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Global Value Chains: Integration, Upgrading, and Inclusive Outcomes

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To my Mom,

whose unwavering support made this journey possible.

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Résumé

Cette thèse, structurée en trois chapitres, examine comment la politique de taux de change influence la participation des pays aux chaînes de valeur mondiales (CVM) ainsi que leur capacité à progresser au sein des réseaux internationaux de production. Elle analyse également dans quelle mesure l'intégration dans les CVM se traduit par des retombées de développement plus larges, notamment en matière de transformation structurelle et d'autonomisation économique des femmes. En mobilisant des analyses aux niveaux macroéconomique, sectoriel et des entreprises, la thèse apporte de nouveaux éclairages sur les déterminants de la participation aux CVM, les dynamiques de montée en gamme et leurs implications pour un développement plus inclusif.

Le chapitre 1 évalue l'impact de la politique de taux de change sur la participation des pays aux CVM, tant en amont qu'en aval, en mettant l'accent sur deux facteurs modérateurs : la qualité des institutions et le niveau de digitalisation. L'analyse repose sur la base de données EORA, couvrant 143 pays sur la période 1995–2018. Les résultats montrent qu'une sous-évaluation de la monnaie exerce un effet positif sur ces deux formes de participation aux CVM. Conformément à un courant récent de la littérature, la sous-évaluation agit comme un mécanisme compensatoire pour les pays caractérisés par des institutions relativement faibles. Par ailleurs, l'effet positif de la sous-évaluation se renforce à mesure que le niveau de digitalisation de l'économie augmente. Ces résultats demeurent robustes aux tests de robustesse.

Le chapitre 2 examine l'impact de la dépréciation bilatérale du taux de change réel (TCR) sur les liens en amont et en aval dans les CVM, ainsi que ses implications pour la montée en gamme. L'analyse s'appuie sur des données sectorielles issues de tableaux entrées-sorties multirégionaux (MRIO) pour l'Égypte sur la période 1995–2022. L'Égypte constitue un cas d'étude particulièrement pertinent, compte tenu du recours actif au TCR comme instrument de politique économique parallèlement aux efforts visant à renforcer la participation aux CVM et à diversifier les exportations. Les résultats indiquent qu'une dépréciation du TCR favorise l'intégration dans les CVM à travers les deux types de liens, avec des gains plus importants en amont dans les secteurs primaires et en aval dans les secteurs de haute technologie. Toutefois, la dépréciation du TCR, prise isolément, ne génère pas de montée en gamme. Lorsque les effets d'apprentissage associés aux connaissances étrangères incorporées dans les

intrants importés sont pris en compte à l'aide d'un indice de retombées de connaissances construit à cet effet, la dépréciation du TCR devient significativement associée à la montée en gamme. Ces effets sont particulièrement prononcés dans les flux de valeur ajoutée Sud–Nord et demeurent robustes à différentes spécifications. Les implications de politique économique suggèrent que, si la flexibilité du taux de change peut favoriser l'intégration dans les CVM, une montée en gamme durable requiert des réformes structurelles complémentaires visant à élargir l'accès aux intrants intensifs en connaissances et à réorienter les politiques de soutien vers des secteurs à forte productivité et orientés vers l'exportation.

Le chapitre 3 analyse l'impact de l'intégration des entreprises dans les CVM sur la participation des femmes au commerce international selon trois dimensions : la propriété féminine des entreprises, la présence de femmes aux postes de direction et l'emploi féminin. L'analyse repose sur des données au niveau des entreprises issues des enquêtes de la Banque Mondiale (WBES). Les résultats montrent que la définition de base de l'intégration aux CVM accroît la probabilité de propriété féminine, tandis que les deux définitions de CVM renforcent significativement l'emploi féminin. En revanche, la participation aux CVM est associée à une probabilité plus faible que des femmes occupent des postes de direction. Ces résultats demeurent robustes après prise en compte des problèmes d'endogénéité. L'analyse de l'hétérogénéité sectorielle révèle que les services, les secteurs intensifs en travail peu qualifié et les industries à faible intensité technologique constituent les principales sources d'emploi féminin. Par ailleurs, l'intégration dans les CVM favorise la propriété féminine et l'accès des femmes aux postes de direction dans les secteurs manufacturiers et de technologie moyenne à élevée par rapport aux entreprises non intégrées dans les CVM. Les résultats indiquent également que les dispositions relatives au genre dans les accords commerciaux régionaux modèrent l'impact de l'intégration dans les CVM, en particulier en ce qui concerne l'emploi féminin. Enfin, l'analyse des mécanismes suggère que la formation sur le lieu de travail, la modernisation technologique et l'amélioration de l'accès au financement constituent des canaux clés par lesquels la participation aux CVM améliore la participation économique des femmes.

JEL Classification: F12, F14, F16, F23, F31, F40, J16, O24

Mots-clés : politique de taux de change, analyse au niveau des entreprises, chaînes de valeur mondiales, analyse sectorielle, commerce et genre, montée en gamme

Summary

This dissertation examines how exchange rate policy shapes countries' participation in global value chains (GVCs) and their ability to upgrade within international production networks. It further investigates how integration into GVCs translates into broader development outcomes, including structural transformation and women's economic empowerment. By combining evidence at the country, sector, and firm levels, the thesis provides new insights into the determinants, upgrading dynamics, and inclusive development implications of GVC participation.

Chapter 1 assesses the impact of exchange rate policy on countries' backward and forward participation in GVCs, with a particular focus on two moderating factors: institutional quality and digitalization. The analysis relies on the EORA dataset covering 143 countries over the period 1995–2018. The results show that real exchange rate (RER) undervaluation has a positive impact on both forms of GVC participation. Consistent with recent contributions in the literature, undervaluation appears to act as a compensatory mechanism for countries with weak institutions. Moreover, the positive effect of undervaluation becomes more pronounced as the level of digitalization in the economy increases. These findings remain robust to a battery of robustness checks.

Chapter 2 examines the impact of bilateral RER depreciation on forward and backward GVC linkages and its implications for upgrading. The analysis uses sector-level Multi-Region Input-Output (MRIO) data for Egypt over the period 1995–2022. Egypt provides a relevant case, given the active use of the RER as a policy instrument alongside ongoing efforts to expand GVC participation and diversify exports. The results show that RER depreciation increases GVC integration through both linkages, with stronger forward gains observed in primary sectors and stronger backward gains in high-technology sectors. However, RER depreciation alone does not generate upgrading. When learning effects from foreign knowledge embedded in imported inputs are captured through a constructed knowledge-spillover index, RER depreciation is associated with significant upgrading. These effects are stronger in South–North value-added trade flows and remain robust to alternative specifications.

Chapter 3 examines the impact of GVC integration on women's participation in international trade across three dimensions: female ownership, female top management, and female employment. The analysis uses firm-level data from the World Bank Enterprise Surveys (WBES) conducted over the period 2006–2025. The results indicate that the baseline definition of GVC integration increases the likelihood of female ownership, while both the least restrictive and the most restrictive definitions significantly enhance female employment. In contrast, GVC participation is associated with a lower probability of women holding top managerial positions. These results remain robust after addressing potential endogeneity using instrumental variable estimation and propensity score matching. Sectoral heterogeneity analysis reveals that services, unskilled labor-intensive sectors, and low-technology industries constitute the primary sources of female employment. Moreover, GVC integration promotes female ownership and managerial opportunities in manufacturing and medium-high-technology sectors relative to non-GVC firms. The results further show that gender-related provisions in regional trade agreements (RTAs) moderate the impact of GVC integration, particularly with respect to female employment. Finally, mechanism analysis suggests that on-the-job training, technological upgrading, and improved access to finance represent key channels through which GVC participation enhances women's economic outcomes.

JEL Classification: F12, F14, F16, F23, F31, F40, J16, O24

Keywords: exchange rate policy, firm-level, global value chains, sectoral analysis, trade and gender, upgrading

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List of Acronyms

ADB	Asian Development Bank
CERDI	Centre d'Études et de Recherches sur le Développement International
CPI	Consumer Price Index
CNRS	Centre National de la Recherche Scientifique
DOLS	Dynamic Ordinary Least Squares
DVA	Domestic Value Added
DVX	Domestic Value Added embodied in other countries' exports
ERF	Economic Research Forum
FVA	Foreign Value Added
GDP	Gross Domestic Product
GDPPC	Gross Domestic Product per capita
GVC	Global Value Chain
ICRG	International Country Risk Guide
IFS	International Financial Statistics
IMF	International Monetary Fund
IV	Instrumental Variable
MRIO	Multi-Region Input-Output
NER	Nominal Exchange Rate
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PPP	Purchasing Power Parity
PPML	Poisson Pseudo-Maximum Likelihood
PSM	Propensity Score Matching
RER	Real Exchange Rate
RTA	Regional Trade Agreement
SDG	Sustainable Development Goal
TiVA	Trade in Value Added
UNCTAD	United Nations Conference on Trade and Development
WBES	World Bank Enterprise Surveys
WDI	World Development Indicators
WGI	World Governance Indicators
WIOD	World Input-Output Database
XR	Exchange Rate

General Introduction

"Made in the World rather than Made in the UK or Made in France.

Most likely Made in China, you might add!"

Pascal Lamy, Former Director-General of the World Trade Organization (WTO)

Over the past few decades, the geography of production has undergone a profound transformation. Production processes that were once largely confined within national borders have become increasingly fragmented across countries. Therefore, international trade is no longer primarily characterized by the exchange of final goods but rather by a complex and interconnected process of value creation spanning multiple economies. The traditional "Made in" labels that once identified the country of origin of a product now represent a relic of an earlier era. Today, most goods are more accurately described as being "Made in the World", reflecting the intricate international fragmentation of production across borders.

This transformation is closely associated with the rise of global value chains (GVCs). According to recent estimates by the Organization for Economic Co-operation and Development (OECD), nearly 70 percent of global trade now involves intermediate goods and services that cross borders multiple times before reaching final consumers. In this context, production is organized across countries through sequential stages, with each stage contributing a portion of value to the final product. GVCs can be broadly defined as production processes consisting of multiple stages involved in producing a good or service, with each stage adding value and at least two stages are located in different countries (Antràs, 2020). These stages may involve trade in raw materials (such as copper or aluminum), intermediate inputs (such as textile fabrics or semiconductor chips), or specific tasks and services (such as software development or data processing).

The possibility of fragmenting production across borders has created new opportunities for vertical specialization. Instead of developing complete domestic production systems, firms, particularly in developing and emerging economies, can integrate into specific segments of global production networks (Baldwin, 2012;

Cattaneo et al., 2013; Montalbano et al., 2018). In this sense, participation in GVCs allows countries to specialize in specific tasks or stages of production according to their comparative advantages. Moreover, GVC participation has often been viewed as a pathway to industrialization and economic upgrading. Several East and Southeast Asian economies, including China, Vietnam, Thailand, and Malaysia, have successfully adopted GVC-led growth strategies, deepening their participation in electronics, automotive, and machinery value chains. This integration has contributed to rapid productivity gains and sustained export expansion (Lee and Lim, 2001; Baldwin, 2013; Lee et al., 2018).

Despite these opportunities, concerns remain regarding the developmental implications of GVC participation. In particular, there are worries about the potential deterioration in the terms of trade for developing countries, whose exports remain largely dominated by primary commodities (Montalbano and Nenci, 2022). While the initial objective for many countries is to integrate into GVCs, a more complex challenge lies in upgrading toward higher value-added activities and avoiding what is often referred to as the low value-added trap. The literature on GVC upgrading remains relatively less developed than that on GVC participation, and there is still limited consensus on how to effectively capture and measure upgrading along GVCs[1].

A key feature distinguishing GVC trade from traditional trade is the intensity of firm-to-firm relationships that coordinate cross-border production networks. These relationships often involve complex contractual arrangements, specialized inputs, and long-term investment linkages between firms located in different countries (Antràs, 2015). As a result, the emergence of GVCs has generated increasing interest among both researchers and policymakers in understanding not only the determinants of countries' participation in global production networks, but also the broader developmental consequences of such participation.

[1] See Pietrobelli and Rabellotti (2011), Baldwin (2012), Fenandez-Stark et al. (2012), Costinot et al. (2013), Taglioni and Winkler (2016), and Montalbano and Nenci (2022) for a comprehensive overview on how GVC upgrading and positioning is documented in the literature.

Before examining these determinants and outcomes, it is useful to briefly review how GVC participation is typically measured. Participation in GVCs is commonly captured through two complementary indicators: forward linkages and backward linkages. Forward participation refers to the domestic value added embodied in other countries' exports, whereas backward participation measures the foreign value added contained in a country's own exports. These indicators rely on multi-region input–output tables, which allow researchers to trace value-added flows across countries and sectors. The most widely used databases include the World Input–Output Database (WIOD), the OECD Trade in Value Added (TiVA) database, the EORA Global Supply Chain Database, and the Asian Development Bank (ADB) Multi-Region Input–Output Database.

I. Determinants of GVC Participation

Given the structural differences between traditional trade and trade within GVCs, an important question arises: are GVCs driven by the same determinants as traditional trade, or do they respond to additional structural and policy factors?

In the conceptual frameworks traditionally used to analyze traditional trade, such as the Heckscher-Ohlin model, factor endowments play a central role in shaping trade patterns. Countries abundant in skilled labor tend to specialize in the production and export of skill-intensive goods, while importing goods that rely more heavily on low-skilled labor. Similarly, countries endowed with abundant natural resources are expected to specialize in the production and export of primary commodities.

In the context of GVCs, however, factor endowments influence not only the structure of specialization but also the position of countries along the value chain (Antràs, 2015). For instance, countries rich in natural resources are more likely to occupy upstream positions within value chains, characterized by higher levels of forward participation, as their exports often serve as inputs for downstream production processes in other economies.

Beyond factor endowments, trade policy remains a key determinant of GVC integration[2]. Trade costs, including tariffs, non-tariff measures (NTMs), and regulatory barriers, as well as preferential trade agreements such as free trade agreements (FTAs) and customs unions, play an important role in shaping participation in global production networks. In fact, the impact of trade costs may be even more pronounced in GVC trade than in traditional trade, since intermediate goods and semi-finished products often cross borders multiple times before final assembly (Balié et al., 2019; Fernandes et al., 2022). In addition, other structural determinants have received increasing attention in the literature, including institutional quality and governance (Kowalski et al., 2015; Giovannetti and Marvasi, 2018; Le et al., 2022) and connectivity, encompassing infrastructure, logistics, and digital networks (Fernandes et al., 2022; Gniniguè et al., 2023).

Among the policy instruments discussed in the international trade literature, exchange rate policy has received particular attention, especially in the context of developing economies[3]. However, the empirical evidence regarding its impact on trade performance remains inconclusive. A competitive real exchange rate (RER) is often associated with improved export performance, as it lowers the relative price of domestic goods in international markets, thereby stimulating external demand. At the same time, currency depreciation raises the cost of imported inputs, potentially reducing imports. However, this relationship is not universal and depends on country-specific structural characteristics. In particular, the magnitude and direction of the effect may vary according to factors such as the composition of traded products and trade patterns (Caglayan and Demir, 2019), the quality of institutions (e.g. Aghion et al., 2009), as well as other structural and macroeconomic conditions.

In the context of GVCs, where production involves importing intermediate inputs, transforming them, and subsequently re-exporting them, this traditional framework becomes insufficient. Much of the existing literature overlooks the distinction between exports of final goods and trade in intermediate inputs and value added. As a result, the literature examining how exchange rate policy influences GVC integration remains relatively scarce. Most existing studies instead focus on the reverse

[2] Comprehensive evidence on the role of lower tariffs on intermediate inputs is documented both at the macro (Cheng et al., 2015; Kowalski et al., 2015) and firm levels (Bas and Strauss-Kahn, 2015; Pierola et al., 2018).

[3] See Bahmani-Oskooee and Ardalani (2006); Rodrik (2008); Krugman et al. (2012); and Genc and Artar (2014) as just a few examples from this broad strand of the literature.

relationship, analyzing how participation in GVCs affects the exchange rate elasticity of exports (Greenway et al., 2010; Berman et al., 2012; Ahmed et al., 2017; Bang and Park, 2018; Tan et al., 2019; De Soyres et al., 2021).

To the best of our knowledge, Cheng et al. (2016) is the only study that directly examines the impact of the RER on GVC integration. Their findings indicate that RER appreciation reduces both domestic and foreign value added embodied in exports, suggesting a strong complementarity between the two. The magnitude of this effect depends on the share of foreign value added contained in exports. These findings contrast with predictions from traditional trade theory, which would suggest that exchange rate appreciation should increase imports. Instead, they support the view that domestic and foreign value-added components are complementary within GVC production processes. Consequently, a decline in domestic value-added exports may also reduce the demand for imported foreign value added.

Regarding GVC upgrading, the literature examining the role of exchange rate policy remains even more limited. To the best of our knowledge, no existing study directly investigates the relationship between exchange rate policy and upgrading along GVCs. Nevertheless, several studies highlight the role of competitive exchange rates in export diversification and technological upgrading (Álvarez and López, 2009; Cimoli et al., 2013). Historical evidence, particularly from East Asian economies, also illustrates the potential role of exchange rate policy in facilitating export-led growth and structural transformation. A competitive or undervalued RER has frequently been identified as an important factor behind the rapid economic expansion experienced in the region. It has been described as a key driver of the East Asian economic miracle, supporting the transition from agriculture-based economies toward industrialization and service-led growth (Ghura and Grennes, 1993; Collier and Gunning, 1999). For example, China's strategic management of its exchange rate, combined with trade and industrial policy reforms, is widely viewed as a critical component of its transformation from an agrarian economy into a global manufacturing powerhouse (Dutta, 2005). Similar dynamics have been observed in other Asian economies such as South Korea, Japan, and Taiwan (Johnson, 1982; Amsden, 1989; Wade, 1990).

Against this background, the first part of this dissertation investigates the role of exchange rate policy in shaping countries' integration into GVCs, while accounting

for structural country-specific characteristics (Chapter 1). In addition, it examines how RER flexibility influences countries' positioning along the value chain, thereby affecting opportunities for upgrading and structural transformation (Chapter 2).

II. Economic Outcomes of GVCs

As discussed earlier, GVCs have created new opportunities for developing economies to participate in international production networks. By enabling countries to specialize in specific stages of production rather than entire industries, GVCs have opened alternative pathways for economic development. For many developing and emerging economies, participation in these global production networks represents not only a strategy for export expansion but also a potential catalyst for structural transformation, productivity growth, and socio-economic upgrading.

An expanding body of literature therefore examines the economic consequences of GVC participation across multiple dimensions. A first strand of research focuses on economic upgrading and productivity gains. Empirical evidence suggests that integration into GVCs can significantly enhance productivity and technological capabilities. For instance, Del Prete et al. (2017) and Pahl and Timmer (2020) show that deeper participation in GVCs is associated with improvements in economic upgrading and productivity growth across countries. At the labor-market level, jobs linked to GVC activities are typically found to be more productive than jobs outside global production networks (Pahl et al., 2022). At the firm level, integration into GVCs often exposes firms to international competition, new technologies, and advanced managerial practices, which can stimulate skill upgrading (Ehab and Zaki, 2021).

Beyond productivity improvements, participation in GVCs can also foster innovation and technological diffusion. By interacting with foreign buyers, suppliers, and multinational enterprises, firms operating within GVCs gain access to new knowledge, advanced production techniques, and international quality standards. These interactions can generate important learning effects and knowledge spillovers. Empirical evidence confirms that GVC integration is associated with improvements in innovation performance both at the country level (Eissa and Zaki, 2023) and at the firm level (Eissa and Zaki, 2025). Such dynamics highlight the role of GVCs as a channel through which developing economies can acquire technological capabilities and progressively move toward higher value-added activities.

In addition to productivity and innovation effects, participation in GVCs also has important implications for labor market outcomes. In particular, GVCs have increasingly been recognized as powerful engines of employment generation and income growth (Carneiro et al., 2024; Lu et al., 2024). By facilitating firms' access to international markets and expanding cross-border production networks, GVC participation can stimulate job creation and contribute to broader development outcomes. Recent evidence further suggests that integration into global production networks may help reduce inequality through the expansion of employment opportunities and income gains (Coveri et al., 2024).

Despite these potential benefits, the gender implications of GVC participation remain complex and are often characterized as a double-edged sword. On the one hand, integration into GVCs can facilitate job creation and expand employment opportunities for women, particularly in labor-intensive and low-skilled sectors where female labor is relatively abundant (Farole, 2016). In many developing economies, export-oriented industries such as textiles, apparel, and electronics assembly have historically provided important entry points for women into formal employment. On the other hand, GVC integration may also deepen gender disparities in wages, job security, and working conditions. Women may remain concentrated in lower-paid and less secure tasks, often characterized by limited upward mobility and weaker bargaining power (Koenig and Poncet, 2022; Calvo-Calvo et al., 2025). Consequently, the gender outcomes associated with GVC participation are not uniform and depend critically on sectoral structures, institutional contexts, and firm characteristics.

Several theoretical frameworks provide insights into the mechanisms through which trade and global production integration may influence female labor market outcomes. A first explanation emerges from the neoclassical theory of discrimination, rooted in Becker's (1957) seminal contribution. According to this framework, increased market competition reduces firms' incentives to engage in discriminatory practices. Barth and Dale-Olsen (2009) and Webber (2016) argue that discrimination against female workers may stem from biased perceptions or perceived mobility constraints linked to legal, cultural, or structural barriers. However, discriminatory practices generate efficiency losses for firms operating in competitive markets. Firms that discriminate against women may therefore face higher production costs and reduced competitiveness, which may ultimately threaten their survival (Elson, 1999; Doris and

Rudolf, 2007; Heyman et al., 2013). As trade participation intensifies competition, discrimination becomes increasingly costly, encouraging firms to adopt more gender-neutral hiring practices (World Bank, 2011; Juhn et al., 2014).

A second mechanism relates to the comparative advantage channel in the trade–gender nexus. Galor and Weil (1993) and Juhn et al. (2014) argue that women tend to possess a comparative advantage in cognitive-intensive tasks relative to physically demanding activities. As trade liberalization lowers barriers to foreign market entry, firms are incentivized to adopt more advanced technologies and production processes. Such technological changes may reduce the demand for routine physical tasks while increasing the demand for cognitive-intensive tasks, thereby potentially expanding employment opportunities for women. Nevertheless, the impact of technological change depends on its nature. Capital- and skill-intensive production processes aimed at improving product quality may require higher levels of human capital, which could negatively affect female employment if women remain underrepresented in higher-skilled occupations (Pearson, 1995; Berik, 2000).

A third explanation is provided by the Heckscher–Ohlin framework, which offers further insights into the relationship between trade, GVC participation, and female employment. According to this theory, countries specialize in the production and export of goods that intensively use their relatively abundant factors of production. In developing economies characterized by an abundance of semi-skilled and unskilled labor, trade expansion is expected to increase demand for such labor. Because women are often disproportionately represented in lower-skilled occupations, while men are more concentrated in higher-skilled positions, trade and GVC participation may generate relatively stronger employment opportunities for women (Wood, 1991; Çağatay and Özler, 1995; Özler, 2000). Taken together, these theoretical perspectives suggest that trade, and by extension GVC participation, can influence female labor force participation through multiple channels, including competitive pressures, changes in discriminatory behavior, and technological upgrading.

Empirical evidence on the relationship between trade participation and female labor market outcomes remains mixed. Several studies find that trade participation can generate positive labor market outcomes for women, including increases in female employment and reductions in the gender wage gap (Amin and Islam, 2023; Boler et al., 2015; Juhn et al., 2014; Black and Brainerd, 2004). These benefits tend to be more

pronounced in sectors that rely heavily on female labor and in institutional contexts that are supportive of women's participation in the workforce.

However, other studies highlight potential adverse or limited effects. Trade-induced competition may increase wage discrimination or fail to improve women's relative labor market outcomes (Berik et al., 2004; Gaddis and Pieters, 2017). Moreover, the impact of trade reforms often varies across sectors and institutional environments, with some evidence showing wage premiums favoring male and white-collar workers in certain industries (Giovannetti et al., 2021). In addition, complementary policies and external factors, such as labor standards, anti-sweatshop activism, and minimum wage regulations, may shape the employment effects associated with trade liberalization (Harrison and Scorse, 2010; Del Carpio et al., 2015).

When focusing specifically on GVCs, the empirical evidence remains similarly nuanced. Using the OECD Trade in Value Added (TiVA) database, Deb (2021) finds that neither backward nor forward GVC linkages improve relative female wages in India. In contrast, Jenkins (2005) reports that women's wages and working conditions may be relatively better in GVC-related employment. Additional evidence suggests that GVC participation can increase female employment, particularly in developing economies (Shepherd and Stone, 2013; Bamber and Staritz, 2016; Pham and Jinjarak, 2023; Gopalan et al., 2024).

Building on this literature, the second part of this dissertation focuses on the gender dimension of GVC participation by examining the impact of firms' integration into GVCs on women's economic outcomes. In particular, it analyzes how GVC participation influences female ownership of firms, women's access to managerial positions, and female employment, distinguishing between production and non-production workers.

III. Chapters Overview and Contribution

This dissertation is composed of three chapters that examine external competitiveness and the role of exchange rate policy in shaping participation in GVCs and their development outcomes. Chapter 1 focuses on the country-level determinants of GVC integration and examines how exchange rate policy influences countries' external competitiveness and their insertion into international production networks. Chapter 2 extends the analysis by investigating how exchange rate policy interacts with structural transformation and sectoral positioning, thereby contributing to upgrading along the value chain and helping countries move toward higher value-added activities. Chapter 3 shifts to the firm-level and analyzes the impact of firms' integration into GVCs on women's economic empowerment and female labor force participation, highlighting the inclusive development dimension of global production integration.

All three chapters share a common focus on GVC-related themes and contribute to the literature on both the determinants and the outcomes of GVC participation. In particular, this dissertation advances our understanding of how exchange rate policy and structural factors jointly shape countries' ability not only to integrate into GVCs but also to upgrade and avoid remaining trapped in low value-added segments, notably through knowledge spillovers and learning dynamics. Finally, it highlights the inclusive role of GVCs by examining gender-related outcomes, thereby linking international production integration to women's economic empowerment and broader development objectives. The contribution of each chapter, together with a detailed overview, is presented in the following paragraphs.

Chapter 1

The first chapter examines whether the evidence from the received literature on the growth and export-promoting role of RER undervaluation also extends to the case of GVCs. We assess the impact of this policy on countries' backward and forward participation in value chains, with a special focus on two moderating factors, namely the quality of institutions and digitalization. Therefore, we use the UNCTAD-EORA dataset for 143 countries over the period 1995–2018 and we follow a cointegration strategy.

We find that RER undervaluation positively affects forward and backward GVC participation. While the observed positive impact on backward linkages may initially seem counterintuitive relative to prior literature, it aligns with the underlying notion that domestic and foreign value added within GVCs are complementary in the production process. Accordingly, an increase of domestic value added for export purposes raises the derived demand for imported intermediate inputs, thereby reinforcing the role of undervaluation in promoting backward GVC integration. Accounting for the quality of institutions and the degree of digitalization, we find that undervaluation can act as a catalyst for GVC participation in countries with inefficient institutions. This result highlights the dual nature of undervaluation, beneficial where absorptive capacity is constrained, but less so where institutions already support competitiveness through non-price channels. Moreover, the effect is also amplified in economies with higher levels of digital adoption. To address potential endogeneity concerns, we employ an instrumental variable (IV) approach and include the lagged value of RER. Both strategies confirm and reinforce the baseline results on the impact of undervaluation. We extend our empirical analysis in three ways. First, given that some countries might explicitly have a dominant currency, we examine how the absence of a separate legal tender shapes GVC integration and moderates the effect of RER undervaluation. We find that lacking a separate legal tender reduces risks and uncertainty associated with the operating cycle. Moreover, the interaction with RER undervaluation shows that in these countries, RER undervaluation is associated with even higher forward GVC participation compared with other countries. Second, we consider a country's position within the value chain, distinguishing upstream from downstream roles. RER undervaluation consistently exerts a positive impact on forward GVC participation, regardless of position. For backward linkages, the effect remains positive and highly significant for downstream countries, while becoming negative for upstream participants. This finding may be attributed to the cushioning effect that downstream countries enjoy over upstream ones due to the relative price flexibility advantage that downstream countries possess. Third, we explore heterogeneity by estimating regressions across income groups, sub-periods, and regions. Together, these strategies provide deeper insights into the role of undervaluation in shaping GVC participation and reinforce the credibility of our findings.

This chapter contributes to the existing literature in three key ways. First, while most prior studies examine the impact of RER undervaluation on traditional trade, this study delves into the impact on both forward and backward GVC participation.

Second, we investigate how this impact is contingent upon structural factors, namely the institutional quality and the degree of digital adoption. Third, we assess the heterogeneity of this impact based on a country's position within the value chain, distinguishing between upstream and downstream countries.

Chapter 2

The second chapter uses sector-level Multi-Region Input-Output (MRIO) data for Egypt over 1995–2022 and runs PPML regressions to examine the impact of bilateral RER depreciation on forward and backward GVC linkages and its implications for upgrading. Egypt provides a particularly compelling case for examining the role of exchange rate policy in promoting GVC integration and shaping sectoral positioning along the value chain. Over the past decades, the exchange rate has been actively used as a policy instrument, with the country experiencing several waves of currency devaluation aimed at boosting competitiveness. However, unlike many Asian economies that successfully leveraged exchange rate policies to integrate into GVCs and upgrade along them, Egypt's outcomes have been more limited.

The main findings reveal that RER depreciation increases GVC integration through both forward and backward linkages, which act as complements in the production process. Disaggregating sectors by technological intensity, gains through forward linkages are strongest in primary sectors, whereas backward linkage responsiveness is more pronounced in high-tech sectors. However, RER depreciation alone does not lead to GVC upgrading. Once learning effects arising from foreign knowledge embedded in imported inputs are accounted for, the impact of RER depreciation on upgrading becomes positive and statistically significant, particularly in high-technology sectors. Heterogeneity analysis further reveals that South-North value-added trade flows are more responsive to RER depreciation than South-South flows, and that the effects are more pronounced during the subperiods 2004–2010 and 2011–2016. All results are robust to a wide range of alternative specifications. These findings carry clear policy implications: while exchange rate flexibility can facilitate deeper GVC integration, sustained upgrading requires complementary structural policies that expand access to knowledge-intensive imports, strengthen innovation and skills, and reorient policy support toward high-productivity and export-oriented sectors.

This chapter makes three main contributions to the existing literature. First, to our knowledge, it provides the first sector-level analysis of the impact of RER depreciation

on Egypt's integration into GVCs. Second, it explores the potential for sectoral upgrading and the prospects for moving up the value chain. Third, it constructs a knowledge spillover index to assess how foreign knowledge embedded in imported inputs contributes to upgrading.

Chapter 3

This chapter examines the impact of GVC integration on women's economic participation, across three dimensions: female ownership, female top management, and female employment. We use firm-level data for 253,000 firms across 152 countries (73 percent of which are developing and emerging economies) over the period 2006–2025.

The main findings show that the baseline definition of GVC integration increases the likelihood of female ownership, while both the least restrictive and the most restrictive definitions enhance female employment. A negative effect is observed for female top management positions. These results remain robust after addressing potential endogeneity using instrumental variable estimation and propensity score matching. Sectoral heterogeneity analysis shows that services, unskilled labor-intensive sectors, and low-technology industries are the primary employers of women. Moreover, GVC integration fosters ownership and managerial opportunities in manufacturing and medium-high-technology sectors relative to non-GVC firms. GVCs can therefore be perceived as a catalyst for promoting female labor force participation and female entrepreneurship in emerging economies. Furthermore, gender provisions in RTAs moderate the impact of GVC integration, particularly with respect to female employment. Mechanism analysis suggests that training, technological upgrading, and improved access to finance constitute key transmission channels linking GVC participation to women's economic outcomes.

This paper contributes to existing literature in three principal ways. First, while existing studies predominantly focus on female employment shares or wage gaps, this paper extends the analysis to women's entrepreneurship and leadership by examining female ownership and female top management alongside employment outcomes. To our knowledge, no prior cross-country firm-level study has simultaneously analyzed these three dimensions of women's economic participation in the context of GVC integration. Second, the analysis explores heterogeneity along both internal and external dimensions: internal firm characteristics (sector of operation, skill intensity, and technological intensity) and external institutional frameworks, namely gender-

related provisions in regional trade agreements (RTAs). Third, the chapter investigates the mechanisms through which GVC integration may affect female entrepreneurship and labor force participation, focusing on on-the-job training, innovation through R&D expenditure and foreign technology licensing, and access to finance.

IV. Policy Implications and Lessons

Beyond its academic contributions, this dissertation also provides several policy implications derived from the empirical findings of the three chapters.

From a policy perspective, the first chapter highlights that RER undervaluation can act as a second-best solution to mitigate the economic cost associated with weak institutions and market failures that penalize the tradable sector. In particular, it can support the process of productive transformation in developing countries by facilitating greater participation in GVCs. However, the effectiveness of this strategy is not uniform across countries and depends on structural conditions such as income level, institutional quality, and the degree of digital adoption. To sustain the positive effects of RER undervaluation, exchange rate policy should therefore be complemented by broader structural reforms. Ultimately, while undervaluation may be feasible as a short-term strategy, it is neither sustainable nor a comprehensive policy solution. Long-term competitiveness and deeper integration into GVCs require coordinated reforms aimed at strengthening institutions, improving financial systems, and accelerating digital transformation. Policymakers should thus consider exchange rate policy as part of a broader development strategy tailored to a country's structural characteristics and stage of development.

Focusing on the Egyptian case, the second chapter highlights the critical role of exchange rate flexibility in promoting Egypt's integration into GVCs. Exchange rate flexibility can serve as an important policy lever to enhance competitiveness and facilitate deeper participation in international production networks. At the same time, the results show that sectoral responses to exchange rate movements are heterogeneous, implying that sector-specific strategies are necessary to maximize the benefits of exchange rate policy. Nevertheless, exchange rate flexibility alone is not sufficient to achieve upgrading and escape the low value-added trap. A more comprehensive policy approach is required, combining exchange rate flexibility with

structural reforms aimed at strengthening Egypt's productive capacity. Such an approach should include trade and tariff reforms to rationalize tariffs and non-tariff measures, particularly those that raise the cost of knowledge-intensive imported inputs; labor market policies to enhance skills and productivity; investment and innovation policies aimed at attracting FDI and encouraging technological upgrading; and tax and incentive reforms that redirect fiscal support toward export-oriented and high-productivity sectors. At the same time, policymakers must strike an appropriate balance between increased reliance on foreign value added, an important source of embodied knowledge, learning, and technological diffusion, and sustained investment in domestic R&D and technological capabilities. This highlights the importance of careful resource allocation: while foreign inputs can accelerate integration and learning, long-term competitiveness ultimately depends on strengthening domestic innovation capacity. Taken together, this comprehensive policy mix would enable Egypt not only to increase its participation in GVCs but also to upgrade its position toward more innovation-driven and sustainable forms of integration.

Finally, the third chapter provides policy insights at the firm-level. Four main policy directions emerge from the analysis. First, sectoral heterogeneity matters. The impact of GVC integration varies across sectors depending on their technological intensity, skill requirements, and production structures. Consequently, trade and industrial policies should avoid adopting a one-size-fits-all approach. Instead, policymakers should design sector-specific strategies that align industrial upgrading with gender inclusion objectives. In labor-intensive sectors, policies may focus on consolidating and formalizing women's employment gains, while in medium- and high-technology sectors targeted interventions may be necessary to address structural barriers that limit women's access to managerial and ownership positions. Integrating gender impact assessments into trade and industrial policy design can help prevent unintended distributional effects that disproportionately disadvantage women workers.

Second, investment in skills and capacity building is essential. The empirical evidence highlights the importance of on-the-job training and technological upgrading as mechanisms linking GVC participation to women's economic outcomes. Expanding access to technical training, managerial education, digital skills development, and leadership programs can strengthen women's ability to move beyond production roles and access higher value-added positions, including management and

entrepreneurship. Skill development policies should therefore be closely aligned with sectoral upgrading strategies to ensure that women are not confined to low-wage segments of GVCs.

Third, improving women's access to finance represents another key policy priority. Since access to financial services operates as a key transmission channel linking GVC integration to female ownership, policy makers should seek to reduce the financial constraints faced by women entrepreneurs. Potential measures include expanding credit guarantee schemes, promoting gender-sensitive lending practices, supporting financial products tailored to women-led businesses, and removing legal or institutional barriers that limit women's borrowing capacity. Strengthening financial inclusion can facilitate women's entry into entrepreneurship and enable them to scale their activities within internationally integrated sectors.

Fourth, broader institutional and cultural transformation remains fundamental. Persistent stereotypes, discriminatory norms, and gender biases continue to limit women's participation in leadership and decision-making roles. Policies aimed at promoting gender equality should therefore extend beyond purely economic instruments to include awareness campaigns, corporate governance reforms, diversity incentives, and stronger enforcement of anti-discrimination frameworks. Embedding gender equality objectives within trade agreements and industrial strategies can further reinforce these efforts by aligning economic integration with social inclusion goals.

Taken together, these policy implications suggest that GVC integration can serve as an important lever for women's economic empowerment, provided that complementary policies are implemented to address existing structural constraints. Trade integration alone is insufficient; its potential to generate inclusive outcomes ultimately depends on supportive institutional frameworks, improved financial access, and sustained investment in human capital.

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Chapter 1

Unravelling the Nexus Between Exchange Rate Undervaluation and Global Value Chain Participation

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1.1 Introduction

A burgeoning body of literature highlights the pivotal role of participation in global value chains (GVCs) in fostering both sustained economic growth and structural transformation of GDP. This is largely attributed to the opportunities GVCs offer for vertical specialization, allowing countries to integrate into specific niches along the chain without the need to produce the whole product (De Melo and Solleder, 2022a). Building on this literature, this study investigates the particular role the real exchange rate (RER) undervaluation plays among a set of other GVCs determinants, including institutions and digitalization[1].

The debate regarding the role of RER in macroeconomic policy and long-term growth occupies a central position in economic research. As an economy-wide relative price, it signals for inter-sectoral resource transfers and factor movements in the economy, and it largely determines the relative profitability of investment in both traded and non-traded sectors. Thus, RER significantly affects capital accumulation and effectively regulates the evolution of foreign trade. In this context, the received literature finds a robust association between RER undervaluation and exports. Indeed, it has been argued that RER undervaluation essentially acts like an economy-wide industrial policy, supporting the competitiveness of a country's exports. Rodrik (2008) has put forward an additional argument. The empirical findings on the prominence of the RER would be, in fact, a reflection of a deeper causal effect. According to him, to the extent that tradable economic activities are more "complex" and, therefore, entail more transaction-intensive activities, they tend to be more affected by the cost associated with weak institutions. Hence, the economy-wide subsidy provided by the RER undervaluation should at least partially reduce this cost. The evidence on the robust association between mild undervaluation and fast export-oriented growth could be explained by the fact that, in general, tradables also tend to be more dynamic than do nontradables. In the same vein, the equally robust evidence on the negative effect of RER overvaluation could be explained as well[2].

Subscribing to the above discussion, this paper examines whether the evidence from the received literature on the growth and export-promoting role of RER undervaluation also extends to the case of GVCs (Ollivaud et al., 2015; Fauceglia et al.,

[1] See (Kowalski et al., 2015; Dasgupta and Mondria, 2018; De Melo and Solleder , 2022a, b; Fernandes et al., 2022; Gniniguè et al., 2023) and other literature cited therein.
[2] See Dornbusch (1984) and Rodrik (1986).

2018). Yet, in a world which has been so far characterized by the increasing role of GVCs since the 1990s and cross-border fragmentation of production, the evidence from the previous strands of the literature may become less intuitive. Indeed, the evidence on the role of RER undervaluation hinges on the assumption that countries export only final goods that do not require imported intermediate inputs. Such a simplifying assumption does not reflect the complex reality of trade relations, especially trade within GVCs, where products become multi-country products as intermediate inputs are imported, transformed, and then re-exported. Thus, GVC-related trade is expected to respond differently to exchange rate undervaluation compared to traditional trade in single-country goods.

As it has been shown in the literature, GVC integration can be measured through two key dimensions: the forward linkage, which captures the extent to which a country's domestic value added (DVX) is embodied in the exports of other countries; and the backward linkage, which reflects the reliance of a country's exports on imported inputs in foreign value added (FVA). While it seems intuitive that findings from traditional trade literature should extend to forward GVC participation, the relationship is a priori less clear in the case of backward linkages. Moreover, an extensive body of literature[3] highlights the significance of institutional quality and digital adoption in enhancing trade performance and, consequently, fostering participation in GVCs. However, there is a dearth of research examining the role of RER undervaluation in shaping GVC participation, particularly when accounting for these determinants.

To address this question, we build a panel dataset of 143 countries over 1995–2018 drawn from the UNCTAD-EORA database. This dataset provides key GVC indicators, specifically foreign value added (FVA) and domestic value added embodied in other countries' exports (DVX), derived from the EORA Multi-Region Input-Output (MRIOs) tables. Hence, this study makes a threefold contribution to the literature. First, it assesses the impact of RER undervaluation on both forward and backward GVC participation. Second, it investigates how this effect is mediated by structural factors, particularly institutional quality, and digital adoption. Third, it examines how the aforementioned impact varies with a country's position in the value chain, distinguishing between upstream countries, which are primarily involved in early-stage production activities, and downstream countries, which are more engaged in

[3] See (Freund and Weinhold, 2002; Rodrik, 2008; Aghion et al., 2009; Elbadawi et al., 2012; Sekkat, 2016; Fernandes et al., 2019; Cusolito et al., 2020; Elbadawi and Zaki, 2021; De Melo and Solleder, 2022a, b).

final assembly or distribution closer to the end consumer. This distinction is crucial, as a country's position in the value chain serves as a proxy for the relative strength of its forward and backward linkages.

Consistent with conventional trade theory, our findings indicate that RER undervaluation positively affects forward and backward GVC participation. While the observed positive impact on backward linkages may initially seem counterintuitive relative to prior literature, it aligns with the underlying notion that domestic and foreign value-added within GVCs are complementary in the production process. Accordingly, an increase of domestic value added for export purposes raises the derived demand for imported intermediate inputs, thereby reinforcing the role of undervaluation in promoting backward GVC integration. Accounting for the quality of institutions and the degree of digitalization, we find that undervaluation can act as a catalyst for GVC participation in countries with inefficient institutions. Moreover, the effect is also amplified in economies with higher levels of digital adoption. To address potential endogeneity concerns, we employ an instrumental variable (IV) approach and include the lagged value of RER. Both strategies confirm and reinforce the baseline results on the impact of undervaluation.

We extend our empirical analysis in three ways. First, given that some countries might explicitly have a dominant currency, we examine how the absence of a separate legal tender shapes GVC integration and moderates the effect of RER undervaluation. We find that lacking a separate legal tender reduces risks and uncertainty associated with the operating cycle. Moreover, the interaction with RER undervaluation shows that in these countries, RER undervaluation is associated with even higher forward GVC participation compared with other countries[4]. Second, we consider a country's position within the value chain, distinguishing upstream from downstream roles. RER undervaluation consistently exerts a positive impact on forward GVC participation, regardless of position. For backward linkages, the effect remains positive and highly significant for downstream countries, while becoming negative for upstream participants. This finding may be attributed to the cushioning effect that downstream countries enjoy over upstream ones due to the relative price flexibility advantage that downstream countries possess. Third, we explore heterogeneity by estimating regressions across income groups, sub-periods, and regions. Together, these strategies provide deeper insights into the role of undervaluation in shaping GVC participation and reinforce the credibility of our findings.

[4] Similar results are obtained for countries having a fixed exchange rate regime.

The remainder of the paper is structured as follows. Section 1.2 reviews the literature, highlighting the salient theoretical framework as well as the main empirical predictions underpinning the relationship between exchange rate undervaluation and GVC participation. Section 1.3 presents the data we use. Section 1.4 details the econometric specification and discusses the associated empirical findings. Section 1.5 undertakes robustness checks. Section 1.6 performs some extensions and heterogeneity analysis. Section 1.7 concludes and discusses some policy implications.

1.2 Literature Review

The literature on exchange rate misalignment and its effects on trade performance is extensive, yet empirically inconclusive. In this paper, we delve into two main strands of the literature. The first examines the impact of exchange rate misalignment on conventional trade performance, while the second explores how participation in GVCs influences the exchange rate elasticity of exports. Additionally, given their prominent role as determinants of GVC integration, we also explore the role of institutional quality and digital adoption as moderating factors.

