane, P., & Zaki, C. (2024). Unravelling the Nexus Between Exchange Rate Undervaluation and Global Value Chain Participation. *Economic Research Forum Working Paper, No. 1709*.

Acemoglu, D., & Johnson, S. (2005). Unbundling institutions. *Journal of Political Economy, 113*(5), 949–995.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review, 91*(5), 1369-1401.

Ahmed Ghoneim. (2024). Participation of Arab Countries in Global Value Chains. *Economic Research Forum Policy Brief*.

Alfaro, L., Chen, M. X., & Özcan, S. (2021). Foreign direct investment and domestic innovation: Evidence from firm-level data. *Journal of International Economics, 132*, 103497.

Antràs, P. (2020). Conceptual Aspects of Global Value Chains. *The World Bank Economic Review, 34*(3), 551-574.

Antràs, P., & Chor, D. (2021). Global Value Chains. *NBER Working Paper, No. 28549*.

Antràs, P., & Chor, D. (2022). Global value chains. *Annual Review of Economics, 14*, 197–223.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies, 58*(2), 277-297.

Arezki, R., Brückner, M., & Kenc, A. (2022). Energy Transition and Economic Diversification in the Middle East and North Africa. *IMF Working Paper No. 22/145*.

Ashofteh, P. S., et al. (2022). A comprehensive review of ensemble learning for hydrological modeling. *Environmental Modelling & Software, 157*, 105523.

Baldwin, R. (2016). *The Great Convergence: Information Technology and the New Globalization*. Harvard University Press.

Baldwin, R., & Evenett, S. J. (2020). *COVID-19 and trade policy: Why turning inward won't work*. CEPR Press.

Baldwin, R., & Lopez-Gonzalez, J. (2015). Supply-chain trade: A portrait of global patterns and several testable hypotheses. *The World Economy, 38*(11), 1682-1721.

Baldwin, R., & Venables, A. (2013). Spiders and Snakes: Offshoring and Agglomeration. *Journal of International Economics, 90*(1), 27-38.

Baltagi, B. H. (2021). *Econometric analysis of panel data* (6th ed.). Springer.

Banga, R. (2022). Digitalisation and Global Value Chain Participation: Firm-Level Evidence from India. *Economic Research Institute for ASEAN and East Asia Working Paper, No. 2022-76*.

Barrientos, S., Gereffi, G., & Rossi, A. (2009). The impact of the global financial crisis on private voluntary standards in the agro-food chains of developing countries. *IDS Working Paper, No. 335*.

Blalock, G., & Garet, M. S. (2008). Spillovers from foreign direct investment in manufacturing to domestic suppliers in Kenya. *World Development, 36*(6), 1127-1142.

Borin, A., & Mancini, M. (2019). Measuring What Matters in Global Value Chains. *OECD-WTO TiVA Working Paper, No. 5*.

Casella, B., Bolwijn, R., Moran, D., & Kanemoto, K. (2019). Improving the analysis of global value chains: The UNCTAD-Eora database. *Transnational Corporations, 26*(3), 115-142.

Chen, M. X., Eslava, M., & Xu, B. (2020). Firm-level impacts of global value chain participation: Evidence from Colombia. *Journal of International Economics, 127*, 103366.

Chen, T., & Guestrin, C. (2016). XGBoost: A scalable tree boosting system. In *Proceedings of the 22nd acm sigkdd international conference on knowledge discovery and data mining* (pp. 785-794).

Clements, M. P., & Hendry, D. F. (1999). *Forecasting non-stationary economic time series*.

MIT press.

Collier, P., Elliott, V. L., Hegre, H., Hoeffler, A., Reynal-Querol, M., & Sambanis, N. (2003). *Breaking the conflict trap: Civil war and development policy*. World Bank Publications.

Diebold, F. X. (2015). Comparing predictive accuracy, twenty years later: A personal perspective on the use and abuse of Diebold-Mariano tests. *Journal of Business & Economic Statistics, 33*(1), 1-9.

Diebold, F. X., & Mariano, R. S. (1995). Comparing predictive accuracy. *Journal of Business &; economic statistics, 13*(3), 253-263.

Dinh, H. T., Gourdon, J., & Suedekum, J. (2022). Digital infrastructure and global value chains. *Journal of International Economics, 134*, 103529.

Dollar, D., & Kidder, M. (2017). Institutional Quality and GVC Participation. In *Global Value Chain Development Report 2017* (pp. 161-174). World Bank.

Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of economics and statistics, 80*(4), 549-560.

Efron, B., & Tibshirani, R. J. (1993). *An introduction to the bootstrap*. Chapman & Hall/CRC.

Elbadawi, I., & Zaki, C. (2021). Global value chains and service liberalization: Do they matter for skill-upgrading? *Applied Economics, 53*(12), 1342–1360.

Feki, S., et al. (2022). GVC Participation, Institutional Quality and Current Account Balances in MENA. *ERF Working Paper, No. 1556*.

Fouad, Y., & Selim, R. (2023). Institutional thresholds for global value chain participation in Arab countries. *World Development, 161*, 106127.

Foudil, R. (2024). Skill Development to Maximize the Benefits of Integration into Global Value Chains. *The Academic Network for Development Dialogue*. https://doi.org/10.29117/andd.2022.014

Gereffi, G., & Fernandez-Stark, K. (2016). *Global Value Chain Analysis: A Primer*. Duke University.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains.

*Review of International Political Economy, 12*(1), 78-104.

Ghazal, R., & Tchantchane, A. (2022). Regional integration and global value chains in the Arab world. *Middle East Journal of Culture and Communication, 15*(2), 145-167.

Giacomini, R. (2015). Economic forecasting. In *International Encyclopedia of the Social & Behavioral Sciences* (2nd ed., Vol. 7, pp. 68-74). Elsevier.

Guedidi, Y., Haddad, M., & Limam, Y. (2024). Exchange rate policies and value addition in global value chains. *Economic Modelling, 132*, 106452.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics, 93*(2), 345-368.

Hertog, S. (2020). Political Economy of Global Value Chains in the Arab World. *London School of Economics Middle East Centre Paper No. 56*.

Humphrey, J., & Schmitz, H. (2002). How Does Insertion in GVCs Affect Upgrading in Industrial Clusters? *Regional Studies, 36*(9), 1017-1025.

Hymans, S. H. (2025). Forecasting and econometric models. In *The New Palgrave Dictionary of Economics*. Palgrave Macmillan.

Jiménez, A., et al. (2021). The Role of Institutional Quality on Participation in GVCs. *Cuadernos de Economía, 60*, 1-25.

Kano, L., Tsang, E. W., & Yeung, H. W. (2020). Entrepreneurial state, global value chains, and economic upgrading: Special economic zones in China. *Journal of International Business Studies, 51*(7), 1051-1075.

Kaufmann, D., & Kraay, A. (2024). *The worldwide governance indicators: Methodology and 2024 update* (World Bank Policy Research Working Paper No. 10952). World Bank.

Khan, M. S. (2009). The GCC monetary union: Choice of exchange rate regime. *Peterson Institute for International Economics Working Paper 09-1*.

Kissami, R. (2022). Can Foreign Direct Investment Increase Global Values Chains? Evidence from Middle East and North African Countries. *North-South Journal of Economics, 12*(4), 789-807.

Koopman, R., Wang, Z., & Wei, S. J. (2014). Tracing value-added and double counting in gross exports. *American Economic Review, 104*(2), 459-494.

Morocco Ministry of Industry. (2023). *Automotive Ecosystems Performance Report*.

Nayyar, D. (2022). Global value chains and development: Redefining the contours of 21st century capitalism. *World Development, 150*, 105734.

Rodrik, D. (2008). The real exchange rate and economic growth. *Brookings Papers on Economic Activity, 2008*(2), 365-412.

Rodrik, D. (2016). Premature De-industrialisation. *Journal of Economic Growth, 21*(1), 1-33.

Rodrik, D. (2018). What do trade agreements really do? *Journal of Economic Perspectives, 32*(2), 73-90.

Stempień, J., & Ślepaczuk, R. (2025). Hybrid models in financial forecasting. *Journal of Forecasting*.

Svirydzenka, K. (2016). *Introducing a new broad-based index of financial development* (IMF Working Paper No. 16/5). International Monetary Fund.

UNCTAD. (2020). *World Investment Report 2020: International production beyond the pandemic*. United Nations Publications.

World Bank. (2020). *World Development Report 2020: Trading for Development in the Age of Global Value Chains*. World Bank.

World Bank. (2021). *Arab World Economic Outlook 2021*. World Bank.

Zaki, C. (2021). The impact of GVCs on labor markets in Morocco. In *Global Value Chains and Development*. Cambridge University Press.