First, by way of motivating potential relevance to GVCs, we selectively review the evidence from the literature on the role of RER misalignment on traditional trade. In this literature, exchange rate misalignment has historically been perceived as a policy tool for industrialization and welfare enhancement (Rodrik, 1986). Early studies (Kafka, 1961; Furtado, 1963; Hirschman, 1968) argue that an overvalued exchange rate can simulate industrialization by favorably altering relative prices in the industrial sector. An overvalued exchange rate serves as an indirect tax on the export-oriented agricultural sector and a subsidy for the industrial sector, thereby making imported inputs cheaper[5]. However, this argument fails to hold up in real-world scenarios for two reasons. First, it assumes that the manufacturing sector is isolated from global markets, which is the case only when domestic production is protected from external competition with the drawbacks observed in the internal resource allocation process. In an open economy, the relative prices between the manufacturing and agricultural sectors are determined by global prices that are independent of the exchange rate. Consequently, an exchange rate policy cannot influence the internal terms of trade among tradables as long as both sectors engage in international trade (unless costly and inefficient multiple exchange rate regimes are adopted). Second, overvaluation

[5] See Rodrik (1986) for more details on the stylized model of a developing country.

cannot be sustained indefinitely since it leads to a deterioration in the balance of payments, necessitating correction at some point. Therefore, the requirement for an intertemporal balance in external payments implies that a period of overvaluation (deficit) must be followed by a period of undervaluation (surplus). Hence, a policy of maintaining a misaligned exchange rate in a given period is essentially a policy of promoting the opposite type of misalignment in the following one (Dornbusch, 1984).

Recent studies highlight the pivotal role of RER undervaluation as a key driver of export-led economic growth across various economies (Da Piedade and Plane, 2025). This is notably the case for Japan and West Germany during the postwar era, China, several East Asian countries, and Chile over the past three decades (Dooley et al., 2004). Moreover, it has been argued that RER may have to depreciate quite considerably, potentially overshooting its eventual equilibrium value, to make the non-traditional export sector an appealing destination for investment (Williamson, 1997)[6]. This strategy serves a dual purpose: first, to overcome initial constraints in manufacturing and non-traditional export capacity; and second, to give exporters a competitive edge in international markets. With few exceptions[7], the empirical literature lends strong support to this view, suggesting that RER undervaluation fosters export expansion and economic growth, whereas overvaluation tends to erode export competitiveness and dampen overall growth[8].

This evidence coheres with Steinberg (2016) who argues that central banks are likely to influence exchange rate policy in developing countries with a large manufacturing sector. Indeed, a developing country can get benefit of RER undervaluation in two main ways. First, undervaluation helps developing economies to overcome the challenges related to the limited export competitiveness they may face by making their exports relatively cheaper, and thus more competitive (Frieden, 1991). Second, countries that intentionally keep their exchange rates undervalued have a lower probability of encountering financial crises. This is due to the fact that undervaluation leads to current account surpluses, which, in turn, reduces the economy's reliance on foreign capital inflows and mitigates the risk of capital flight (Frankel and Saravelos, 2012).

[6] See Bayoumi et al. (1994); Odedokun (1997); Edwards and Golub (2004); Elbadawi and Helleiner (2004), Frieden et al. (2006); and Freund and Pierola (2012) for similar arguments in the African context.
[7] The very few exceptions include Eaton et al., 2007; Glüzmann et al., 2012; Rowbotham et al., 2014; Rasbin et al., 2021.
[8] See Mamun et al. (2021); Genc and Artar (2014); Bahmani-Oskooee and Ardalani (2006); Haddad and Pancaro (2010); Krugman et al. (2012), as a very few examples from this vast strand of the literature.

However, it is also important to understand that sustaining RER undervaluation long enough to achieve the desired resource reallocation toward tradable activities could be challenging for countries that heavily rely on imported inputs in FVA to produce final goods. Also, for countries with high foreign debts, RER undervaluation will amplify the burden of debt service in domestic currency (Pepinsky, 2009; Walter, 2013). Moreover, successful undervaluation requires considerable fiscal and monetary discipline, to avoid recourse to inflationary finance of domestic deficit and premature policy reversal.

Against this background, a more balanced and theoretically more appealing strand of the literature is the one that finds only mild undervaluation to be an effective (*de facto*) policy instrument. Indeed, the effect of RER undervaluation is non-monotonic, whereby beyond a certain threshold it might undermine export performance and reduce growth as well as the present wellbeing of the national community (Elbadawi and Zaki, 2021; Chaffai and Plane, 2024).

As discussed in the introduction, while earlier strands of literature provide robust empirical evidence and sound theoretical foundations, their insights do not necessarily carry over to GVCs trade. These studies often fail to distinguish between trade in final goods and trade in value added and intermediate inputs, assuming that countries export final goods that do not rely on imported intermediate inputs. This simplification may lead to overestimation of the impact of RER undervaluation on trade flows. This is because deeper integration into GVCs, reflected in a higher share of FVA in exports, is expected to dampen the impacts of undervaluation on exports performance. An undervaluation raises the cost of imported inputs, potentially offsetting the competitive advantage traditionally associated with undervaluation. Therefore, disaggregating exports into domestic value added embodied in other countries' exports (DVX) and FVA allows for a more precise identification of the effect on domestic value added and its competitiveness. Furthermore, distinguishing trade in intermediate goods from gross trade flows helps mitigate aggregation bias common in empirical studies using total exports and imports, which implicitly assume a uniform exchange rate elasticity across all trade categories.

To the best of our knowledge, no existing studies directly address the impact of RER undervaluation on GVC participation. However, a substantial body of literature explores the impact of GVC integration on the exchange rate elasticity of exports. For instance, Ahmed et al. (2016) use panel data for 46 countries spanning 1996-2012 and

find that countries that are more integrated into GVCs experience a partial improvement in the competitiveness of the value of final good exports following currency depreciation. They also observe that GVC participation reduces on average the RER elasticity of manufacturing exports by 22 percent. Similarly, Bang and Park (2018) use country-level data for three East Asian countries (China, Japan, and South Korea) and conclude that GVC participation diminishes the exchange rate elasticity of exports. They argue that the significance of this impact depends on the intensity of GVC integration, as well as countries' position within the value chain. Moreover, Tan et al. (2019) find that a higher share of FVA embodied in exports completely offsets the negative impact of RER appreciation on real gross exports. Additionally, a higher FVA share dampens the negative relationship between increased RER volatility and exports. Many studies also conclude that the exchange rate pass-through to export prices is weaker when countries are deeply integrated into GVCs and exported goods rely more intensively on foreign imported inputs (Greenaway et al., 2010; Berman et al., 2012; Amiti et al., 2014; Ollivaud et al., 2015; and Fauceglia et al., 2018). De Soyres et al. (2021) employ sectoral-level panel data from the World Input-Output Database (WIOD) tables over the period 1995-2009 and test three main predictions. First, the higher the share of FVA in exports, the lower the response of export volumes to exchange rate fluctuations. Second, the higher the share of exports that returns as imports, the lower the response of exports volumes to exchange rate changes. Third, the higher the share of inputs that is going to be re-exported, the higher the response of exports to the nominal effective exchange rate of its trading partner. The findings provide support for these three predictions.

Considering the direct impact of RER appreciation on GVC participation, Cheng et al. (2016) use the OECD-WTO Trade in Value-Added (TiVA) database and find that a real appreciation not only reduces the exports of domestic value added (DVA), in line with the conventional trade theory, but also decreases the imports of FVA. This finding is consistent with the notion of complementarity between GVC-related FVA and DVA in production. The magnitude relies on the share of FVA in exports. A share of FVA in exports that exceeds 60 percent leads to a shift in the sign of import and export elasticities from negative to positive, suggesting that currency appreciation is associated with increases in both DVA and FVA.

Within the broader literature on the effects of RER undervaluation, a growing number of studies emphasize the importance of contextual factors, particularly institutional quality and the level of digital adoption, in conditioning these effects. With respect to

institutions, the literature shows strong evidence that the positive impact of undervaluation on trade performance and economic growth is more pronounced when a country has weak institutions and suffers from market failures[9]. Two plausible explanations have been proposed for this finding. First, Méon and Sekkat (2008) argue that sophisticated goods are more relationship and contracts intensive than primary ones. Weak institutions in a country impose implicit taxes on relationship and contracts-intensive exports compared to primary product. Therefore, a currency undervaluation would at least partially ameliorate these implicit taxes; thus, promoting manufactured and other sophisticated exports. Second, Rodrik (2008) contends that poor economic institutions, more noticeable for developing countries, create a wedge between private and social returns, particularly in traded economic activities. This wedge leads to a resource misallocation in favor of non-traded sectors and to large dynamic distortions in the traded ones. Since traded sectors are more dynamic, a rise in the relative prices of traded to non-traded goods should lead to an enhancement of static efficiency and growth in a second-best fashion. Hence, by offering an economy-wide subsidy to tradable sectors, undervaluation is expected to partially reduce the negative effect of weak economic institutions. Instead, an alternative view suggests that currency undervaluation would lead to an increase in the cost of imported inputs required to produce sophisticated goods such as machinery. Accordingly, an overvaluation would reduce the cost of imported inputs and thereby stimulates, not impedes, export diversification (Svensson, 2003; and Brach and Naudé, 2012).

As a second structural factor beside institutions, access to telecommunication technology and digital adoption is another potential driver of GVC participation on its own right. Numerous empirical studies provide evidence supporting their positive impact on export performance and GVC participation (Freund and Weinhold, 2002; Clarke, 2008; Kowalski et al., 2015; Fernandes et al., 2019; Cusolito et al., 2020; De Melo and Solleder, 2022a and b), especially for developing countries (Clarke and Wallsten, 2006). Beyond the advantages of accessing knowledge, these technologies facilitate the coordination of complex production processes that are spread across different geographical locations. Furthermore, telecommunications play a vital role in enabling firms to outsource intricate production activities across borders.

[9] See Rodrik (2008), Aghion et al. (2009), Freund and Pierola (2012), Elbadawi and Kaltani (2016), Combes et al. (2019), and Elbadawi and Zaki (2021).

Moreover, while the literature has yet to examine the interaction between RER undervaluation and digital adoption in shaping GVC participation, it is plausible to expect that improved internet access amplifies the positive effects of undervaluation. Unlike robust institutions, which will likely act as a substitute to RER undervaluation as promoter of GVC participation, we argue that access to telecommunication technology and digital connectivity might actually amplify its impact. Higher connectivity and use of internet favor a quicker supply-side response, reduce transaction costs, and minimize information asymmetries. These factors create optimal conditions for production expansion even in settings with weak institutional environments. As such, the competitiveness gains from undervaluation are likely to be more substantial in economies with higher levels of digitalization.

Against this background, resolving these contrasting theoretical debates is an empirical question. In this context, this paper contributes to the existing literature in three key ways. First, while most prior studies examine the impact of RER undervaluation on traditional trade, our paper delves into the impact on both forward and backward GVC participation. Second, we investigate how this impact is contingent upon structural factors, namely the institutional quality and the degree of digital adoption. Third, we assess the heterogeneity of this impact based on a country's position within the value chain, distinguishing between upstream and downstream countries.

1.3 Data and Stylized Facts

In this section, we provide an overview of the construction of the RER undervaluation index. We also describe the GVC indicators obtained from the UNCTAD-EORA dataset, along with the other variables considered in the analysis. Moreover, we present some stylized facts and an initial assessment of the association between RER undervaluation and GVC participation[10].

Following Rodrik (2008), the RER is derived from the principle of purchasing power parity that provides an approximate measure of unit costs across countries. Hence, RER is measured as a domestic price level adjusted for the Balassa-Samuelson effect (see Appendix 1B). The main advantage of this index is its comparability between

[10] A comprehensive overview of the definitions, sources of all the variables and the corresponding summary statistics are presented in Appendix 1A.

countries and over time since it adjusts the relative price of tradables to nontradables to the level of development, as proxied by income per capita.

To allow for the comparability between countries with different income levels, the sample is divided into four income groups following the World Bank classification (see Appendix 1C). Table 1.1 shows that almost 49 percent and 75 percent of low/ lower-middle income and upper middle-income countries, respectively, have an undervalued RER. However, this is the case for only 30 percent of high-income countries. Overall, almost 48 percent of countries have an undervalued RER, corroborating Steinberg (2016)'s arguments discussed earlier.

Table 1.1 Descriptive Statistics of RER Undervaluation (log units) 1995–2018

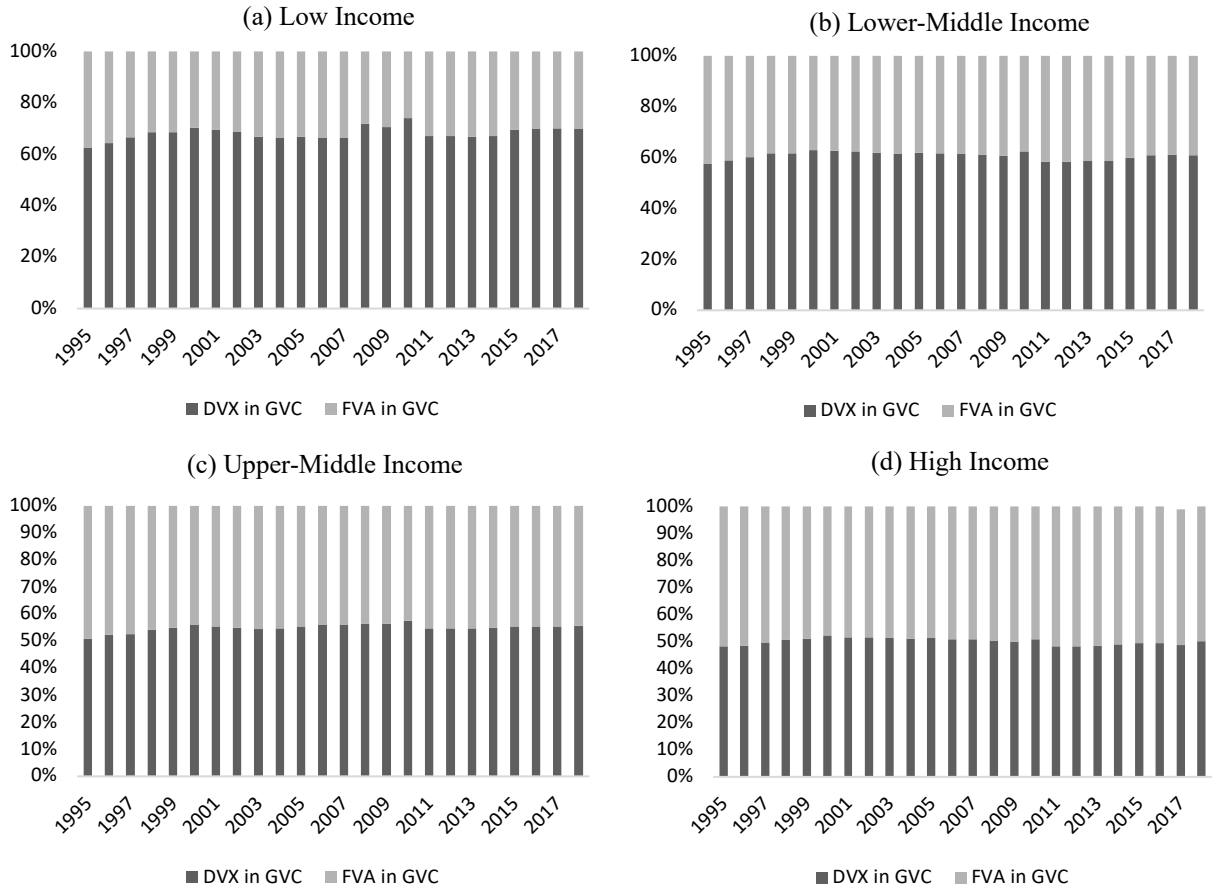
	Obs.	Mean	Std. Dev.	Min	Max	Undervaluation	Overvaluation
Low/Lower-Mid. Income	1458	0.018	0.394	-1.47	1.28	708	750
Upper Middle Income	931	0.169	0.241	-0.44	1.40	694	237
High Income	1346	-0.137	0.397	-1.04	1.25	408	938
All	3735	6.44e-10	0.381	-1.47	1.40	1810	1925

Source: Authors' own calculations.

For GVCs, we use the UNCTAD-EORA Global Supply Chain database on backward and forward linkages (Casella et al., 2019). As already mentioned, this dataset provides the key GVC indicators: foreign value added (FVA) embodied in a country's exports and domestic value added (DVX) embodied in foreign countries' exports generated from the EORA Multi-Region Input-Output tables (MRIOs) for 143 countries over the period 1995–2018. These tables provide inter-industry flows of goods and services across countries. To calculate different GVC indices, Casella et al. (2019) rely on intermediate input, final demand, and value-added matrices and calculate the Leontief inverse. Figure 1.1 illustrates the share of domestic and foreign value-added components in GVC for four income groups. Two remarks are worth mentioning. First, the higher the income level, the lower the domestic value-added content in the final GVC product. Second, low-income countries rely more on their domestic value added to produce a final GVC product. In contrast, high-income countries rely more on foreign intermediate inputs in their production. This goes in line with Bems and Johnson (2017) who argue that large exporting sectors are at the same time large importers. Hence, producing and exporting more domestic value added increases the derived demand for imported intermediate inputs in foreign value added.

Figure 1.2 shows the association between our two variables of interest, namely RER undervaluation and the domestic value added (DVX) of a country embodied in the exports of other countries (Figure 1.2a and 1.2b), and the foreign value added (FVA) embodied in the exports of a specific country (Figure 1.2c and 1.2d). In both cases, GVC participation is positively correlated with undervaluation in developing countries (mainly Africa and Asia), but not for developed ones.

Figure 1.1 The Share of Domestic and Foreign Value-Added in GVC



Source: Authors' own construction.

As previously noted, our analysis focuses on evaluating the marginal contribution of RER undervaluation while explicitly considering the role of institutional quality and digitalization, two structural factors that feature prominently in the GVC literature. In line with the growing body of research linking trade performance to institutional frameworks, we hypothesize that undervaluation may serve as a more effective policy instrument in contexts characterized by institutional weaknesses. Furthermore, in the era of the Fourth Industrial Revolution, where automation and digital technologies are reshaping production and trade networks, digitalization emerges as a critical

determinant of GVC participation. Consequently, we posit that higher levels of digital adoption may amplify the positive impact of undervaluation[11].

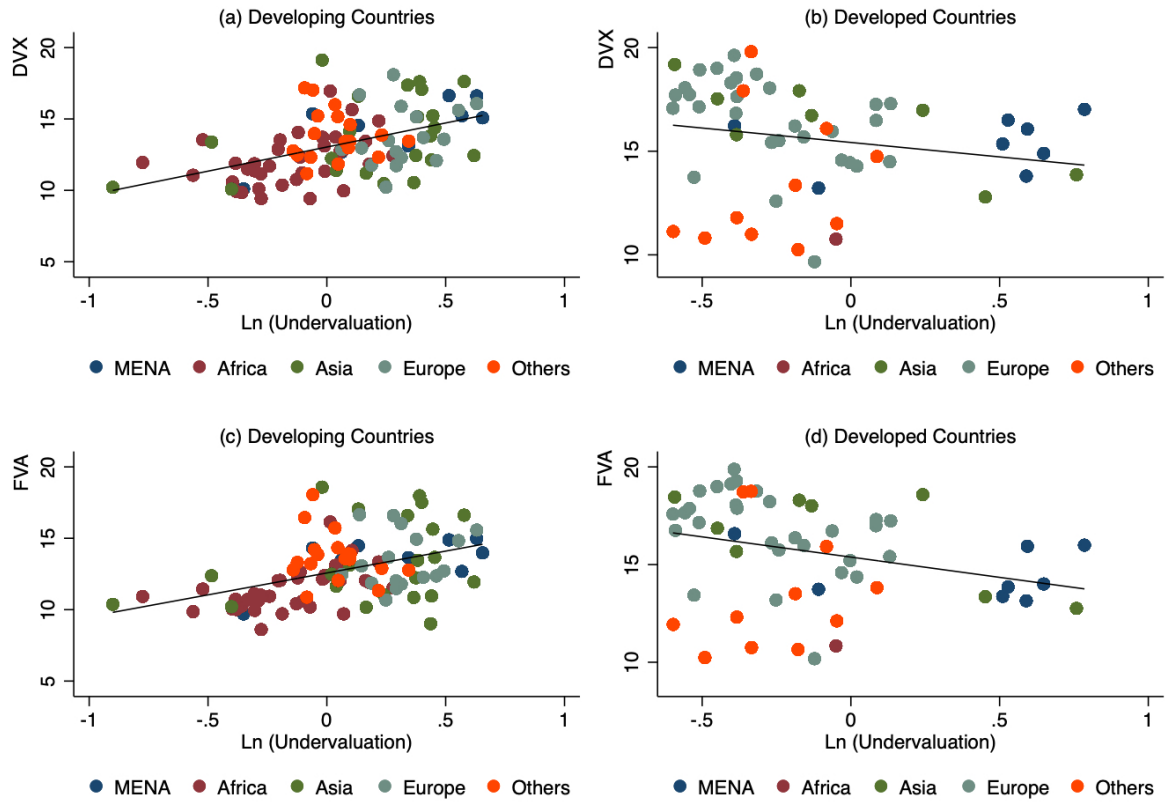
Regarding data sources, we include two variables into our analysis to capture institutional quality. First, we use the government effectiveness index from the World Governance Indicators (WGI), which assesses the quality of public and civil services, and the degree of its independence from political pressures. Second, we include the financial institutions efficiency index from the Financial Development Index database provided by the International Monetary Fund (IMF). This index incorporates various metrics, such as banking sector net interest margin, lending-deposits spread, non-interest income to total income, overhead costs to total assets, return on assets and equity, to reflect the overall efficiency of the financial sector. Figure 1.3 illustrates the correlation between GVC participation, measured through both forward and backward linkages, and the log of RER undervaluation, separately for countries with low and high institutional quality. Consistent with our expectations and in line with previous studies, RER undervaluation is positively associated with GVC participation in countries with weaker institutions, while the relationship turns negative in countries with stronger institutions.

As pointed out earlier, digital adoption, particularly internet usage, is expected to promote GVC participation through different channels. First, it enables firms to communicate effectively with customers, suppliers, distributors, and workers regardless of their geographic location (Clarke, 2008; Hagsten and Kotnik, 2017). Second, it facilitates access to timely and accurate information about economic agents and global market conditions, enabling firms to expand internationally (Mostafa et al., 2005). Third, it reduces the cost linked to finding an expensive intermediary traditionally required to establish trade relations (Fernandes et al., 2019). Lastly, internet access enables swift cross-border interactions among firms, offering a cost-effective channel of engaging in global markets (Kim, 2020). To gauge the degree of digitalization, we employ the share of individuals using the internet in the total population from the WDI. Figure 1A.1 in Appendix 1A confirms the positive association between GVC participation and digital adoption, especially for Asia.

After presenting these associations, we proceed with the empirical setup to investigate the impact of RER undervaluation on GVC participation.

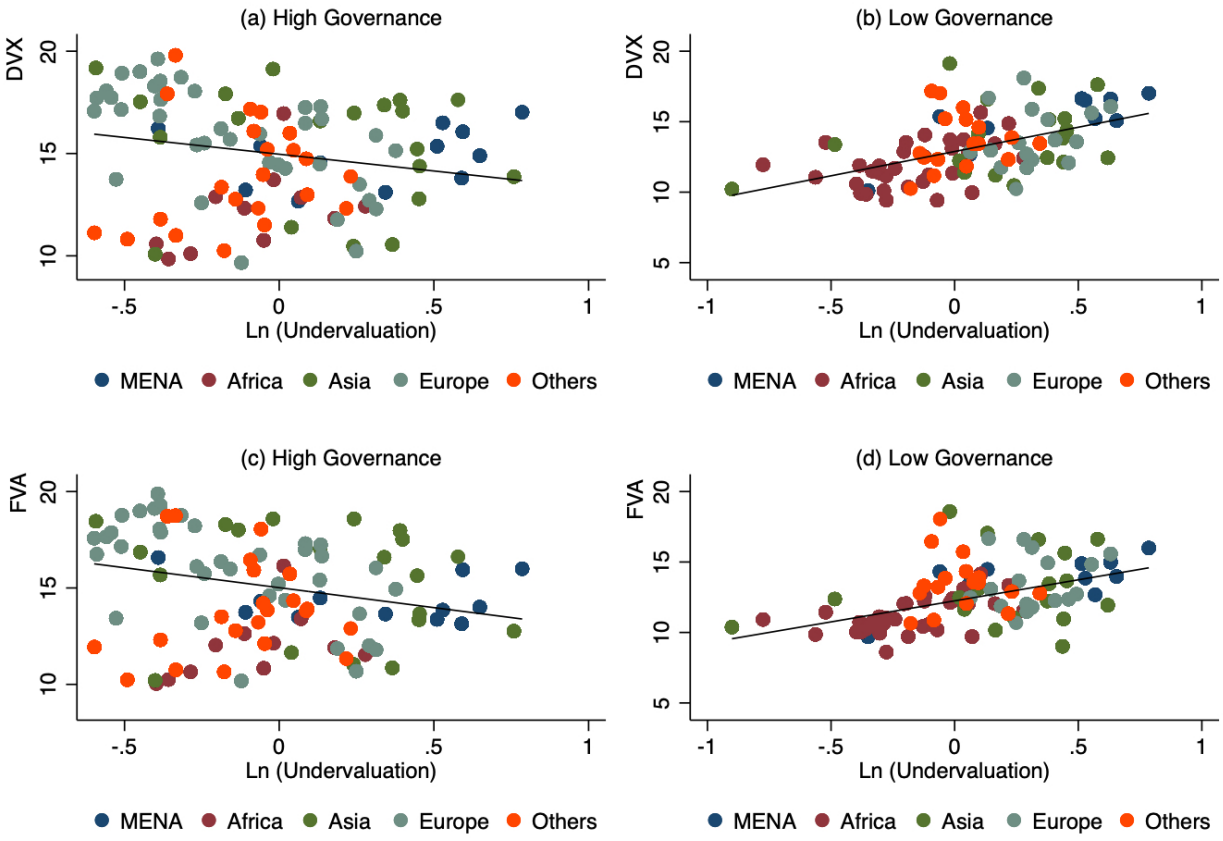
[11] Figure 1A.1 in Appendix 1A illustrates the association between the moderating variables and GVC participation.

Figure 1.2 The Relation between GVC Participation and RER Undervaluation



Source: Authors' own construction.
Positive (negative) values of ln(Undervaluation) correspond to RER undervaluation (overvaluation).

Figure 1.3 The Relation between GVC Participation and Institutional Quality



Source: Authors' own construction.
Institutional quality is measured using the Government Effectiveness Index from the WGI. Countries below the sample median are classified as "low governance" and those above as "high governance."

1.4 Empirical Strategy and Findings

Our analysis is conducted in two main steps. First, being a macroeconomic variable, exchange rate measure can be non-stationary. Thus, we test the stationarity, as well as the existence of a long-term relationship between the variables. Second, we examine the relationship between RER undervaluation and GVC participation. In addition, we test the robustness of our results, on the one hand, by changing the variables we use to measure RER undervaluation, digitalization, and institution, and on the other by changing the estimation method. Finally, our analysis is extended in three ways. First, given that most trade flows are invoiced and priced in a single dominant currency, which can moderate the impact of exchange rate dynamics on GVC, we test the dominant currency paradigm. Second, we analyze how RER undervaluation affects GVC position. Finally, we analyze the heterogeneity observed at the income, region and time levels.

1.4.1 Baseline Setup

Regarding the baseline setup, to assess the stationarity of the series, we employ three widely used unit-root tests[12] (Harris and Tzavalis, 1999; Choi, 2001; Im et al., 2003). The results confirm that some variables are stationary, and others are integrated of order one, I(1). Two panel cointegration tests are then performed to check the existence of long-run relationship between the variables (Kao, 1999; Pedroni 1999, 2004). The findings from both tests confirm the presence of cointegration across variables (see Tables 1D.1 and 1D.2 in Appendix 1D). Accordingly, we proceed with cointegration methods appropriate for non-stationary and cointegrated series.

Moreover, to reduce the bias of standard ordinary least squares (OLS) in regressions with non-stationary variables, a Dynamic OLS (DOLS) model is estimated. DOLS is a cointegration method appropriate for non-stationary but cointegrated series (Nouira et al., 2011; Fišera and Horváth, 2022). This parametric approach relies on the inclusion of lags and leads of explanatory variables in the regression. Hence, it accounts for potential endogeneities (that is due to the simultaneity bias), should cleanse the error term from correlation and heteroskedasticity, and address the problem of different orders of integration (Kao and Chiang, 2001; Mark and Sul, 2003).

We posit the following RER undervaluation-focused model for GVC participation:

$$\ln(GVC_{it}) = \alpha_0 + \alpha_1 \ln(Undervaluation_{it}) + \alpha_2 \eta_{it} + \alpha_3 \zeta_{it} + \delta_i + \mu_t + \tau_{it} \quad (1)$$

where $\ln(GVC_{it})$ is the GVC participation index of country i at year t measured through the forward (DVX) and backward (FVA) linkages. $\ln(Undervaluation_{it})$ represents RER undervaluation estimated as in Rodrik (2008). η_{it} is a vector of covariates that includes the following variables. First, the real GDP per capita (in log) is a proxy for the level of development. Second, the total value of natural resource rents (in log) accounts for the size of country's endowments. A higher level of rents is generally seen as a factor reducing economic diversification due to the Dutch disease or the curse of raw materials. Third, a weighted mean of applied tariffs faced by a country and applied by its trade partners (forward linkage) as well as tariffs imposed by a country on its imports (backward linkage) are included to control for trade openness

[12] The different tests and the corresponding null and alternative hypotheses are reported in Appendix 1D.

(in log)[13]. ζ_{it} is a vector of variables capturing institutional quality and digital adoption. δ_i and μ_t denote country and year fixed effects, respectively. τ_{it} is the error term.

As previously discussed, GVC participation can influence RER undervaluation, raising concerns about potential endogeneity in estimating the effect of RER undervaluation. While the DOLS helps mitigate simultaneity bias arising from endogeneity, the Instrumental Variable (IV) approach is employed to address endogeneity concerns attributable to omitted variables.

For forward linkages, we employ two distinct instruments. The first is the RER undervaluation of the country's main trade partner. This instrument is motivated by Cheng et al. (2016), who argue that the competitiveness effects of exchange rate vary depending on a country's contribution to the DVA embedded in the final GVC output. Specifically, countries with a limited DVA contribution to the final GVC product exert a minor influence on the overall competitiveness of the entire supply chain. Therefore, the response in terms of DVA and FVA to its own RER undervaluation will be muted. Conversely, countries with a substantial DVA contribution can significantly affect the competitiveness of the entire supply chain. In such cases, a depreciation of the RER in a country with a large DVA contribution may generate spillover effects that enhance the competitiveness of supply chain partners. Consequently, a country with an appreciating RER but a minor DVA contribution may still benefit indirectly from its partner's undervaluation. The second instrument, inspired by Autor et al. (2013), is a "leave-one-out" mean measure of RER undervaluation. This instrument is constructed by averaging the undervaluation values of a set of countries sharing same structural characteristics with country *i* in year *t*, excluding country *i* itself. This "leave-one-out" mean approach has since been widely adopted in empirical research (Alby et al., 2013; Clarke et al. 2015; Dovis and Zaki, 2020; Ehab and Zaki, 2021; Cette et al., 2022; Gopalan et al., 2022). The procedure involves two steps. First, to match each country with others that share similar characteristics, we apply a stratification matching approach. Specifically, we estimate propensity scores for each country *i* in year *t* based on a comprehensive set of observable characteristics, including GDP per capita, imposed and faced tariffs, domestic and foreign value added, natural resource rents, institutional quality, financial development, and digitalization. This approach allows us to draw inference from a reference group that is sufficiently similar in structural

[13] Following Fontagné et al. (2015), we include ln ($tariff_{it}$ +1) in the model to account for the case of zero tariff.

characteristics to provide a credible counterfactual. Second, we compute the average RER undervaluation across countries within the same propensity score block[14], omitting the observation of country *i*. By following this empirical procedure, we strengthens causal inference by mitigating concerns of reverse causality in the relationship between RER undervaluation and GVCs.

As per the backward linkage, we employ two instruments. First, we retain the previously described "leave-one-out" mean instrument, constructed over a set of countries that exhibit similar structural characteristics to country *i* in year *t*, excluding country *i*'s own RER undervaluation. This procedure ensures that the instrument captures exogenous variation in RER undervaluation from comparable peers, while mitigating reflection bias. Second, we incorporate a regional "leave-one-out" mean instrument. This instrument is defined as the average RER undervaluation across countries within the same geographical region and year, excluding the observation of the country of interest. Unlike the forward linkage specification, RER undervaluation of the country's main trade partner is not used as an instrument, as it may directly affect FVA and therefore violates the exclusion restriction. The instruments appear to satisfy the relevance condition as shown by the positive and significant coefficient of the instruments in the first stage regressions[15].

1.4.2 Baseline Regressions

Examining the relationship between RER undervaluation and GVC participation, Table 1.2 presents the results[16] for both forward (columns a and b) and backward linkages (columns d and e) estimated using DOLS regressions, as well as the IV estimates (columns c and f).

Our findings show that the coefficient of undervaluation is positive and highly significant for both forward and backward linkages. The estimated elasticity of exports to exchange rate is broadly consistent with the elasticities reported by Berman et al. (2012), Fitzgerald and Haller (2018), and Fontagné et al. (2018), who report elasticities ranging from 0.5 to 0.8, closely aligned with our estimates. While the positive effect of undervaluation on backward linkages may seem counterintuitive

[14] A comprehensive description of blocks is available upon request.
[15] The results of the first stage regressions as well as the endogeneity and validity tests are reported in Table 1E.3 in Appendix 1E.
[16] The marginal effects of the interaction terms are reported in Table 1E.5 of Appendix 1E.

from the perspective of conventional trade theory, which predicts a decline in imports, this result aligns with the view that GVC-related domestic and foreign value added are complementary within GVCs. Hence, producing and exporting more DVX increases the derived demand for imported FVA, especially in countries that export final goods reliant on imported intermediate inputs. Moreover, the interaction between income level and RER undervaluation yields negative and highly significant coefficients, corroborating the earlier findings of Rodrik (2008), suggesting that RER undervaluation is particularly important for developing countries.

As it was mentioned before, institutional quality has long been recognized as an important determinant of economic performance, including international trade[17]. While numerous studies demonstrate that better institutions positively impact exports performance, the effect varies across sectors and may differ between low value-added products (i.e. raw materials), manufactured, and higher value-added products (Méon and Sekkat, 2008). However, there is a dearth of literature on the role of institutions in the GVC context. In our analysis, we find that the coefficient of institutional quality measured by financial efficiency is positive and highly significant for both the forward and backward linkages. Clearly, at least through the opportunity to access domestic bank credit at a reasonable interest rate, a financial system appropriately assessing and managing risks greatly contribute to support a broader participation in GVCs. However, the coefficient of government effectiveness is surprisingly negative and highly significant in the DOLS regressions for both forward and backward linkages (regressions b and e). These counter-intuitive results are partly addressed by controlling for potential endogeneity as the effects are now not significant (regressions c and f). A potential reason, albeit untestable in our context, might relate to the heterogeneity of the type of exported products (manufactured, low value-added, or high value-added). Examining the interaction between institutional variables and RER undervaluation, the interaction terms are negative and highly significant for both forward and backward linkages, except for the interaction with the financial development index, which is not statistically significant. These findings align with the argument that RER undervaluation is unlikely to be effective nor necessary for promoting exports in economies with developed institutions. Instead, it becomes a counter-productive policy instrument for GVC promotion, as first best solutions already exist.

[17] See Anderson and Marcouiller (2002); Borrmann et al. (2006); Soeng and Cuyvers (2018), and Karam and Zaki (2019).

As per the role of connectivity and internet usage, the results indicate that internet usage is positive and statistically significant for backward linkage, lending support to the role of access to internet in enabling firms to source intermediate inputs from abroad and integrate more deeply into international production networks. These findings are consistent with Gopalan et al. (2022), who emphasize the role of internet in deepening firms' integration into GVCs. However, this intuitive finding does not carry over to the case of forward linkages, negative and highly significant for both the DOLS and IV regressions. One explanation for this is that the quality of internet access is a more representative variable of the actual use of new information technologies than the subscription rate itself. It should also be noted that the connectivity-RER undervaluation yields positive and highly significant coefficients for both forward and backward linkages. This suggests that internet usage serves as a catalyst, amplifying the positive impact of RER undervaluation on GVC participation. Moreover, for a plausible range of RER undervaluation, the net effect of connectivity on GVC participation is positive even for the case of forward linkages[18].

With respect to income levels, higher income countries tend to exhibit greater shares of both domestic and foreign value-added in exports. This is consistent with the idea that developed economies are deeply engaged in GVCs, both as suppliers and as users of intermediate goods. In contrast, natural resources rents are negatively associated with both forward and backward linkages. Resource-abundant economies are less likely to participate in GVCs, likely due to their specialization in commodities located at the periphery of the product space, which limits their economic and institutional ability to diversify, produce new products, and undergo structural transformation. In contrast, economies with strong manufacturing bases tend to occupy denser parts of the product space, enabling more complex and interconnected production (Hausmann and Klinger, 2007).

When considering the impact of tariffs, backward participation is more sensitive to tariffs imposed by the domestic country on its imports as it encompasses imports into the country levying tariffs. Conversely, forward participation is influenced by tariffs imposed by trade partners on the country's exports. Therefore, a distinction is made between tariffs faced by a country on its exports (forward linkage) and the one imposed by a country on its imports (backward linkage). Our findings confirm that tariffs significantly reduce both forward and backward GVC participation, consistent

[18] The partial derivative of regressions b and c of Table 1.2, suggests that for RER undervaluation index larger than 0.12, the (combined) net effect of connectivity on GVC participation is positive.

with Kowalski et al. (2015). Tariffs, particularly those imposed on intermediate inputs, raise production costs, and hinder a country's ability to access foreign inputs, thereby ultimately impeding downstream sector growth. In this context, the recent rise in protectionist measures in various economies poses a significant challenge to the participation of developing countries in GVCs and may further exacerbate the fragmentation of global trade.

Controlling for the potential endogeneity of RER undervaluation, Table 1.2 (columns c and f) presents the 2SLS estimation results. RER undervaluation consistently exerts a positive and highly significant impact on both forward and backward linkages. It is pertinent to note that, accounting for endogeneity amplifies the economic impact of RER undervaluation, as evidenced by larger coefficients relative to the DOLS estimates. Thus, failing to fully account for endogeneity may result in underestimated effects.

As per interactions, the coefficients for financial efficiency and internet usage align with the baseline results for forward linkage, whereas the previously observed negative interaction with government effectiveness is no longer present. For backward linkage, the coefficients for internet usage and government effectiveness (column f) remain consistent with the findings of DOLS regressions.

Table 1.2 GVC Participation and RER Undervaluation – Baseline Regressions

	Forward Linkage			Backward Linkage		
	(a) DOLS	(b) DOLS	(c) IV	(d) DOLS	(e) DOLS	(f) IV
[1] ln(Undervaluation)	0.233***	0.449***	1.504**	0.175***	0.578***	1.661***
	(0.043)	(0.061)	(0.610)	(0.016)	(0.049)	(0.583)
[2] ln(GDPPC)	0.595***	0.540***	0.648***	0.560***	0.518***	0.516***
	(0.009)	(0.009)	(0.029)	(0.003)	(0.007)	(0.034)
[1] * [2]	-0.072***	-0.114***	-0.215***	-0.033***	-0.121***	-0.241***
	(0.005)	(0.007)	(0.071)	(0.002)	(0.006)	(0.068)
ln(Tariff +1)	-0.030***	-0.017***	-0.012*	-0.026***	-0.024***	-0.011
	(0.003)	(0.003)	(0.007)	(0.001)	(0.003)	(0.012)
ln(Rents)	-0.006***	-0.005***	-0.008*	-0.004***	-0.002***	0.002
	(0.001)	(0.001)	(0.004)	(0.000)	(0.001)	(0.005)
[3] Government Effectiveness	-0.002	-0.027***	-0.001	-0.031***	-0.050***	-0.020
	(0.006)	(0.005)	(0.017)	(0.002)	(0.004)	(0.021)
[4] Financial Development	0.218***	0.217***	0.189***	0.112***	0.144***	0.151***
	(0.017)	(0.016)	(0.052)	(0.006)	(0.013)	(0.057)
[5] ln(Internet Usage)	-0.001	-0.018***	-0.033**	0.053***	0.044***	0.052***
	(0.002)	(0.002)	(0.012)	(0.001)	(0.002)	(0.011)
[1] * [3]		-0.091***	0.292***		-0.023***	-0.165*
		(0.011)	(0.102)		(0.008)	(0.092)
[1] * [4]		-0.271***	-2.10***		-0.008	0.359
		(0.039)	(0.349)		(0.031)	(0.344)
[1] * [5]		0.140***	0.392***		0.132***	0.167***
		(0.003)	(0.046)		(0.002)	(0.029)
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent variable	14.831	14.831	14.831	14.597	14.597	14.597
Observations	2,649	2,649	2,629	2,649	2,649	2,652

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Two instruments are used for the forward linkage: a leave-one-out mean by common characteristics and the undervaluation of the main trade partner. For the backward linkage, we use a leave-one-out mean over region and year, and a leave-one-out mean over countries sharing common characteristics.

1.5 Robustness Checks

To ensure the robustness of our previous empirical results, we conduct a set of robustness checks. First, we investigate whether the observed effects of RER misalignment are primarily driven by episodes of undervaluation or overvaluation. We also assess the absolute magnitude of misalignment to test whether larger deviations from RER equilibrium, irrespective of sign, systematically affect GVC participation. Second, we use alternative measures of institutional quality and digital adoption. Third, we re-estimate the regressions using panel fixed effects regressions with Driscoll-Kraay robust standard errors, as well as with the lagged value of RER undervaluation.

1.5.1 Undervaluation vs. Overvaluation

The baseline specification shows that the sign of the deviation from the RER equilibrium level matters. An additional empirical question is whether the magnitude of the effects varies or not with the sign of the exchange rate disequilibrium. For developing countries, Rodrik (2008) finds that the positive effect of an increase of undervaluation on economic growth is just as powerful as the negative growth effect of overvaluation. We investigate this question by disentangling misalignments into two distinct variables, as indicated by equation (2):

$$\ln(\mathrm{GVC}_{it}) = \gamma_1 |\mathrm{Misalignment}_{it}| + \gamma_2 (\mathrm{Misalignment}_{it} * \mathrm{Dummy}_{it}) + \mathrm{Controls} \qquad (2)$$

where $|\mathrm{Misalignment}_{it}|$ is the absolute value of misalignment and $(\mathrm{Misalignment}_{it} * Dummy)$ is the misalignment interacted with a dummy variable taking the value 1 if RER misalignment > 0 (undervaluation) and 0 if RER misalignment < 0 (overvaluation). The equation incorporates all control variables, quality of institutions and access to internet measures, as well as fixed effects, consistent with the baseline model presented in equation (1).

Including the absolute value of RER misalignment allows capturing the magnitude of RER disequilibrium, regardless of whether it reflects undervaluation or overvaluation. The interaction between this variable and a dummy reflecting the sense of disequilibrium yields three potential scenarios for γ_2. First, a non-significant coefficient would imply no difference between undervaluation and overvaluation. Second, a significant and positive coefficient would suggest that the observed impact is predominantly driven by undervaluation. Third, a significant and negative coefficient would indicate that the impact is driven by overvaluation.

Table 1.3 reports the results for both forward and backward linkages, in columns a and b, respectively. Irrespective of whether the RER is overvalued or undervalued, misalignment exerts a substantial and statistically significant positive effect on DVX. A comparatively less significant but still positive impact is observed on FVA. Regarding the interaction between RER misalignment and the undervaluation dummy (=1), we find a highly significant and positive coefficient for both forward and backward linkages. The positive impact is therefore primarily driven by undervaluation[19]. Furthermore, the interaction terms between undervaluation and

[19] The T-test reported in the last row of Table 1.3 confirms that the difference in impact between RER undervaluation and RER overvaluation is statistically highly significant.

institutional quality, as well as internet usage, consistently mirror the baseline findings for both forward and backward linkages.

Compared to the earlier results (columns b and e of Table 1.2), the coefficient associated with the absolute value of RER misalignment is smaller than what we get when both, positive and negative values of misalignment are considered. However, once we interact misalignment with the dummy variable representing undervaluation, we observe a higher coefficient for the backward linkage relative to what is observed when we keep both, positive and negative values. Additionally, the interaction coefficients involving institutional quality and digitalization are notably higher than those obtained under the specification that includes both undervaluation and overvaluation, reinforcing the moderating role of these variables in shaping the effectiveness of undervaluation policies on GVC integration.

Table 1.3 GVC Participation and RER Misalignment – Undervaluation vs. Overvaluation

	(a) Forward Linkage	(b) Backward Linkage
| Misalignment |	0.281***	0.027*
	(0.012)	(0.016)
Dummy (1= Undervaluation)	0.025***	0.028***
	(0.004)	(0.005)
[1] Misalignment * Dummy (1= Undervaluation)	0.356***	1.412***
	(0.078)	(0.104)
[2] ln(GDPPC)	0.651***	0.656***
	(0.009)	(0.011)
[1] * [2]	-0.140***	-0.206***
	(0.009)	(0.012)
ln(Tariffs +1)	-0.008***	-0.014***
	(0.002)	(0.004)
ln(Rents)	-0.006***	-0.006***
	(0.001)	(0.001)
[1] * Government Effectiveness	-0.314***	-0.086***
	(0.016)	(0.021)
[1] * Financial Development	-0.531***	-0.359***
	(0.050)	(0.066)
[1] * ln(Internet Usage)	0.176***	0.143***
	(0.004)	(0.005)
Difference T-test: Undervaluation vs. Overvaluation	-0.612***	
Country & Year FE	Yes	Yes
Intercept & Controls	Yes	Yes
Mean of dependent variable	14.831	14.597
Observations	2,649	2,649

Rescaled standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

1.5.2 Alternative Measures of Institutional Quality and Digitalization

As a second robustness check, we re-estimate eq. (1) using alternative measures of institutional quality and digital adoption. For institutional quality, we employ the government stability risk index from the International Country Risk Guide (ICRG), which captures both a government's ability to carry out its declared programs, and its ability to stay in office. The risk rating assigned is the sum of three subcomponents: government unity, legislative strength, and popular support. Lower risk points indicate higher risk, while higher points indicate lower risk. For digital adoption, we use mobile cellular subscription from the WDI as a proxy.

Our results (Table 1.4) remain consistent with the baseline findings: RER undervaluation positively affects both forward and backward linkages. Moreover, interactions with the alternative measures show that undervaluation is particularly effective in countries with weaker institutions, while higher digital adoption amplifies the positive effect of undervaluation on GVC participation.

Table 1.4 GVC Participation and RER Undervaluation – Alternative Measures

	Forward Linkage	Backward Linkage
[1] ln(Undervaluation)	0.882***	0.864***
	(0.050)	(0.028)
[2] ln(GDPPC)	0.510***	0.543***
	(0.010)	(0.005)
[1] * [2]	-0.114***	-0.064***
	(0.006)	(0.003)
[1] * Government Stability	-0.053***	-0.060***
	(0.003)	(0.001)
[1] * ln(Mobile Cellular Subs.)	0.099***	0.095***
	(0.004)	(0.002)
[1] * Financial Development	-0.320***	-0.441***
	(0.046)	(0.025)
Country & Year FE	Yes	Yes
Intercept & Controls	Yes	Yes
Mean of dependent variable	14.831	14.597
Observations	2,194	2,194

Rescaled standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

1.5.3 Driscoll-Kraay SE and Lagged Values of Undervaluation

As a third robustness check, we estimate panel fixed effects regressions with Driscoll-Kraay (1998) robust standard errors, which correct for spatial and serial cross-sectional dependence (Table 1.5, columns a and c), and we include the lagged value of RER undervaluation (columns b and d)[20]. Including the lagged undervaluation captures potential delayed effects on forward and backward linkages and helps mitigate concerns about potential endogeneity.

The results confirm that undervaluation consistently exerts a positive impact on forward GVC participation, though the coefficient is not statistically significant for backward linkages. Furthermore, the findings confirm the moderating roles of government effectiveness and digital adoption for both forward and backward linkages, in line with our baseline results.

Table 1.5 GVC Participation and RER Undervaluation – Lagged RER and Driscoll-Kraay SE

	Forward Linkage		Backward Linkage	
	(a) Driscoll-Kraay	(b) Lagged RER	(c) Driscoll-Kraay	(d) Lagged RER
[1] ln(Undervaluation)[a]	0.347*	0.141**	-0.095	0.016
	(0.182)	(0.066)	(0.258)	(0.061)
[2] ln(GDPPC)	0.600***	0.529***	0.459***	0.438***
	(0.057)	(0.010)	(0.049)	(0.009)
[1] * [2]	-0.096***	-0.081***	-0.027	-0.044***
	(0.028)	(0.008)	(0.035)	(0.007)
[1] * Government Effectiveness	-0.049***	-0.077***	-0.109***	-0.095***
	(0.016)	(0.012)	(0.026)	(0.011)
[1] * Financial Development	-0.290*	-0.056	0.177	0.090***
	(0.158)	(0.041)	(0.121)	(0.003)
[1] * ln(Internet Usage)	0.120***	0.123***	0.080***	0.234***
	(0.010)	(0.004)	(0.016)	(0.037)
Country & Year FE	Yes	Yes	Yes	Yes
Intercept & Controls	Yes	Yes	Yes	Yes
Observations	2,652	2,600	2,652	2,600
Number of groups	145	-	145	-

Driscoll-Kraay Robust Standard errors in parentheses (columns a and c), *** p<0.01, ** p<0.05, * p<0.1
Note: [a]ln(Undervaluation) in columns b and d is the lagged value.

[20] The marginal effects of the interaction terms are reported in Table 1E.5 of Appendix 1E.

1.6 Extensions and Heterogeneity Analysis

As mentioned before, we extend the analysis by examining sources of heterogeneity. First, we assess how the absence of a separate legal tender affects GVC integration and the specific role of RER undervaluation. Second, we explore heterogeneity in the impact of RER undervaluation by estimating regressions separately across income groups, geographic regions, and sub-periods.

1.6.1 Dominant Currency Paradigm

In line with the evolving literature, a more recent strand has emerged over the past two decades, focusing on the role of invoicing and payment currencies in shaping the effects of exchange rate fluctuations within GVCs (Gopinath et al., 2020; Adler et al., 2023). This research highlights the dominance of the U.S. dollar—and, to a lesser extent, the euro—as the primary currencies used for trade invoicing (Goldberg and Tille, 2009). Notably, Gopinath and Itskhoki (2022) report that over half of global exports are invoiced in U.S. dollars, despite the United States accounting for only about 10 percent of global trade. This phenomenon underpins the dominant currency paradigm, which posits that prices are invariant in dollar. As a result, the external terms of trade tend to remain stable following currency depreciation and the competitiveness gains for the depreciating country may be modest, at least in the short run.

Analyzing the nexus between the dominant currency paradigm, GVC integration, and exchange rate undervaluation ideally requires highly granular data on bilateral trade by product, including export prices and invoicing currencies (Gopinath et al., 2020). In our empirical context, such detailed information is unavailable given that trade flows are aggregated, and invoicing currencies are not identified. Nonetheless, the potential advantages of being pegged to a dominant currency, such as the US dollar, can still be examined. Using a dominant currency simplifies producer's economic calculations and reduces transaction costs. Exchange rate risks associated with the operating cycle (such as the asynchronous nature of imported input purchases and exported goods sales) are weakened. In other words, firms face lower currency risk and may avoid costly hedging, which is not always available in all countries. However, this benefit comes with a trade-off because reliance on a vehicle currency creates dependence on the monetary policy of the issuing country, potentially leading to welfare losses.

To empirically capture this mechanism, we examine how the absence of a separate legal tender affects GVC integration and its interaction with RER undervaluation. We follow the de facto exchange rate arrangement classification[21] (Ilzetzki et al., 2019, 2022). Consistent with expectations, having no separate legal tender reduces risks and uncertainty associated with the operating cycle, as reflected in a positive and highly significant impact on both forward and backward linkages (Table 1.6). When interacted with RER undervaluation, we find a positive and highly significant effect on forward linkages, while the coefficient for backward ones is not statistically significant. This suggests that, in countries without a separate legal tender, RER undervaluation is associated with even higher forward GVC participation compared with countries with independent currencies. Hence, RER undervaluation enhances the ability of dollarized or multi-currency economies to integrate into GVCs through forward linkages, likely by making domestic inputs cheaper and more competitive for foreign firms, despite the absence of independent monetary policy. Similar results are obtained when we interact undervaluation with a dummy variable that takes the value of one if the country adopts a fixed exchange rate regime (see Table 1E.2 in Appendix 1E).

[21] Table 1E.1 and Figure 1E.2 in appendix 1E present the arrangement classification, as well as the share of countries within each category. In our sample, and throughout the whole time period, around 17.5 percent of the countries do not have a separate legal tender and 43 percent have a fixed exchange rate regime.

Table 1.6 GVC Participation and RER Undervaluation – No Separate Legal Tender

	Forward Linkage		Backward Linkage	
	(a)	(b)	(c)	(d)
[1] ln(Undervaluation)	0.561***	0.550***	0.932***	0.929***
	(0.066)	(0.066)	(0.064)	(0.063)
[2] ln(GDPPC)	0.470***	0.469***	0.530***	0.530***
	(0.009)	(0.009)	(0.009)	(0.009)
[1] * [2]	-0.125***	-0.125***	-0.164***	-0.164***
	(0.008)	(0.008)	(0.007)	(0.007)
ln(Tariff +1)	-0.015***	-0.017***	-0.025***	-0.025***
	(0.003)	(0.003)	(0.003)	(0.003)
ln(Rents)	-0.003**	-0.002	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
[1] * Government Effectiveness	-0.102***	-0.110***	0.003	0.002
	(0.011)	(0.011)	(0.011)	(0.011)
[1] * ln(Internet Usage)	0.146***	0.142***	0.128***	0.127***
	(0.004)	(0.004)	(0.003)	(0.003)
[1] * Financial Development	-0.216***	-0.213***	0.118***	0.117***
	(0.042)	(0.042)	(0.039)	(0.039)
[3] No separate legal tender (dummy=1)	0.062***	0.070***	0.066***	0.068***
	(0.006)	(0.007)	(0.006)	(0.006)
[1] * [3]		0.145***		0.011
		(0.019)		(0.018)
Country & Year FE	Yes	Yes	Yes	Yes
Intercept & Controls	Yes	Yes	Yes	Yes
Mean of dependent variable	14.831	14.831	14.597	14.597
Observations	2,572	2,572	2,572	2,572

Rescaled standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

1.6.2 GVC Position and RER Undervaluation

To comprehensively assess the impact of undervaluation on GVC participation, it is crucial to account for a country' position within the value chain. Although two countries may exhibit similar levels of GVC participation, their position within the value chain may differ significantly, with some specialization in upstream activities and others in downstream stages. To capture this distinction, we split the sample into two subsamples. Following the literature (Koopman et al., 2010; Ahmed et al., 2016, Banerjee and Zeman, 2022; Fišera and Horváth, 2022), a country is considered to specialize in upstream activities if its DVA exceeds its FVA. Conversely, countries engaged in downstream activities are more likely to import a greater share of intermediate inputs, thus displaying higher backward than forward linkages. We then estimate separate regressions for each sub-sample.

The results (see Table 1.7) show that undervaluation exerts a consistently positive and highly significant impact on forward linkages, irrespective of a country's position within the value chain. In contrast, its impact on backward linkages varies by position: while downstream countries experience a significantly positive effect, upstream countries face a strong negative one. A plausible explanation is that exports and

imports are better cushioned and protected from exchange rate changes in countries that are more downstream in the supply chain (Riad et al., 2012). Positioned closer to the end consumer, these countries benefit from greater price flexibility, allowing them to partially absorb or pass on cost changes to suppliers or customers. This capacity to cope with currency fluctuations helps mitigate the effects of exchange rate volatility, thereby reducing trade disruption. The stronger coefficients observed for undervaluation in downstream countries, across both forward and backward linkages, further support this interpretation.

Comparing these coefficients with those reported in the baseline regressions (Table 1.2, columns b and e), undervaluation has a stronger impact, both for forward and backward linkages, when focusing on downstream countries. For upstream countries, the coefficient for the backward linkage is also relatively higher in absolute terms, while the forward linkage shows a smaller effect.

Regarding the interaction terms[22], they consistently align with the baseline findings for the forward linkage, across both upstream and downstream countries. Similarly, for the backward linkage, the coefficients for upstream countries align with those observed in the baseline regressions.

Table 1.7 GVC Participation and RER Undervaluation – Upstream vs. Downstream

	Forward Linkage: DVX		Backward Linkage: FVA	
	(a) Upstream	(b) Downstream	(c) Upstream	(d) Downstream
[1] ln(Undervaluation)	0.157*	0.695***	-0.814***	2.861***
	(0.086)	(0.149)	(0.098)	(0.239)
[2] ln(GDPPC)	0.443***	0.459***	0.337***	0.585***
	(0.014)	(0.015)	(0.016)	(0.024)
[1] * [2]	-0.073***	-0.127***	0.067***	-0.430***
	(0.010)	(0.017)	(0.011)	(0.027)
ln(Tariffs +1)	-0.005	-0.001	-0.083***	0.109***
	(0.004)	(0.004)	(0.006)	(0.009)
ln(Rents)	-0.003**	0.009***	0.010***	0.007**
	(0.002)	(0.002)	(0.002)	(0.003)
[1] * Government Effectiveness	-0.211***	-0.129***	-0.236***	0.247***
	(0.017)	(0.020)	(0.019)	(0.031)
[1] * Financial Development	-0.293***	-0.599***	-0.291***	0.461***
	(0.053)	(0.070)	(0.060)	(0.112)
[1] * ln(Internet Usage)	0.118***	0.207***	0.120***	0.214***
	(0.005)	(0.008)	(0.005)	(0.012)
Country & Year FE	Yes	Yes	Yes	Yes
Intercept & Controls	Yes	Yes	Yes	Yes
Mean of dependent variable	14.831	14.831	14.597	14.597
Observations	1,431	1,215	1,431	1,215

Rescaled standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

[22] The marginal effects of the interaction terms are reported in Table 1E.6 of Appendix 1E.

1.6.3 Undervaluation and GVC Participation: by Income Level, Regions, and Periods

The effects of RER undervaluation on GVC participation may vary substantially depending on a country's level of economic development, geographic region, and major domestic or global events during the study period. To capture this heterogeneity, we re-estimate the baseline models by per capita income group (Table 1.8), across different sub-periods reflecting major global shocks (Table 1.9), and by region to identify potential asymmetries (Table 1.10).

Regarding the income criterion, RER undervaluation has a positive and highly significant impact on forward linkages in upper middle–income countries, while its effect on backward linkages is insignificant. By contrast, for both lower-middle and high-income countries, undervaluation exerts a significantly negative impact on forward and backward GVC participation. These results support the notion of complementarity between DVX and FVA in production: producing and exporting less (more) DVX reduces (increases) the demand for imported FVA. It is important to highlight that these patterns may partially reflect the overrepresentation of undervalued upper-middle income countries (Table 1.1). Furthermore, these results help explain the negative correlation between RER undervaluation and GVC participation observed in developed countries (Figure 1.2b, d). Finally, for low-income countries, undervaluation turns to be insignificant. This likely reflects structural limitations, such as a small industrial base and heavy reliance on unprocessed commodity exports, which constrain the ability of these economies to integrate into GVCs, even under favorable exchange rate conditions (Gereffi, 2019).

As a second dimension of heterogeneity, we examine whether the period following the 2008 financial crisis exhibits different patterns compared to the overall sample. Indeed, the financial crisis reduced trust in pure floating regimes, especially in emerging markets. It also pushed many countries toward managed floats and heavy reserve accumulation (Ghosh et al., 2015). To do so, we include a dummy variable equal to 1 for the years 2009-2018 (post-crisis) and 0 otherwise, and interact it with RER undervaluation to assess differential effects[23]. The results show that the post-crisis dummy has a positive and highly significant impact, indicating that both forward and backward linkages increased after the crisis relative to the pre-crisis period. When interacting the dummy with RER undervaluation, the coefficient for forward linkages is not statistically significant, suggesting that the crisis did not

[23] We also split the sample into three sub-periods: 1995–2001, 2002–2008 (post–internet boom), and 2009–2018 (post–financial crisis). Results are available upon request.

strengthen the effect of undervaluation on forward integration. In contrast, the positive and significant interaction for backward linkages implies that the post-crisis period amplified the positive impact of RER undervaluation on backward GVC participation.

Third, regional heterogeneities matter. Indeed, East Asia experienced the deepest integration in electronics, machinery, and the automotive industry with ASEAN countries climbing the value chain. In Europe, regional value chains are centered on Germany with Central and Eastern European countries suppling intermediate goods (mainly in automotive and machinery). Moreover, while GVCs in Middle East and North Africa (MENA) countries are resource-based with a limited participation in chemicals and metals, Latin America and the Caribbean (LAC) is integrated into GVCs around the US by supplying main commodities (oil, copper, etc.). Finally, Sub-Saharan Africa (SSA) is still at an early stage of GVC integration that is concentrated in resource and agriculture sectors.

Hence, to capture potential regional asymmetries, we break the sample into five groups following the World Bank's regional classification: SSA, MENA, Asia[24], LAC, and Europe and Central Asia (ECA). For brevity, only the marginal effects are reported in Table 1.10. Relative to ECA, the interaction between RER undervaluation and regional dummies is positive and highly significant for both forward and backward linkages. For forward GVC participation, the effect is strongest in SSA, suggesting that undervaluation is particularly effective in developing and emerging economies, consistent with Rodrik (2008). In contrast, for backward linkages, the coefficient is largest for Asia. This reflects the region's deep integration into manufacturing supply chains, where production relies heavily on imported intermediates. Undervaluation increases export competitiveness, which in turn raises demand for foreign inputs, thereby amplifying backward GVC participation. SSA also shows a relatively strong effect, second only to Asia, but the mechanism is different. Given SSA's more resource-based export structure, integration is less import-intensive than in Asia's manufacturing-driven supply chains, which explains why the impact, while positive, is comparatively smaller.

[24] Asia includes East Asia and Pacific (EAP) and South Asia.

Table 1.8 GVC Participation & RER Undervaluation – by income level

Forward Linkage	(a) Low	(b) Lower-Middle	(c) Upper-Middle	(d) High Income
[1] ln(Undervaluation)	1.065	-0.625**	0.334***	-0.881***
	(0.758)	(0.264)	(0.093)	(0.017)
[1] * Government Effectiveness	0.555	0.038	0.042	-0.052***
	(0.440)	(0.144)	(0.048)	(0.005)
[1] * Financial Development	-1.724	0.622	-1.489***	-0.750***
	(1.096)	(0.487)	(0.174)	(0.023)
[1] * ln(Internet Usage)	0.378***	0.081**	0.088***	0.250***
	(0.102)	(0.033)	(0.013)	(0.002)
Backward Linkage	(a) Low	(b) Lower-Middle	(c) Upper-Middle	(d) High Income
[1] ln(Undervaluation)	0.386	-0.644***	-0.279	-0.666***
	(0.402)	(0.094)	(0.471)	(0.095)
[1] * Government Effectiveness	1.249***	-0.060	0.137	0.107***
	(0.224)	(0.051)	(0.247)	(0.031)
[1] * Financial Development	-0.448	0.781***	0.148	-1.170***
	(0.596)	(0.166)	(0.877)	(0.131)
[1] * ln(Internet Usage)	0.383***	0.142***	0.0779	0.270***
	(0.060)	(0.011)	(0.067)	(0.012)
Country & Year FE	Yes	Yes	Yes	Yes
Intercept & Controls	Yes	Yes	Yes	Yes
Observations	178	715	664	1,083

Rescaled standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 1.9 GVC Participation & RER Undervaluation – by period

	Forward Linkage		Backward Linkage	
	(a)	(b)	(c)	(d)
[1] ln(Undervaluation)	0.449***	0.438***	0.578***	0.575***
	(0.074)	(0.074)	(0.108)	(0.108)
[2] ln(GDPPC)	0.540***	0.541***	0.518***	0.498***
	(0.010)	(0.011)	(0.015)	(0.015)
[1] * [2]	-0.114***	-0.113***	-0.121***	-0.116***
	(0.009)	(0.009)	(0.013)	(0.013)
ln(Tariff +1)	-0.017***	-0.018***	-0.024***	-0.021***
	(0.003)	(0.003)	(0.006)	(0.006)
ln(Rents)	-0.005***	-0.005***	-0.002	-0.001
	(0.001)	(0.001)	(0.002)	(0.003)
[1] * Government Effectiveness	-0.091***	-0.098***	-0.023	0.019
	(0.013)	(0.013)	(0.019)	(0.019)
[1] * Ln (Internet Usage)	0.140***	0.144***	0.132***	0.096***
	(0.004)	(0.005)	(0.005)	(0.007)
[1] * Financial Development	-0.271***	-0.283***	-0.008	0.038
	(0.047)	(0.047)	(0.067)	(0.067)
[3] Post Financial Crisis (dummy=1)	1.255***	1.625***	1.812***	1.593***
	(0.038)	(0.035)	(0.109)	(0.091)
[1] * [3]		-0.006		0.124***
		(0.009)		(0.013)
Country & Year FE	Yes	Yes	Yes	Yes
Intercept & Controls	Yes	Yes	Yes	Yes
Mean of dependent variable	14.831	14.831	14.597	14.597
Observations	2,649	2,649	2,649	2,649

Rescaled standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 1.10 GVC Participation & RER Undervaluation: Marginal Effects – by region

	Forward Linkage	Backward Linkage
ln(Undervaluation)*SSA	0.396***	0.439***
	(0.023)	(0.055)
ln(Undervaluation)*MENA	0.069***	0.333***
	(0.020)	(0.047)
ln(Undervaluation)*Asia	0.138***	0.691***
	(0.018)	(0.044)
ln(Undervaluation)*LAC	0.150***	0.193***
	(0.019)	(0.045)
Country and Year FE	Yes	Yes
Intercept and Controls	Yes	Yes
Observations	2603	2603

Rescaled standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
SSA stands for Sub-Saharan Africa, MENA Middle East and North Africa, Asia includes East Asia and Pacific and South Asia, LAC Latin America and the Caribbean. The reference category is "ECA, Europe, and Central Asia".

1.7 Conclusion and Policy Implications

The increasing fragmentation of global production sheds light on new patterns of production and trade and, therefore, the need to understand how trade in value-added and intermediate inputs respond to exchange rate undervaluation. This paper investigates this question by employing an adequate empirical strategy and controlling for key structural factors such as income level, institutional quality, and digital adoption.

Our findings reveal that RER undervaluation has a positive and statistically significant effect on both forward and backward components of GVC participation. This underscores undervaluation as an important lever of competitiveness in a fragmented global economy. This effect is particularly pronounced in countries with higher degree of digitalization, while it becomes counterproductive in countries with strong institutions. This finding highlights the dual nature of undervaluation, beneficial where absorptive capacity is constrained, but less so where institutions already support competitiveness through non-price channels.

The results remain robust regardless of the method used to address the potential endogeneity of RER undervaluation. The same conclusion prevails when other empirical estimation methods are adopted, distinguishing between episodes of undervaluation and overvaluation, applying panel fixed effects with robust Driscoll-Kraay standard errors, and using alternative measures. Additional sensitivity tests also confirm these conclusions.

Expanding the analysis to consider a country's position within the value chain, undervaluation consistently enhances forward participation regardless of whether a country is upstream or downstream. For backward linkages, the impact remains positive and highly significant for downstream economies but turns negative for upstream ones, likely reflecting the greater price flexibility and cushioning advantage that they have over upstream countries. Substantial asymmetries also emerge when regressions are estimated across income groups, sub-periods, and regions, highlighting the heterogeneous impact of RER undervaluation on GVC.

From a policy perspective, undervaluation can act as a second-best solution to mitigate the economic cost of poor institutions and market failures that penalize the tradable sector, particularly the process of productive transformation of developing countries through greater participation in GVCs. The effectiveness of this strategy is not uniform across countries and depends on structural factors such as the income level, institutional strength, and digital adoption. Hence, to maintain the positive effect of RER undervaluation, exchange rate policy should be coupled with other policies. Ultimately, while undervaluation is doable in the short term, it is neither sustainable nor a comprehensive policy solution. Long-term competitiveness and deeper integration into GVCs require coordinated reforms aimed at strengthening institutions, enhancing financial systems, and accelerating digital transformation. Policymakers should thus consider exchange rate policy as part of a broader development strategy, tailored to a country's structural conditions and stage of development.

References of Chapter 1

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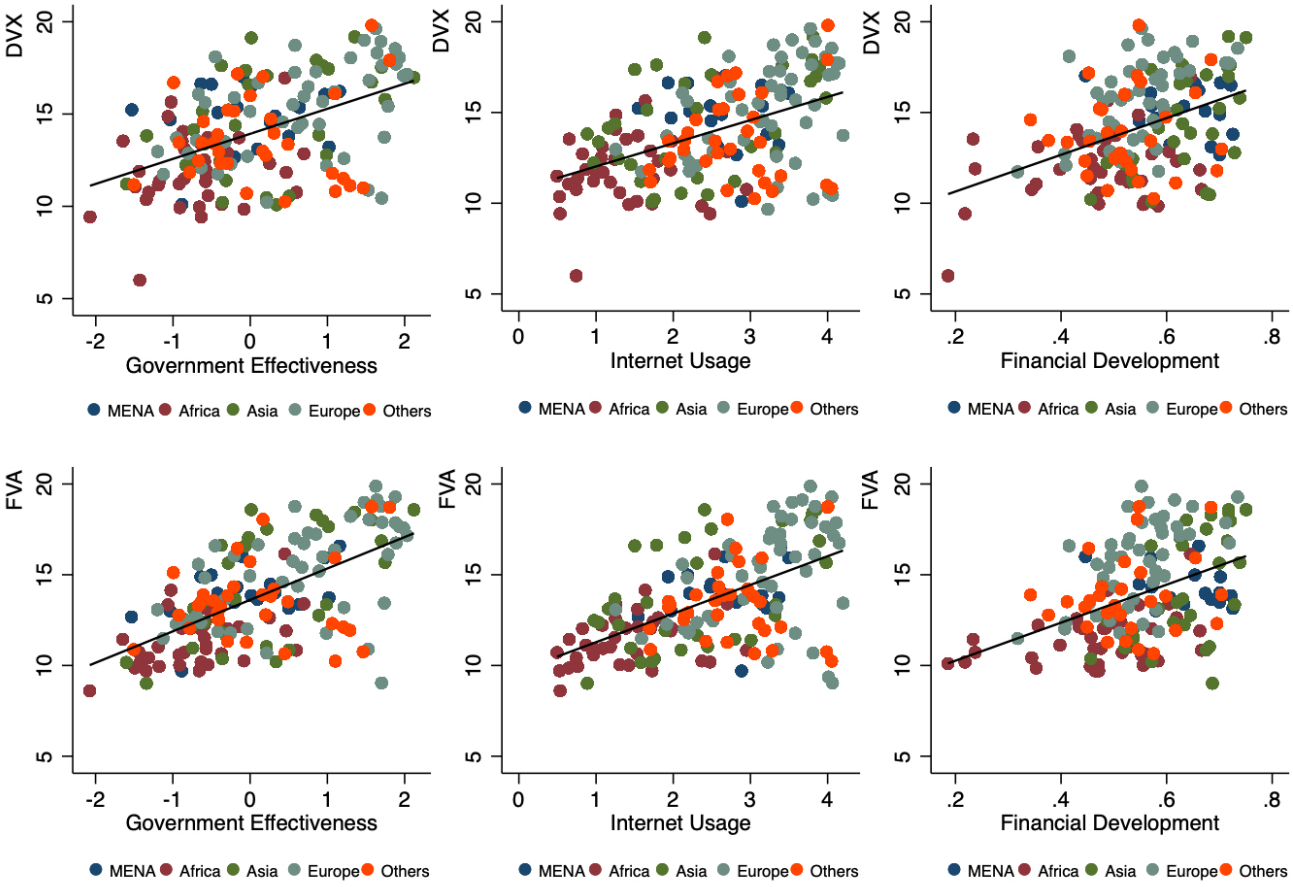
Appendix 1A: Data Sources and Stylized Facts

Figure 1A.1 Determinants of GVC Participation



Source: Authors' own construction.

Table 1A.1 Variables Definition

Variable	Definition	Source	Coverage
XR	Exchange rate, national currency/USD	WDI	1995–2018
PPP	Purchasing power parity	WDI	1995–2018
ln(DVX)	Ln of the domestic value added of this country, which is embodied in the exports of other countries. This corresponds to the Forward GVC participation component of the participation index	UNCTAD-EORA	1995–2018
ln(FVA)	Ln of the foreign value added which is embodied in this country's exports. This corresponds to the Backward GVC participation component of the GVC participation index	UNCTAD-EORA	1995–2018
ln(GDPPC)	Ln of the real GDP per capita, Constant 2015	WDI	1995–2018
ln(Tariffs +1)	Ln of the weighted mean tariff rate (applied) +1 imposed on the exports of country i by its main trade partners for the case of DVX or the average tariff imposed by country i on the exports of other countries for the case of FVA	WDI	1995–2018
ln(Rents)	Ln of total natural resources rents value which are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	WDI	1995–2018
Gvt. Eff.	Government Effectiveness reflects the quality of public and civil services and the degree of their independence from political pressures. The estimate ranges from -2.5 (weak) to 2.5 (strong) governance performance	WGI	1995–2018
Government Stability	A measure of both government's ability to carry out its declared program(s), and its ability to stay in office. The risk rating assigned is the sum of three subcomponents: Government Unity, Legislative Strength, and Popular Support. Maximum score is 12 points. The lower the risk point, the higher the risk, and the higher the risk point, the lower the risk	ICRG	1995–2018
ln(Internet Usage)	Ln of individuals using the internet (% of population)	WDI	1995–2018
ln((Mobile Cellular Subs.)	Ln of Mobile cellular subscriptions (per 100 people)	WDI	1995–2018
Fin. Inst. Efficiency	Includes data on banking sector net interest margin, lending-deposits spread, non-interest income to total income, overhead costs to total assets, return on assets, and return on equity	IMF	1995–2018

Table 1A.2 Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
ln(DVX)	2652	14.831	2.521	9.018	20.342
ln(FVA)	2652	14.597	2.63	8.321	20.59
ln(Undervaluation)	2652	-.001	.354	-.986	1.251
ln(GDPPC)	2652	8.831	1.427	5.614	11.63
ln(Tariffs imposed +1)	2652	1.683	.736	0	5.023
ln(Tariffs faced +1)	2652	.618	.763	0	3.385
ln(Rents)	2652	20.036	3.932	0	27.178
Government Eff. Estimate	2652	.258	.941	-2.14	2.43
Government Stability	2197	8.095	1.545	3	11.5
Financial Efficiency Index	2652	.569	.118	.093	.845
ln(Internet Usage)	2652	2.973	1.308	0	4.612
ln((Mobile Cellular Subs.)	2197	3.978	1.196	0	5.587

Source: Authors' own calculations.

Appendix 1B: Real Exchange Rate Undervaluation Index

Following Rodrik (2008), the undervaluation index is estimated in three steps. First, data from the WDI on exchange rates (XR) and purchasing power parity conversion factors (PPP) expressed as national currency units per U.S. dollar and controls for price level differences with respect to the U.S. economy from the WDI[25] is used to calculate a RER as follows:

$$\ln(\text{RER}_{it}) = \ln\left(\frac{\text{XR}_{it}}{\text{PPP}_{it}}\right) \qquad (1)$$

where i and t denote country and year, respectively. A value of RER greater than one indicates that the currency is more depreciated than indicated by PPP. Nevertheless, through the Balassa-Samuelson effect, the relative prices of nontradables tend to increase as countries become richer due to a higher productivity in tradables. However, nontradables are cheaper in poorer countries. Hence, in a second step, we account for this effect by regressing ln(RER) on real gross domestic product per capita (GDPPC), which proxies the productivity level, as follows:

$$\ln(\text{RER}_{it}) = \beta_0 + \beta_1 \ln(\text{RGDPPC}_{it}) + f_t + \varepsilon_{it} \qquad (2)$$

where f_t denotes year fixed effects and ε_{it} is the disturbance term. The regression (Table 1B.1) yields an estimate beta ($\hat{\beta}_1 = -0.25$ with a high t-statistic of around 48.31) close to the beta ($\hat{\beta} = -0.24$) estimated by Rodrik (2008). This result suggests a strong estimated Balassa-Samuelson effect as it shows that an increase of income by 10 percent leads to a decrease of RER by 2.5 percent. As a final step, RER undervaluation is estimated as the difference between the actual RER and its predicted one as follows:

$$\ln(\text{Undervaluation}_{it}) = \ln(\text{RER}_{it}) - \ln(\widehat{\text{RER}_{it}}) \qquad (3)$$

where $\ln(\widehat{\text{RER}_{it}})$ is the predicted RER from equation (2). A positive value corresponds to RER undervaluation, and a negative one corresponds to overvaluation. Figure 1B.1 depicts the distribution of the undervaluation measure, which is centered at zero and has a standard deviation of 0.38.

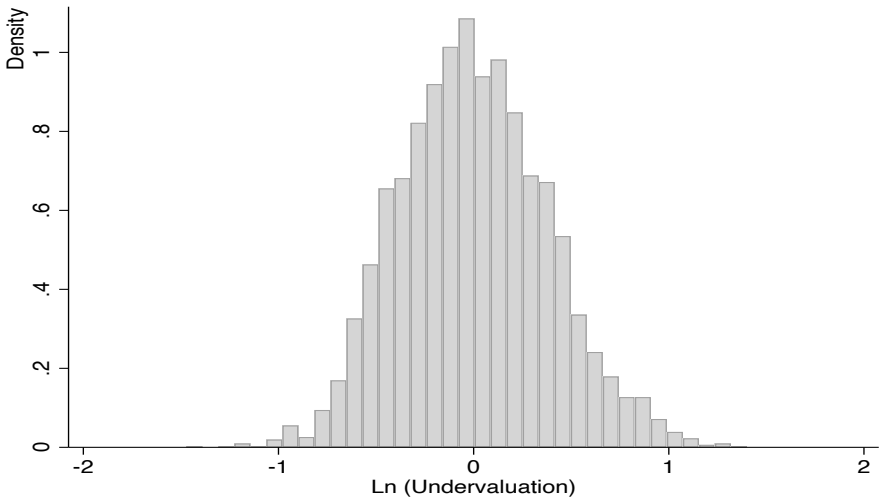
[25] Following Rodrik (2008), we estimate the RER using data from the Penn Worlds Table version 7.1 and the results are in line with our findings using the WDI.

Table 1B.1 RER Adjusted for Balassa-Samuelson Effect

	ln (RER)
ln(GDPPC)	-0.249***
	(0.005)
Constant	3.038***
	(0.048)
Year FE	Yes
Observations	3,735
R-squared	0.434

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 1B.1 Distribution of the Undervaluation Measure across Countries (1995–2018)



Source: Authors' own calculations.

Positive (negative) values correspond to RER undervaluation (overvaluation).

Appendix 1C: Countries in the sample

Low Income	Upper Middle Income	High Income
Burundi	Argentina - TFYR Macedonia	Antigua – Malta
Central African Republic	Armenia - Thailand	Aruba – Netherlands
Gambia	Azerbaijan - Turkey	Australia – New Zealand
Madagascar	Bosnia and Herzegovina	Austria – Norway
Malawi	Botswana	Bahamas – Oman
Mali	Brazil	Bahrain – Poland
Mozambique	Bulgaria	Barbados – Portugal
Niger	China	Belgium – Qatar
Rwanda	Colombia	Bermuda - Seychelles
Sierra Leone	CostaRica	Brunei Darussalam – Singapore
Uganda	Dominican Republic	Canada – Slovak Republic
Lower-Middle Income	Ecuador	Chile – Slovenia
Algeria - Gaza Strip	Fiji	Croatia – South Korea
Angola - Ghana	Gabon	Cyprus – Spain
Bangladesh - Haiti	Georgia	Czech Republic – Sweden
Bhutan - Honduras	Guatemala	Denmark – Trinidad and Tobago
Bolivia - India	Jamaica	Estonia – United Arab Emirates
Cambodia - Indonesia	Jordan	Finland – United Kingdom
Cameroon - Iran	Kazakhstan	France – United States of America
Cape Verde - Kenya	Lebanon	Germany - Uruguay
Côte d'ivoire - Kyrgyzstan	Malaysia	Greece
Egypt - Lao PDR	Maldives	Hong Kong
El Salvador - Lesotho	Mauritius	Hungary
Mauritania - Mongolia	Mexico	Iceland
Morocco - Myanmar	Montenegro	Ireland
Nepal - Nicaragua	Namibia	Israel
Nigeria - Pakistan	Panama	Italy
Philippines - Sao Tome and Principe	Paraguay	Japan
Senegal - Sri Lanka	Peru	Kuwait
Swaziland - Tajikistan	Romania	Latvia
Tanzania - Togo	Russia	Lithuania
Tunisia – Ukraine - Uzbekistan	South Africa	Luxembourg
Vietnam - Zambia	Suriname	Macao SAR

Source: Authors' own elaboration following the World Bank online classification.

Appendix 1D: Unit-root and Cointegration Tests

To test for the stationarity of the series, we rely on three main unit-root tests. First, Im-Pesaran-Shin test (Im et al., 2003) that tests the null hypothesis "all panels contain unit roots" against the alternative hypothesis "some panels are stationary". Second, Harris-Tzavalis test (Harris and Tzavalis, 1999) that tests a more flexible null-hypothesis "panels contain unit roots" against the same alternative hypothesis of the latter. Third, Fisher test (Choi, 2001) that tests the same null-hypothesis of Im-Pesaran-Shin test but a broader alternative hypothesis "at least one panel is stationary". Table 1D.1 shows that the results of the three tests are in line as they confirm that the components of GVC, exchange rate undervaluation and GDPPC are I(1) - integrated of order one - and tariffs, financial development, and digitalization indicators are stationary.

Table 1D.1 Unit-root Tests

	ln(DVX)		ln(FVA)		ln(Undervaluation)		ln(GDPPC)	
Test		1st diff.		1st diff.				1st diff.
Fisher Unit-root test								
H_0: All panels contain unit roots								
H_a: At least one panel is stationary								
Inverse chi-squared	1.000	0.000	1.000	0.000	0.000		0.551	0.000
Inverse normal	0.999	0.000	1.000	0.000	0.000		1.000	0.000
Inverse logit	0.991	0.000	1.000	0.000	0.000		1.000	0.000
Modified inv. Chi-squared	1.000	0.000	1.000	0.000	0.000		0.561	0.000
Im-Pesaran-Shin test								
H_0: All panels contain unit roots								
H_a: Some panels are stationary								
Z-t-tilde-bar	0.969	0.000	1.000	0.000	-		-	-
Harris-Tzavalis test								
H_0: Panels contain unit roots								
H_a: Some panels are stationary								
rho	1.000	0.000	1.000	0.000	-		-	-
	ln(Tariffs +1)		ln(Rents)		ln(Int Usage)	Fin Dev	Gvt. Eff.	
				1st diff.				1st diff.
Fisher Unit-root test								
H_0: All panels contain unit roots								
H_a: At least one panel is stationary								
Inverse chi-squared	0.000		0.2629	0.000	0.000	0.000	0.449	0.000
Inverse normal	0.000		0.0021	0.000	0.000	0.000	0.452	0.000
Inverse logit	0.000		0.0031	0.000	0.000	0.000	0.429	0.000
Modified inv. Chi-squared	0.000		0.2682	0.000	0.000	0.000	0.459	0.000
Im-Pesaran-Shin test								
H_0: All panels contain unit roots								
H_a: Some panels are stationary								
Z-t-tilde-bar	-		-	-	-	0.000	0.373	0.000
Harris-Tzavalis test								
H_0: Panels contain unit roots								
H_a: Some panels are stationary								
rho	-		-	-	-	0.000	0.009	0.000

Note: The table reports the p-values for each test. Some p-values cannot be estimated for Im-Pesaran-Shin and Harris-Tzavalis because they require strongly balanced data.

Table 1D.2 Panel Cointegration Tests

	(a) Forward Linkage (Domestic Value Added)
Test	P-value
Kao test for cointegration	
H_0: No cointegration	
H_a: All panels are cointegrated	
Modified Dickey-Fuller t	0.001
Augmented Dickey-Fuller t	0.000
Pedroni test	
H_0: No cointegration	
H_a: All panels are cointegrated	
Modified Phillips-Perron t	0.000
Phillips-Perron t	0.000
Augmented Dickey-Fuller t	0.000
	(b) Backward Linkage (Foreign Value Added)
Test	P-value
Kao test for cointegration	
H_0: No cointegration	
H_a: All panels are cointegrated	
Modified Dickey-Fuller t	0.000
Augmented Dickey-Fuller t	0.000
Pedroni test	
H_0: No cointegration	
H_a: All panels are cointegrated	
Modified Phillips-Perron t	0.000
Phillips-Perron t	0.001
Augmented Dickey-Fuller t	0.018

Note: The table reports the p-values for each test.

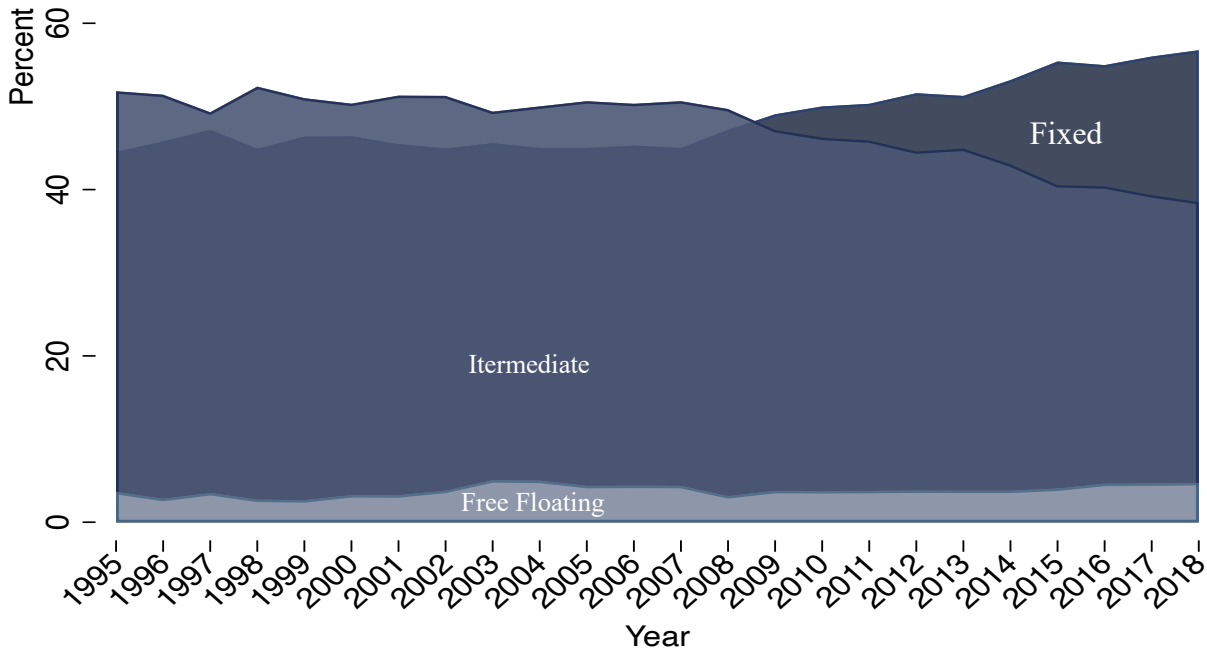
Appendix 1E: Extensions and Robustness Checks

Table 1E.1 Fine De Facto Exchange Rate Arrangement Classification

codes	Definition	Regime	
1	No separate legal tender or currency union	Fixed	
2	Preannounced peg or currency board arrangement		
3	Preannounced horizontal band that is narrower than or equal to +/-2%		
4	De facto peg		
5	Preannounced crawling peg, de facto moving band narrower than or equal to +/-1%	Crawling Peg	Intermediate
6	Preannounced crawling band that is narrower than or equal to +/-2% or de facto horizontal band that is narrower than or equal to +/-2%		
7	De facto crawling peg		
8	De facto crawling band that is narrower than or equal to +/-2%		
9	Preannounced crawling band that is wider than or equal to +/-2%		
10	De facto crawling band that is narrower than or equal to +/-5%	Managed Floating	
11	Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)		
12	De facto moving band +/-5%/ Managed floating		
13	Freely floating	Free Floating	

Source: Authors' construction following Ilzetzki et al. (2019) and Ilzetzki et al. (2022).

Figure 1E.2 Exchange Rate Classification – Share of Countries 1995-2018



Source: Authors' construction following Ilzetzki et al. (2019) and Ilzetzki et al. (2022).

Table 1E.2 GVC Participation and RER Undervaluation – Fixed Exchange Rate

	Forward Linkage		Backward Linkage	
	(a)	(b)	(c)	(d)
[1] ln(Undervaluation)	0.579***	0.531***	0.889***	0.819***
	(0.054)	(0.055)	(0.035)	(0.033)
[2] ln(GDPPC)	0.472***	0.468***	0.528***	0.522***
	(0.007)	(0.008)	(0.005)	(0.004)
[1] * [2]	-0.124***	-0.121***	-0.159***	-0.156***
	(0.006)	(0.006)	(0.004)	(0.004)
ln(Tariff +1)	-0.015***	-0.015***	-0.023***	-0.026***
	(0.002)	(0.002)	(0.002)	(0.002)
ln(Rents)	-0.007***	-0.007***	0.007***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
[1] * Government Effectiveness	-0.103***	-0.116***	0.007	-0.013**
	(0.009)	(0.010)	(0.006)	(0.006)
[1] * ln(Internet Usage)	0.145***	0.144***	0.120***	0.118***
	(0.003)	(0.003)	(0.002)	(0.002)
[1] * Financial Development	-0.277***	-0.258***	0.133***	0.158***
	(0.034)	(0.035)	(0.022)	(0.021)
[3] Fixed Regime (dummy=1)	0.029***	0.031***	0.048***	0.049***
	(0.004)	(0.004)	(0.002)	(0.002)
[1] * [3]		0.036***		0.080***
		(0.009)		(0.005)
Country & Year FE	Yes	Yes	Yes	Yes
Intercept & Controls	Yes	Yes	Yes	Yes
Mean of dependent variable	14.831	14.831	14.597	14.597
Observations	2,527	2,527	2,527	2,527

Rescaled standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 1E.3 Instrumental Variable Approach – First Stage

ln(Undervaluation)	Forward Linkage	Backward Linkage
Leave-one-out mean by region & year	-	0.851***
		(0.044)
ln(Undervaluation_Partner)	0.088***	-
	(0.014)	
Leave-one-out mean by common characteristics	2.789***	2.372***
	(0.523)	(0.492)
ln(Tariffs +1)	0.009	-0.034***
	(0.007)	(0.009)
ln(Rents)	0.010***	0.011***
	(0.004)	(0.003)
ln(GDPPC)	0.018	0.011
	(0.025)	(0.023)
Government Effectiveness	0.018	-0.002
	(0.017)	(0.016)
Financial Development	-0.190***	-0.225***
	(0.044)	(0.041)
ln(Internet Usage)	-0.069***	-0.048***
	(0.007)	(0.007)
Country & Year FE	Yes	Yes
Intercept	Yes	Yes
Observations	2,629	2,652
Endogeneity Test		
H0: Variables are exogenous		
Durbin (score) chi2 (1)	(0.000)	(0.000)
Wu-Hausman F (1,2620)	(0.000)	(0.000)
Weak identification test		
Cragg-Donald Wald F statistic	34.70	206.3
Overidentification test		
Sargan statistic	0.505	0.479

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

We have two different first stages for the backward and forward linkages as tariffs are not the same. For the endogeneity test, p-values are reported into parentheses.

Table 1E.4 Undervaluation vs. Overvaluation – Pre & Post Financial Crisis

	Pre Financial Crisis	Post Financial Crisis
Undervaluation	567	745
Overvaluation	693	665
Total	1,260	1,410

Source: Constructed by the authors.

Table 1E.5 DOLS, IV, and Lagged RER Estimations – Marginal Effects

	Forward Linkage			Backward Linkage		
Marginal Effect	(a) DOLS	(b) IV	(c) Lagged	(d) DOLS	(e) IV	(f) Lagged
ln(under) * ln(GDPPC)	-0.286***	-0.288**	-0.233***	-0.077***	-0.066	-0.037***
	(0.010)	(0.134)	(0.009)	(0.015)	(0.091)	(0.010)
ln(under) * Gov. Effectiveness	-0.286***	-0.442***	-0.220***	-0.103***	-0.017	-0.049***
	(0.010)	(0.134)	(0.009)	(0.014)	(0.021)	(0.011)
ln(under) * Fin. Development	-0.317***	-0.342***	-0.254***	-0.110***	0.194***	0.010
	(0.010)	(0.132)	(0.008)	(0.014)	(0.075)	(0.008)
ln(under) * ln(Internet Usage)	0.018***	0.037	0.020***	0.042***	0.161**	0.093***
	(0.003)	(0.142)	(0.003)	(0.004)	(0.074)	(0.009)

Rescaled standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Marginal effects are estimated at the median and 75% percentiles.

Table 1E.6 Undervaluation & GVC: Upstream vs. Downstream – Marginal Effects

	Forward Linkage: DVX		Backward Linkage: FVA	
Marginal Effect	(a) Upstream	(b) Downstream	(c) Upstream	(d) Downstream
ln(under) * ln(GDPPC)	-0.304***	-0.139***	-0.068***	0.314***
	(0.011)	(0.015)	(0.023)	(0.030)
ln(under) * Gov. Effectiveness	-0.291***	-0.142***	-0.072***	-0.185***
	(0.011)	(0.015)	(0.023)	(0.031)
ln(under) * Fin. Development	-0.298***	-0.224***	-0.080***	-0.016
	(0.011)	(0.011)	(0.023)	(0.022)
ln(under) * ln(Internet Usage)	0.018***	0.028***	0.075***	0.107***
	(0.003)	(0.003)	(0.028)	(0.007)

Rescaled standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Marginal effects are estimated at the median and 75% percentiles.

Chapter 2

Shaping Egypt's Sectoral Positioning in Global Value Chains: The Role of Bilateral Real Exchange Rate

2.1 Introduction

In the pursuit of economic development, many developing countries have successfully adopted a Global Value Chain (GVC)-led growth strategy as a pathway to industrialization. In East and Southeast Asia, countries such as China, Vietnam, Thailand, and Malaysia have deepened their participation in electronics, automotive, and machinery value chains, generating rapid productivity gains and sustained export expansion (Lee and Lim, 2001; Baldwin, 2013; Lee et al., 2018). GVC integration enables firms, particularly in developing economies, to participate in international production networks by specializing in specific stages of production and niche activities, rather than striving to build full-fledged domestic production systems (Baldwin, 2012; Cattaneo et al., 2013; Montalbano et al., 2018). While the initial phase of this strategy focuses on integration into global production networks, the more intricate and consequential challenge lies in upgrading within these chains. Advancing from low value-added activities to higher value-added segments is crucial to avoid the so-called "low value-added trap". Yet, upgrading is inherently non-linear, uncertain, and multifaceted, often requiring the development of industrial clusters, institutional support, and technological capabilities (Stojčić and Matić, 2024).

Unlike GVC participation, which is relatively well documented, there is a lack of unified consensus on how to measure GVC upgrading. Baldwin (2012) visualizes GVC upgrading through a "smiling curve", which illustrates how value added is distributed along the chain. Activities in the middle of the curve, tend to be low-value-added, are characterized by low barriers to entry, and are subject to intense price-based competition (Pietrobelli and Rabellotti, 2011). In contrast, high value-added activities are typically concentrated in either upstream or downstream segments of the chain. Firms operating in the middle of the curve are therefore encouraged to move toward upstream or downstream activities, where entry barriers are higher and competition is less fierce (Mudambi, 2008).

A further conceptual framework (Fernandez-Stark et al., 2012; Taglioni and Winkler, 2016) distinguishes three types of upgrading. First, product upgrading refers to the production of more sophisticated products within the same value chain. Second, functional upgrading involves moving into more sophisticated tasks, thereby increasing the value-added share in the final product. Third, inter-sectoral upgrading entails shifting to new supply chains with higher value-added shares. Despite their relevance, these forms of upgrading are seldom empirically tested in developing

economies, primarily due to the scarcity of firm-level and task-specific data. In this paper, we adopt a sector-level GVC position index as a proxy for potential upgrading trajectories[1].

A second strand of literature highlights the central role of the real exchange rate (RER) in shaping export performance, industrialization, and long-term growth, a relationship that is especially salient in developing economies[2]. A competitive RER enhances a country's export potential by making its products relatively cheaper and more attractive to foreign markets, thereby stimulating external demand. Conversely, it may also dampen imports as their prices become relatively more expensive. Historical evidence, particularly from East Asian economies, demonstrates the effectiveness of exchange rate policy in driving export-led growth and industrial diversification. A depreciated RER has been widely recognized as a catalyst for the economic boom experienced in the Asian region, serving as a central driver behind the 'miracle' of the Asian countries and the structural transformation from agriculture-based economies toward industrialization and service-led growth (Ghura and Grennes, 1993; Collier and Gunning, 1999). For instance, China's strategic undervaluation of its currency, alongside trade and industrial policy reforms, is often credited for its transition from an agricultural to an industrial economy (Dutta, 2005). Similar dynamics are observed in South Korea, Japan, and Taiwan (e.g. Johnson 1982; Amsden, 1989; Wade 1990).

In a GVC context, the literature on how countries integrate into GVCs and leverage participation for upgrading remains largely fragmented. The dynamics appear to be shaped by multiple factors and policy frameworks including, though not limited to, domestic institutional quality (Gereffi and Sturgeon, 2013; Pipkin and Fuentes, 2017; Montalbano and Nenci, 2022; Stojčić and Matić, 2024), workforce development and investment in human capital (Barrientos et al., 2011; Fernandez-Stark et al., 2011), as well as adherence to labor, social, and environmental standards (Kummritz et al., 2017). Nevertheless, the literature examining how exchange rate policy influences GVC integration is scarce. Most existing studies instead focus on how GVC participation affects the exchange rate elasticity of exports (e.g. Greenway et al., 2010; Berman et al., 2012; De Soyres et al., 2021). Only a few studies investigate the direct

[1] Further details regarding the construction of the index and the intuition behind it are provided in the methodology section.

[2] See Bahmani-Oskooee and Ardalani (2006); Rodrik (2008); Krugman et al. (2012); and Genc and Artar (2014) as just a few examples from this broad strand of the literature.

impact of RER misalignment on GVC integration (Cheng et al., 2016; Abdou et al., 2026), and even these generally overlook sectoral heterogeneity or the prospects for upgrading along the value chain.

Egypt provides a particularly compelling case for examining the role of exchange rate policy in promoting GVC integration and shaping sectoral positioning along the value chain[3]. Over the past decades, the exchange rate has been actively used as a policy instrument, with the country experiencing several waves of currency devaluation aimed at boosting competitiveness. However, unlike many Asian economies that successfully leveraged exchange rate policies to integrate into GVCs and upgrade along them, Egypt's outcomes have been more limited. Existing empirical work on Egypt focuses almost exclusively on export performance, either at the macro level (Nouira et al., 2011; Brixiova et al., 2014) or at the firm level (Zaki et al., 2019). To date, no study has examined the effectiveness of the RER as a policy tool for Egypt's integration into GVCs, particularly at the sectoral level, or its role in supporting upgrading and strategic positioning along the value chain.

Against this background, this paper aims to investigate the impact of RER depreciation on Egypt's integration into GVCs at the sectoral level and its potential implications for sectoral upgrading along the value chain. To this end, we use the UNCTAD-EORA Multi-Region Input-Output (MRIOs) tables, which provide key bilateral GVC indicators, including foreign value added (FVA), direct domestic value added (DVA), and indirect domestic value added (DVX) for 26 sectors over the period 1995-2022.

This paper makes three main contributions to the existing literature. First, to our knowledge, it provides the first sector-level analysis of the impact of RER depreciation on Egypt's integration into GVCs. Second, it explores the potential for sectoral upgrading and the prospects for moving up the value chain. Third, it constructs a knowledge spillover index to assess how foreign knowledge embedded in imported inputs contributes to upgrading.

[3] A detailed overview of the Egyptian context is provided in Section 2.3.

Our main findings reveal that RER depreciation increases GVC integration through both forward and backward linkages, which act as complements in the production process. Disaggregating sectors by technological intensity, gains through forward linkages are strongest in primary sectors, whereas backward linkage responsiveness is more pronounced in high-tech sectors. However, RER depreciation alone does not lead to GVC upgrading. Once learning effects arising from foreign knowledge embedded in imported inputs are accounted for, the impact of RER depreciation on upgrading becomes positive and statistically significant, particularly in high-technology sectors. Heterogeneity analysis further reveals that South-North value-added trade flows are more responsive to RER depreciation than South-South flows, and that the effects are more pronounced during the subperiods 2004–2010 and 2011–2016. All results are robust to a wide range of alternative specifications. These findings carry clear policy implications: while exchange rate flexibility can facilitate deeper GVC integration, sustained upgrading requires complementary structural policies that expand access to knowledge-intensive imports, strengthen innovation and skills, and reorient policy support toward high-productivity and export-oriented sectors.

The remainder of the paper is organized as follows. Section 2.2 reviews the literature, highlighting the salient theoretical framework and empirical predictions underpinning the relationship between RER depreciation and GVC participation. Section 2.3 details the data and provides an overview of the Egyptian context. Section 2.4 outlines the empirical strategy. Section 2.5 presents the main findings. Section 2.6 explores heterogeneity and reports robustness checks. Finally, Section 2.7 concludes and discusses the policy implications.

2.2 Literature Review

This study examines the impact of RER depreciation on Egypt's integration into GVCs, its sectoral positioning, and the potential for moving up the value chain. While the literature on currency depreciation and traditional trade is extensive, research on its effects within a GVC context remains limited. This section first reviews key findings on the relationship between RER depreciation and traditional trade and then explores the emerging literature on the link between RER dynamics and GVC integration.

2.2.1 RER Depreciation and Traditional Trade Performance

The literature examining the impact of RER depreciation on traditional trade is abundant but inconclusive. A competitive RER is often associated with improved export performance, as it makes domestic goods cheaper for foreign countries, stimulating external demand. Simultaneously, depreciation increases the cost of imported inputs, potentially reducing imports (e.g., Bahmani-Oskooee and Ardalani, 2006; Krugman et al., 2012; Genc and Artar, 2014). However, this relationship does not hold true in all circumstances and is contingent on country-specific structural features. For instance, Loto (2011) finds that RER depreciation benefits only countries that are export-oriented prior to the depreciation. Using trade data for Nigeria, where 90 percent of production inputs and raw materials are imported, he shows that RER depreciation undermines export performance. Moreover, using bilateral trade data for 172 countries over the period 1962-2012, Caglayan and Demir (2019) show that the impact of RER depreciation varies by product composition and trade direction. They find that high-skill and primary goods are less sensitive to RER depreciation, while resource-intensive, low- and medium-skill manufactures are more responsive. Furthermore, exports from the Global South are more sensitive to RER changes than those from the Global North in all categories, except primary goods.

In the MENA region, most studies focus on the impact of RER misalignment (Nabli and Véganzonès-Varoudakis, 2004; Nouira et al., 2011; Brixiova et al., 2014) or exchange rate risk (Bahmani-Oskooee et al., 2015a; 2015b) on export performance. Despite Egypt's relevance as a case study for examining the effects of exchange rate developments on export performance, studies specifically analyzing the impact of RER depreciation on Egypt's exports remain limited. Using firm- and sector-level monthly data for the period 2005-2016, Zaki et al. (2019) investigate the impact of RER devaluation on Egypt's intensive margin (the quantity and value of exports) and extensive margin (the ability to export new products and/or enter new markets). Their findings suggest that RER depreciation increases the value but not the quantity of exports, indicating that the price effect outweighs the quantity effect. In other words, while RER depreciation lowers the foreign price of Egyptian exports, it does not necessarily lead to higher export volumes. Moreover, they find a positive and significant effect on the extensive margin, reflected in an increase in both the number of exported products and export destinations. The study also reports some heterogeneity across sectors and destinations. At the sectoral level, RER depreciation appears most beneficial for products in which Egypt has a comparative advantage, such as fruits and vegetables, apparel and clothing, mineral fuels and oils, and certain

chemical products. Destination-wise, European markets exhibit the strongest response to depreciation.

Yet, in a world characterized by the increasing role of GVCs, this strand of literature is becoming less intuitive. Traditional models often overlook the distinction between exports of final goods and trade in value added and intermediate inputs, where imported inputs play a crucial role in production. The following section reviews the literature at the intersection of exchange rate dynamics and GVC integration. Moreover, we outline potential channels through which a competitive RER can enhance a country's position and facilitate its upgrading along the value chain.

2.2.2 RER, GVC Integration and Moving Up the Value Chain

The literature on how exchange rate policy influences GVC integration is scarce, and most existing studies examine the impact of a country's participation in GVCs on the exchange rate elasticity of exports. A substantial body of literature shows that GVC participation reduces the exchange rate elasticity of exports. Using panel data for 46 countries over the period 1996-2012, Ahmed et al. (2016) find that GVC integration reduces the RER elasticity of manufacturing exports by 22 percent on average. Bang and Park (2018) reach similar conclusions in three East Asian countries (China, Japan, and South Korea), though the impact depends on a country's position within the value chain. In this vein, Tan et al. (2019) show that a higher share of foreign value added in a country's exports offsets the negative effect of RER appreciation on gross exports.

Similarly, several studies find that exchange rate pass-through to export prices is dampened when countries are deeply integrated into GVCs and rely more heavily on imported inputs (Greenaway et al., 2010; Berman et al., 2012; Amiti et al., 2014; Fauceglia et al., 2018; De Soyres et al., 2021).

Fewer studies directly address how RER affects GVC integration, but the evidence is suggestive. Cheng et al. (2016), using OECD-WTO Trade in Value Added (TiVA) data, show that real appreciation reduces both domestic and foreign value added in exports, suggesting complementarity between the two. These findings contradict traditional trade theory predicting higher imports with RER appreciation but are consistent with the notion of complementarity between GVC-related domestic and foreign value added in production. Therefore, exporting less domestic value added implies reduced demand for imported FVA. Indeed, the magnitude of response relies on the share of

foreign value added in exports. They find that when FVA exceeds 60 percent of gross exports, RER appreciation raises both domestic and foreign value added. In the same vein, Abdou et al. (2026), using the UNCTAD-EORA dataset for 143 countries over the period 1995–2018, find that RER undervaluation increases GVC participation, through both forward and backward linkages, confirming the complementarity between domestic and foreign value added in the production.

To the best of our knowledge, no existing studies directly examine the impact of RER depreciation on GVC upgrading. However, several studies emphasize the role of competitive exchange rate in diversifying exports and enhancing their technological intensity. Using panel data for 111 countries over the period 1962-2008, Cimoli et al. (2013) adopt a North-South Ricardian framework to test two key hypotheses. First, a competitive RER promotes greater export diversification. Second, such diversification leads to technological upgrading in export composition. Their findings suggest that a competitive RER fosters export diversification and shifts production toward higher-technology and more innovative products, particularly when coupled with active industrial policies that encourage the emergence of new sectors and technological advancement within the production structure. Similarly, Álvarez and López (2009) find that RER depreciation can induce skill-biased technological change within firms, fostering quality upgrading and technological adoption that make exports more skill-intensive.

Moreover, beyond the role of the RER, the literature on GVC upgrading and positioning identifies several determinants that play a role in the upgrading process. These include workforce development and investment in human capital (Barrientos et al., 2011; Fernandez-Stark et al., 2011), institutional quality (Pipkin and Fuentes, 2017; Montalbano and Nenci, 2022; Stojčić and Matić, 2024), labor, social, and environmental standards (Kummritz et al., 2017), innovation (Kummritz et al., 2017), and technology diffusion and learning through backward GVC participation (Tian et al., 2022; Mehta, 2022; Stojčić and Matić, 2024).

In this study, we mainly focus on the impact of RER depreciation on GVC integration and upgrading, emphasizing the technology diffusion channel operating through GVC participation. This channel highlights the potential for learning via imported inputs that are intensive in technology and R&D. Using input-output tables derived from the WIOD, Tian et al. (2022) and Stojčić and Matić (2024) find that backward GVC integration provides significant opportunities for upgrading, especially for

developing countries, by enabling them to import sophisticated inputs. Such imports foster learning through embodied knowledge, allowing domestic firms to build and expand their own technological capabilities. Similarly, Mehta (2022) confirms the upgrading hypothesis within GVCs by examining the electronics industries of South Korea, Taiwan, and Mexico.

Building on the above discussion, this paper makes three key contributions to the existing body of literature. First, it represents, to the best of our knowledge, the first attempt to examine the impact of RER depreciation on Egypt's GVC integration at the sectoral level. Second, it investigates the potential for sectoral upgrading and the prospects for moving up along the value chain. Third, it constructs a knowledge spillover index to assess how foreign knowledge embedded in imported inputs contributes to upgrading, thereby bridging two strands of literature: that on the role of RER depreciation and that on learning through backward GVC participation.

2.3 Data and Overview of the Egyptian Context

This section introduces the data sources and key variables used in the analysis. It also outlines the relevance of the Egyptian case within the broader context of GVC integration and exchange rate policy.

2.3.1 GVC Indicators: Backward and Forward Linkages

To assess the impact of RER depreciation on Egypt's integration into GVCs, this study uses data from the UNCTAD-EORA Global Supply Chain Database[4] (Casella et al., 2019), generated from Multi-Region Input-Output (MRIO) tables. The database is constructed using intermediate input, final demand, and value-added matrices, and the Leontief inverse is calculated accordingly. The dataset provides annual observations for Egypt across 26 sectors over the period 1995-2022 (see Table 2A.1 in Appendix 2A).

The analysis focuses on two key GVC indicators. First, domestic value added in exports (DVX) measures the value added generated in Egypt and embodied in the exports of its trading partners, reflecting Egypt's forward linkage. Second, foreign

[4] UNCTAD-EORA is, to our knowledge, the only available database with the coverage needed for our study.

value added (FVA) embodied in Egypt's gross exports captures the extent to which Egypt relies on imported inputs in its export production, thereby reflecting its backward linkage. Both indicators are expressed as shares of gross exports[5] to account for the role of production fragmentation in value-added creation for exports.

Additionally, a comprehensive GVC participation index is constructed, also expressed as a share of gross exports, and defined as the sum of forward and backward linkages (DVX + FVA). This metric captures the overall depth of Egypt's integration into global production networks.

2.3.2 Bilateral Real Exchange Rate

The key explanatory variable in our analysis is the logarithm of the bilateral RER, denoted as $\ln(RER_{ijt})$, where RER_{ijt} is constructed as follows:

$$RER_{ijt} = E_{ijt} \times \frac{P_{jt}}{P_{it}} \quad (1)$$

where i, j, and t refer to the domestic country (Egypt), the foreign partner country, and the year, respectively. E_{ijt} is the bilateral Nominal Exchange Rate (NER), sourced from the IMF's International Financial Statistics (IFS) and is defined as the number of units of the domestic currency (Egyptian pound) per unit of the partner country's currency[6]. P_{jt} and P_{it} denote the price level indices in the foreign and domestic country, respectively. They are measured by the Consumer Price Index (CPI), obtained from the World Development Indicators (WDI). Constructed in this way, an increase (decrease) in the RER corresponds to a real depreciation (appreciation) of the Egyptian pound relative to the partner country's currency.

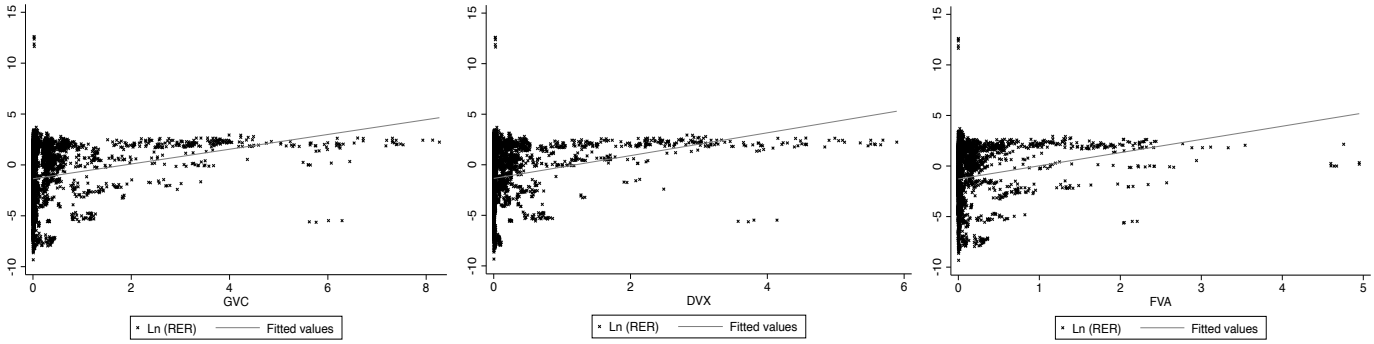
Figure 2.1 illustrates the association between Egypt's bilateral RER and its GVC participation. Specifically, Panel (a) plots the overall GVC participation index, Panel (b) shows the forward linkage, and Panel (c) displays the backward linkage. In all three panels, a positive correlation emerges between RER depreciation and GVC integration, suggesting that a more competitive exchange rate may be associated with deeper involvement in GVCs, through both forward and backward linkages.

[5] By definition, gross exports are the sum of direct domestic value added (DVA) and FVA in absolute terms.

[6] Using the NER of each trade partner with respect to the USD, a bilateral NER is calculated for Egypt and each trading partner (E_{ijt}).

Figure 2.1 The Correlation between the Bilateral RER and GVC Participation

(a) GVC Participation (DVX+FVA) (b) Forward Linkage (DVX) (c) Backward Linkage (FVA)



Source: Author's own construction based on data from UNCTAD-EORA, IMF's IFS, and WDI.
An increase (decrease) in the RER corresponds to a real depreciation (appreciation) of the Egyptian pound relative to the foreign currency. GVC, DVX, and FVA are shares of gross exports.

2.3.3 Egyptian Context

Egypt presents a compelling case for examining the relationship between RER dynamics and GVC integration, given the country's substantial shifts in both its *de jure* and *de facto* exchange rate regimes over the period 1995–2022.

Since the early 1990s, the Central Bank of Egypt (CBE) has adopted several exchange rate arrangements as part of broader macroeconomic and structural reforms. Between 1991 and 2001, Egypt operated under a *de facto* peg, maintaining the Egyptian pound (EGP) at approximately 3.4 EGP/USD (Figure 2.2, Panel a). In 2001, the regime shifted to a crawling peg, leading to a depreciation of the EGP to 4.48 EGP/USD by the end of the period. Between 2000Q4 and 2004Q4, the NER against the USD depreciated by nearly 66 percent, from 3.69 to 6.13 EGP/USD, driven largely by a sequence of discretionary devaluations aimed at addressing overvaluation (Mohieldin and Kouchouk, 2003; Hosni and Rofael, 2015; Noureldin, 2018). Following this episode, the EGP gradually appreciated, reaching 5.4 EGP/USD by 2009Q4, before weakening again in the aftermath of the 2011 revolution, when the exchange rate slipped to 6.01 EGP/USD amid heightened economic and political uncertainty.

A major turning point occurred in 2016, when Egypt formally adopted a floating exchange rate regime. The flotation, introduced as part of a wider reform program supported by the IMF, was designed to restore macroeconomic stability, address external imbalances, and improve export competitiveness. The transition triggered a

sharp depreciation, with the NER reaching 18.12 EGP/USD in 2016Q4. Although the currency appreciated slightly in subsequent years, recording 17.6 EGP/USD in 2017Q4 and stabilizing around 15.9–15.66 EGP/USD between 2019 and 2021, it underwent a second major depreciation in 2022, when the CBE enacted another flotation. By 2022, the EGP had depreciated by nearly 58 percent, reaching 24.6 EGP/USD.

Figure 2.3 traces the evolution of Egypt's NER and RER vis-à-vis its main trading partners. The NER displays a general trend of depreciation, with a few exceptions. For instance, from 1996Q4 to 2002Q4, the EGP appreciated slightly against the Turkish lira, and between 2013Q4 and 2015Q4, it appreciated modestly against the euro, British pound, and Turkish lira, developments largely driven by periods of USD appreciation.

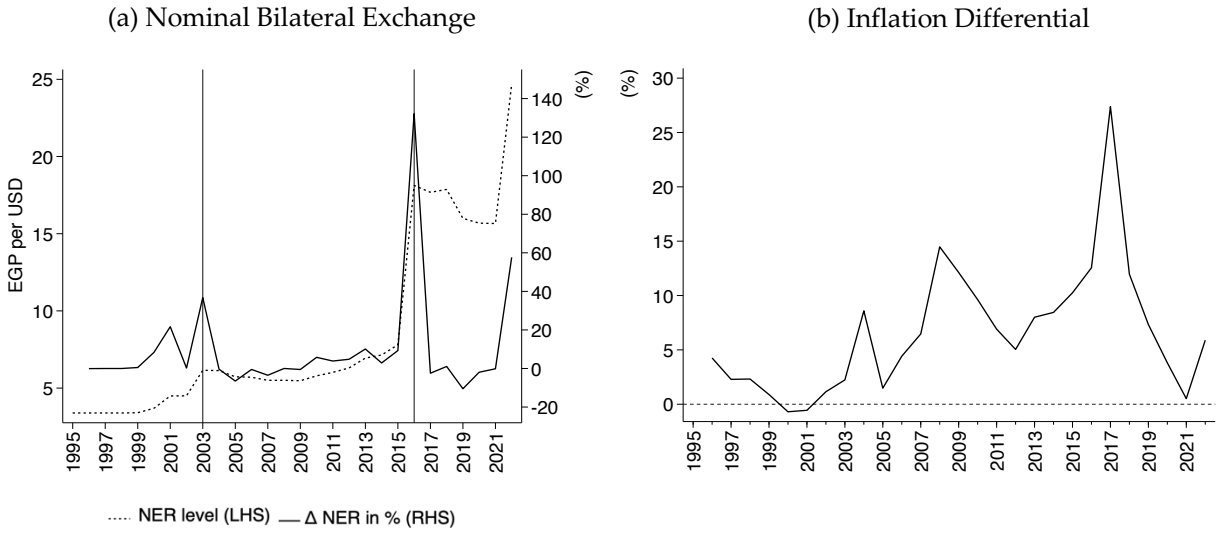
Changes in the bilateral RER reflect both NER movements and inflation differentials. Between 2000Q4–2003Q4, Egypt witnessed a sharp RER depreciation driven by successive nominal devaluations. A modest real appreciation followed from 2005 onward, supported by improved economic fundamentals (Noureldin, 2018), nominal appreciation of the EGP (Figure 2.2, Panel a), and a significant rise in Egypt's inflation relative to the USA (Panel b). With the onset of economic and political turmoil in Egypt in 2011, the post-2011 environment witnessed a renewed mild real depreciation, driven by a combination of declining inflation differentials and a gradual nominal depreciation of the currency.

Between 2013Q4 and 2015Q4, the nominal depreciation against the USD averaged 7.4 percent, resulting in only a marginal real appreciation due to Egypt's relatively high inflation. Moreover, despite this nominal weakening, Egypt witnessed a real appreciation against other major currencies (Figure 2.3), causing the EGP to diverge strongly from its equilibrium level and contributing to the emergence of a parallel market[7]. This pattern reversed sharply in 2016 after floating the currency, as discussed above.

In sum, Egypt's exchange rate trajectory has been marked by alternating periods of managed and market-determined regimes, with significant implications for trade performance and GVC participation. These fluctuations make Egypt a highly relevant case for analyzing how exchange rate depreciation affects GVC participation and sectoral integration.

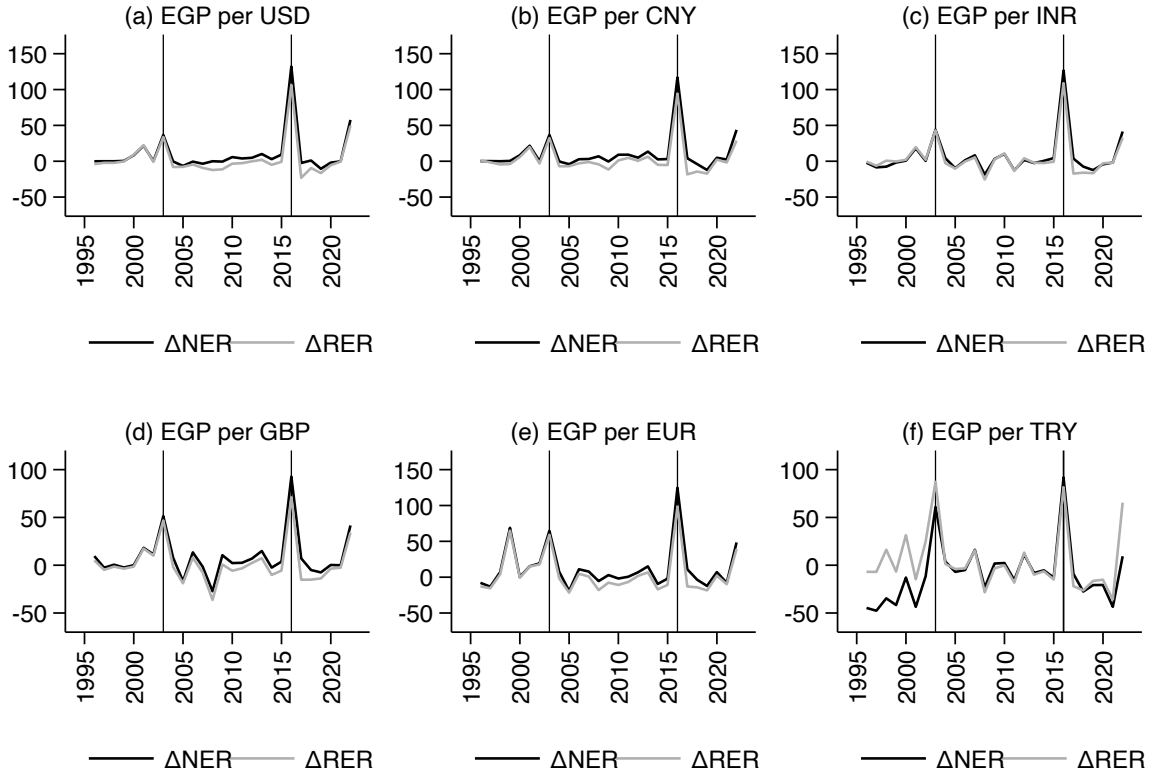
[7] See Noureldin (2018) for a detailed discussion of the factors underlying the liquidity squeeze and the emergence of the parallel market.

Figure 2.2 Exchange Rate and Inflation Developments



The plotted series are based on data from the IMF International Financial Statistics (IFS) database, and the Central Bank of Egypt. Rates are calculated on an annual, rather than a quarterly, basis. An increase (decrease) corresponds to a depreciation (appreciation) of the EGP relative to the foreign currency.

Figure 2.3 Bilateral NER and RER Development over Years: Egypt's Top Partners (%)



Source: Author's own calculations using data from the IFS (IMF) and the WDI.
The Deutschmark (DEM) is used for Germany (Panel e) until 2002. An increase (decrease) corresponds to a depreciation (appreciation) of the EGP relative to the foreign currency.

Regarding Egypt's integration into GVCs and its performance relative to its peers, Figure 2.4 maps the share of GVC participation in total exports across countries. The highest shares of GVC participation are observed in Europe, where Luxembourg, Slovakia, and Belgium record shares of 86 percent, 80 percent, and 78 percent of their exports, respectively. In Asia, Singapore leads with 78 percent, followed by Hong Kong (71 percent), Malaysia (65 percent), and the Philippines (63 percent). Within North Africa, Algeria ranks first with 66 percent, followed by Tunisia (57 percent), Mauritania (56 percent), Morocco (52 percent), and Egypt (47 percent). This relatively low level of integration is noteworthy given the series of exchange rate reforms and devaluations that, in principle, should have enhanced Egypt's export competitiveness.

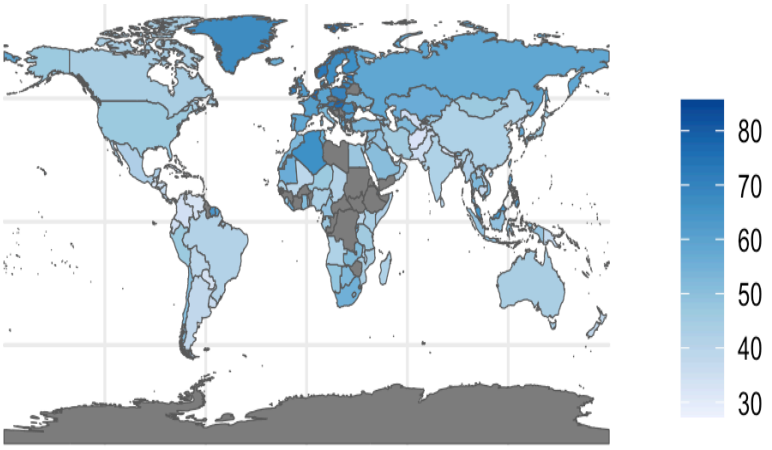
Turning to the evolution of Egypt's GVC participation over time (Figure 2.5), the data reveal a gradual increase from the mid-1990s until 2003, followed by a faster acceleration between 2003 and 2008, when participation peaked at 55 percent of total exports. During this expansion phase, both forward and backward linkages contributed to the rise in participation, with forward participation increasing by 16 percent and backward participation by 13.4 percent. However, consistent with the global slowdown in GVC trade after the 2008–09 financial crisis (OECD, 2023), Egypt's participation declined to about 50 percent, a reduction of roughly 10 percent, between 2008 and 2009.

Sectorally, Figure 2A.1 in Appendix 2A shows that GVC participation is highest in petroleum, chemical and non-metallic mineral products, metal products, textiles and wearing apparel, transport equipment, and electrical and machinery. When sectors are classified by technological intensity (see Table 2A.2) into primary, low-tech, and high-tech sectors, Figure 2A.4 shows that Egypt is most integrated into GVCs through high-tech sectors, followed by low-tech and primary sectors. Over time, participation in primary sectors has declined, while participation in high- and low-tech sectors has increased.

Disentangling forward and backward linkages, Figure 2.6 reveals a more nuanced pattern: forward participation is dominated by primary sectors, and the share of primary sectors has increased further since 2016. By contrast, backward participation is driven mainly by low- and high-tech sectors, with primary sectors playing a marginal and declining role, especially after 2016.

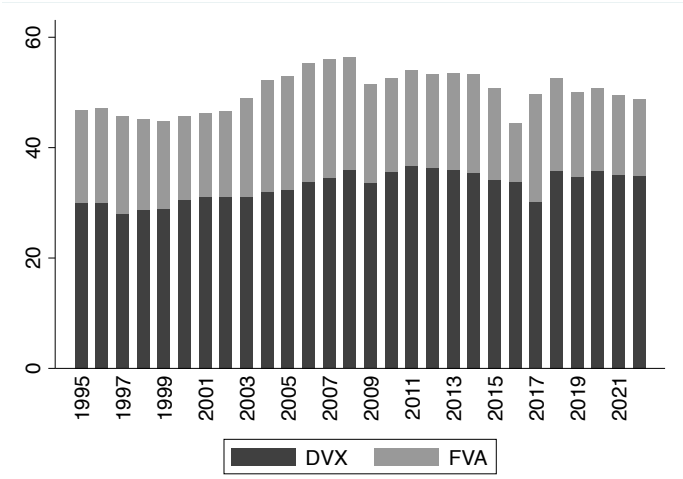
Taken together, the combination of Egypt's modest GVC integration relative to regional peers, the structural shift toward technology-intensive backward linkages, and the major shifts in exchange rate policy provide a compelling basis for analyzing how bilateral RER depreciation affects both sectoral GVC integration and upgrading.

Figure 2.4 GVC Participation (DVX + FVA) as Share of Exports



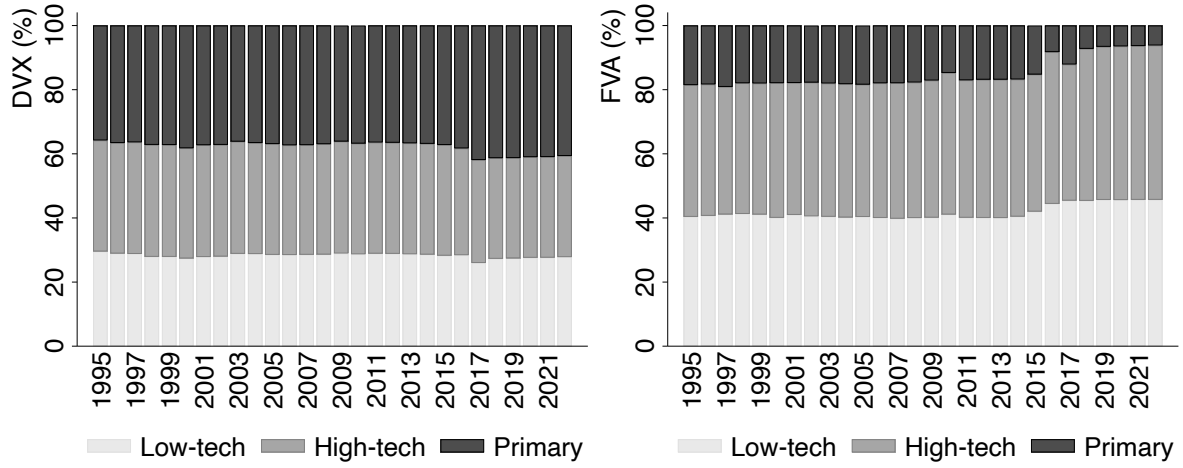
Source: Author's own construction using the UNCTAD-EORA dataset.
The map is an average over the period 1995–2018. Countries in gray are not covered by our sample.

Figure 2.5 Egypt's GVC Participation (DVX + FVA) as Share of Exports



Source: Author's own construction using the UNCTAD-EORA dataset.

Figure 2.6 DVX and FVA as Share of Exports – by Technological Intensity



Source: Author's own construction using the UNCTAD-EORA dataset.

2.4 Empirical Strategy

This section outlines the empirical strategy used to assess the impact of bilateral RER depreciation on Egypt's integration into GVCs and its positioning along the value chain. The first part (Section 2.4.1) investigates how RER depreciation affects GVC participation through both forward and backward linkages. The second part (Section 2.4.2) examines the potential for sectoral upgrading, and the underlying channels that drive this process.

2.4.1 Bilateral RER and GVC Integration

To estimate the effect of bilateral RER depreciation on Egypt's GVC participation, we follow the Poisson Pseudo-Maximum Likelihood (PPML) approach (Santos Silva and Tenreyro, 2006; 2011). This estimator is well-suited for trade data, as it effectively handles the presence of zero trade flows and heteroskedasticity. We estimate the following equation:

$$GVC_{Egy,j,s,t} = \exp[\alpha_1 \ln(RER_{Egy,j,t}) + \alpha_2 \ln(Tariffs_{Egy,j,s,t} + 1) + \alpha' W_{j,t} + \psi_{j,s} + \phi_{t,s} + \tau_{Egy,j,s,t}] \quad (2)$$

where $GVC_{Egy,j,s,t}$ is Egypt's GVC participation index with partner country *j*, in sector *s*, and year *t*. This index is measured through three variables: (i) forward linkage (DVX), i.e., the domestic value added of Egypt embodied in its partner's exports; (ii)

backward linkage (FVA), i.e., the foreign value added embodied in Egyptian exports; and (iii) total GVC participation index (DVX + FVA). These measures are expressed as shares of exports. $\ln(\text{RER}_{\text{Egy,j,t}})$ is the log of the bilateral RER, as defined in Section 2.3.2. $\ln(\text{Tariffs}_{\text{Egy,j,s,t}} + 1)$ represents sector-specific bilateral weighted average applied tariffs[8] to control for trade openness. $W_{j,t}$ is a vector of partner-specific controls, including the real GDP per capita (in log) to proxy economic development; and the total natural resource rents (in log), capturing resource dependence. A higher level of rents is generally seen as a factor reducing economic diversification due to the Dutch disease or the curse of raw materials. Moreover, oil dependence hampers innovation by concentrating economies in low-value-added extractive sectors (Namazi and Mohammadi, 2018). $\psi_{j,s}$ and $\phi_{t,s}$ denote partner-sector and year-sector fixed effects, respectively. $\tau_{\text{Egy,j,s,t}}$ is the error term. Standard errors are clustered at the partner-year level, the same dimension as the variable of interest to control for further error correlation bias.

2.4.2 Bilateral RER and GVC Upgrading

While participation in GVCs is important, it is not in itself an indicator of economic transformation. True competitiveness also requires upgrading, moving into higher value-added segments of the value chain, and escaping the low-technology trap.

Due to the limited availability of firm-level and task-specific data, particularly in developing countries such as Egypt, the various forms of upgrading discussed above are difficult to measure empirically. To address this challenge, the analysis adopts Egypt's GVC position as a proxy for upgrading, or movement up the value chain. GVC position is captured through upstreamness and downstreamness indices (Costinot et al., 2013; Montalbano and Nenci, 2022). Upstreamness measures the distance of a country or sector's production from final demand: the greater the distance, the higher the upstreamness index (Antràs et al., 2012). Conversely, downstreamness captures the distance from factors of production (value-added sources), with higher values indicating greater separation from input provision (Antràs and Chor, 2013). The use of GVC position or increases in domestic value-added content, especially in high-technology, more productive, or more skill-intensive sectors, as a proxy for upgrading is well motivated and widely used in the literature (e.g., Raei et al., 2019; Mehta, 2022).

The literature has long expressed concern that developing countries are predominantly confined to downstream segments of value chains, often characterized

[8] Following Fontagné et al. (2015), we include ln(tariffs +1) to account for cases of zero tariffs.

by low wages (Kummritz, 2016). Yet, upstreamness and downstreamness indices should be interpreted with caution. A country's position along the value chain, without considering the sector of operation and its technological intensity, does not inherently signal upgrading. In advanced economies, upstream positions are often associated with the provision of high-value intangible assets, such as R&D and design. For instance, the United States plays an upstream role in the IT sector (high-tech sector) by contributing core intellectual inputs to products such as the iPhone. In contrast, upstream positions in developing countries may reflect specialization in low-value-added activities, such as the extraction or supply of raw materials, with limited prospects for functional upgrading (Foster-McGregor et al., 2015). For instance, Egypt's upstream position in the metal products and wood and paper sectors (see Figure 2A.1 in Appendix 2A) primarily reflects activities related to raw-material supply and basic processing rather than advanced manufacturing or design, offering relatively modest prospects for technological advancement.

To accurately assess whether Egypt's position reflects genuine upgrading, we follow two complementary strategies. First, we analyze the GVC position of each sector separately to capture sector-specific dynamics. Second, sectors are classified into primary, low-, and high-tech categories following Foster-McGregor et al. (2015), allowing us to contextualize Egypt's position according to technological intensity (see Table 2A.2).

Following Koopman et al. (2010), Ahmed et al. (2017), and Wang et al. (2021), the upstreamness index at the partner-sector-year level is defined as:

$$\text{Upstreamness}_{\text{Egy,j,s,t}} = \ln\left(\frac{\text{DVX}_{\text{Egy,j,s,t}}}{\text{EXP}_{\text{Egy,j,s,t}}}\right) - \ln\left(\frac{\text{FVA}_{\text{Egy,j,s,t}}}{\text{EXP}_{\text{Egy,j,s,t}}}\right) \qquad (3)$$

If Egypt is upstream in the production process, its domestic value added (forward linkage) is more likely to be higher than its foreign value added (backward linkage). Conversely, if Egypt specializes in the final stages of production as a downstream supplier, it relies more heavily on imported intermediate inputs and exhibits higher backward than forward linkages. Constructed in this way, positive values indicate upstream positioning, while negative values reflect downstream positioning.

To estimate the impact of bilateral RER depreciation on upstreamness, we estimate the following OLS fixed-effects model:

$$\text{Upstreamness}_{Egy,j,s,t} = \beta_1 \ln(\text{RER}_{Egy,j,t}) + \beta_2 \ln(\text{Tariffs}_{Egy,j,s,t} + 1) + \beta' W_{j,t} + \psi_{j,s} + \phi_{t,s} + \mu_{Egy,j,s,t} \quad (4)$$

where the right-hand side includes the same covariates and fixed effects as in Eq. (2), and $\mu_{Egy,j,s,t}$ denotes the error term.

We estimate Eq. (2) in three steps. First, regressions are run over the full sample to capture aggregate effects across all sectors. Second, sectors are grouped by technological intensity into primary, low-technology, and high-technology categories. Third, sector-specific regressions are conducted to account for heterogeneity across sectors.

In contrast, for the analysis of GVC upgrading (Eq. (4)), we focus on the second and third steps only. This approach allows us to evaluate whether Egypt's position and performance within GVCs differ across sectors and technological levels while abstracting from aggregate effects that may obscure upgrading dynamics.

We extend the analysis in two additional directions. First, we examine the role of foreign knowledge embedded in imported inputs in driving GVC upgrading (Section 2.5.2.1). Second, we explore two sources of heterogeneity. First, we distinguish between South–North and South–South trade flows to assess whether exchange rate movements affect Egypt's integration differently depending on the development level of its trading partners (Section 2.6.1.1). Second, we split the sample into three subperiods to assess potential temporal variation in the findings (Section 2.6.1.2). Finally, we assess the robustness of all results through additional checks, including lagged-RER specifications and exclusion of top trading partners (Section 2.6.2).

2.5 Empirical Findings

Section 2.5.1 presents the empirical results on the impact of bilateral RER depreciation on Egypt's GVC integration, examining both forward and backward linkages, differences across sectors classified by technological intensity, and sector-specific responses. Section 2.5.2 then turns to the question of GVC upgrading and assesses whether foreign knowledge embedded in imported inputs serves as a channel through which the RER can foster upgrading along the value chain.

2.5.1 Bilateral RER and GVC Integration

The results for the entire sample[9] are reported in Table 2.1 for GVC participation index and Table 2.2 for forward and backward linkages. Bilateral RER depreciation is found to significantly enhance Egypt's overall GVC integration (Table 2.1 column 1). A 10 percent bilateral RER depreciation increases total GVC participation by 0.27 percent, with positive effects observed for both forward and backward linkages, raising forward linkages by 0.18 percent and backward linkages by 0.22 percent (Table 2.2). It is important to distinguish between these two indicators of GVC participation for two reasons. First, the forward linkage, which captures the value added of Egypt embodied in its partners' exports, should in theory respond positively to RER depreciation in line with conventional trade theory and standard export elasticity expectations. In contrast, the backward linkage, which measures the foreign value added embodied in Egypt's exports, depends on intermediate input imports, the share of foreign inputs in total exports, and the availability (or lack) of domestic substitutes. Second, as illustrated in Figure 2A.1, Egypt's forward and backward linkages display markedly different sectoral compositions. Egypt predominantly occupies upstream positions in primary sectors, such as agriculture, fishing, and mining and quarrying, and low-tech sectors, such as wood and paper, and metal products. In contrast, backward linkages are largely concentrated in high-tech sectors, including electrical and machinery and transport equipment. These distinct sectoral patterns underscore Egypt's asymmetric position within GVCs, upstream in resource-based industries and downstream in technology-intensive ones, highlighting the importance of distinguishing between forward and backward GVC participation.

[9] We run the baseline regression with alternative fixed effects and additional gravity controls. The results are presented in Appendix 2B.

The results are intuitive in two respects. First, in a GVC context, recent studies suggest that forward and backward linkages tend to be complementary rather than substitutive (Cheng et al., 2016; Gonzalez, 2016; Montalbano and Nenci, 2022; Abdou et al., 2026). Increasing Egypt's forward integration often requires a greater use of imported intermediate inputs, thereby strengthening backward linkages. Thus, both linkages are likely to respond similarly to RER depreciation or appreciation.

Second, Egypt's strong reliance on foreign intermediate inputs, especially in high-tech sectors such as electrical and machinery and transport equipment, constrains its ability to substitute these imports with domestic alternatives. Building the necessary domestic capabilities in these sectors would require substantial investments in human capital, infrastructure, and technological development. Even in relatively less sophisticated sectors, such as textiles and wearing apparel or food and beverages, Egypt's production processes remain closely tied to global input chains. As noted by Ali et al. (2016), protectionist measures that restrict access to foreign inputs may undermine competitiveness and hinder industrial specialization. Yet, excessive reliance on imported inputs without parallel efforts to develop domestic capacity risks jeopardizing structural transformation and binding endeavors to move the economy away from low-value-added activities, a pattern observed in several developing economies.

At the sectoral level, and distinguishing sectors by technological intensity, the results in Table 2.1 (Columns 2- 4) confirm that RER depreciation increases GVC integration across all categories, with effects more pronounced in high- and low-tech sectors. When disentangling the impact across forward and backward linkages (Table 2.2), the findings reveal that primary sectors respond most strongly on the forward side, with a 10 percent depreciation increasing DVX by 0.21 percent in primary sectors. By contrast, both low-tech and high-tech sectors exhibit substantial gains in backward participation, rising by 0.55 percent and 0.77 percent, respectively. The muted forward response in high-tech sectors is unsurprising, given Egypt's limited comparative advantage in producing technologically sophisticated inputs. Instead, Egypt's forward linkages remain concentrated in primary sectors (e.g., extractives and fishing) and low-tech industries (e.g., metal products).

The strong and significant results for backward linkages, particularly in high-tech sectors, are encouraging. Backward participation provides a key channel for learning and upgrading, as it exposes domestic firms in developing economies to more

sophisticated inputs and production technologies (Tian et al., 2022). Such exposure fosters knowledge transfer, productivity gains, and shifts in sectoral composition that support upward movement along the value chain, a pattern widely observed in many Asian countries (Raei et al., 2019). This mechanism of learning through imported inputs is examined in greater depth in Section 2.5.2.1.

A closer look at sector-specific outcomes reinforces these dynamics. Figure 2.7 shows that the impact of RER depreciation on overall GVC participation is most pronounced in the electrical and machinery sector, followed by food and beverages sectors. Figure 2.8 highlights that metal products (low-tech) and mining and quarrying (primary) benefit the most in terms of forward linkages. Meanwhile, Figure 2.9 reveals that transport equipment (high-tech), followed by textiles and wearing apparel and food and beverages (low-tech), exhibit the strongest response in backward linkages. Such imports of equipment, machinery, and electronics act as vehicles for *know-how* and *know-what*, enabling domestic firms to acquire knowledge embodied in foreign capital goods (Kim, 1980; Bloom, 1993; Kim and Lee, 2002). Taken together, these patterns reinforce earlier findings: RER depreciation raises DVX in primary sectors while simultaneously increasing imports of foreign inputs in both high- and low-tech sectors, suggesting a gradual restructuring of Egypt's production system that may lay the groundwork for future upgrading.

Controlling for bilateral sector-specific applied tariffs, the analysis indicates that tariffs hinder GVC integration, particularly through backward linkages (Table 2.2). Tariffs, especially those imposed on intermediate inputs, restrict access to foreign inputs, raise production costs, and ultimately impede the growth of downstream industries (Cheng et al., 2015; Kowalski et al., 2015). Accordingly, trade liberalization emerges as an important determinant of GVC participation. In this context, recent protectionist measures adopted in various countries risk limiting developing economies' participation in GVCs and reinforcing global production fragmentation (Fernandes et al., 2022).

When controlling for the real GDP per capita of Egypt's trading partners, used as a proxy for income level, the results show that higher partner income is associated with greater GVC integration through both forward and backward linkages. This finding is consistent across the full sample and the sectoral breakdown and aligns with Egypt's trade profile, which shows deep integration with high-income and upper-middle-income partners (see Figure 2A.2). Finally, the variable capturing natural

resource rents does not yield significant effects in most specifications, suggesting that resource dependence has not played a major role in shaping Egypt's sectoral integration into GVCs over the period of analysis.

Table 2.1 Bilateral RER and GVC Participation – PPML Estimates

	GVC			
	All	Primary	LowTech	HighTech
ln(RER)	0.026***	0.019***	0.031***	0.042***
	(0.006)	(0.0063)	(0.010)	(0.014)
ln(Tariffs +1)	-0.014*	0.013	-0.012	-0.028**
	(0.008)	(0.014)	(0.009)	(0.011)
ln($GDPPC_{jt}$)	0.894***	0.718***	0.876***	0.961***
	(0.048)	(0.063)	(0.049)	(0.050)
ln($Rents_{jt}$)	-0.012	0.001	-0.017	-0.011
	(0.011)	(0.013)	(0.012)	(0.012)
Year-Sector FE	✓	✓	✓	✓
Partner-Sector FE	✓	✓	✓	✓
Clusters	jt	jt	jt	jt
# of clusters	3,918	3,797	3,795	3,762
Mean of dep. Δ	0.378	0.339	0.387	0.417
Observations	37,022	8,446	14,316	10,719
Pseudo R^2	0.658	0.624	0.669	0.677

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The GVC participation index is expressed as share of exports.

The intercept is included.

Table 2.2 Bilateral RER, Forward and Backward Linkages – PPML Estimates

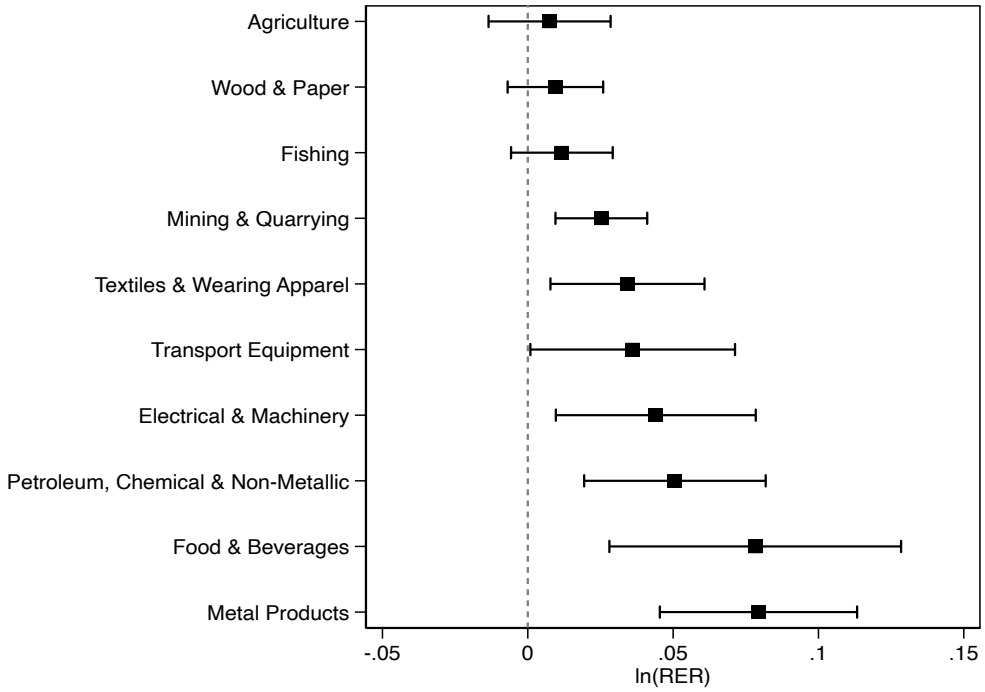
	DVX				FVA			
	All	Primary	LowTech	HighTech	All	Primary	LowTech	HighTech
ln(RER)	0.018***	0.021***	0.016	0.015	0.022***	0.001	0.055***	0.077***
	(0.007)	(0.008)	(0.011)	(0.017)	(0.008)	(0.007)	(0.014)	(0.014)
ln(Tariffs +1)	0.010	0.034**	0.007	-0.020	-0.032***	-0.008	-0.028***	-0.036***
	(0.011)	(0.016)	(0.010)	(0.014)	(0.008)	(0.007)	(0.010)	(0.011)
ln($GDPPC_{jt}$)	0.742***	0.810***	0.657***	0.766***	0.998***	0.971***	0.930***	1.043***
	(0.076)	(0.081)	(0.082)	(0.076)	(0.039)	(0.049)	(0.040)	(0.040)
ln($Rents_{jt}$)	-0.019	0.001	-0.028**	-0.023	-0.005	0.003	-0.0004	-0.009
	(0.013)	(0.014)	(0.012)	(0.014)	(0.012)	(0.013)	(0.013)	(0.013)
Year-Sector FE	✓	✓	✓	✓	✓	✓	✓	✓
Partner-Sec FE	✓	✓	✓	✓	✓	✓	✓	✓
Clusters	jt	jt	jt	jt	jt	jt	jt	jt
# of clusters	3,918	3,797	3,795	3,762	3,918	3,797	3,795	3,762
Mean of dep. Δ	0.229	0.274	0.224	0.235	0.149	0.065	0.163	0.182
Observations	37,022	8,446	14,316	10,719	37,022	8,446	14,316	10,719
Pseudo R^2	0.632	0.627	0.652	0.625	0.594	0.421	0.547	0.599

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The GVC participation index, DVX, and FVA are expressed as shares of exports.

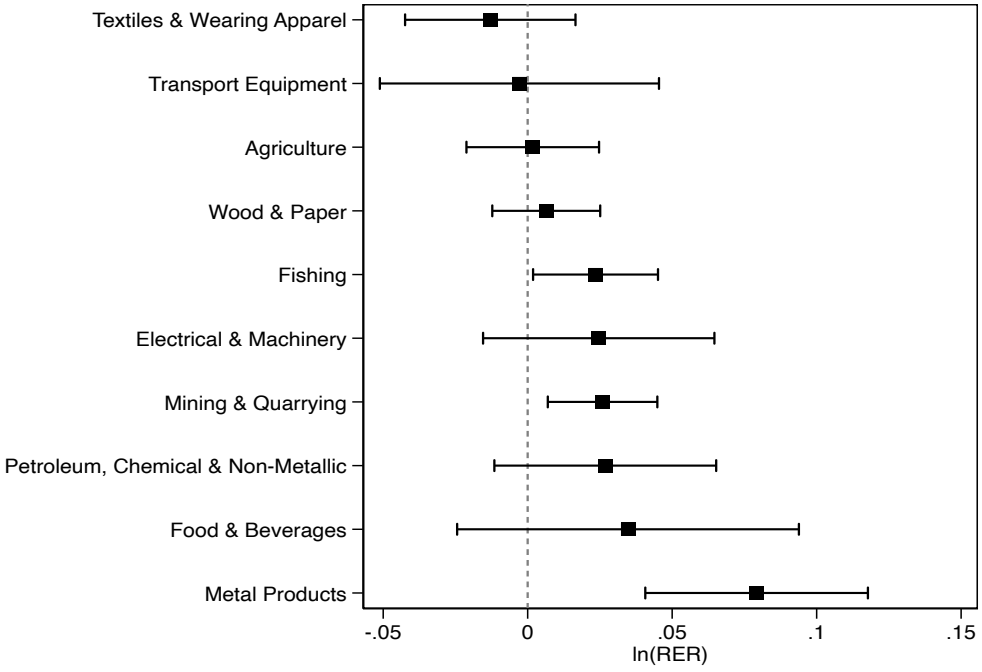
The intercept is included.

Figure 2.7 Bilateral RER and GVC Participation (DVX + FVA) – by Sector



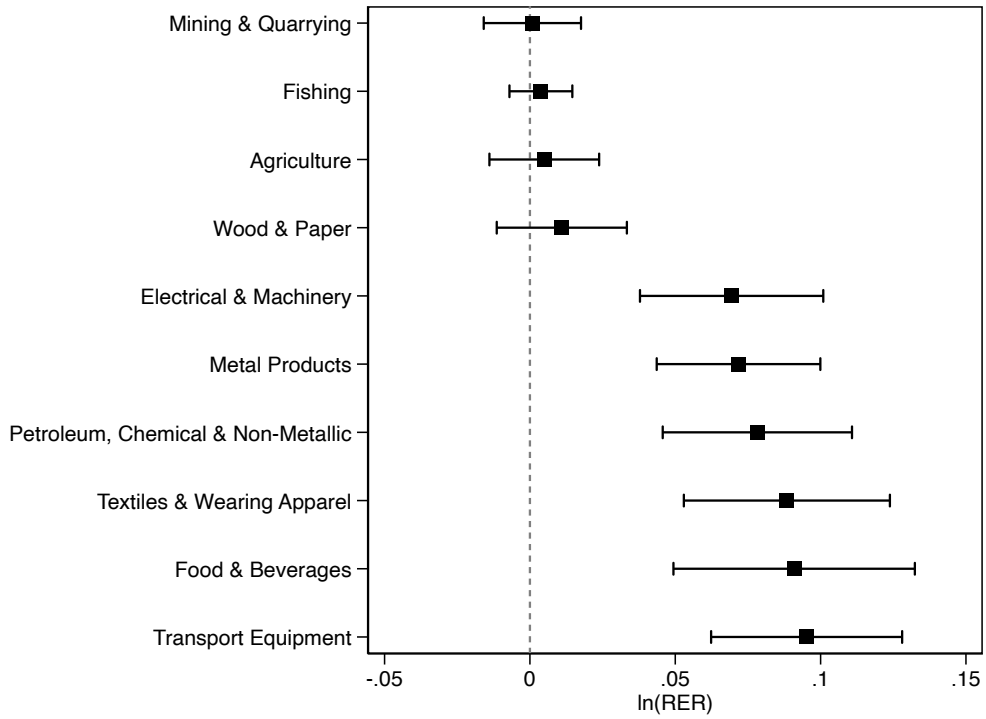
Note: The specification includes all control variables, as well as year and partner fixed effects.
Standard errors are clustered at the partner-year level.
For brevity, only the estimated coefficients for the RER are reported.

Figure 2.8 Bilateral RER and Forward Linkage (DVX) – by Sector



Note: The specification includes all control variables, as well as year and partner fixed effects.
Standard errors are clustered at the partner-year level.
For brevity, only the estimated coefficients for the RER are reported.

Figure 2.9 Bilateral RER and Backward Linkage (FVA) – by Sector



Note: The specification includes all control variables, as well as year and partner fixed effects.
Standard errors are clustered at the partner-year level.
For brevity, only the estimated coefficients for the RER are reported.

2.5.2 Bilateral RER and GVC Upgrading

As noted earlier, a country's competitiveness is not determined solely by its ability to join a value chain, but by the strategic position it occupies along the value chain and its capacity to upgrade from low- to high-value-added sectors. Since the upstreamness index serves as an indicator of positioning and a proxy for upgrading, presenting results for the full sample would be misleading: an increase in upstreamness cannot automatically be interpreted as upgrading unless sectors are classified by technological intensity (Table 2.3) or examined individually (Figure 2.10).

Table 2.3 shows that the bilateral RER does not exhibit any statistically significant impact on the upstreamness index across any of the three technological categories. A sector-by-sector analysis (Figure 2.10) confirms the same conclusion. These findings reinforce the idea that, while exchange rate policy is a significant tool for enhancing Egypt's GVC integration across all sectors, it is not sufficient on its own to generate upgrading. Moving up the value chain requires more than trade cost adjustments. It requires changes in the structure of production, investment in skills, and access to new knowledge and technology, all of which differ markedly across sectors.

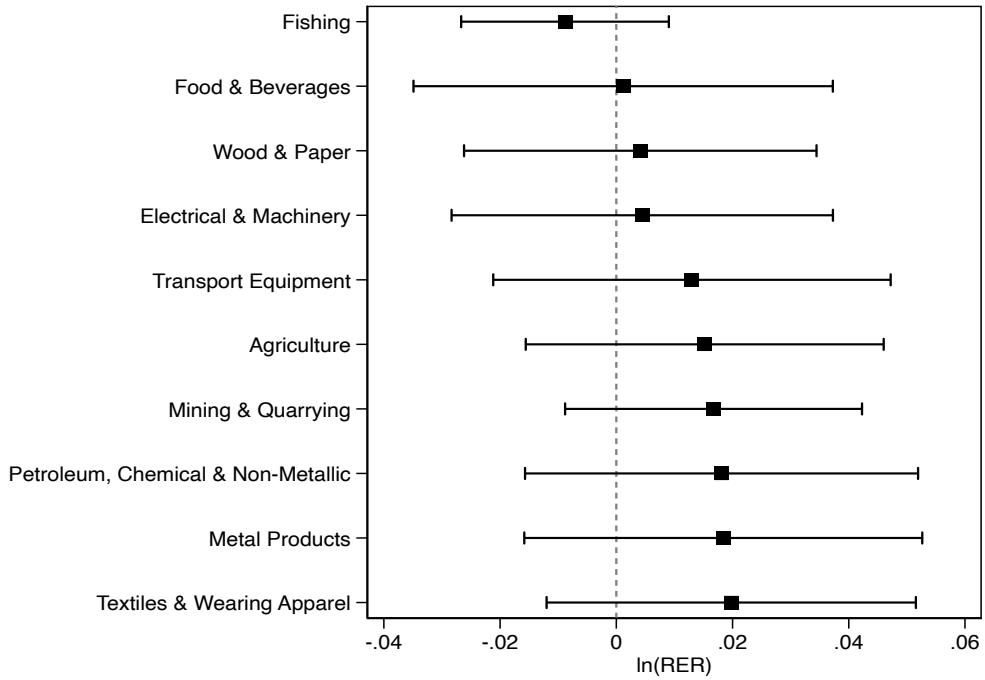
In the following section, we therefore examine the role of foreign knowledge embedded in imported inputs as a potential driver of Egypt's movement up the value chain. We also assess whether this knowledge channel enables the exchange rate to translate not only into greater GVC integration, but into improved strategic positioning along the chain.

Table 2.3 Bilateral RER and GVC Upgrading – by Technological Intensity

	Upstreamness		
	(1) Primary	(2) LowTech	(3) HighTech
ln(RER)	0.012	0.011	0.012
	(0.011)	(0.017)	(0.017)
ln(Tariffs +1)	-0.016*	-0.030***	-0.043***
	(0.008)	(0.008)	(0.008)
$\ln(GDPPC_{jt})$	-0.367***	-0.423***	-0.464***
	(0.039)	(0.044)	(0.043)
$\ln(Rents_{jt})$	-0.003	-0.003	-0.006*
	(0.003)	(0.004)	(0.00343)
Partner-Sector FE	✓	✓	✓
Year-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,963	4,012	3,977
Mean of dep. Δ	0.973	0.070	0.509
Observations	9,028	15,167	11,325

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included.

Figure 2.10 Bilateral RER and GVC Upgrading – by Sector



Note: The specification includes all control variables, as well as year and partner fixed effects.
Standard errors are clustered at the partner-year level.
For brevity, only the estimated coefficients for the RER are reported.

2.5.2.1 Knowledge Spillover Effect

As clarified earlier in the literature review section, knowledge gained through importing from technologically advanced trade partners serves as a channel through which RER depreciation can lead to upgrading and a shift in the technological composition of DVX. This idea is consistent with the early work of Coe et al. (1997), who demonstrate that by trading with industrial countries that possess large stocks of knowledge accumulated through R&D efforts, developing countries can boost productivity by importing a wider range of intermediate goods and capital equipment that embody foreign knowledge, as well as by accessing information that would otherwise be costly to obtain. We therefore assess the mitigating role of trading with R&D-intensive partners in fostering upgrading within GVCs through a two-step approach. First, we interact the bilateral RER with a measure capturing the level of R&D investment in the partner country (Table 2.4). Second, we construct a GVC knowledge spillover index to capture the learning effects associated with trading with partners that are highly intensive in R&D (Table 2.5).

The findings in Table 2.4 indicate that trading with R&D-intensive partners is associated with an increase in the upstreamness index, with the effect being more pronounced in high-tech sectors, followed by low-tech sectors, suggesting an upgrade along the value chain. When interacted with the bilateral RER, the interaction term and the corresponding marginal effects are positive and highly significant, with the impact again more pronounced in high-tech sectors. These findings support the idea that trading with industrial countries intensive in R&D facilitates upgrading by allowing knowledge diffusion, consistent with the evidence in Coe et al. (1997).

Table 2.4 Bilateral RER, R&D, and GVC Upgrading

	Upstreamness		
	(1) Primary	(2) LowTech	(3) HighTech
[1] ln(RER)	-0.022	-0.045***	-0.047***
	(0.017)	(0.017)	(0.015)
[2] ln($R\&D_{jt}$)	0.044*	0.091***	0.093***
	(0.023)	(0.025)	(0.024)
[1] * [2]	0.008**	0.016***	0.017***
	(0.004)	(0.005)	(0.004)
[1]*[2] Marginal Effect (at median)	0.022 (0.014)	0.041** (0.017)	0.045*** (0.017)
Partner-Sector FE	✓	✓	✓
Year-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	2,510	2,486	2,478
Mean of dep. Δ	0.973	0.070	0.509
Observations	6,257	9,625	7,214

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The intercept and controls are included but not reported for brevity.

Building on these results, following Eissa and Zaki (2023) and the offshoring definition of Feenstra and Hanson (1996), we construct a GVC knowledge spillover index to capture the learning effect embodied in Egypt's imports of intermediate inputs from its trade partners. The index reflects the extent to which exposure to foreign R&D, transmitted through technology-intensive intermediate inputs, contributes to domestic value-added generation and facilitates upgrading along GVCs. To quantify the potential for learning through imported inputs, we define the knowledge spillover index as follows:

$$\text{Knowledge Spillover Index}_{ijt} = \frac{\sum_i^t VA_{ijt} \times RD_{jt}}{(\sum_i^t VA_{ijt} \times RD_{jt}) + (DVA_{it} \times RD_{it})} \qquad (5)$$

where i refers to the destination country (Egypt in our case), j to the partner (exporter) country, and t to the year. VA_{ijt} is absorbed foreign value added[10], DVA_{it} is the direct domestic value added, and RD is R&D measured by resident patent applications from the WDI, used as a proxy for the stock of knowledge.

Controlling for this spillover index in our estimations (Table 2.5), we find no statistically significant effect of either the RER or the spillover index on upstreamness in primary sectors. This result is intuitive, since these sectors are typically less reliant on foreign imported inputs and technology-driven production processes. By contrast, the spillover index exhibits a positive and highly significant effect for both low-tech and high-tech sectors, suggesting a strong learning effect from foreign intermediate inputs, consistent with technology diffusion via backward GVC participation (Tian et al., 2022; Stojčić and Matić, 2024).

Furthermore, the interaction term between the RER and the spillover index is also positive and significant in both low- and high-tech sectors, with a more pronounced effect observed in the latter. This indicates that, when coupled with active industrial policies encouraging the import of technologically intensive inputs, exchange rate depreciation can foster upgrading by enabling domestic firms to acquire foreign knowledge, expand technological capabilities, and improve productivity.

[10] Following the United Nations System of National Accounts (SNA) 1993, VA is measured as the sum of six variables: compensation of employees, subsidies on production, taxes on production, net mixed income, net operating surplus, and consumption of fixed capital, using GLORIA multi-region input-output database.

Sector-specific analysis (Figure 2.11) shows that the interaction between the RER and the spillover index is most pronounced in the electrical and machinery sector (high-tech), followed by metal products (low-tech) and transport equipment (high-tech).

We assess the robustness of these findings using two alternative approaches. First, inspired by Raei et al. (2019), we measure upgrading as the share of high-tech sectors in Egypt's value-added exports. Table 2B.2 in Appendix 2B shows that the RER alone does not increase this share. However, once foreign learning is incorporated through the spillover index, RER depreciation is associated with a higher share of high-tech value added, reflecting an upgrading effect consistent with our main results. Second, we recalculate the knowledge spillover index using FVA from UNCTAD-EORA (Columns 1-3, Table 2B.2), and the findings remain unchanged: controlling for foreign knowledge embedded in imported inputs, RER depreciation significantly increases upstreamness, with the strongest effect observed in high-tech sectors followed by low-tech sectors.

These findings underscore the importance of distinguishing between sectoral dynamics. In a GVC context, real upgrading is driven not by primary sectors but by gains in high- and low-tech sectors. Thus, the results highlight the dual role of RER depreciation: it not only improves competitiveness but, when paired with foreign knowledge embedded in imported intermediate inputs, also fosters technological learning, productivity improvements, and upward movement along the value chain.

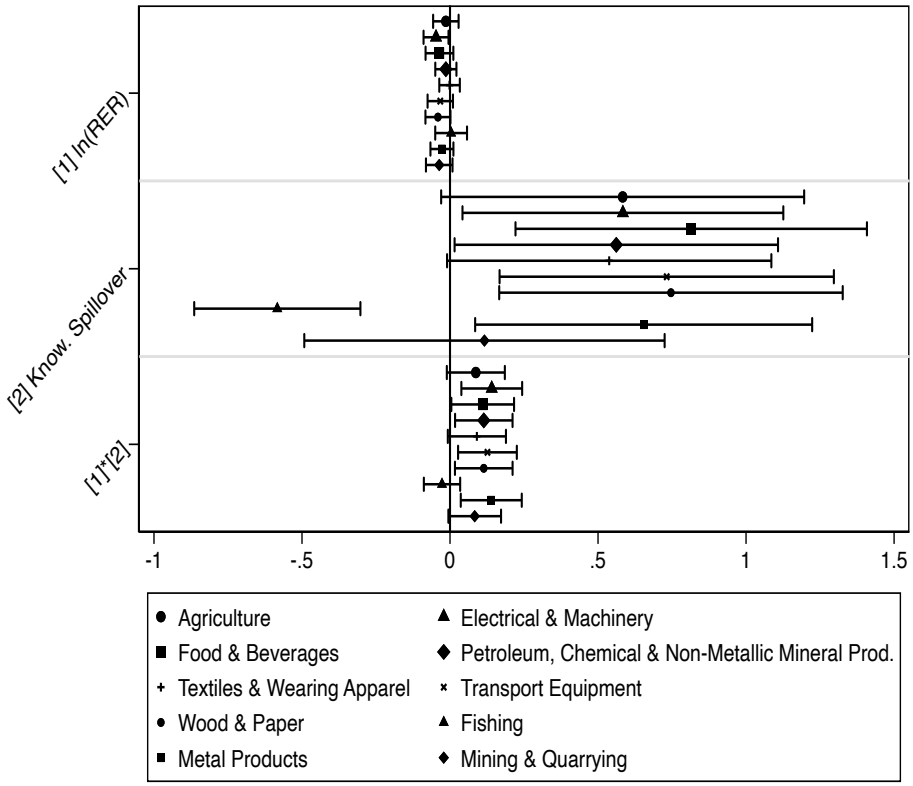
Table 2.5 Bilateral RER, Knowledge Spillover, and GVC Upgrading

	Upstreamness		
	(1) Primary	(2) LowTech	(3) HighTech
[1] ln(RER)	-0.021	-0.026	-0.030
	(0.020)	(0.020)	(0.019)
[2] Know. Spillover Index	0.174	0.685**	0.634**
	(0.260)	(0.288)	(0.278)
[1] * [2]	0.064	0.112**	0.126**
	(0.040)	(0.050)	(0.049)
[1]*[2] Marginal Effect (at median)	0.034 (0.021)	0.058** (0.025)	0.065*** (0.025)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	2,276	2,259	2,249
Mean of dep. Δ	1.212	0.156	0.417
Observations	5,719	8,763	6,570

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The intercept and controls are included but not reported for brevity.

Figure 2.11 RER, Knowledge Spillover, and GVC Upgrading – by Sector



Note: The specification includes all control variables, as well as year and partner fixed effects.
Standard errors are clustered at the partner-year level.
For brevity, only the estimated coefficients for the RER are reported.

2.6 Heterogeneity Analysis and Robustness Checks

2.6.1 Heterogeneity Analysis

The previous analysis examines the impact of RER depreciation on Egypt's GVC integration without distinguishing between trade partners, their income classification, or key time periods associated with major policy shifts and episodes of devaluation or depreciation of the Egyptian pound. This section introduces these sources of heterogeneity by estimating the model across tailored subsamples. In particular, we analyze trade direction (Table 2.6) and the impact across different subperiods (Table 2.7).

2.6.1.1 Direction of Trade: South-South vs. South-North

Caglayan and Demir (2019) emphasize that both the composition and direction of trade are critical in determining how RER movements affect bilateral trade flows. Their analysis categorizes trade into four groups[11]: South-South, South-North, North-South, and North-North, and shows that Southern exports are generally more sensitive to RER depreciation than Northern exports, except in the case of primary goods. Moreover, they argue that South-North trade tends to react more strongly to RER depreciation than South-South trade, due to differences in development levels and macroeconomic channels (Dahi and Demir, 2017).

Motivated by this insight, and treating Egypt as a Southern country, we examine whether the effect of RER depreciation differs depending on the income level of its trading partners. Following the World Bank country income classification (Appendix 2A), we first disaggregate Egypt's partners into four groups: low, lower-middle, upper-middle, and high-income. We then group them into two categories: Egypt-North and Egypt-South and estimate separate regressions for each group while allowing sectoral composition to vary. Table 2.6 reports only the RER coefficients for brevity.

We find that overall GVC participation responds positively and significantly to RER depreciation only in Egypt-North trade. By contrast, no significant effect is observed in Egypt-South trade, regardless of sectoral breakdown. Disaggregating further, we observe that in Egypt-South trade, DVX increases with RER depreciation only in primary sectors. In Egypt-North trade, however, DVX rises significantly across all sectors, with the strongest effects observed in high-tech sectors. This pattern is consistent with Caglayan and Demir (2019), who note that primary exports from the South are less sensitive to RER depreciation when destined for the North, since primary goods exported by the South are typically priced in hard currencies, especially the USD. Freund and Pierola (2012) and Chen and Juvenal (2016) further suggest that RER depreciation facilitates high-tech Southern exports to Northern markets via macroeconomic and developmental channels, enabling less competitive Southern firms producing high-skill products to penetrate Northern markets. However, this dynamic does not apply to South-South trade in high-tech goods.

[11] South refers to a developing economy, while North refers to a developed one.

A clear asymmetry emerges when examining backward linkages. When inputs originate from Southern partners, the effect of RER depreciation on FVA becomes negative, suggesting a contraction in imported inputs sourcing from the South. In contrast, FVA increases significantly when inputs originate from Northern partners, with the largest effects observed in high-tech sectors. This aligns with Coe et al. (1997), who show that developing economies can boost productivity by trading with technologically advanced economies. By importing a wider range of inputs and capital equipment that embody foreign knowledge, these economies not only benefit from embedded technology but also gain access to information and know-how that would otherwise be costly or difficult to acquire domestically. The findings for low-tech sectors further support Caglayan and Demir (2019), who argue that RER depreciation gives Northern exporters a competitive edge in low-skill products for which they have a comparative disadvantage, due to the increasing importance of noncore (less efficient) products in the Northern export basket (Chatterjee et al., 2013).

In summary, relative to the baseline estimates, the heterogeneity results reveal that forward participation is primarily driven by trade with Southern partners, whereas backward participation is predominantly driven by Northern partners. This distinction reinforces the idea that Egypt's role in GVCs is shaped not only by sectoral characteristics but also by the development level of its trade partners and the direction of value-added flows.

Table 2.6 RER Depreciation and GVC Integration – Direction of Trade

	GVC Participation							
	South Partner				North Partner			
	Full Sample	Primary	LowTech	HighTech	Full Sample	Primary	LowTech	HighTech
ln(RER)	0.037	0.059	0.041	0.021	0.031***	0.025**	0.040***	0.067***
	(0.034)	(0.070)	(0.033)	(0.026)	(0.006)	(0.010)	(0.011)	(0.018)
FE[1]	✓	✓	✓	✓	✓	✓	✓	✓
Clusters	jt	jt	jt	jt	jt	jt	jt	jt
Obs.	23,521	4,958	9,340	6,966	13,501	3,488	4,976	3,753
Pseudo R^2	0.635	0.549	0.652	0.657	0.585	0.484	0.544	0.582
	Forward Linkage							
	South Partner				North Partner			
	Full Sample	Primary	LowTech	HighTech	Full Sample	Primary	LowTech	HighTech
ln(RER)	0.061*	0.146***	0.062	0.026	0.026***	0.024***	0.024**	0.032*
	(0.036)	(0.054)	(0.038)	(0.031)	(0.007)	(0.008)	(0.010)	(0.019)
FE[1]	✓	✓	✓	✓	✓	✓	✓	✓
Clusters	jt	jt	jt	jt	jt	jt	jt	jt
Obs.	23,521	4,958	9,340	6,966	13,501	3,488	4,976	3,753
Pseudo R^2	0.506	0.535	0.504	0.490	0.568	0.578	0.585	0.533
	Backward Linkage							
	South Partner				North Partner			
	Full Sample	Primary	LowTech	HighTech	Full Sample	Primary	LowTech	HighTech
ln(RER)	-0.046*	-0.078**	-0.037	-0.051**	0.033***	0.009	0.080***	0.125***
	(0.026)	(0.034)	(0.028)	(0.026)	(0.011)	(0.008)	(0.020)	(0.023)
FE[1]	✓	✓	✓	✓	✓	✓	✓	✓
Clusters	jt	jt	jt	jt	jt	jt	jt	jt
Obs.	23,521	4,958	9,340	6,966	13,501	3,488	4,976	3,753
Pseudo R^2	0.666	0.479	0.684	0.680	0.491	0.372	0.488	0.500

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

[1]All regressions include year-sector and partner-sector fixed effects.

Control variables and the intercept are included in all regressions but not reported for brevity.

South partner denotes a developing country partner, whereas North partner denotes a developed country partner.

2.6.1.2 Analysis over different subperiods

The second heterogeneity analysis examines how the impact of RER depreciation varies across distinct subperiods within 1995–2022. To capture temporal variation linked specifically to major episodes of devaluation or depreciation of the Egyptian pound, the sample is split into four comparable subperiods: (i) 1995–2003, (ii) 2004–2010, (iii) 2011–2016, and (iv) 2017–2022. This stratification allows us to assess how the effect of RER depreciation on Egypt's GVC integration evolves over time.

The results (Table 2.7) show that in the first period (1995–2003), the coefficients are generally statistically insignificant or negative across all GVC measures. This outcome is consistent with the exchange-rate dynamics of the period, which is characterized by a *de facto* peg and successive discretionary devaluations that generated uncertainty and limited the competitiveness gains from depreciation. A similarly weak pattern emerges in the fourth period (2017–2022). Despite the significant 2016 devaluation, its

effect on GVC participation appears limited. Zaki et al. (2019) document three plausible factors that help explain the muted export response. First, the high share of imported intermediates in production (almost 75 percent), which makes depreciation inflationary and raises input costs. Second, potential efficiency losses, whereby depreciation reduces firms' incentives to upgrade productivity. Third, persistent supply-side bottlenecks that constrain the expansion of production and exports. In addition, the years 2017–2020 overlap with the COVID–19 shock, during which global disruptions, rising costs, and sector-specific losses, particularly in textiles and wood and paper sectors, further dampened the response (IFPRI, 2020; Eldeep and Zaki, 2022).

By contrast, the second (2004–2010) and third (2011–2016) periods display positive and statistically significant coefficients. These intervals coincide with episodes in which depreciation appears to have translated more effectively into competitiveness and integration. During 2003–2010, the gains followed the 2003 devaluation and overlapped with major trade agreements, notably the Euro-Med (2004) and Agadir (2007) agreements, which facilitated Egypt's participation in regional and European value chains (Kahouli and Maktouf, 2015; Helmy et al., 2018). The 2011–2016 period, despite political turbulence following the revolution, featured gradual depreciation accompanied by substantial Gulf financial support, which helped maintain macroeconomic stability and enabled firms to continue operating amid adjustment pressures. Relative to the baseline estimates, the magnitude of the coefficients in these two periods is relatively larger across most sector categories.

In summary, both the direction and sectoral composition of trade and the timing of analysis critically shape the relationship between RER depreciation and GVC integration. The findings suggest that South-North value-added trade flows are more responsive to RER depreciation and the responsiveness varies across subperiods, with the strongest effects observed in 2004–2010 and 2011–2016.

Table 2.7 RER Depreciation and GVC Integration – Subperiods

GVC Participation	1995-2003	2004-2010	2011-2016	2017-2022
Full Sample	-0.003	0.019***	0.474***	-0.031
	(0.006)	(0.006)	(0.163)	(0.048)
Primary	-0.006	0.022***	0.469**	-0.131***
	(0.007)	(0.009)	(0.192)	(0.050)
LowTech	0.001	0.016***	0.438***	-0.020
	(0.005)	(0.006)	(0.155)	(0.048)
HighTech	-0.011	0.021***	0.532***	-0.015
	(0.007)	(0.007)	(0.182)	(0.048)
Forward Linkage	1995-2003	2004-2010	2011-2016	2017-2022
Full Sample	-0.009	0.011**	0.509**	-0.052**
	(0.007)	(0.006)	(0.235)	(0.027)
Primary	-0.011	0.024***	0.504**	-0.080**
	(0.008)	(0.008)	(0.222)	(0.039)
LowTech	-0.004	0.007	0.453**	-0.021
	(0.006)	(0.005)	(0.218)	(0.021)
HighTech	-0.025***	0.011*	0.614**	-0.076*
	(0.009)	(0.006)	(0.299)	(0.042)
Backward Linkage	1995-2003	2004-2010	2011-2016	2017-2022
Full Sample	0.004	0.043***	0.398***	0.010
	(0.005)	(0.014)	(0.144)	(0.075)
Primary	0.002	0.048***	0.518***	-0.079
	(0.006)	(0.015)	(0.215)	(0.191)
LowTech	0.010	0.041***	0.370***	0.035
	(0.007)	(0.014)	(0.136)	(0.087)
HighTech	0.001	0.048***	0.411***	-0.026
	(0.011)	(0.016)	(0.146)	(0.049)

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
All regressions include year-sector and partner-sector fixed effects.
Control variables and the intercept are included in all regressions but
Not reported for brevity. Each cell represents a separate regression.

2.6.2 Robustness Checks

After showing the heterogeneity of the results across trade directions and subperiods, we conduct a series of robustness checks to ensure the stability of the findings. First, we re-estimate the baseline regressions using a one-year lag of the RER in place of its contemporaneous value. Second, we assess the dynamic effects of the RER by introducing sequential yearly lags into the regressions. Third, we test the sensitivity of the results to the composition of Egypt's trading partners by re-estimating the models after progressively excluding the top 10 percent, 30 percent, and 50 percent of Egypt's trade partners, thereby verifying that the results are not driven solely by Egypt's largest trading relationships.

2.6.2.1 Dynamic and Lagged Effects of the RER

To assess whether the effect of RER depreciation on GVC integration is purely contemporaneous or unfolds gradually over time, we begin by re-estimating the baseline models using a one-year lag of the RER. This exercise also helps mitigate endogeneity concerns linked to expectations of exchange rate movements. The results (Tables 2B.3-2B.6 in Appendix 2B) are fully consistent with the baseline findings for total GVC participation, forward and backward linkages, and GVC upgrading.

Building on this, we further extend the analysis by estimating separate regressions that incorporate yearly lagged values of the RER, up to five years prior[12], for overall GVC participation and for forward and backward linkages. While the baseline estimates (Table 2.1) indicate that RER depreciation exerts an immediate effect on GVC participation and on both domestic and foreign value added, such effects may not be fully contemporaneous, since firms typically adjust sourcing strategies, production structures, and export decisions over time. To account for these delayed adjustments and following Bas et al. (2025), we estimate a dynamic specification in which lagged RER terms are sequentially introduced.

The results (Table 2B.7) show that the effect of RER depreciation is more persistent for DVX rather than for FVA. The coefficient remains statistically significant up to the fourth lag for the forward linkage, but only up to the second lag for the backward linkage. Regarding the magnitude of effects, the first-lagged RER is almost identical in size and significance to the contemporaneous coefficient for both the GVC participation index and FVA. This indicates that the impact of RER depreciation is not only immediate, but also stable and persistent over the first two years. Thereafter, the coefficients decline gradually for the GVC index but fall sharply for FVA.

In contrast, the forward linkage behaves differently: the effect of the first-lagged RER exceeds that of the contemporaneous value, implying that DVX adjusts more slowly to exchange rate movements. This lagged response is consistent with the fact that expanding domestic production requires structural changes in production capacity, technology, and market access. Therefore, it takes time to materialize.

[12] The regressions are estimated using lags of up to ten years; however, the results are reported only up to the point at which the coefficients cease to be statistically significant for the three GVC indicators.

Taken together, these findings point to an asymmetric dynamic response across the two dimensions of GVC participation: backward linkages react quickly but their effects dissipate sooner, whereas forward linkages adjust more slowly but persist for a longer period.

2.6.2.2 Eliminating Top Partners

Given the bilateral structure of our dataset, reverse causality is unlikely to pose a threat to identification. In other words, Egypt's exchange rate policy is not determined by sector- or partner-specific domestic or foreign value-added flows, and therefore bilateral GVC participation cannot plausibly drive movements in the RER. Nonetheless, to ensure that our findings are not disproportionately driven by Egypt's major trading partners, we re-estimate all regressions on progressively restricted samples in which the largest partners, ranked by their contribution to bilateral domestic and foreign value added, are removed.

Tables 2B.8-2B.11 (Appendix 2B) report the results after successively excluding the top 10 percent, 30 percent, and 50 percent of partners with the highest GVC participation shares in Egypt's exports. Across all specifications, including the baseline GVC integration regressions, the upgrading regressions, and the estimations incorporating the knowledge spillover index, the results remain fully consistent with the main findings. This confirms that the estimated effects are not driven by a small subset of dominant trade partners and that the results do not suffer from reverse causality or partner concentration bias.

To sum up, RER depreciation exerts a positive impact on GVC integration through both forward and backward linkages, while foreign knowledge embedded in imported intermediate inputs operates as a transmission channel through which RER depreciation fosters GVC upgrading. The robustness checks, whether lagged specifications or partner-exclusion exercises, reinforce the validity and stability of the baseline results.

2.7 Conclusion and Policy Implications

To conclude, this paper examines the impact of RER depreciation on Egypt's integration into GVCs at the sectoral level, as well as its potential to foster sectoral upgrading along the value chain. Using bilateral sector-level input-output tables from UNCTAD-EORA over the period 1995-2022, the main findings show that RER depreciation increases GVC integration through both forward and backward linkages. When distinguishing sectors by technological intensity, the results indicate that forward linkages respond most strongly in primary sectors, reflecting Egypt's comparative advantage in resource-based activities. By contrast, backward linkages are most responsive in high-tech sectors, followed by low-tech sectors.

Turning to upgrading, measured by a sectoral upstreamness index, the results show that RER depreciation alone does not generate statistically significant gains in any of the three technological categories. However, once the role of foreign knowledge embedded in imported intermediate inputs is accounted for through a knowledge spillover index, a positive and statistically significant effect on upstreamness emerges, most notably in high-tech sectors. This supports the view that exchange rate policy can contribute to upgrading only when coupled with complementary industrial policy and tailored structural reforms that encourage knowledge acquisition from technologically advanced trade partners.

Further heterogeneity analysis reveals that South-North value-added trade flows are substantially more responsive to RER depreciation than South-South flows. Moreover, the effect of the RER varies across subperiods. All results are robust to a wide range of robustness checks.

In terms of policy implications, the results highlight the critical role of exchange rate flexibility in promoting Egypt's integration into GVCs. Policymakers can leverage exchange rate flexibility to foster integration, while recognizing that sector-specific strategies are essential given the heterogeneous responses across sectors. Yet, exchange rate policy alone is not sufficient for upgrading and escaping the low value-added trap. A more comprehensive approach that combines exchange rate flexibility with structural reforms to strengthen Egypt's productive capacity is needed.

Such an approach should include trade and tariff reforms to rationalize tariffs and non-tariff measures, particularly those that raise the cost of knowledge-intensive imported inputs, labor market policies to enhance skills and productivity, investment

and innovation policies to attract FDI and encourage technological upgrading, and tax and incentive reforms to redirect fiscal support toward export-oriented and high-productivity sectors. At the same time, policymakers must strike a balance between greater reliance on foreign value added, an important source of embodied knowledge, learning, and sustained investment in domestic R&D and technological capabilities. This underscores the need for careful resource allocation: while foreign inputs can accelerate integration and learning, long-term competitiveness ultimately depends on building domestic innovation capacity.

Taken together, this comprehensive policy mix would enable Egypt not only to participate more in GVCs, but also to climb the value chain toward more innovation-driven and sustainable integration.

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Appendix 2A: Data and Stylized Facts

Table 2A.1 EORA26 Sectors

1. Agriculture	14. Construction
2. Fishing	15. Maintenance and Repair
3. Mining and Quarrying	16. Wholesale Trade
4. Food and Beverages	17. Retail Trade
5. Textiles and Wearing Apparel	18. Hotels and Restaurants
6. Wood and Paper	19. Transport
7. Petroleum, Chemical and Non-Metallic Mineral Products	20. Post and Telecommunications
8. Metal Products	21. Financial Intermediation and Business Activities
9. Electrical and Machinery	22. Public Administration
10. Transport Equipment	23. Education, Health and Other Services
11. Other Manufacturing	24. Private Households
12. Recycling	25. Re-export & Re-import
13. Electricity, Gas and Water	26. Others

Source: UNCTAD-EORA dataset.

Sectors shown in bold indicate those included in our analysis.

Table 2A.2 Sectors Classification by Technological Intensity

Primary	Low-Tech. Manufacturing	High-Tech Manufacturing
Agriculture	Food & Beverages	Electrical & Machinery
Fishing	Metal Products	Petroleum, Chemical & Non-Metallic Mineral Pr.
Mining and Quarrying	Wood & Paper	Transport Equipment
	Textiles & Wearing Apparels	

Source: Foster-Mcgregor et al. (2015).

Table 2A.3 Harmonized EORA Sectors and the ISIC Rev 3. Classification

EORA Sectors	ISIC Rev 3. Correspondence
Agriculture	1, 2
Fishing	5
Mining & Quarrying	10, 11, 12, 13, 14
Food & Beverages	15, 16
Textiles & Wearing Apparel	17, 18, 19
Wood & Paper	20, 21, 22
Petroleum, Chemical and Non-Metallic Mineral Products	23, 24, 25, 26
Metal Products	27, 28
Electrical and Machinery	29, 30, 31, 32, 33
Transport Equipment	34, 35
Other Manufacturing	36

Source: EORA and WITS-TRAINS datasets.

Table 2A.4 Summary Statistics

	Full Sample				
	Obs	Mean	Std. Dev.	Min	Max
GVC_EXP	37022	.378	1.089	0	14.651
DVX_EXP	37022	.229	.756	0	12.955
FVA_EXP	37022	.149	.509	0	13.881
ln(RER)	37022	-1.05	2.789	-9.324	12.607
ln(Tariffs +1)	37022	1.609	1.317	-4.2	6.33
$\ln(GDPPC_{jt})$	37022	2.248	1.254	-.87	4.942
$\ln(Rents_{jt})$	37022	.318	2.431	-9.143	4.191
Upstreamness	37022	.373	1.538	-13.982	9.849
	Low-Technology Intensive Sectors				
	Obs	Mean	Std. Dev.	Min	Max
GVC_EXP	14316	.387	1.132	0	14.651
DVX_EXP	14316	.224	.759	0	11.017
FVA_EXP	14316	.163	.576	0	13.881
ln(Tariffs +1)	14316	1.797	1.326	-3.401	6.33
Upstreamness	14316	.083	1.726	-13.982	7.531
	High-Technology Intensive Sectors				
	Obs	Mean	Std. Dev.	Min	Max
GVC_EXP	10719	.418	1.164	0	11.29
DVX_EXP	10719	.235	.721	0	10.405
FVA_EXP	10719	.182	.561	0	7.377
ln(Tariffs +1)	10719	1.555	1.257	-4.2	5.74
Upstreamness	10719	.527	1.247	-11.803	7.867
	Primary Sectors				
	Obs	Mean	Std. Dev.	Min	Max
GVC_EXP	8446	.34	1.017	0	14.256
DVX_EXP	8446	.274	.903	0	12.955
FVA_EXP	8446	.065	.18	0	3.179
ln(Tariffs +1)	8446	1.257	1.256	-3.912	5.721
Upstreamness	8446	.974	1.405	-11.161	9.849

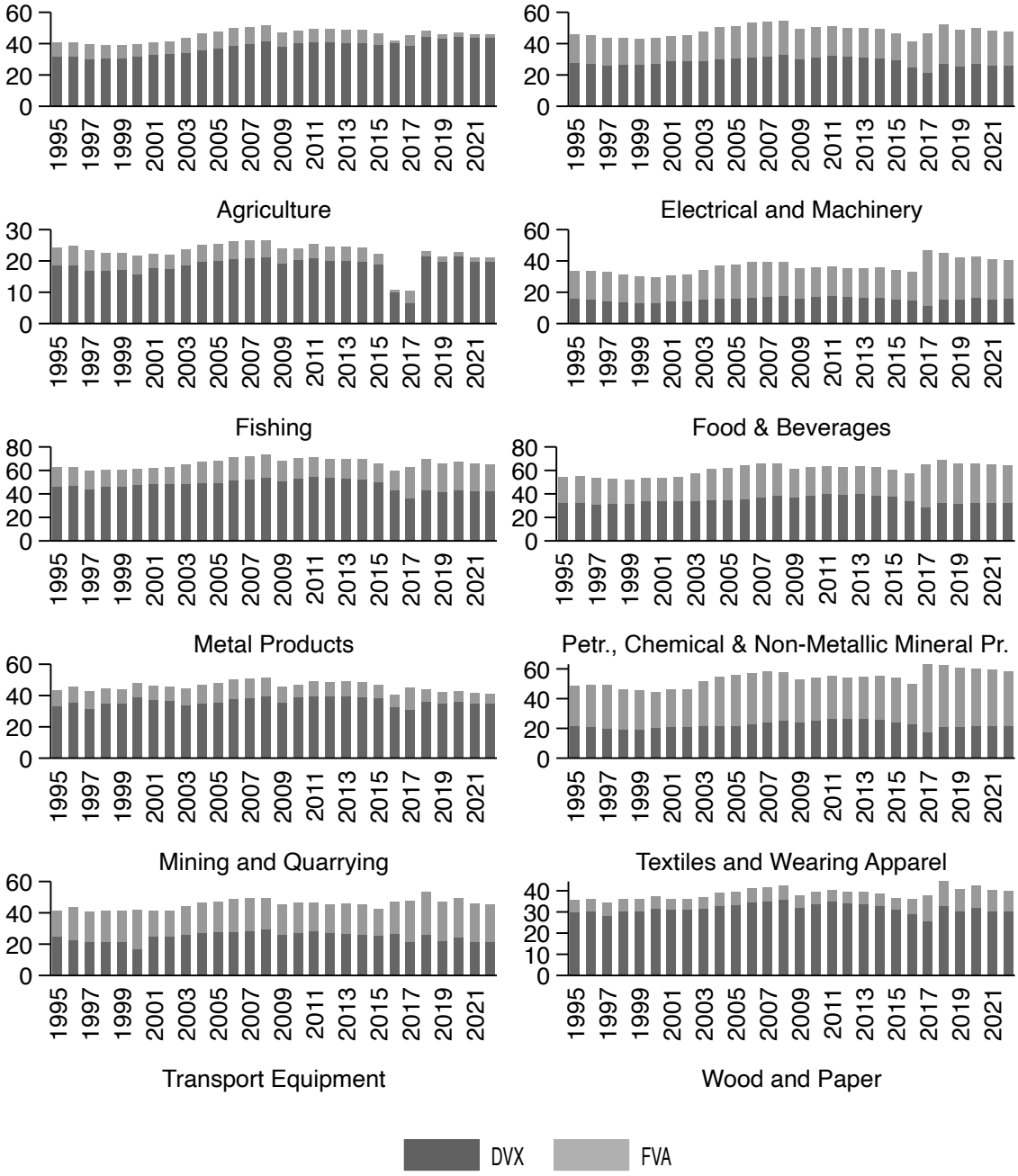
Source: Author's own calculations.

Table 2A.5 Income Classification of Egypt's Partners in the Sample

Low Income	Lower-Middle Income	Upper Middle Income	High Income
Afghanistan – Benin (before 2018)- Burkina Faso- Burundi- Central African Republic- Chad- Congo- DR Congo- Eritrea- Ethiopia- Gambia- Guinea- Liberia- Madagascar- Malawi- Mali- Mozambique- Niger- Rwanda- Sierra Leone- Somalia- South Sudan- Sudan- Syria- Togo- Uganda- Yemen	Algeria- Angola- Bangladesh- Belize- Benin (after 2018)- Bhutan- Bolivia- Cambodia- Cameroon- Cape Verde- Côte d'Ivoire- Djibouti- El Salvador- Gaza Strip- Ghana- Haiti- Honduras- India- Indonesia- Iran- Kenya- Kyrgyzstan- Laos- Lesotho- Mauritania- Mongolia- Morocco- Myanmar- Nepal- Nicaragua- Nigeria- Pakistan- Papua New Guinea- Philippines- Samoa- Sao Tome and Principe- Senegal- Sri Lanka- Swaziland- Tajikistan- Tanzania- Tunisia- Ukraine- Uzbekistan- Vanuatu- Vient Nam- Zambia- Zimbabwe	Albania- Argentina- Armenia- Azerbaijan- Belarus- Bosnia and Herzegovina- Botswana- Brazil- Bulgaria- China- Colombia- Costa Rica- Cuba- Dominican Republic- Ecuador- Fiji- Gabon- Georgia- Guatemala- Guyana- Iraq- Jamaica- Jordan- Kazakhstan- Lebanon- Libya- Malaysia- Maldives- Mauritius- Mexico- Moldova- Montenegro- Namibia- Panama- Paraguay- Peru- Romania- Russia- Serbia- South Africa- Suriname- TFYR Macedonia- Taiwan- Thailand- Turkey- Turkmenistan- Venezuela	Andorra- Antigua- Aruba- Australia- Austria- Bahamas- Bahrain- Barbados- Belgium- Bermuda- British Virgin Islands- Brunei- Canada- Cayman Islands- Chile- Croatia- Cyprus- Czech Republic- Denmark- Estonia- Finland- France- French Polynesia- Germany- Greece- Greenland- Hong Kong- Hungary- Iceland- Ireland- Israel- Italy- Japan- Kuwait- Latvia- Liechtenstein- Lithuania- Luxembourg- Macao SAR- Malta- Monaco- Netherlands- Netherlands Antilles- New Caledonia- New Zealand- Norway- Oman- Poland- Portugal- Qatar- San Marino- Saudi Arabia- Seychelles- Singapore- Slovakia- Slovenia- South Korea- Spain- Sweden- Switzerland- Trinidad and Tobago- United Arab Emirates- United Kingdom- United States of America- Uruguay

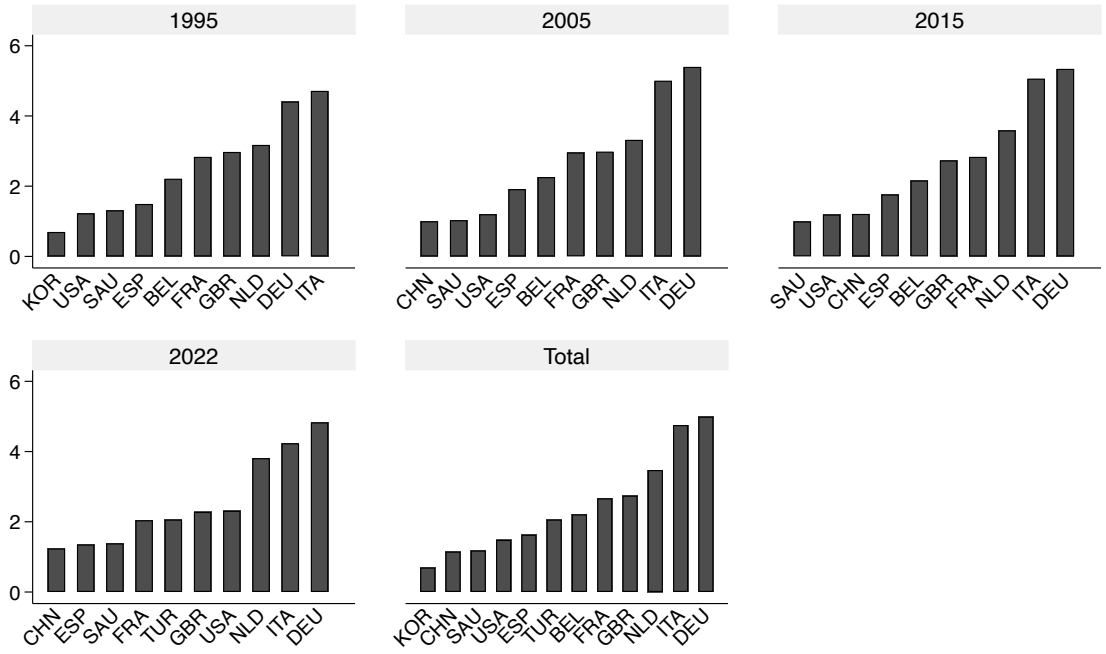
Source: Author's elaboration based the World Bank classification.

Figure 2A.1 Egypt's Sectoral GVC Participation (DVX + FVA), 1995-2022



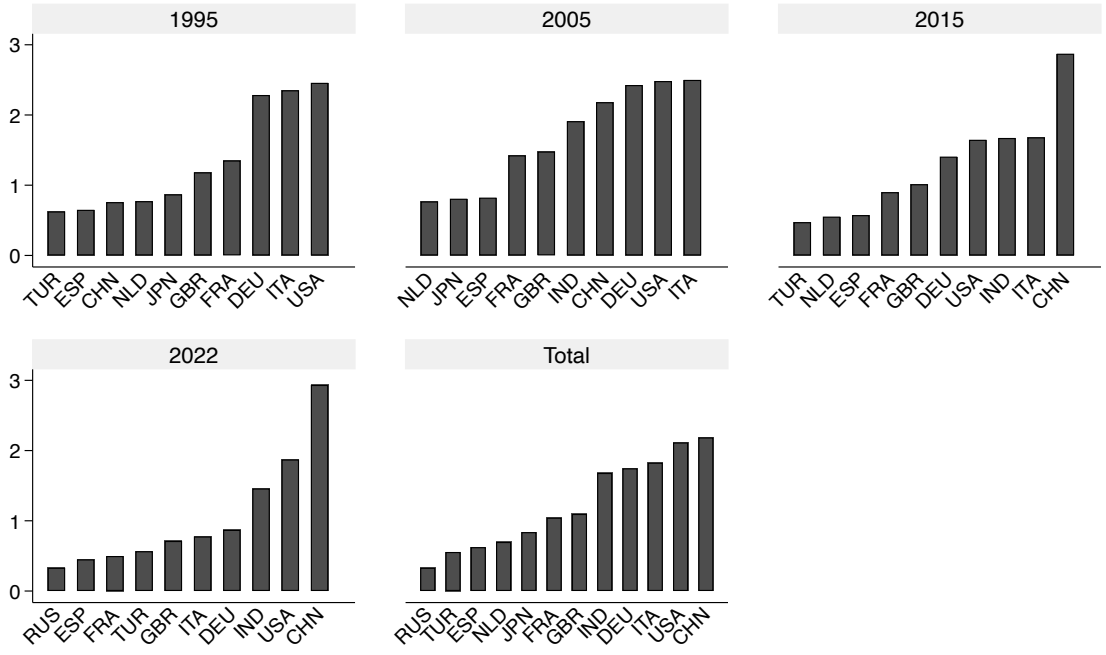
Source: Author's own construction using the UNCTAD-EORA dataset.
DVX and FVA are expressed as shares of gross exports.

Figure 2A.2 Top 10 Trade Partners – Forward Linkage as a share of exports



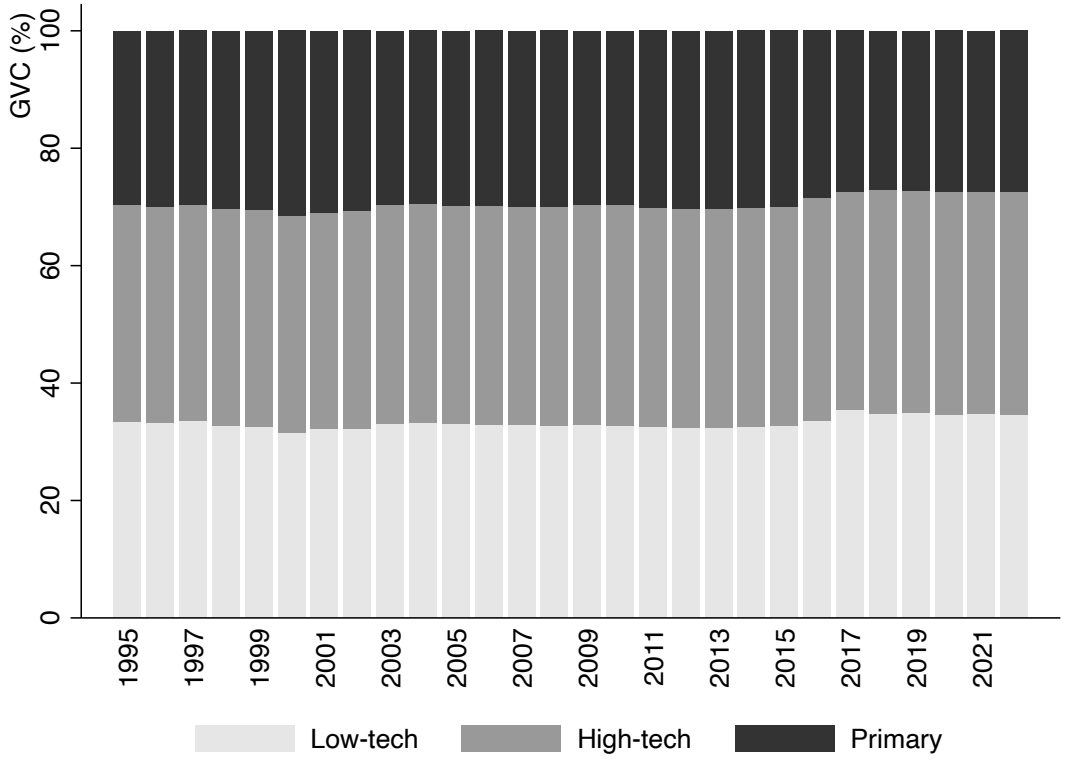
Source: Author's own construction using UNCTAD-EORA dataset.

Figure 2A.3 Top 10 Trade Partners – Backward Linkage as a share of exports



Source: Author's own construction using UNCTAD-EORA dataset.

Figure 2A.4 GVC Participation as a Share of Exports – by Technological Intensity



Source: Author's own construction using UNCTAD-EORA dataset.

Appendix 2B: Robustness Checks

Table 2B.1 Bilateral RER and GVC Integration – Alternative Specification

	(1) GVC	(2) DVX	(3) FVA
ln(RER)	0.148***	0.160***	0.133***
	(0.016)	(0.019)	(0.015)
ln(Tariffs +1)	-0.121***	-0.188***	-0.112***
	(0.023)	(0.031)	(0.019)
$\ln(GDPPC_{jt})$	0.567***	0.624***	0.495***
	(0.040)	(0.043)	(0.047)
$\ln(Rents_{jt})$	-0.081***	-0.104***	-0.047***
	(0.010)	(0.011)	(0.011)
ln(Distance)	-0.046	-0.149***	0.104**
	(0.043)	(0.048)	(0.047)
FTA (dummy=1)	0.205**	0.573***	-0.319***
	(0.094)	(0.094)	(0.105)
Contiguity	-0.704***	-0.621***	-0.749***
	(0.126)	(0.144)	(0.120)
Year-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,918	3,918	3,918
Observations	37,022	37,022	37,022
Pseudo R^2	0.229	0.279	0.172

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The intercept is included.

Table 2B.2 Bilateral RER, Knowledge Spillover, and GVC Upgrading – Alternative Measures

	HighTech in VA Exports	Upstreamness		
		(1) Primary	(2) LowTech	(3) HighTech
[1] ln(RER)	-0.009***	0.017	0.032*	0.034*
	(0.003)	(0.014)	(0.019)	(0.0179)
[2] Know. Spillover Index	0.115***	0.619***	0.530***	0.561***
	(0.029)	(0.184)	(0.180)	(0.207)
[1] * [2]	0.011***	0.145**	0.123*	0.247***
	(0.004)	(0.066)	(0.072)	(0.088)
Year-Sector FE	✓	✓	✓	✓
Partner-Sector FE	✓	✓	✓	✓
Intercept & Controls	✓	✓	✓	✓
Clusters	jt	jt	jt	jt
# of clusters	2,200	2,343	2,328	2,318
Observations	21,665	5,838	9,019	6,749
Estimation Method	PPML	OLS	OLS	OLS

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2B.3 Lagged RER and GVC Integration – PPML

	(1) GVC	(2) DVX	(3) FVA
RER_{t-1} (ln)	0.025***	0.020***	0.022***
	(0.005)	(0.006)	(0.008)
ln(Tariffs +1)	-0.012	0.012	-0.031***
	(0.009)	(0.011)	(0.008)
$ln(GDPPC_{jt})$	0.883***	0.730***	0.985***
	(0.048)	(0.078)	(0.039)
$ln(Rents_{jt})$	-0.014	-0.020	-0.008
	(0.011)	(0.013)	(0.012)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,769	3,769	3,769
Observations	35,727	35,727	35,727
Pseudo R^2	0.6593	0.6331	0.5949

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
The intercept is included.

Table 2B.4 Lagged RER and GVC Integration by Technological Intensity – PPML

	GVC			DVX			FVA		
	Primary	LowTech	HighTech	Primary	LowTech	HighTech	Primary	LowTech	HighTech
RER_{t-1} (ln)	0.023***	0.025***	0.036***	0.027***	0.010	0.009	0.002	0.047***	0.073***
	(0.005)	(0.007)	(0.010)	(0.007)	(0.007)	(0.013)	(0.006)	(0.011)	(0.011)
ln(Tariffs +1)	0.019	-0.010	-0.030***	0.041**	0.007	-0.023	-0.004	-0.025**	-0.037***
	(0.015)	(0.010)	(0.011)	(0.017)	(0.010)	(0.014)	(0.007)	(0.011)	(0.012)
$ln(GDPPC_{jt})$	0.710***	0.866***	0.947***	0.813***	0.641***	0.749***	0.942***	0.923***	1.029***
	(0.064)	(0.050)	(0.050)	(0.082)	(0.083)	(0.076)	(0.049)	(0.041)	(0.039)
$ln(Rents_{jt})$	-0.003	-0.018	-0.012	-0.002	-0.028**	-0.023	-0.001	-0.002	-0.010
	(0.013)	(0.012)	(0.012)	(0.014)	(0.013)	(0.014)	(0.014)	(0.013)	(0.013)
Year-Sector FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Partner-Sec FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Clusters	jt	jt	jt	jt	jt	jt	jt	jt	jt
# of clusters	3,661	3,666	3,631	3,661	3,666	3,631	3,661	3,666	3,631
Observations	8,157	13,862	10,361	8,157	13,862	10,361	8,157	13,862	10,361
Pseudo R^2	0.6250	0.6701	0.6780	0.6276	0.6527	0.6258	0.4415	0.6054	0.6128

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
GVC participation, forward, and backward linkages are expressed as shares of exports.
The intercept is included.

Table 2B.5 Lagged RER and GVC Upgrading – by Technological Intensity

	Upstreamness		
	(1) Primary	(2) LowTech	(3) HighTech
RER_{t-1} (ln)	0.004	-0.005	-0.003
	(0.012)	(0.017)	(0.017)
ln(Tariffs +1)	-0.015*	-0.031***	-0.044***
	(0.009)	(0.008)	(0.009)
$ln(GDPPC_{jt})$	-0.368***	-0.418***	-0.458***
	(0.040)	(0.046)	(0.045)
$ln(Rents_{jt})$	-0.003	-0.003	-0.006
	(0.003)	(0.004)	(0.004)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,814	3,872	3,835
Mean of dep. Δ	0.973	0.070	0.509
Observations	8,710	14,675	10,938
Adj. R-squared	0.7033	0.4340	0.6523

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
The intercept is included.

Table 2B.6 Lagged RER, Knowledge Spillover and GVC Upgrading – by Technological Intensity

	Upstreamness		
	(1) Primary	(2) LowTech	(3) HighTech
[1] RER_{t-1} (ln)	-0.036*	-0.037*	-0.036*
	(0.021)	(0.021)	(0.020)
[2] Know. Spillover Index	0.213	0.723**	0.661**
	(0.264)	(0.294)	(0.284)
[1] * [2]	0.072*	0.105**	0.114**
	(0.040)	(0.050)	(0.049)
ln(Tariffs +1)	-0.024**	-0.037***	-0.073***
	(0.011)	(0.011)	(0.013)
$ln(GDPPC_{jt})$	-0.357***	-0.443***	-0.510***
	(0.050)	(0.058)	(0.059)
$ln(Rents_{jt})$	-7.62e-05	-0.003	-0.005*
	(0.003)	(0.003)	(0.003)
[1] * [2] Marginal Effect (at median)	0.026 (0.020)	0.043* (0.024)	0.051** (0.025)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	2,189	2,182	2,170
Mean of dep. Δ	1.212	0.156	0.417
Observations	5,517	8,483	6,352
Adj. R-squared	0.6705	0.4712	0.6920

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included.

Table 2B.7 Dynamic Effects of RER and GVC Integration – PPML

	RER (ln)	RER_{t-1} (ln)	RER_{t-2} (ln)	RER_{t-3} (ln)	RER_{t-4} (ln)	RER_{t-5} (ln)
GVC	0.026***	0.025***	0.021***	0.013**	0.009*	0.003
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
DVX	0.018***	0.020***	0.018***	0.013**	0.010*	0.005
	(0.007)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
FVA	0.022***	0.022***	0.014*	0.004	0.001	-0.005
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Year-Sector FE	✓	✓	✓	✓	✓	✓
Partner-Sector FE	✓	✓	✓	✓	✓	✓
Clusters	jt	jt	jt	jt	jt	jt
# of clusters	3,918	3,769	3,617	3,471	3,325	3,174
Observations	37,022	35,727	34,404	33,102	31,777	30,412

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

GVC, DVX, and FVA are the dependent variables in each regression and are expressed as shares of exports.

The intercept and controls are included in all regressions.

Each cell represents a separate regression.

Table 2B.8 RER Depreciation and GVC Participation: Top Partners Eliminated – PPML

	GVC Participation		
	(a) Top 10%	(b) Top 30%	(c) Top 50%
ln(RER)	0.025***	0.021**	0.015*
	(0.007)	(0.009)	(0.009)
ln(Tariffs +1)	-0.008	-0.012	-0.010
	(0.007)	(0.007)	(0.008)
$ln(GDPPC_{jt})$	0.884***	0.846***	0.801***
	(0.053)	(0.047)	(0.063)
$ln(Rents_{jt})$	-0.009	-0.011	-0.035***
	(0.011)	(0.011)	(0.010)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,891	3,839	3,758
Observations	36,835	36,338	35,532
Pseudo R^2	0.6405	0.5948	0.5294

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The intercept is included.

Table 2B.9 RER Depreciation and GVC Participation by Tech. Intensity: Top Partners Eliminated – PPML

	Top 10%		
	(a) Primary	(b) LowTech	(c) HighTech
ln(RER)	0.021***	0.035***	0.037***
	(0.008)	(0.011)	(0.013)
ln(Tariffs +1)	0.010	-0.004	-0.022**
	(0.014)	(0.008)	(0.010)
$\ln(GDPPC_{jt})$	0.774***	0.854***	0.947***
	(0.068)	(0.053)	(0.053)
$\ln(Rents_{jt})$	-0.001	-0.012	-0.009
	(0.012)	(0.011)	(0.012)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,770	3,777	3,744
Observations	8,394	14,250	10,669
Pseudo R^2	0.6113	0.6519	0.6564
	Top 30%		
	(a) Primary	(b) LowTech	(c) HighTech
ln(RER)	0.017	0.033***	0.029**
	(0.012)	(0.012)	(0.012)
ln(Tariffs +1)	-0.002	-0.006	-0.026**
	(0.013)	(0.007)	(0.011)
$\ln(GDPPC_{jt})$	0.825***	0.791***	0.900***
	(0.068)	(0.045)	(0.048)
$\ln(Rents_{jt})$	-0.001	-0.016	-0.011
	(0.012)	(0.011)	(0.011)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,718	3,730	3,699
Observations	8,254	14,074	10,537
Pseudo R^2	0.5455	0.6079	0.6186
	Top 50%		
	(a) Primary	(b) LowTech	(c) HighTech
ln(RER)	0.017	0.021*	0.020*
	(0.013)	(0.011)	(0.011)
ln(Tariffs +1)	0.004	-0.009	-0.024**
	(0.014)	(0.007)	(0.011)
$\ln(GDPPC_{jt})$	0.769***	0.743***	0.862***
	(0.090)	(0.060)	(0.065)
$\ln(Rents_{jt})$	-0.012	-0.044***	-0.040***
	(0.013)	(0.010)	(0.011)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,637	3,655	3,624
Observations	8,030	13,789	10,321
Pseudo R^2	0.4741	0.5483	0.5479

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept and the control variables are included in all regressions but not reported for brevity.

Table 2B.10 RER Depreciation and GVC Upgrading by Tech. Intensity: Top Partners Eliminated – PPML

	Top 10%		
	(a) Primary	(b) LowTech	(c) HighTech
ln(RER)	0.011	0.011	0.012
	(0.012)	(0.017)	(0.0170)
ln(Tariffs +1)	-0.016*	-0.030***	-0.043***
	(0.009)	(0.008)	(0.008)
$\ln(GDPPC_{jt})$	-0.363***	-0.425***	-0.469***
	(0.040)	(0.045)	(0.044)
$\ln(Rents_{jt})$	-0.003	-0.004	-0.006
	(0.003)	(0.004)	(0.003)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,936	3,988	3,953
Observations	8,952	15,077	11,257
	Top 30%		
	(a) Primary	(b) LowTech	(c) HighTech
ln(RER)	0.010	0.010	0.012
	(0.012)	(0.017)	(0.017)
ln(Tariffs +1)	-0.017**	-0.031***	-0.044***
	(0.009)	(0.008)	(0.009)
$\ln(GDPPC_{jt})$	-0.366***	-0.427***	-0.470***
	(0.040)	(0.046)	(0.044)
$\ln(Rents_{jt})$	-0.003	-0.003	-0.006
	(0.003)	(0.004)	(0.003)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,882	3,939	3,906
Observations	8,801	14,893	11,120
	Top 50%		
	(a) Primary	(b) LowTech	(c) HighTech
ln(RER)	0.010	0.011	0.013
	(0.012)	(0.017)	(0.017)
ln(Tariffs +1)	-0.017*	-0.032***	-0.045***
	(0.009)	(0.008)	(0.009)
$\ln(GDPPC_{jt})$	-0.380***	-0.436***	-0.478***
	(0.041)	(0.047)	(0.045)
$\ln(Rents_{jt})$	-0.005	-0.003	-0.005
	(0.003)	(0.004)	(0.004)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	3,801	3,864	3,831
Observations	8,577	14,608	10,904

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept and the control variables are included in all regressions but not reported for brevity.

Table 2B.11 RER Depreciation, Knowledge Spillover and GVC Upgrading by Tech. Intensity: Top Partners Eliminated – PPML

	Top 10%		
	(a) Primary	(b) LowTech	(c) HighTech
[1] ln(RER)	-0.021	-0.026	-0.029
	(0.020)	(0.020)	(0.019)
[2] Know. Spillover Index	0.171	0.685**	0.628**
	(0.262)	(0.288)	(0.279)
[1] * [2]	0.064	0.112**	0.124**
	(0.042)	(0.051)	(0.049)
[1] * [2] Marginal Effect[1]	0.034 (0.022)	0.058** (0.024)	0.064*** (0.024)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	2,252	2,237	2,226
Observations	5,650	8,678	6,505
	Top 30%		
	(a) Primary	(b) LowTech	(c) HighTech
[1] ln(RER)	-0.020	-0.026	-0.029
	(0.020)	(0.020)	(0.019)
[2] Know. Spillover Index	0.176	0.689**	0.628**
	(0.263)	(0.289)	(0.280)
[1] * [2]	0.062	0.112**	0.123**
	(0.042)	(0.051)	(0.049)
[1] * [2] Marginal Effect[1]	0.032 (0.021)	0.054** (0.023)	0.060*** (0.023)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	2,209	2,198	2,188
Observations	5,531	8,531	6,395
	Top 50%		
	(a) Primary	(b) LowTech	(c) HighTech
[1] ln(RER)	-0.016	-0.022	-0.024
	(0.020)	(0.020)	(0.019)
[2] Know. Spillover Index	0.179	0.682**	0.618**
	(0.266)	(0.291)	(0.281)
[1] * [2]	0.058	0.107**	0.118**
	(0.042)	(0.051)	(0.050)
[1] * [2] Marginal Effect[1]	0.031 (0.020)	0.050** (0.021)	0.055*** (0.021)
Year-Sector FE	✓	✓	✓
Partner-Sector FE	✓	✓	✓
Clusters	jt	jt	jt
# of clusters	2,134	2,127	2,117
Observations	5,320	8,259	6,189

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept and the control variables are included in all regressions but not reported for brevity.
[1]Marginal effects are estimated at the median value.

Chapter 3

Global Value Chain Integration and Women's Economic Empowerment: Firm-Level Evidence

This chapter is a joint work with Chahir Zaki (LÉO, University of Orléans). An earlier version is published as a *World Bank Policy Research Working Paper* https://doi.org/10.1596/1813-9450-10667

3.1 Introduction

Women have long played a fundamental role in economic activity through their participation in business, agriculture, industry, and unpaid care work. Despite sustained policy efforts to enhance women's economic inclusion, substantial disparities persist. According to the World Bank's Women, Business and the Law report (2022), approximately 2.4 billion women worldwide lack equal economic opportunities relative to men. The United Nations Development Programme (UNDP) further highlights the structural imbalance in global labor contributions: women roughly perform two-thirds of total work and produce half of the world's food, yet receive only 10 percent of global income. While these inequalities characterize the broader economy, they are often even more pronounced in international trade and global value chains (GVCs), where women remain underrepresented and frequently concentrated in lower-value segments (Fontana, 2009).

Against this backdrop, this study examines the impact of firms' integration into GVCs on women's economic empowerment, measured through female ownership, female managerial representation, and female labor force participation.

Over recent decades, and notwithstanding recent protectionist waves, the relationship between globalization and gender equality has attracted growing academic attention (Juhn et al., 2014). GVCs, in particular, have been recognized as powerful engines of employment generation, income growth, and structural transformation (Pham and Jinjarak, 2023). However, their gender implications are often characterized as a double-edged sword. On the one hand, participation in GVCs can facilitate job creation and generate new employment opportunities for women, especially in labor-intensive and low-skilled sectors (Farole, 2016). On the other hand, GVC integration may deepen gender gaps in wages, job security, and working conditions, potentially confining women to low-paid and undervalued tasks (Koenig and Poncet, 2022; Calvo-Calvo et al., 2025). The gender implications of GVC participation are therefore not unidirectional but depend on sectoral structures, institutional contexts, and firm characteristics.

Several theoretical frameworks provide insight into the mechanisms through which trade may influence female labor outcomes. First, the neoclassical theory of discrimination, rooted in Becker's (1957) theory, posits that increased market competition reduces firms' incentives to discriminate against women. Barth and Dale-

Olsen (2009) and Webber (2016) argue that discrimination against female workers may stem from biased perceptions or perceived mobility constraints resulting from legal, cultural, or structural barriers. However, in competitive environments, discriminatory practices generate efficiency losses that may threaten firm survival (Elson, 1999; Doris and Rudolf, 2007; Heyman et al., 2013). As firms face intensified competition through trade participation, discrimination becomes costly, compelling firms to reduce biased practices and potentially increase female hiring (World Bank, 2011; Juhn et al., 2014).

Second, the comparative advantage channel offers further insight into the trade-gender nexus. Galor and Weil (1993) and Juhn et al. (2014) argue that women tend to possess a comparative advantage in cognitive-intensive tasks compared to physically intensive tasks. Trade liberalization lowers barriers to foreign market entry, incentivizing firms to adopt modern technologies and production processes. This technological upgrading may reduce demand for routine physical tasks while increasing demand for cognitive-intensive tasks, thereby expanding female employment, including in higher-skilled blue-collar occupations. However, the impact depends on the nature of technological change. Capital- and skill-intensive production processes aimed at enhancing product quality may require higher levels of human capital, potentially exerting adverse effects on female employment if women remain underrepresented in high-skill occupations (Pearson, 1995; Berik, 2000).

Third, the Heckscher-Ohlin theory sheds additional light on the relationship between trade, GVC integration, and female employment. According to this theory, countries specialize in goods that intensively use their relatively abundant factors of production. In developing countries characterized by an abundance of semi-skilled and unskilled labor, trade expansion should increase demand for such labor. Given that women are often disproportionately represented in lower-skilled occupations while men are more concentrated in higher-skilled positions, trade and GVC participation may create employment opportunities for women relative to men (Wood, 1991; Çağatay and Özler, 1995; Özler, 2000). Building upon these theoretical perspectives, trade, and by extension GVC integration may influence female labor force participation through changes in competitive pressures, discriminatory behavior, and technological upgrading.

Empirical evidence provides mixed conclusions. Using firm-level data for 91 developing countries, Amin and Islam (2023) find that transitioning from non-exporting to exporting status increases the share of female workers by 6.6 percent, particularly in industries that heavily reliant on female labor and in countries with supportive labor laws and societal attitudes. Boler et al. (2015), employing matched employer-employee data from Norwegian manufacturing, demonstrate that trade participation narrows the gender wage gap among exporting firms. Similar findings are reported by Juhn et al. (2014) and Black and Brainerd (2004). However, contrasting evidence exists. Berik et al. (2004) show that trade-induced competition increased wage discrimination against female workers in India, Taiwan, and China, contradicting neoclassical predictions. Using difference-in-differences estimation with Brazilian Census data, Gaddis and Pieters (2017) find that trade liberalization reduces both male and female labor force participation, with larger effects on men, thereby narrowing gender gaps without improving women's relative outcomes. Considering heterogeneities among sectors, Giovannetti et al. (2021) show that trade reforms in Egypt generated uneven effects across sectors, with wage premiums favoring male and white-collar workers in food and textile industries. Other studies attribute limited or negative employment effects to concomitant factors such as anti-sweatshop activism (Harrison and Scorse, 2010) and minimum wage requirements linked to export tariff privileges (Del Carpio et al., 2015). Examining the reverse relationship, Karam and Zaki (2021) find that female labor participation in the MENA region positively affects both the intensive and extensive margins of exports, and that female ownership increases export probability among large firms.

Focusing specifically on GVCs, Deb (2021), using the OECD Trade in Value Added (TiVA) database, concludes that neither backward nor forward linkages improve relative female wages in India. In contrast, Jenkins (2005) reports that women's wages and working conditions may be better with GVCs-linked employment. Additional evidence suggests that GVC participation increases female employment, particularly in developing economies (Shepherd and Stone, 2013; Bamber and Staritz, 2016; Pham and Jinjarak, 2023; Gopalan et al., 2024).

Against this background, this paper contributes to the literature in three principal ways. First, while existing studies predominantly focus on female employment shares or wage gaps, this paper extends the analysis to women's entrepreneurship and leadership by examining female ownership and female top management alongside employment outcomes. To our knowledge, no prior cross-country firm-level study

has simultaneously analyzed these three dimensions of women's economic participation in the context of GVC integration. Second, the analysis explores heterogeneity along both internal and external dimensions: internal firm characteristics (sector of operation, skill intensity, and technological intensity) and external institutional frameworks, namely gender-related provisions in regional trade agreements (RTAs). Third, the paper investigates the mechanisms through which GVC integration may affect female entrepreneurship and labor force participation, focusing on on-the-job training, innovation through R&D expenditure and foreign technology licensing, and access to finance.

The main findings indicate that the baseline definition of GVC integration increases the likelihood of female ownership, while both the least restrictive and the most restrictive definitions enhance female employment. A negative effect is observed for female top management positions. These results remain robust after addressing endogeneity using instrumental variable estimation and propensity score matching, where treatment is defined as GVC participation. Sectoral heterogeneity analysis shows that services, unskilled labor-intensive sectors, and low-technology industries are the primary employers of women. Moreover, GVC integration fosters ownership and managerial opportunities in manufacturing and medium-high-technology sectors relative to non-GVC firms. GVCs can therefore be perceived as a catalyst for promoting female labor force participation and female entrepreneurship in emerging economies. Furthermore, gender provisions in RTAs moderate the impact of GVC integration, particularly with respect to female employment. Mechanism analysis suggests that training, technological upgrading, and improved access to finance constitute key transmission channels linking GVC participation to women's economic outcomes.

The remainder of the paper is organized as follows. Section 3.2 describes the data and empirical strategy. Section 3.3 presents the empirical results, robustness checks, and heterogeneity analysis. Section 3.4 discusses the mechanisms through which GVC integration affects female entrepreneurship and labor force participation. Section 3.5 concludes and outlines policy implications.

3.2 Data and Empirical Strategy

3.2.1 Data

To examine the relationship between firms' integration into GVCs and female labor force participation as entrepreneurs, managers and employees, this study relies on pooled firm-level data from the WBES. These surveys are based on stratified random sampling by firm size, sector of operation, and geographical location. They provide detailed information on multiple aspects of the business environment, including access to finance, trade participation, corruption, competition, and infrastructure.

Summary Statistics are reported in Table 3B.2 (Appendix 3B). The final sample covers approximately 253,000 firms across 152 countries, 72 percent of which are developing and emerging economies, over the period 2006-2025 (see Appendix 3A). The sample is evenly split between manufacturing (50.7 percent) and services (49.3 percent). Firms are, on average, 30 years old, although there is substantial heterogeneity in firm size; the average firm employs 108 workers. Government ownership is limited on average.

Regarding gender-related outcomes, 32.7 percent of firms report at least one female owner, while 16.2 percent have a female top manager. Women represent 31.6 percent of full-time employees. Among firms reporting worker composition by occupation, 54.2 percent of female employees are concentrated in production roles, while 45.8 percent are employed in non-production positions. This indicates that female employment is more heavily represented in operational and production-related activities rather than in administrative or managerial functions.

GVC integration is defined following Dovis and Zaki (2020), using four alternative definitions that capture progressively stricter levels of engagement. The least restrictive definition (GVC1) identifies firms that simultaneously export and import, capturing two-way traders. Two stricter definitions classify firms as part of GVCs when they are two-way traders and either hold an international certification (GVC2) or have foreign ownership participation (GVC3). The most restrictive definition (GVC4) combines all criteria. Each indicator is constructed as a dummy variable equal to one if the firm satisfies the corresponding criteria. Approximately 20 percent of firms qualify as GVC participants under the least restrictive definition, whereas only about 2.7 percent satisfy the strictest criteria combining two-way trade, foreign capital

participation, and international certification (Table 3B.1). These measures capture GVC participation at the extensive margin rather than the intensity of integration.

Table 3.1 reports average female employment across firms by GVC status. A clear pattern emerges: firms participating in GVCs employ substantially more female workers in absolute terms than non-GVC firms, across all definitions. This pattern holds for both production and non-production workers, although the increase is particularly pronounced for production workers. Under the baseline definition (GVC1), GVC firms employ, on average, more than three times as many female employees as non-GVC firms. This pattern persists across all GVC definitions. However, under the most restrictive definition, part of the observed effect may reflect firm-size differences, as larger and more productive firms are both more likely to integrate into GVCs and to employ a larger workforce overall. Therefore, these descriptive statistics should be interpreted as indicating a positive association between GVC participation and female employment levels rather than proportional changes in gender composition. Nevertheless, the positive association between GVC participation and female employment remains encouraging. GVC activities are often linked to production processes that rely on tasks where female labor is relatively abundant in many emerging economies, which may contribute to expanding employment opportunities for women, particularly in operational and production-related roles.

Table 3.1 Average Female Employment in Firms across GVC Participation Definitions

	GVC1		GVC2		GVC3		GVC4	
	No	Yes	No	Yes	No	Yes	No	Yes
Female Employees	20.14	75.78	23.55	102.79	26.10	126.07	27.75	143.08
Female Production Workers	15.82	74.02	22.13	83.69	23.99	130.51	26.80	126.09
Female Non-Production Workers	5.59	19.72	6.29	26.19	7.86	29.59	8.10	37.58

Source: Constructed by the authors using the WBES.

GVC1 refers to firms that export and import simultaneously, GVC2 = GVC1 + international certification, GVC3= GVC1+ share of its capital owned by a foreign firm, GVC4 combines the four criteria altogether.

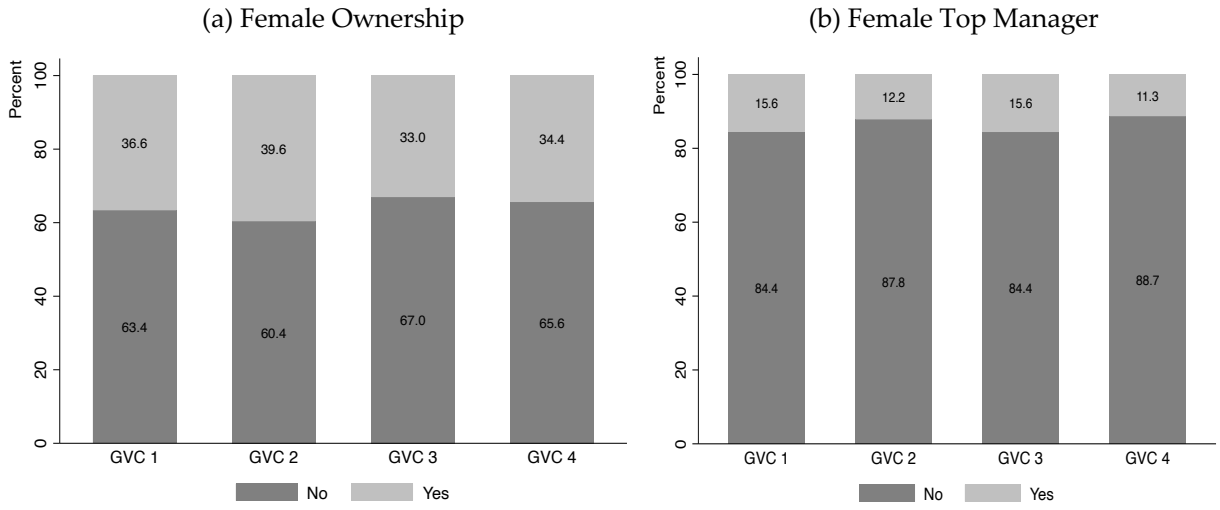
While employment captures one dimension of women's participation, leadership roles are better captured through ownership and managerial representation. Figure 3.1 compares the shares of female-owned and female-managed firms among GVC participants across alternative definitions. Three stylized facts emerge. First, female ownership and management remain relatively limited compared to their male counterparts, indicating persistent gender gaps in leadership positions within

internationally integrated firms. Second, the share of female owners consistently exceeds that of female managers among GVC firms, suggesting that entrepreneurship represents an important channel through which women attain positions of strategic control, whereas managerial roles reflect organizational authority within existing firm hierarchies. Third, both ownership and management shares decline as the definition of GVC participation becomes more restrictive. Female ownership decreases from roughly 37 percent under GVC1 to about 34 percent under GVC4, and female management declines from around 15 percent to 11 percent. Importantly, this pattern does not contradict the firm-size evidence shown in Figure 3.2. While stricter GVC definitions are increasingly dominated by large firms, and many female-led GVC firms are large, the overall proportion of female-led firms still declines, suggesting that deeper forms of global integration may involve structural requirements that limit the relative presence of women in leadership roles rather than reflecting firm size alone.

Figure 3.2 illustrates the firm-size distribution of female ownership and management among GVC participants. As the definition of GVC participation becomes more restrictive, the composition of firms shifts increasingly toward large firms, which account for the majority of female-owned and female-managed GVC participants under GVC3 and GVC4. In contrast, small firms represent a substantial share only under the least restrictive definition (GVC1), suggesting that deeper forms of international integration are more prevalent among larger and more established firms, likely due to higher fixed costs and certification requirements. Overall, the figure indicates that firm size is a key structural dimension underlying women's participation in GVC-linked firms rather than evidence of systematic gender disparities across size categories.

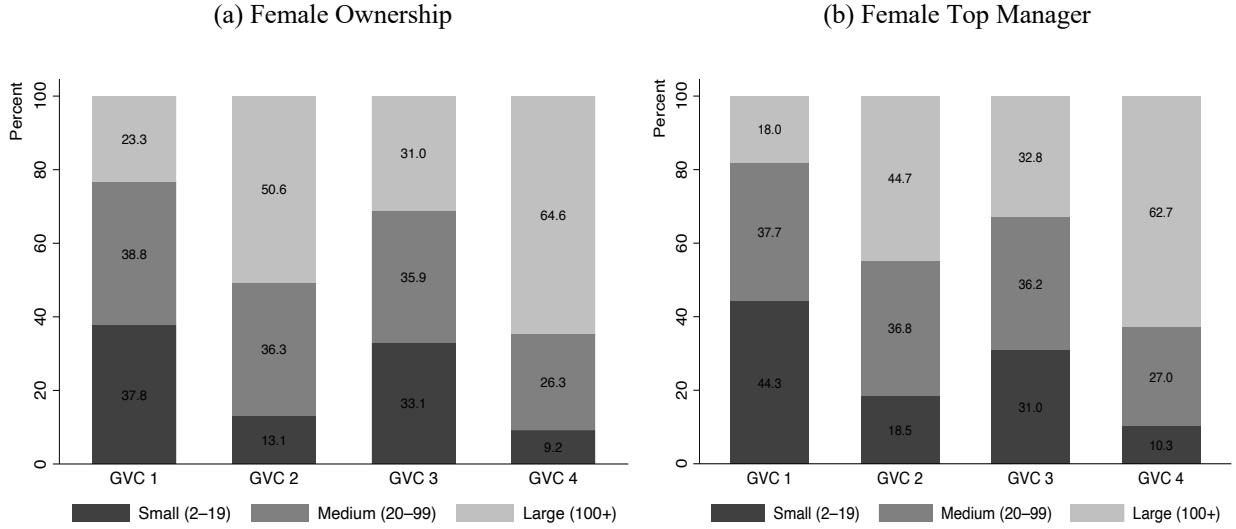
Taken together, these stylized facts provide preliminary evidence of a nuanced relationship between GVC participation and women's economic empowerment. While international integration may expand employment opportunities for women, leadership roles remain unevenly distributed. The next section examines these relationships to assess whether GVC participation has a systematic impact on female empowerment outcomes.

Figure 3.1 Shares of Female Owned and Managed Firms across GVC Participation Definitions



Source: Constructed by the authors using the WBES.
Note: GVC1 refers to firms that export and import simultaneously, GVC2 = GVC1 + international certification, GVC3= GVC1+ share of its capital owned by a foreign firm, GVC4 combines the four criteria altogether.

Figure 3.2 Firm Size Composition of Female Ownership and Management across GVC Participation Definitions



Source: Constructed by the authors using the WBES.
GVC1 refers to firms that export and import simultaneously, GVC2 = GVC1 + international certification, GVC3= GVC1+ share of its capital owned by a foreign firm, GVC4 combines the four criteria altogether.

3.2.2 Empirical Strategy

Using firm-level data from the WBES, we estimate the impact of firms' integration into GVCs on women's economic empowerment as follows:

$$\text{Female}_{ijct} = \lambda\, \text{GVC}_{ijct} + \rho\, X_{ijct} + \zeta_t + \gamma_c + \theta_j + \delta_{ijct} \qquad (1)$$

where i, j, c and t denote firms, sector, country and year, respectively. The dependent variable Female_{ijct} captures women's economic participation along three distinct dimensions: A dummy variable equal to one if the firm has a female owner and zero otherwise; A dummy variable equal to one if the firm's top manager is female and zero otherwise; Female full-time employment, measured either as the share or number of female workers. These indicators jointly capture entrepreneurship, leadership, and workforce participation dimensions of women's economic empowerment within firms. The key explanatory variable GVC_{ijct} captures firms' integration into GVCs and is constructed following Dovis and Zaki (2020) using four alternative definitions that reflect increasing degrees of international embeddedness. GVC participation is defined along four dimensions: export status, import status, international quality certification, and foreign ownership participation.

The least restrictive definition (GVC1) classifies firms as GVC participants if they simultaneously export and import, thereby identifying two-way traders. A second and third definition introduce additional conditions, requiring two-way traders to either hold an international certification (GVC2) or to have foreign capital participation (GVC3). The most restrictive definition (GVC4) combines all four criteria: firms must simultaneously export and import, hold an international certification, and have foreign ownership participation in their capital.

These progressively stricter definitions allow us to distinguish between basic engagement in international production networks and more selective forms of GVC participation that are typically associated with higher fixed requirements, such as certification standards and foreign ownership linkages. Importantly, all four measures capture GVC participation at the extensive margin, as they are constructed as binary indicators and therefore do not measure the intensity of integration. In the empirical analysis, we focus primarily on the first (GVC1) and the fourth (GVC4) definitions.

The vector X_{ijct} includes firm-level characteristics that may influence female entrepreneurship and labor force participation, including firm's age, type of ownership, and size. Firm age is measured as the difference between the survey year and the year in which the establishment began operations. The share of government ownership captures the percentage of the firm's capital held by public entities, reflecting the possibility that partial public ownership may be associated with more gender-inclusive employment practices. Firm size is included as a categorical variable distinguishing small, medium, and large firms, recognizing that larger firms may benefit from economies of scale, more formalized management structures, and greater resource availability, which could influence both GVC participation and female employment outcomes. Table 3B.3 provides detailed definitions of all variables used in the analysis.

Given the pooled cross-country and multi-year nature of the dataset, the specification includes year, country, and sector fixed effects to control for unobserved heterogeneity across time, national institutional environments, and sector-specific characteristics. Year fixed effects (ζ_t) capture global macroeconomic shocks and temporal trends, country fixed effects (γ_c) account for institutional and structural differences across economies, and sector fixed (θ_j) effects control for industry-specific production structures and gender patterns. δ_{ijct} is the error term.

The baseline estimations are conducted using pooled Ordinary Least Squares (OLS) when the dependent variable is continuous and Linear Probability Models (LPM) when the dependent variable is binary. LPM models facilitate direct interpretation of coefficients as marginal effects[1].

The baseline estimates cannot be interpreted as causal due to potential endogeneity arising from simultaneity and self-selection. Simultaneity bias may occur if firms with higher female participation are more likely to engage in international trade. Self-selection may arise because more productive firms are both more likely to integrate into GVCs and more likely to employ or promote women. To address these concerns, we implement two complementary identification strategies. First, we employ an instrumental variable (IV) approach to isolate exogenous variation in GVC participation. Second, we apply propensity score matching (PSM) estimations,

[1] Probit estimations reported in Appendix 3C yield results consistent with those obtained using the LPM.

defining treatment as participation in GVCs, to compare observationally similar firms that differ in their integration status.

Beyond the baseline specification, the analysis explores heterogeneity along both internal and external dimensions. Internal heterogeneity is examined through sectoral classifications that distinguish between manufacturing and services, between skill-intensive and unskilled labor-intensive sectors, and between low-technology and medium-high-technology industries. External heterogeneity is assessed by incorporating the presence of gender-related provisions in RTAs, thereby evaluating whether institutional trade frameworks moderate the relationship between GVC participation and women's economic outcomes.

Finally, we investigate potential mechanisms through which GVC integration may influence female entrepreneurship and labor force participation. In particular, we examine whether firms integrated into GVCs are more likely to provide on-the-job training, engage in technological upgrading through R&D expenditures or foreign technology licensing, and experience improved access to finance. These channels allow us to identify the pathways through which deeper international integration may translate into changes in women's economic participation within firms.

3.3 Empirical Results

Our empirical analysis examines women's economic participation within firms along three complementary dimensions: female ownership, female top management, and female employment. These indicators capture distinct yet interconnected aspects of women's economic empowerment, ranging from entrepreneurial control to leadership representation and overall labor force participation.

The results are presented in three stages. First, Section 3.3.1 reports the baseline estimates of the relationship between GVC participation and the three measures of female participation. Second, Section 3.3.2 addresses potential endogeneity concerns through instrumental variable (IV) estimation and propensity score matching (PSM) techniques. Third, Section 3.3.3 explores heterogeneity in the estimated effects, examining both sectoral differences and the moderating role of gender-related provisions in RTAs.

3.3.1 Baseline Estimates

Table 3.2 reports the baseline regression results. Turning first to the control variables, larger and older firms are more likely to be female-owned and to employ a higher share of female workers. Larger firms are typically more productive, more formalized, and more likely to be listed, which may foster greater gender diversity in leadership structures. Evidence from Li and Chen (2018), based on panel data from listed non-financial firms in China, shows that gender diversity on corporate boards improves firm performance. Similar findings are reported by Said et al. (2021) for Egyptian firms. Regarding ownership structure, a higher share of government ownership is associated with a greater likelihood of female ownership. This result is consistent with the broader evidence that the public sector tends to employ a higher proportion of women and often offers stronger institutional support and wage premia relative to the private sector.

Focusing on our variable of interest, the least restrictive definition of GVC participation (GVC1) is positively associated with the probability of female ownership and with higher female employment. In contrast, deeper integration into GVCs (GVC4) reduces the likelihood of female ownership. It is important to emphasize that the negative relationship between the most restrictive definition of GVC participation (GVC4) and female ownership does not constitute an inconsistency in the results. The different GVC measures are not alternative proxies for the same concept but rather capture progressively stricter forms of integration into global production networks. While GVC1 reflects broad two-way trade participation, GVC4 imposes additional requirements, including foreign ownership participation and international quality certification. These conditions are typically associated with higher fixed costs, greater capital intensity, and stronger external control structures, which may reduce the likelihood of female ownership, particularly in contexts where women face structural constraints in accessing capital and international networks. Therefore, the differing effects across definitions reflect heterogeneity in GVC engagement rather than conflicting empirical evidence. Moreover, GVC participation is negatively associated with the probability of having a female top manager.

Three remarks are worth highlighting. First, it is important to distinguish between ownership and management positions. Firm owners hold residual control rights and directly bear profits and losses, whereas managers are salaried employees responsible for operational decision-making (Woods and Joyce, 2003). From an economic

empowerment perspective, ownership may confer greater strategic influence than managerial roles. Accordingly, the positive association between GVC participation and female ownership may signal enhanced entrepreneurial participation, even though the negative effect on female top management suggests persistent barriers in executive positions.

Second, GVC integration is positively associated with female employment. While this finding indicates expanded employment opportunities for women, it should be interpreted with caution, as our data do not capture job quality. The Rana Plaza collapse in Bangladesh in April 2013 illustrates how integration into global garment supply chains may generate employment alongside serious concerns regarding working conditions (Koenig and Poncet, 2022). The collapse of the building that housed five garment factories killed more than a thousand people and injured more than 2,500. Although GVC participation can stimulate job creation (Kumar, 2017), the quality and security of these jobs remain important considerations.

Third, many emerging economies possess a comparative advantage in labor-intensive industries such as processed food, textiles, and ready-made garments, where production activities rely heavily on blue-collar workers. Distinguishing between production and non-production workers (Table 3C.2), we find that GVC participation increases the share of female production workers, consistent with Shepherd (2018) and World Bank (2020) evidence that women are more concentrated in production-related tasks than in managerial or administrative roles. These findings align with Guha-Khasnobis et al. (2022) for India and Pham and Jinjarak (2022) for Vietnam, who document that deeper GVC integration generates employment opportunities particularly for unskilled and female production workers. Kumar (2017) similarly finds that young, low-skilled female workers account for a substantial share of employment creation in labor-intensive value chains such as apparel and electronics. By contrast, the negative association between GVC participation and female non-production employment is consistent with the earlier result showing a lower probability of female top management in GVC-integrated firms.

The baseline analysis focuses on firms simultaneously engaged in exporting and importing (GVC1). However, it is informative to disentangle the roles of exporting and importing separately. From a comparative advantage perspective, exporting may enhance women's economic participation when firms operate in sectors where the country has a relative advantage (Fontana and Wood, 2000). Importing, on the other

hand, may increase competitive pressures and improve access to higher-quality intermediate inputs, thereby raising productivity (Martínez-Zarzoso et al., 2021). The effects of import exposure on women's employment are context-dependent, with some studies finding positive effects (Heckl, 2024) and others documenting negative or heterogeneous impacts (Mansour et al., 2022). For example, Fatima and Khan (2019) use industry-level data for 21 developing economies and show that high-tech imports from developed countries increase female employment in developing economies.

Table 3C.3 shows that exporting increases the probability of female ownership and female employment, while reducing the likelihood of having a female top manager. Similarly, importing is positively associated with female ownership and female employment but negatively associated with female top management. The magnitudes of the coefficients suggest that forward (export-based) and backward (import-based) integration contribute comparably to female ownership outcomes. Furthermore, imports reflect the share of intermediate inputs sourced from abroad, capturing the backward integration of firms, while exports represent the forward integration of firms. Taken together, these findings imply that GVC participation promotes female labor force participation through both forward and backward linkages, even though gender disparities persist in managerial positions.

Table 3.2 GVCs and Female Labor Force Participation – Baseline Results

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
ln(Age)	0.047***	0.048***	-0.010***	-0.010***	0.063***	0.068***
	(0.002)	(0.002)	(0.002)	(0.006)	(0.004)	(0.004)
ln(Gov. Own.)	0.021***	0.022***	-0.003*	-0.003*	0.055***	0.056***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.006)	(0.006)
Medium	0.000	0.003	-0.037***	-0.037***	0.992***	1.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)
Large	-0.001	0.008***	-0.060***	-0.060***	2.589***	2.623***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.007)	(0.007)
GVC	0.020***	-0.049***	-0.007***	-0.022***	0.276***	0.454***
	(0.003)	(0.006)	(0.002)	(0.004)	(0.006)	(0.016)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	248,044	247,578	225,332	224,853	230,319	229,915
R-squared	0.108	0.108	0.084	0.084	0.601	0.598

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included.

3.3.2 Tackling Endogeneity

The baseline estimates cannot be interpreted as a causality due to potential endogeneity between GVC participation and female labor force outcomes. Two main sources of endogeneity may bias the results. First, simultaneity bias may arise if the gender composition of a firm influences its trade integration decisions, rather than GVC participation affecting gender outcomes (Karam and Zaki, 2021). Second, self-selection bias may occur because only the most productive firms self-select into international markets, as suggested by the heterogeneous-firm trade literature (Melitz, 2003). Firms that are inherently more productive or better managed may both integrate into GVCs and employ more women, thereby confounding the estimated relationship.

To address simultaneity concerns, we implement an IV strategy using a Two-Stage Least Squares (2SLS) approach (Table 3.3). Specifically, we construct a leave-one-out mean of GVC participation aggregated at the country-year-sector-geographical zone level, excluding the firm's own GVC status. This instrument captures exogenous variation in firms' exposure to GVC integration driven by sectoral and geographical dynamics, while removing firm-level idiosyncratic components. The use of leave-one-out mean instruments is well established in the literature (Alby et al., 2013; Dovis and Zaki, 2020; Ehab and Zaki, 2021; Cette et al., 2022).

The first-stage equation is specified as follows:

$$GVC_{ijct} = \alpha\ \ln(age)_{ijct} + \beta\ln(govown)_{ijct} + \xi\ size_{ijct} + \upsilon\ IV\_GVC_{ijct} + \zeta_t + \gamma_c + \theta_j + \in_{ijct} \qquad (2)$$

where IV_GVC_{ijct} denotes the leave-one-out mean of firms' GVC participation calculated at the industry-country-year-geographical zone level, excluding the firm itself. $\in_{ijct}$ represents the error term. Standard tests confirm the validity and strength of the instrument[2].

[2] The minimum Eigenvalue is higher than the critical values at the 10% threshold, and the p-value is significant at the 1% level. We therefore reject the null hypothesis of weak instruments.

Table 3.3 indicates that the positive effects of GVC participation on female ownership and female employment remain robust and, in fact, become stronger under the IV specification. This suggests that the baseline estimates may have been downward biased, likely due to endogeneity. The effect of GVC participation on female top management is either insignificant or negative. Overall, these findings provide stronger support for a causal interpretation of the relationship between GVC integration and female empowerment, particularly in terms of ownership and employment outcomes.

Table 3.3 GVCs and Female Labor Force Participation – IV Approach

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
ln(Age)	0.046***	0.048***	-0.010***	-0.010***	0.057***	0.066***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)
ln(Gov. Own.)	0.021***	0.022***	-0.003	-0.002	0.049***	0.048***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)
Medium	-0.004*	0.003	-0.037***	-0.036***	0.960***	0.991***
	(0.002)	(0.002)	(0.00Z)	(0.002)	(0.005)	(0.005)
Large	-0.014***	0.013***	-0.060***	-0.052***	2.496***	2.512***
	(0.004)	(0.005)	(0.003)	(0.004)	(0.008)	(0.011)
GVC	0.072***	-0.108**	-0.006	-0.134***	0.640***	1.884***
	(0.010)	(0.055)	(0.009)	(0.044)	(0.023)	(0.118)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	247,761	247,295	225,080	224,602	230,047	229,643
R-squared	0.002	0.003	0.005	0.003	0.502	0.482

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included.

To further address self-selection concerns, we employ a PSM[3] (Table 3.4). This approach constructs a counterfactual group of firms that are similar along observable characteristics but do not particiapte in GVCs. The treatment is defined as GVC participation, and the average treatment effect (ATE) is estimated as:

$$\text{ATE} = \text{E}(\text{Y}_{\text{ijct}} / \text{T}_{\text{ijct}} = 1,\ \text{X}_{\text{ijct}}) - \text{E}(\text{Y}_{\text{ijct}} / \text{T}_{\text{ijct}} = 0,\ \text{X}_{\text{ijct}}) \qquad (3)$$

where Y_{ijct} represents female-related outcomes: female ownership, female top management, and female employment. T = 1 if the firm participates in GVCs and 0 otherwise. The vector X_{ijct} includes observable firm characteristics such as age, size,

[3] To assess the robustness of the matching results, propensity scores are estimated using alternative matching specifications, including Kernel pair matching with replacement and cross-validation bandwidth selection based on the means of the covariates. Matching statistics and corresponding results are reported in Appendix 3D.

and share of government ownership, in addition to the fixed effects included in the baseline specification. The PSM approach assumes that selection into GVC participation is based solely on observables.

The estimated ATE confirms the baseline findings. The positive effects of GVC participation on female ownership (for GVC1) and female employment are preserved, while the effect on female top management remains negative and statistically consistent with earlier results. Matching diagnostics, reported in Appendix 3D, indicate a high level of common support across both GVC definitions and the full sample. Overall, the PSM results corroborate the baseline and IV estimates, reinforcing the robustness of the findings.

Table 3.4 GVCs and Female Labor Force Participation – PSM

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
ATE	0.027***	-0.018***	-0.005**	-0.019*	0.190***	0.440***
	(0.004)	(0.009)	(0.003)	(0.006)	(0.014)	(0.031)

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
All the regressions include country, year, and sector fixed effects.

3.3.3 Heterogeneity Analysis

Given that the sample spans multiple sectors characterized by heterogeneous production structures, task compositions, and employment patterns, it is important to account for sectoral heterogeneity (Section 3.3.3.1). Beyond firm-level characteristics, institutional frameworks may condition the extent to which GVC participation translates into improved gender outcomes. In particular, trade agreements that explicitly incorporate gender provisions may alter the regulatory and normative environment in which firms operate and thus shape the inclusiveness of international integration. We therefore examine whether the presence of gender-related provisions in RTAs is explicitly associated with improvements in female labor force participation (Section 3.3.3.2).

3.3.3.1 Sector Heterogeneity

To explore heterogeneity across sectors, we conduct a sectoral analysis using three complementary classification approaches[4]. First, sectors are grouped into manufacturing and services (Table 3.5), reflecting well-documented gender patterns whereby women tend to be more represented in services and in selected labor-intensive manufacturing activities such as textiles and food processing. Second, to capture differences in production structures, sectors are classified according to the resource-intensity framework developed by the Empirical Trade Analysis Center (ETAC), distinguishing between primary and natural resource sectors, unskilled labor-intensive sectors, human capital-intensive sectors, and technology-intensive sectors (Table 3.6). Third, to account for variations in technological sophistication (Table 3.7), manufacturing sectors are categorized by technological intensity following the United Nations Industrial Development Organization (UNIDO) classification based on ISIC Revision 4, separating low-technology from medium-high-technology sectors. Service sectors are further classified using the OECD taxonomy of Economic Activities based on R&D Intensity (Galindo Rueda and Verger, 2016) and measures of digital intensity (Calvino et al., 2018).

Table 3.5 shows that, relative to service-sector firms, manufacturing firms are less likely to have female owners, female top managers, and female employees, consistent with existing evidence on gender segregation across industries. One possible explanation is that service activities often involve lower capital requirements and more flexible organizational structures, which may facilitate women's participation in leadership roles. These findings align with Christiansen et al. (2016), who document higher representation of women in senior corporate positions within service industries in Europe. When interacting the manufacturing dummy with GVC participation, the results indicate that integration into GVCs increases the likelihood of female ownership and female top management under the most lenient definition (GVC1). Moreover, it enhances female participation in the workforce under both definitions of GVC.

With respect to sectoral skill and resource intensity (Table 3.6), firms operating in unskilled labor-intensive and human capital-intensive sectors are associated with a higher probability of female ownership and female management, as well as higher female employment. The interaction with GVC participation reveals additional

[4] Sector classifications are available upon request.

heterogeneity. Under the baseline GVC definition (GVC1), firms in unskilled labor-intensive sectors that participate in GVCs experience an increase in female employment. Conversely, participation in GVCs within human capital-intensive sectors are associated with a decline in female employment. These findings are consistent with Gopalan et al. (2024), who show that GVC participation tends to benefit female employment more strongly in labor-intensive industries such as food processing, textiles, apparel, and leather goods, whereas high and medium-technology sectors, including machinery, electronics, and chemicals, remain predominantly male-dominated due to structural and cultural barriers, including workplace masculinities and systemic gender biases.

Finally, Table 3.7 examines differences across technological intensity levels. Manufacturing industries are classified according to the UNIDO technological intensity framework, while services follow OECD classifications based on R&D and digital intensity. Relative to low-technology sectors, medium-high-technology sectors are associated with a lower probability of female ownership and top management, as well as lower female employment. However, GVC participation partially offsets these gaps, as firms integrated into GVCs within medium-high-technology sectors exhibit an increased likelihood of having a female owner and top manager.

Table 3.5 GVCs and Female Labor Force Participation – Manufacturing vs. Services

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
[1]GVC	0.009**	-0.015	-0.020***	-0.025***	0.125***	0.299***
	(0.004)	(0.013)	(0.003)	(0.009)	(0.008)	(0.029)
[2]Manufacturing	-0.019***	-0.012***	-0.025***	-0.022***	-0.089***	-0.028***
	(0.002)	(0.002)	(0.008)	(0.002)	(0.005)	(0.004)
[1]*[2]	0.014***	-0.055***	0.019***	-0.006	0.240***	0.163***
	(0.005)	(0.015)	(0.004)	(0.011)	(0.011)	(0.034)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	248,044	247,578	225,332	224,853	230,319	229,915
R-squared	0.101	0.101	0.070	0.070	0.568	0.564

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included. The reference sector is *Services*.
All the regressions control for firms' age, size, and type of ownership.

Table 3.6 GVCs and Female Labor Force Participation – Skilled, Unskilled and Technology Intensive Sectors

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
[1]GVC	0.008	-0.075***	-0.012**	-0.031***	0.175***	0.381***
	(0.007)	(0.016)	(0.005)	(0.010)	(0.017)	(0.044)
[2]Unskilled labor	0.062***	0.066***	0.071***	0.071***	0.347***	0.478***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.011)	(0.010)
[3]Technology int.	-0.021***	-0.015***	-0.015***	-0.014***	-0.157***	-0.160***
	(0.005)	(0.004)	(0.004)	(0.003)	(0.013)	(0.012)
[4]Hum. Cap. int.	0.033***	0.032***	0.050***	0.050***	0.201***	0.195***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.008)	(0.008)
[1]*[2]	0.011	-0.051**	6.07e-05	-0.031	0.469***	0.273***
	(0.010)	(0.026)	(0.008)	(0.019)	(0.026)	(0.084)
[1]*[3]	0.002	-0.047**	0.005	-0.006	-0.031	0.160**
	(0.010)	(0.023)	(0.007)	(0.015)	(0.026)	(0.064)
[1]*[4]	0.005	0.014	-0.007	-0.012	-0.068***	-0.036
	(0.010)	(0.030)	(0.008)	(0.023)	(0.022)	(0.077)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126,625	126,435	113,207	113,023	116,532	116,401
R-squared	0.128	0.129	0.099	0.100	0.595	0.591

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included. The reference sector is *primary and natural-resource intensive sectors*.
All the regressions control for firms' age, size, and type of ownership.
Sectors are classified following the Empirical Trade Analysis Center (ETAC) classification.

Table 3.7 GVCs and Female Labor Force Participation – High vs. Low-Tech. Intensive Sectors

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
[1]GVC	0.015***	-0.084***	-0.017***	-0.053***	0.355***	0.477***
	(0.004)	(0.012)	(0.003)	(0.009)	(0.011)	(0.037)
[2]Medium-High Tech.	-0.058***	-0.052***	-0.067***	-0.063***	-0.299***	-0.294***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.005)
[1]*[2]	0.013**	0.027*	0.019***	0.028***	-0.083***	-0.071*
	(0.006)	(0.015)	(0.004)	(0.010)	(0.014)	(0.042)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	183,192	182,849	166,908	166,568	170,553	170,274
R-squared	0.115	0.115	0.084	0.084	0.588	0.585

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included. The reference sector is *low technology*.
All regressions control for firms' age, size, and type of ownership.
Manufacturing sectors are classified following the United Nations Industrial Development Organization (UNIDO) classification by technological intensity (ISIC Revision 4). Services are classified following the OECD Taxonomy of Economic Activities Based on R&D Intensity (Galindo Rueda and Verger, 2016) and their digital intensity following (Calvino et al., 2018).

3.3.3.2 Gender Provisions in Regional Trade Agreements (RTAs)

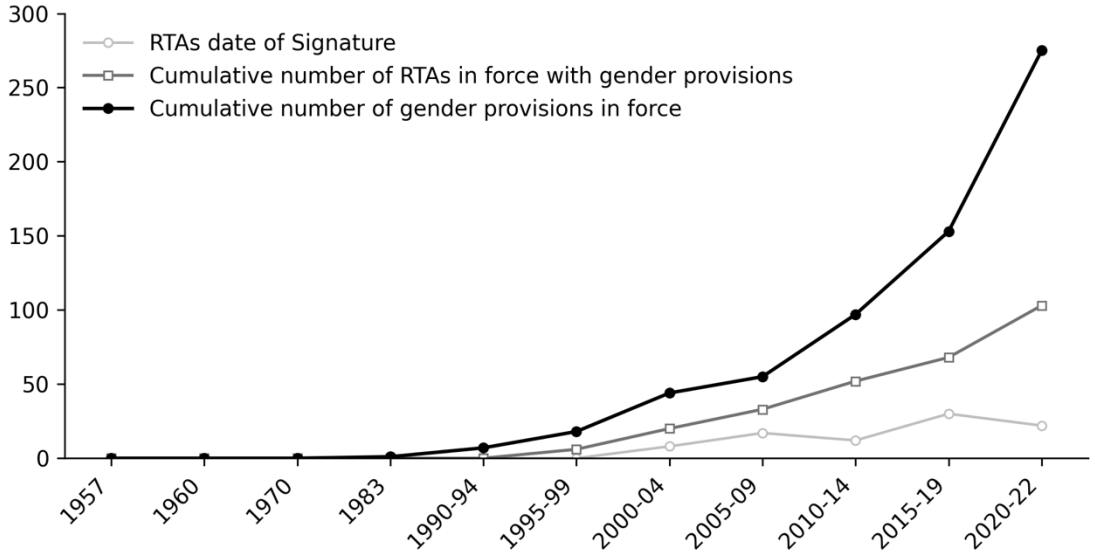
As discussed earlier, the analysis is further extended by examining whether the relationship between GVC participation and female labor market outcomes is moderated by the presence of gender-related provisions in RTAs. Trade agreements that explicitly address gender issues, through references to sex equality, women, girls, or international frameworks such as the Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW), the Beijing Declaration and Platform for Action for the Rights of Women and Girls, the Buenos Aires Declaration on Trade and Women's Economic Empowerment, or the UN Sustainable Development Goal 5 (SDG 5) on gender equality (SDG 5), may create an institutional environment that facilitates women's access to economic opportunities. By reducing regulatory barriers, promoting non-discrimination, and signaling policy commitment, such provisions may reinforce the positive effects of GVC integration on female employment, leadership, and entrepreneurship.

Over the past two decades, the scope of regional and bilateral trade agreements has expanded beyond traditional tariff reduction to incorporate broader SDGs. Many agreements now include environmental and climate-related provisions (Martínez-Zarzoso, 2018), while labor-rights clauses have become increasingly common, with more than 136 countries negotiating at least one FTA containing labor provisions since 2016 (ILO, 2017; Harrison, 2019). In contrast, progress in integrating gender considerations into trade agreements has been comparatively limited. Among all FTAs currently in force, only around 20 percent contain explicit gender-related chapters or clauses aimed at advancing women's empowerment (Monteiro, 2021), and only about 74 out of roughly 500 RTAs include provisions that explicitly prioritize gender issues (UNCTAD, 2020). Importantly, the effectiveness of these provisions depends less on their number or length than on their legal enforceability. Bahri (2021) shows that some agreements, such as the Canada–Chile and Canada–Israel RTAs, include dedicated gender chapters but lack binding obligations that ensure implementation. Conversely, agreements where gender commitments are embedded within enforceable development frameworks, such as the Stabilization and Association Agreement between the European Communities and the Republic of Montenegro, may generate stronger outcomes due to clearer legal obligations and monitoring mechanisms.

Figure 3.3 illustrates the steady increase in the number of RTAs containing gender provisions since the early 2000s. In principle, these provisions can make GVC participation more inclusive through several channels. First, many agreements aim to reduce gender discrimination by promoting equal access to trade-related opportunities. Second, some provisions encourage women's participation in entrepreneurship and economic activities, although relatively few focus on improving women's access to productive resources, such as finance, land, technology, or training, which are critical for firms' participation in international trade. Third, only a limited set of provisions addresses women's leadership and decision-making roles, suggesting that existing agreements may still fall short of tackling structural barriers within firms (WTO, 2022). However, it is important to note that, while the inclusion of such provisions is necessary, it might not be sufficient when enforcement is weak.

Table 3.8 presents the regression results incorporating gender provisions and their interaction with GVC participation. The positive effect of GVC on female ownerships and employment is still confirmed in the regressions. Gender provisions themselves are associated with higher female employment and greater representation in top management positions, suggesting that gender-sensitive trade frameworks may foster a more inclusive business environment. However, their standalone effect on female ownership appears negative, which may reflect the predominance of *de jure* commitments that are not fully enforced. This finding is consistent with the broader institutional discussion above: the presence of gender-related language alone may be insufficient to transform firm ownership structures when enforcement mechanisms are weak. Crucially, the interaction between GVC participation and gender provisions yields a significant positive effect across all three indicators: female ownership, management, and employment. This suggests that gender provisions act as a complementary institutional framework that enhances the inclusiveness of GVC integration. Overall, while the results indicate that trade policy can be leveraged to make GVCs more women-friendly, stronger enforcement and monitoring mechanisms remain essential to translate commitments into measurable outcomes.

Figure 3.3 Evolution of RTAs with Gender Provisions over Time



Source: WTO (2022).

Table 3.8 GVCs and Female Labor Force Participation – Gender Provisions in RTAs

	Gender Provisions in Trade Agreements		
	Female Ownership	Female Top Manager	Full-Time Female Employees
[1] GVC	0.008**	-0.013***	0.266***
	(0.004)	(0.003)	(0.008)
[2] Gender Provisions	-0.025***	0.014**	0.072***
	(0.007)	(0.006)	(0.015)
[1] * [2]	0.019***	0.011***	0.018*
	(0.005)	(0.004)	(0.011)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Controls & Intercept	Yes	Yes	Yes
Observations	248,044	225,332	230,319
R-squared	0.108	0.084	0.601

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

3.4 Discussion

This section explores the potential mechanisms through which firms' integration into GVCs may promote female labor force participation. In particular, we examine three channels frequently highlighted in the literature: on-the-job training, technological upgrading (R&D and technology licensing), and access to finance. These mechanisms are tested empirically, with results reported in Table 3.9 for female ownership and in Table 3.10 for female labor force participation.

3.4.1 On-the-job Training as a Human Capital Channel

Training is widely recognized as a key transmission channel through which GVC participation shapes labor market outcomes. Taglioni and Winkler (2016) argue that firms integrated into GVCs must comply with stricter production standards and quality requirements, which often necessitate investments in workforce training to upgrade skills and improve task performance. Such investments can enhance employability and support upward mobility within firms. Beyond firm-level productivity gains, training initiatives may also foster women's economic participation. McKenzie (2021) shows that business training programs help women start their own enterprises, while Pham and Jinjarak (2022) emphasize the role of training programs in improving long-term career prospects for female workers. Consistent with this perspective, Gopalan et al. (2024) find that GVC-integrated firms in developing economies that provide training are more likely to employ female workers, highlighting training as a potential mechanism linking global integration to gender-inclusive labor outcomes.

Consistent with these arguments, our estimates show that GVC integration is positively associated with a higher likelihood of providing on-the-job training. Table 3.9 shows that GVC-integrated firms are 9.1 percentage points more likely to offer training among female-owned firms. Similarly, Table 3.10 reveals that GVC-integrated firms are 8.3 percentage points more likely to provide training among firms with a majority share of female employees. These findings suggest that skill upgrading may constitute an important mechanism linking international production networks to women's labor market outcomes.

3.4.2 Technology Adoption and Innovation

Technological upgrading represents another important channel through which GVC integration may support female entrepreneurship and labor force participation. Firms engaged in international production networks are often exposed to new knowledge, production standards, and technological requirements that encourage innovation and capability upgrading. Using firm-level data from the WBES, Rigo (2021) shows that GVC participation facilitates technology transfer, particularly through the licensing of foreign technologies, which contributes to significant productivity gains. Similarly, Zeng et al. (2025) argue that GVC integration enhances firms' innovation capacity, which has a positive impact on employment particularly for non-production and skilled workers (Sime and Tadesse, 2025).

Innovation in this study is proxied by firms' R&D expenditures and the use of foreign technology licenses. The results reported in Tables 3.9 and 3.10 indicate that GVC-integrated firms are more likely to invest in R&D and to adopt foreign technologies, both among female-owned firms and among firms with a higher share of female employees. These findings suggest that technological upgrading may constitute an important mechanism through which participation in GVCs reshapes firm organization and enhances competitiveness, potentially creating new opportunities for women within internationally integrated firms.

3.4.3 Access to Finance

Access to finance remains a critical barrier to women's economic participation and entrepreneurship. Despite legal progress in many countries, where explicit gender-based discrimination in access to credit has been reduced, female entrepreneurs continue to face structural constraints in financial markets. According to the World Bank (2021), women often encounter indirect barriers such as limited collateral ownership and weaker asset accumulation, which can restrict their ability to secure loans. Similarly, the ILO (2021) emphasizes that improving women's access to financial services, markets, land, and property rights is essential for enhancing their participation in economic activities. Consistent with these concerns, Figure 3B.1 shows that access to finance represents 14.3 percent of the main operational obstacles reported by female-owned firms, ranking as the most significant constraint.

Empirical evidence also highlights persistent gender gaps in entrepreneurial finance. OECD (2025) indicates that women entrepreneurs are significantly less likely than men to obtain external financing, receive only a small fraction of venture capital

investments, and often face less favorable lending conditions, including higher interest rates and stricter collateral requirements. These disparities reflect a combination of supply- and demand-side factors, including institutional biases in lending practices, limited alignment of financial products with women-led businesses, sectoral differences in firm activity, and lower participation of women in financial decision-making.

Against this backdrop, the results reported in Tables 3.9 and 3.10 suggest that GVC participation may help alleviate some of these financial constraints. Firms integrated into GVCs are more likely to hold checking or savings accounts and exhibit higher borrowing levels from banks and financial institutions. This pattern holds for both female-owned firms and firms with a high share of female employees, indicating that integration into international production networks may improve firms' financial credibility and access to formal financial channels. Taken together, these findings point to enhanced financial inclusion as a plausible mechanism through which GVC participation can support women's economic empowerment within firms.

Table 3.9 GVC Participation and Potential Mechanisms:
Evidence from Female-Owned Firms

	Female Owned Firms				
	(1) On-the-job training	(2) Innovation		(3) Access to finance	
		R&D	Tech. License	Checking/Saving Acc.	Borrowing (ln)
GVC	0.091***	0.145***	0.082***	0.014***	0.231***
	(0.005)	(0.005)	(0.004)	(0.002)	(0.017)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
Controls & Intercept	Yes	Yes	Yes	Yes	Yes
Observations	73,461	63,670	62,822	79,979	74,331
R-squared	0.193	0.184	0.084	0.124	0.132

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 3.10 GVC Participation and Potential Mechanisms:
Firms with Majority Female Employment

	Share of female employees > 50				
	(1) On-the-job training	(2) Innovation		(3) Access to finance	
		R&D	Tech. License	Checking/Saving Acc.	Borrowing (ln)
GVC	0.083***	0.113***	0.093***	0.016***	0.212***
	(0.005)	(0.005)	(0.005)	(0.003)	(0.017)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
Controls & Intercept	Yes	Yes	Yes	Yes	Yes
Observations	63,906	55,156	55,388	75,234	69,892
R-squared	0.195	0.160	0.090	0.149	0.123

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The threshold of 50 percent female employees corresponds to the median share of female employment.

3.5 Conclusion and Policy Implications

This paper examines the impact of firms' integration into GVCs on women's economic participation, measured along three complementary dimensions: female ownership, female top management, and female employment. Using firm-level data covering 152 countries, the analysis provides new evidence on how international production integration shapes women's roles as entrepreneurs, leaders, and workers.

The results indicate that the baseline definition of GVC participation increases the likelihood of female ownership, while both the least restrictive and the most restrictive definitions are associated with higher female employment. The positive employment effect is particularly pronounced for production workers, consistent with the concentration of women in labor-intensive segments of value chains. In contrast, GVC participation is associated with a lower probability of women holding top managerial positions. These findings suggest that while GVC integration may expand employment opportunities and facilitate female entrepreneurship, it does not automatically translate into greater representation in top management roles.

To address potential endogeneity arising from simultaneity and self-selection, the analysis implements both IV estimation and PSM, where treatment is defined as participation in GVCs. The results remain robust across identification strategies, reinforcing the interpretation that GVC integration plays a meaningful role in shaping women's economic outcomes.

Further analysis highlights substantial sectoral heterogeneity along three dimensions: sector type, skill intensity, and technological intensity. Services, unskilled labor-intensive sectors, and low-technology industries emerge as the primary employers of women. Moreover, integration into GVCs significantly enhances female labor force participation and creates ownership and managerial opportunities in unskilled labor-intensive sectors. At the same time, GVC participation fosters female ownership and managerial representation in manufacturing and medium-high-technology sectors relative to comparable firms that are not integrated into GVCs. These findings suggest that international production networks may facilitate upward mobility in more technologically advanced sectors, even where baseline female representation is relatively low.

From a policy perspective, this study speaks directly to two interrelated development challenges: low female labor force participation and limited integration of firms into GVCs. These challenges are mutually reinforcing. Strengthening firms' integration into GVCs can expand employment opportunities in sectors where many developing countries possess comparative advantages and where female labor is relatively intensive, such as textiles, ready-made garments, processed food, and certain segments of electronics manufacturing. Consequently, enhancing women's participation in GVC-linked activities not only supports firm competitiveness but also advances broader development objectives. In this regard, the findings contribute directly to the achievement of SDG 9 (promoting inclusive and sustainable industrialization and fostering innovation) and SDG 5 (achieving gender equality and empowering all women and girls).

Building on the empirical evidence, four policy directions emerge. First, sectoral heterogeneity matters. The impact of GVC integration varies systematically across sector type, skill intensity, and technological intensity. Trade and industrial policies should therefore avoid a one-size-fits-all approach. Instead, policymakers should design sector-specific strategies that align industrial upgrading with gender inclusion objectives. In labor-intensive sectors, policies can consolidate and formalize women's employment gains, while in medium- and high-technology sectors, targeted initiatives may be required to address structural barriers that limit women's entry into managerial and ownership positions. Integrating gender impact assessments into trade and industrial policy design can help prevent unintended distributional effects that disproportionately disadvantage women workers.

Second, investment in skills and capacity building is critical. The evidence highlights the role of on-the-job training and technological upgrading as mechanisms linking GVC participation to women's economic outcomes. Expanding access to technical training, managerial education, digital skills development, and leadership programs can strengthen women's ability to move beyond production roles into higher value-added activities, including management and entrepreneurship. Skill development policies should be aligned with sectoral upgrading strategies to ensure that women are not confined to low-wage segments of value chains.

Third, improving women's access to finance is essential. Since access to financial services operates as a key transmission channel between GVC integration and female ownership, policies should aim to reduce financial constraints faced by women

entrepreneurs. This may involve expanding credit guarantee schemes, promoting gender-sensitive lending practices, supporting women-focused financial products, and reducing legal or institutional barriers that limit women's borrowing capacity. Enhancing financial inclusion can facilitate women's entry into entrepreneurship and enable them to scale operations within internationally integrated sectors.

Fourth, institutional and cultural transformation remains fundamental. Persistent stereotypes, discriminatory norms, and gender biases continue to limit women's participation in leadership and decision-making roles. Policies aimed at promoting gender equality should therefore extend beyond economic instruments to include awareness campaigns, corporate governance reforms, diversity incentives, and stronger enforcement of anti-discrimination frameworks. Embedding gender equality objectives within trade agreements and industrial strategies can reinforce these efforts by aligning economic integration with social inclusion.

Taken together, these policy measures suggest that GVC integration can serve as a lever for women's economic empowerment, provided that complementary policies are implemented to address structural constraints. Trade integration alone is insufficient; its gender-inclusive potential depends critically on supportive institutional, financial, and human capital policies.

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Appendix 3A: List of Countries and years of the WBES

Country	Survey years	Country	Survey years
Afghanistan	2008-2014-2025	Congo, Dem. Rep.	2006-2010-2013-2024
Albania	2007-2013-2019-2025	Denmark	2020
Angola	2006-2010-2024	Djibouti	2013
Antigua and Barbuda	2010	Dominica	2010
Argentina	2006-2010-2017	Dominican Republic	2010-2016
Armenia	2009-2013-2020	Ecuador	2006-2010-2017-2024
Austria	2021-2025	Egypt, Arab Rep.	2013-2016-2020
Azerbaijan	2009-2013-2019-2024	El Salvador	2006-2010-2016-2023
Bahamas	2010	Equatorial Guinea	2024
Bahrain	2024	Eritrea	2009
Bangladesh	2007-2013-2022	Estonia	2009-2013-2019-2023
Barbados	2010-2023	Eswatini	2006-2016-2024
Belarus	2008-2013-2018	Ethiopia	2011-2015-2025
Belgium	2020-2024	Federal Republic of Somalia	2025
Belize	2010	Fiji	2009
Benin	2009-2016-2024	Finland	2020
Bhutan	2009-2015-2024	France	2021
Bolivia	2006-2010-2017-2025	Gabon	2009
Bosnia and Herzegovina	2009-2013-2019-2023	Gambia, The	2006-2018-2023
Botswana	2006-2010-2023	Georgia	2008-2013-2019-2023
Brazil	2009	Germany	2021
Brunei Darussalam	2025	Ghana	2007-2013-2023
Bulgaria	2007-2009-2013-2019-2023	Greece	2018-2023
Burkina Faso	2009-2024	Grenada	2010
Burundi	2006-2014-2025	Guatemala	2006-2010-2017
Cabo Verde	2009-2024	Honduras	2006-2010-2016
Cambodia	2013-2016-2023	Guinea	2006-2016-2025
Cameroon	2009-2016-2024	Guinea-Bissau	2006-2025
Canada	2024	Guyana	2010
Central African Republic	2011-2023	Hong Kong	2023
Chad	2009-2018-2023	Hungary	2009-2013-2019-2023
Chile	2006-2010	Iceland	2024
China	2012-2024	India	2014-2022
Colombia	2006-2010-2017-2023	Indonesia	2009-2015-2023
Comoros	2025	Iraq	2011-2022
Congo, Rep.	2009-2024	Ireland	2020-2024
Costa Rica	2010-2023	Israel	2013-2024
Côte d'Ivoire	2009-2016-2023	Kazakhstan	2009-2013-2019-2024
Croatia	2007-2013-2019-2023	Italy	2019-2024
Cyprus	2019-2024	Jamaica	2010-2024
Czechia	2009-2013-2019-2024	Jordan	2013-2019-2024
Kenya	2007-2013-2018-2025	Romania	2009-2013-2019-2023
Kiribati	2025	Saudi Arabia	2022
Korea Republic	2024	Sao Tome and Principe	2025
Kosovo	2009-2013-2019	Senegal	2007-2014-2024
Kuwait	2025	Russian Federation	2009-2012-2019

Kyrgyz Republic	2009-2013-2019-2023	Serbia	2009-2013-2019-2024
Lao PDR	2009-2012-2016-2018-2024	Seychelles	2023
Latvia	2009-2013-2019-2024	Sierra Leone	2009-2017-2023
Lebanon	2013-2019	Singapore	2023
Lesotho	2009-2016-2023	Slovak Republic	2009-2013-2019-2023
Liberia	2009-2017-2025	Slovenia	2009-2013-2019-2024
Lithuania	2009-2013-2019	Solomon Islands	2015
Luxembourg	2020	South Africa	2007-2020
Madagascar	2009-2013-2022	South Sudan	2014-2024
Malawi	2009-2014-2025	Spain	2021-2024
Malaysia	2015-2019-2024	Sri Lanka	2011
Mali	2007-2010-2016-2024	St Kitts and Nevis	2010
Malta	2019-2024	St Lucia	2010
Mauritania	2006-2014	St Vincent and Grenadines	2010
Mauritius	2009-2023	Sudan	2014
Mexico	2006-2010-2023	Suriname	2010-2018
Micronesia	2009	Sweden	2014-2020-2024
Moldova	2009-2013-2019-2024	Taiwan	2024
Mongolia	2009-2013-2019-2025	Tajikistan	2008-2013-2019-2024
Montenegro	2009-2013-2019-2023	Tanzania	2006-2013-2023
Morocco	2013-2019-2023	Thailand	2016
Mozambique	2007-2018-2025	Timor-Leste	2009-2015-2021
Myanmar	2014-2016	Togo	2009-2016-2023
Namibia	2006-2014-2024	Tonga	2009-2024
Nepal	2009-2013-2023	Trinidad and Tobago	2010-2025
Netherlands	2020	Tunisia	2013-2020-2024
New Zealand	2023	Türkiye	2008-2013-2019-2024
Nicaragua	2006-2010-2016	Turkmenistan	2024
Niger	2009-2017-2025	Uganda	2006-2013-2025
Nigeria	2007-2014-2025	Ukraine	2008-2013-2019
North Macedonia	2009-2013-2019-2023	United Kingdom	2024
Pakistan	2007-2013-2022	United States of America	2024
Panama	2006-2010	Uruguay	2006-2010-2017-2024
Papua New Guinea	2015-2024	Uzbekistan	2008-2013-2019-2024
Paraguay	2006-2010-2017-2023	Vanuatu	2009-2023
Peru	2006-2010-2017-2023	Venezuela, RB	2006-2010
Philippines	2009-2015-2023	Vietnam	2009-2015-2023
Poland	2009-2013-2019-2025	West Bank and Gaza	2013-2019-2023
Portugal	2019-2023	Yemen, Rep.	2010-2013
Rwanda	2006-2011-2019-2023	Zambia	2007-2013-2019
Samoa	2009-2023	Zimbabwe	2011-2016

Source: Constructed by the authors using the WBES.

Appendix 3B: Descriptive Statistics and Variables Definition

Table 3B.1 Firms integrating into GVCs

	Number of firms	Percentage of total firms
GVC 1	51,569	19.76%
GVC 2	22,795	8.82%
GVC 3	13,751	4.47%
GVC 4	6,992	2.69%

Source: Constructed by the authors using the WBES.
GVC1 refers to firms that export and import simultaneously, GVC2 = GVC1 + international certification, GVC3= GVC1+ share of its capital owned by a foreign firm, GVC4 combines the four criteria altogether.

Table 3B.2 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Age (years)	252970	29.817	17.852	1	356
Services Sector	252970	0.493	0.499	0	1
Manufacturing Sector	252970	0.507	0.499	0	1
Government Ownership (%)	252970	0.507	5.691	0	100
Number of Employees	252970	108.163	3447.104	0	1673000
International Quality Certification (dummy)	246480	0.236	0.425	0	1
Share of Firm Owned by Females (%)	53031	53.401	35.267	0	100
Female Owner (dummy)	247046	0.327	0.469	0	1
Female Top Manager (dummy)	224348	0.162	0.368	0	1
Share of Full-Time Female Employees	229935	0.316	0.283	0	1
Share of Full-Time Female Production Workers	91971	0.542	0.375	0	1
Share of Full-Time Female Non-Production Workers	91971	0.458	0.375	0	1
Exporter (dummy)	252970	0.246	0.431	0	1
Importer (dummy)	252970	0.635	0.481	0	1
GVC1	252970	0.193	0.395	0	1
GVC2	251096	0.088	0.283	0	1
GVC3	252970	0.047	0.211	0	1
GVC4	252441	0.026	0.158	0	1

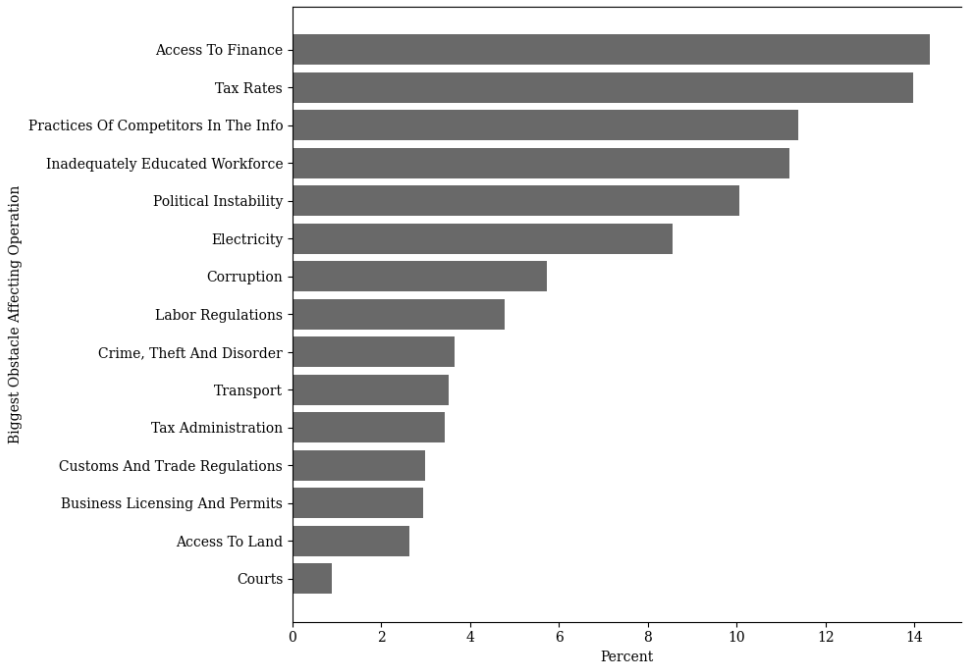
Source: Constructed by the authors using the WBES.

Table 3B.3 Variables Definition

Variable	Definition
ln(Age)	Natural logarithm of firm age, measured as the difference between the survey year and the year in which the establishment began operations
ln(Gov own)	Natural logarithm of the share of government ownership in the firm
Small	Dummy variable equal to 1 if the firm employs fewer than 20 workers, and 0 otherwise
Medium	Dummy variable equal to 1 if the firm employs between 20 and 99 workers, and 0 otherwise
Large	Dummy variable equal to 1 if the firm employs 100 or more workers, and 0 otherwise
Female Ownership	Dummy variable equal to 1 if the firm has at least one female owner, and 0 otherwise
Female Top Manager	Dummy variable equal to 1 if the firm's top manager is female, and 0 otherwise
Fem. Emp.	Natural logarithm of the number of full-time female employees
Fem. Prod. Workers	Share of full-time female production workers
Fem. Non-Prod. Workers	Share of full-time female non-production workers
GVC 1	Dummy variable equal to 1 if the firm simultaneously exports and imports, and 0 otherwise
GVC 2	Dummy variable equal to 1 if the firm simultaneously exports and imports and holds an international quality certification, and 0 otherwise
GVC 3	Dummy variable equal to 1 if the firm simultaneously exports and imports and has private foreign ownership exceeding 10 percent, and 0 otherwise
GVC 4	Dummy variable equal to 1 if the firm simultaneously exports and imports, holds an international quality certification, and has private foreign ownership exceeding 10 percent, and 0 otherwise
On-the-job Training	Dummy variable equal to 1 if the firm provided formal training programs for full-time employees during the last fiscal year, and 0 otherwise.
R&D	Dummy variable equal to 1 if the firm reported expenditures on research and development during the last fiscal year, and 0 otherwise
Technology License	Dummy variable equal to 1 if the firm uses technology licensed from a foreign-owned company, and 0 otherwise
Saving/Checking Account	Dummy variable equal to 1 if the firm has a checking and/or savings account, and 0 otherwise
ln(borrow)	Natural logarithm of the percentage of working capital financed through bank borrowing

Source: Constructed by the authors using the WBES.

Figure 3B.1 Main Operational Obstacles Facing Female-Owned Firms



Source: Constructed by the authors using the WBES.

Appendix 3C: Further Results

Table 3C.1 GVCs and Female Labor Force Participation – Probit Model

	Female Ownership		Female Top Manager	
	GVC 1	GVC 4	GVC 1	GVC 4
ln(Age)	0.140***	0.142***	-0.048***	-0.048***
	(0.006)	(0.006)	(0.007)	(0.007)
ln(Gov. Own.)	0.059***	0.060***	-0.017*	-0.017*
	(0.007)	(0.007)	(0.009)	(0.009)
Medium	0.003	0.011*	-0.157***	-0.158***
	(0.006)	(0.006)	(0.008)	(0.008)
Large	0.003	0.032***	-0.265***	-0.263***
	(0.008)	(0.008)	(0.010)	(0.010)
GVC	0.064***	-0.136***	-0.025**	-0.107***
	(0.008)	(0.018)	(0.010)	(0.023)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Observations	248,036	247,570	225,290	224,811

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included.

Table 3C.2 GVCs and Female Production and Non-Production Workers

	(1) Production	(2) Non-Production
ln(Age)	-0.023***	0.023***
	(0.002)	(0.002)
ln(Gov. Own.)	-0.001	0.001
	(0.002)	(0.002)
Medium	0.018***	-0.018***
	(0.003)	(0.003)
Large	0.088***	-0.088***
	(0.003)	(0.003)
GVC	0.013***	-0.013***
	(0.003)	(0.008)
Country FE	Yes	Yes
Year FE	Yes	Yes
Sector FE	Yes	Yes
Observations	92,019	92,019
R-squared	0.185	0.185

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included.

Table 3C.3 GVCs and Female Labor Force Participation – Exporter vs. Importer

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	Exporter	Importer	Exporter	Importer	Exporter	Importer
Trade	0.022***	0.021***	-0.004**	-0.008***	0.255***	0.143***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.005)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	248,044	248,044	225,332	225,332	230,319	230,319
R-squared	0.108	0.108	0.084	0.084	0.601	0.598

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included. All regressions control for firms' age, size, and type of ownership.
Trade is measured by the exporting or the importing status.

Appendix 3D: Robustness Checks

Table 3D.1 IV Approach – First Stage

	GVC 1	GVC 4
IV: Leave-one-out mean GVC	0.071***	0.378***
	(0.010)	(0.007)
ln(Age)	0.046***	0.001**
	(0.002)	(0.001)
ln(Gov. Own.)	0.021***	0.007***
	(0.002)	(0.001)
Medium	-0.004*	0.011***
	(0.002)	(0.001)
Large	-0.014***	0.071***
	(0.004)	(0.001)
Country FE	Yes	Yes
Year FE	Yes	Yes
Sector FE	Yes	Yes
Observations	247,761	247,295
Underidentification test P-Val	0.0000	0.0000

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The minimum Eigenvalue is higher than all the critical values at 10%.
The intercept is included.

Table 3D.2 PSM First Stage – Probit Estimation

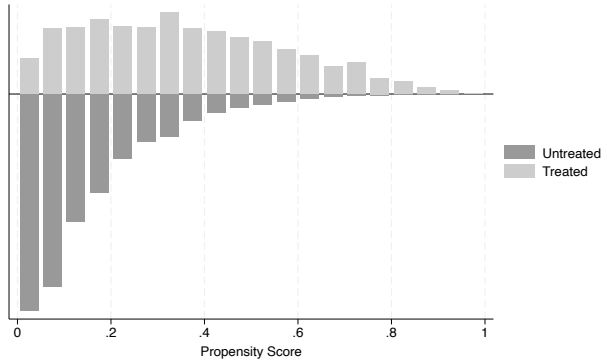
	GVC 1	GVC 4
ln(Age)	0.083***	0.013
	(0.007)	(0.013)
ln(Gov. Own.)	0.422***	0.577***
	(0.008)	(0.020)
Medium	0.989***	1.307***
	(0.009)	(0.020)
Large	0.069***	0.072***
	(0.007)	(0.011)
Country FE	Yes	Yes
Year FE	Yes	Yes
Sector FE	Yes	Yes
Observations	254,030	248,844

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The intercept is included.

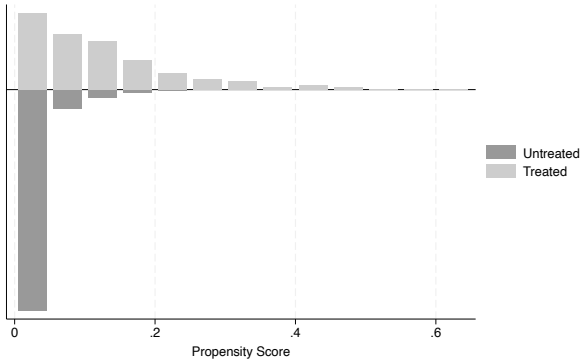
[a] PSM: Nearest Neighborhood Matching Method

Figure 3D.1 Common Support of Propensity Scores between Treated and Untreated Groups

(a) Treatment: GVC1



(b) Treatment: GVC4



Note: Outcome is *Female Ownership*. Psgraphs for other outcomes are available upon request.

Table 3D.3 Common Support, Outcome: Female Ownership

(a) GVC 1

Treatment assignment	Common support On support	Total
Untreated	200,255	200,255
Treated	47,789	47,789
Total	248,044	248,044

(b) GVC 4

Treatment assignment	Common support On support	Total
Untreated	236,698	236,698
Treated	6,014	6,014
Total	242,712	242,712

Table 3D.4 Common Support, Outcome: Female Top Manager

(a) GVC 1

Treatment assignment	Common support On support	Total
Untreated	181,211	181,211
Treated	44,121	44,121
Total	225,332	225,332

(b) GVC 4

Treatment assignment	Common support On support	Total
Untreated	214,379	214,379
Treated	5,953	5,953
Total	220,332	220,332

Table 3D.5 Common Support, Outcome: Ful-Time Female Employees

(a) GVC 1

Treatment assignment	Common support On support	Total
Untreated	185,876	185,876
Treated	44,443	44,443
Total	230,319	230,319

(b) GVC 4

Treatment assignment	Common support On support	Total
Untreated	219,614	219,614
Treated	5,822	5,822
Total	225,436	225,436

[b] PSM: Kernel Pair Matching with Replacement

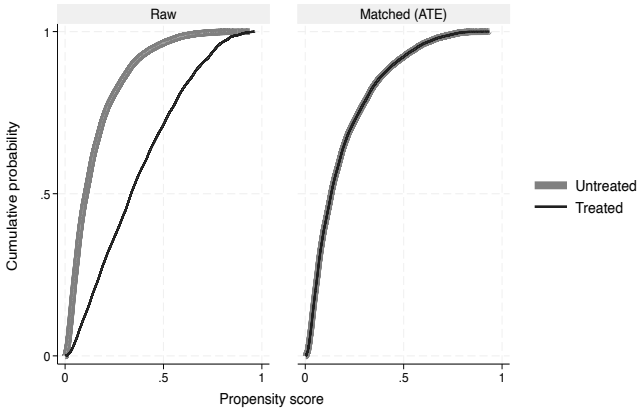
Table 3D.6 GVCs and Female Labor Force Participation – PM with Replacement

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
ATE	0.027***	-0.001	-0.006**	-0.009	0.216***	0.369***
	(0.004)	(0.019)	(0.003)	(0.016)	(0.010)	(0.044)

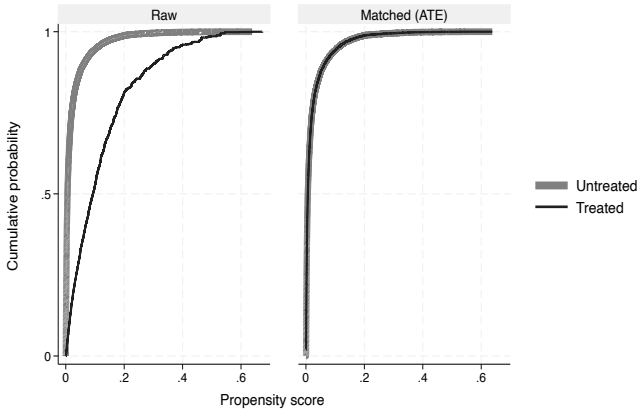
Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
All the regressions include country, year, and sector fixed effects.

Figure 3D.2 Quality of Kernel Matching: Cumulative Distribution Functions of Propensity Scores before and after the PSM

(a) Treatment: GVC 1



(b) Treatment: GVC 4



Note: Outcome is *female ownership*. Psgraphs for other outcomes are available upon request.

Table 3D.7 PSM – Matching Statistics: Kernel pair matching with replacement

	Matched			
Treatment: GVC1	Yes	No	Total	Bandwidth
Treated	46014	1775	47789	0.0001078
Untreated	193429	6826	200255	0.000036
Combined	239443	8601	248044	
Treatment: GVC4				
Treated	5820	194	6014	0.0000779
Untreated	223293	18271	241564	0.0000583
Combined	229113	18465	247578	

Note: outcome is *female ownership*. Statistics for other outcomes are available upon request.

[c] PSM: Kernel Cross Validation

Table 3D.8 GVCs and Female Labor Force Participation – CV

	Female Ownership		Female Top Manager		Full-Time Female Employees	
	GVC 1	GVC 4	GVC 1	GVC 4	GVC 1	GVC 4
ATE	0.028***	0.003	-0.003	-0.009	0.217***	0.359***
	(0.003)	(0.020)	(0.003)	(0.016)	(0.010)	(0.043)

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

All the regressions include country, year, and sector fixed effects.

General Conclusion

The expansion of GVCs represents a new phase in the evolution of international trade, characterized by the fragmentation of production processes across borders and the increasing interconnection of global production networks. In this context, participation in GVCs has become a central component of countries' strategies to enhance competitiveness, foster structural transformation, and achieve sustainable economic development. This dissertation, composed of three empirical chapters, contributes to the growing literature on the determinants and outcomes of GVC participation by examining the role of exchange rate policy in shaping countries' integration into global production networks and by exploring the broader developmental and inclusive implications of such integration. In doing so, it provides several policy-relevant insights, particularly for developing economies seeking to leverage exchange rate policy and GVC participation as tools for economic upgrading and inclusive development.

By combining analyses at the country, sector, and firm levels, this dissertation addresses three main research questions. First, it investigates the impact of RER undervaluation on countries' participation in GVCs and examines how institutional quality and digitalization moderate this relationship. Second, it analyzes how bilateral RER depreciation affects Egypt's integration into GVCs at the sectoral level and how it shapes the country's position along the value chain. Third, it explores the impact of firms' participation in GVCs on women's economic empowerment, focusing on female ownership, managerial representation, and participation in the labor force.

The results across the three chapters provide several important insights into the determinants and outcomes of GVC participation. First, the country-level analysis shows that RER undervaluation positively affects both forward and backward participation in GVCs, reinforcing the complementarity between domestic and foreign value added in production processes. This effect is particularly pronounced in countries characterized by weaker institutional environments and higher levels of digitalization, suggesting that undervaluation may partially compensate for structural constraints while facilitating deeper integration into global production networks. Second, the sector-level analysis focusing on Egypt indicates that RER depreciation strengthens GVC integration through both forward and backward linkages. The gains through forward linkages are particularly strong in primary sectors, while backward

linkages are more responsive in high-technology sectors. However, the findings also show that exchange rate depreciation alone is insufficient to generate upgrading along the value chain. Only when learning effects arising from foreign knowledge embedded in imported inputs are taken into account does RER depreciation translate into significant upgrading outcomes. Third, the firm-level analysis reveals that GVC integration increases the likelihood of female ownership and significantly enhances female employment, although it is associated with a lower probability of women holding top managerial positions. The results further indicate that sectoral characteristics, gender-related provisions in RTAs, and firm-level mechanisms, such as on-the-job training, technological upgrading, and improved access to finance, play a crucial role in shaping the gender-related outcomes of GVC participation.

Taken together, the three chapters demonstrate that participation in GVCs is not merely a matter of trade integration but rather a broader development process involving competitiveness, structural transformation, and social inclusion. The findings highlight that the benefits derived from GVC participation depend not only on the extent of integration itself but also on the policy environment, the position countries and firms occupy within global production networks, and the capacity of economic actors to capture and diffuse the gains associated with integration.

Beyond its empirical contributions, this dissertation also opens several avenues for future research. In the context of the first chapter, which examines the impact of exchange rate undervaluation on countries' participation in GVCs, future research could benefit from the increasing availability of detailed sector-level input–output data. Exploiting such datasets would allow researchers to investigate sectoral heterogeneity in greater depth and provide more granular insights into how exchange rate policies influence different segments of GVCs. Regarding the second chapter, which studies the impact of bilateral RER depreciation on Egypt's sectoral integration into GVCs using the UNCTAD–EORA dataset, it is important to note that this database, despite its extensive coverage, relies on estimation techniques that may introduce measurement limitations, particularly for developing economies. Access to the full EORA input–output tables for all available years would enable more precise estimates of value-added flows and provide more accurate assessments of upgrading dynamics. Finally, regarding the third chapter analyzing the impact of firms' participation in GVCs on women's labor market outcomes, a limitation of the WBES relates to the structure of the data. While the WBES consist of survey waves that can be pooled across countries and years, the availability of true longitudinal firm-level

observations remains limited and varies across countries. Moreover, the surveys mainly cover formal firms, whereas women are also highly represented in the informal sector in many developing economies. Future research could therefore benefit from exploiting country-specific panel surveys or richer longitudinal firm-level datasets, which would allow for a more detailed analysis of the dynamic effects of GVC participation on gender outcomes over time.

As GVCs continue to reshape the organization of production and trade, understanding the conditions that enable countries and firms to benefit from them remains an essential research and policy priority. Ensuring that integration translates into upgrading and more inclusive development will therefore remain a central challenge for both scholars and policymakers.

Résumé Substantiel

Cette thèse se compose de trois chapitres qui examinent la compétitivité extérieure et le rôle de la politique de change dans l'orientation de la participation aux CVM et leurs résultats en matière de développement. Le chapitre 1 se concentre sur les déterminants de l'intégration dans les CVM au niveau national et examine comment la politique de change influence la compétitivité extérieure des pays et leur insertion dans les réseaux de production internationaux. Le chapitre 2 élargit l'analyse en étudiant comment la politique de change interagit avec la transformation structurelle et le positionnement sectoriel, contribuant ainsi à la montée en gamme le long de la chaîne de valeur et aidant les pays à s'orienter vers des activités à plus forte valeur ajoutée. Le chapitre 3 se concentre sur le niveau des entreprises et analyse l'impact de l'intégration des entreprises dans les CVM sur l'autonomisation économique des femmes et la participation des femmes au marché du travail, mettant en évidence la dimension de développement inclusif de l'intégration de la production mondiale.

Ces trois chapitres s'intéressent tous aux thèmes liés aux CVM et enrichissent la littérature tant sur les déterminants que sur les conséquences de la participation à ces chaînes. En particulier, cette thèse permet de mieux comprendre comment la politique de change et les facteurs structurels influencent conjointement la capacité des pays non seulement à s'intégrer dans les CVM, mais aussi à se moderniser et à éviter de rester cantonnés dans des segments à faible valeur ajoutée, notamment grâce aux retombées en matière de connaissances et aux dynamiques d'apprentissage. Enfin, elle met en évidence le rôle inclusif des CVM en examinant les résultats liés au genre, reliant ainsi l'intégration internationale de la production à l'autonomisation économique des femmes et à des objectifs de développement plus larges. La contribution de chaque chapitre, ainsi qu'un aperçu détaillé, sont présentés dans les paragraphes suivants.

Chapitre 1

Le premier chapitre examine si les conclusions tirées de la littérature existante concernant la croissance et le rôle de la sous-évaluation du TCR dans la promotion des exportations s'appliquent également au cas des CVM. Nous évaluons l'impact de cette politique sur la participation des pays aux maillons en amont et en aval des chaînes de valeur, en accordant une attention particulière à deux facteurs modérateurs, à

savoir la qualité des institutions et la numérisation. Nous utilisons donc l'ensemble de données UNCTAD-EORA pour 143 pays sur la période 1995–2018 et suivons une stratégie de cointégration.

Nous constatons que la sous-évaluation du TCR a un effet positif sur la participation aux CVM, tant en amont qu'en aval. Si l'impact positif observé sur les liens en amont peut sembler à première vue contraire à l'intuition par rapport à la littérature antérieure, il s'inscrit dans l'idée sous-jacente selon laquelle la valeur ajoutée nationale et étrangère au sein des CVM sont complémentaires dans le processus de production. En conséquence, une augmentation de la valeur ajoutée nationale destinée à l'exportation accroît la demande dérivée d'intrants intermédiaires importés, renforçant ainsi le rôle de la sous-évaluation dans la promotion de l'intégration en amont des CVM. En tenant compte de la qualité des institutions et du degré de numérisation, nous constatons que la sous-évaluation peut agir comme un catalyseur de la participation aux CVM dans les pays dotés d'institutions inefficaces. Ce résultat met en évidence la double nature de la sous-évaluation, bénéfique lorsque la capacité d'absorption est limitée, mais moins lorsqu'les institutions soutiennent déjà la compétitivité par des canaux autres que les prix. De plus, cet effet est également amplifié dans les économies présentant des niveaux d'adoption du numérique plus élevés. Pour répondre aux préoccupations potentielles liées à l'endogénéité, nous utilisons une approche par variables instrumentales (IV) et incluons la valeur décalée du TCR. Ces deux stratégies confirment et renforcent les résultats de base concernant l'impact de la sous-évaluation. Nous étendons notre analyse empirique de trois manières. Premièrement, étant donné que certains pays peuvent disposer explicitement d'une monnaie dominante, nous examinons comment l'absence d'un moyen de paiement légal distinct façonne l'intégration dans les CVM et tempère l'effet de la sous-évaluation du TCR. Nous constatons que l'absence de monnaie légale distincte réduit les risques et l'incertitude liés au cycle d'exploitation. De plus, l'interaction avec la sous-évaluation du TCR montre que, dans ces pays, la sous-évaluation du TCR est associée à une participation encore plus forte aux CVM en amont par rapport aux autres pays. Deuxièmement, nous examinons la position d'un pays au sein de la chaîne de valeur, en distinguant les rôles en amont de ceux en aval. La sous-évaluation du TCR exerce systématiquement un impact positif sur la participation aux CVM en amont, quelle que soit la position. En ce qui concerne les liens en amont, l'effet reste positif et très significatif pour les pays en aval, tandis qu'il devient négatif pour les participants en amont. Ce résultat peut s'expliquer par l'effet d'amortissement dont bénéficient les pays en aval par rapport à ceux en amont, grâce à l'avantage de flexibilité relative des prix dont disposent les premiers.

Troisièmement, nous explorons l'hétérogénéité en estimant des régressions selon les groupes de revenus, les sous-périodes et les régions. Ensemble, ces stratégies permettent de mieux comprendre le rôle de la sous-évaluation dans la participation aux CVM et renforcent la crédibilité de nos conclusions.

Ce chapitre apporte trois contributions majeures à la littérature existante. Premièrement, alors que la plupart des études antérieures examinent l'impact de la sous-évaluation du TCR sur le commerce traditionnel, la présente étude se penche sur l'impact de ce phénomène sur la participation aux CVM, tant en amont qu'en aval. Deuxièmement, nous examinons comment cet impact dépend de facteurs structurels, à savoir la qualité des institutions et le degré d'adoption du numérique. Troisièmement, nous évaluons l'hétérogénéité de cet impact en fonction de la position d'un pays au sein de la chaîne de valeur, en distinguant les pays en amont et en aval.

Chapitre 2

Le deuxième chapitre utilise des données d'entrées-sorties multirégionales (MRIO) par secteur pour l'Égypte sur la période 1995-2022 et effectue des régressions PPML afin d'examiner l'impact de la dépréciation du TCR bilatéral sur les liens en amont et en aval des CVM ainsi que ses implications pour la mise à niveau. L'Égypte constitue un cas particulièrement intéressant pour examiner le rôle de la politique de change dans la promotion de l'intégration aux CVM et le positionnement sectoriel le long de la chaîne de valeur. Au cours des dernières décennies, le taux de change a été activement utilisé comme instrument de politique économique, le pays ayant connu plusieurs vagues de dévaluation monétaire visant à renforcer la compétitivité. Cependant, contrairement à de nombreuses économies asiatiques qui ont su tirer parti des politiques de change pour s'intégrer aux CVM et se moderniser en suivant leur évolution, les résultats de l'Égypte ont été plus limités.

Les principaux résultats montrent que la dépréciation du TCR renforce l'intégration dans les CVM par le biais de liens en amont et en aval, qui agissent comme des éléments complémentaires dans le processus de production. En ventilant les secteurs selon leur intensité technologique, les gains liés aux liens en amont sont les plus marqués dans les secteurs primaires, tandis que la réactivité des liens en aval est plus prononcée dans les secteurs de haute technologie. Cependant, la dépréciation du TCR ne conduit pas à elle seule à une amélioration de la position dans les CVM. Une fois pris en compte les effets d'apprentissage découlant des connaissances étrangères

intégrées dans les intrants importés, l'impact de la dépréciation du TCR sur la modernisation devient positif et statistiquement significatif, en particulier dans les secteurs de haute technologie. L'analyse d'hétérogénéité révèle en outre que les flux commerciaux de valeur ajoutée Sud-Nord sont plus sensibles à la dépréciation du TCR que les flux Sud-Sud, et que les effets sont plus prononcés au cours des sous-périodes 2004-2010 et 2011-2016. Tous les résultats sont robustes face à un large éventail de spécifications alternatives. Ces conclusions ont des implications politiques claires : si la flexibilité des taux de change peut faciliter une intégration plus poussée dans les CVM, une modernisation durable nécessite des politiques structurelles complémentaires qui élargissent l'accès aux importations à forte intensité de connaissances, renforcent l'innovation et les compétences, et réorientent le soutien politique vers les secteurs à forte productivité et orientés vers l'exportation.

Ce chapitre apporte trois contributions principales à la littérature existante. Premièrement, à notre connaissance, il présente la première analyse sectorielle de l'impact de la dépréciation du TCR sur l'intégration de l'Égypte dans les CVM. Deuxièmement, il explore le potentiel de modernisation sectorielle et les perspectives de progression dans la chaîne de valeur. Troisièmement, il élabore un indice de diffusion des connaissances afin d'évaluer dans quelle mesure les connaissances étrangères intégrées dans les intrants importés contribuent à cette modernisation.

Chapitre 3

Ce chapitre examine l'impact de l'intégration dans les CVM sur la participation économique des femmes, selon trois dimensions : la propriété des entreprises par des femmes, la présence de femmes aux postes de direction et l'emploi des femmes. Nous utilisons des données au niveau des entreprises portant sur 253 000 entreprises réparties dans 152 pays (dont 73 % sont des économies en développement et émergentes) pour la période 2006-2025.

Les principaux résultats montrent que la définition de référence de l'intégration dans les CVM augmente la probabilité que les femmes soient propriétaires d'une entreprise, tandis que les deux définitions : la moins restrictive et la plus restrictive, favorisent toutes deux l'emploi féminin. Un effet négatif est observé en ce qui concerne les postes de direction occupés par des femmes. Ces résultats restent solides après avoir pris en compte l'endogénéité potentielle à l'aide d'une estimation par variables instrumentales et d'un appariement par score de propension. L'analyse de

l'hétérogénéité sectorielle montre que les services, les secteurs à forte intensité de main-d'œuvre non qualifiée et les industries à faible technologie sont les principaux employeurs de femmes. De plus, l'intégration dans les CVM favorise les opportunités de propriété et de gestion dans les secteurs manufacturiers et de moyenne à haute technologie par rapport aux entreprises non intégrées dans les CVM. Les CVM peuvent donc être perçues comme un catalyseur pour promouvoir la participation des femmes au marché du travail et l'entrepreneuriat féminin dans les économies émergentes. En outre, les dispositions relatives à l'égalité des sexes dans les accords commerciaux régionaux modèrent l'impact de l'intégration dans les CVM, en particulier en ce qui concerne l'emploi des femmes. L'analyse des mécanismes suggère que la formation, la modernisation technologique et l'amélioration de l'accès au financement constituent des canaux de transmission clés reliant la participation aux CVM aux résultats économiques des femmes.

Cet article apporte une contribution à la littérature existante de trois manières principales. Premièrement, alors que les études existantes se concentrent principalement sur les taux d'emploi des femmes ou les écarts salariaux, cet article élargit l'analyse à l'entrepreneuriat et au leadership féminins en examinant la propriété des entreprises par des femmes et la présence de femmes aux postes de direction, parallèlement aux résultats en matière d'emploi. À notre connaissance, aucune étude transnationale au niveau des entreprises n'a jusqu'à présent analysé simultanément ces trois dimensions de la participation économique des femmes dans le contexte de l'intégration aux CVM. Deuxièmement, l'analyse explore l'hétérogénéité selon des dimensions tant internes qu'externes : les caractéristiques internes des entreprises (secteur d'activité, intensité en compétences et intensité technologique) et les cadres institutionnels externes, à savoir les dispositions relatives au genre dans les accords commerciaux régionaux. Troisièmement, ce chapitre examine les mécanismes par lesquels l'intégration dans les CVM peut influencer l'entrepreneuriat féminin et la participation au marché du travail, en mettant l'accent sur la formation en cours d'emploi, l'innovation via les dépenses de R&D et l'acquisition de licences technologiques étrangères, ainsi que l'accès au financement.