



Unravelling the nexus between exchange rate undervaluation and global value chains participation

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Accepted: 19 November 2025

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Abstract

Undervaluation of the real exchange rate (RER) can influence exports performance, but also country's participation in global value chains (GVCs). Yet, in GVCs, where products become multi-country products as intermediate inputs are imported, transformed, and then re-exported, GVC-related trade is expected to respond differently to exchange rate undervaluation compared to traditional trade in single-country goods. Thus, using the EORA dataset for 143 countries over the period 1995–2018, we assess the impact of this policy on a country's backward and forward participation in value chains, with a special focus on two moderating factors, namely the quality of institutions and digitalization. Our results show that currency undervaluation displays a positive impact on these two ways of participating in GVCs. Consistent with what has been noted in a recent strand of literature, undervaluation acts as a compensatory factor for countries with weak institutions, and the impact of this undervaluation becomes more pronounced as the level of digitalization in the economy increases. These results remain robust to a battery of robustness checks.

Keywords Global value chains · Exchange rate · Undervaluation · Quality of institutions · Digitalization · Cointegration

JEL Classifications F14 · F31 · F40 · O24

Authors are grateful to Björn Nilsson, Gianluca Orefice, Rémi Bazilier, Jala Emad, Mushegh Tovmasyan, Camille da Piedade, Mohamed Chaffai, as well as participants at the 2nd JM MASE, Paris AFEDev Doctoral Days, CERDI Doctoral Seminars, WTO ICITI, Paris 1-FESP 10th Joint Workshop, Roma Tre Internal Seminar, ERF 31st Annual Conference, and GDRE Orléans for insightful discussions and valuable comments on earlier drafts. This work was supported by the *Agence Nationale de la Recherche* of the French government through the programme 'France 2030' 'ANR-16-IDEX-0001'.

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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 & 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 digitalization¹.

The debate regarding the role of real exchange rate (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 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 well².

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., 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 GVCs trade, where products become multi-country products as intermediate inputs are imported, transformed, and then re-exported. Thus, GVC-related trade is

¹ See (Kowalski et al., 2015; Dasgupta & Mondria, 2018; De Melo and Solleder, 2022a, b; Fernandes et al., 2022; Gniniuguè et al., 2023) and other literature cited therein.

² See Dornbusch (1984) and Rodrik (1986).

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, extensive body of literature³ 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 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

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

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 countries⁴. 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 turning 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.

The remainder of the paper is structured as follows. Section 2 reviews the literature, highlighting salient theoretical framework as well as the main empirical predictions underpinning the relationship between exchange rate undervaluation and GVC participation. Section 3 presents the data we use. Section 4 details the econometric specification and discusses the associated empirical findings. Section 5 undertakes robustness checks. Section 6 performs some extensions and heterogeneity analysis. Section 7 concludes and discusses some policy implications.

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 cheaper⁵. However, this argument fails to hold up in real-world scenarios for two reasons. First, it assumes that the manufacturing sector is isolated from

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

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

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 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 & 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 exceptions⁷, 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 growth⁸.

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 & 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 & Zaki, 2021; Chaffai & 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%. 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 the country's 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% 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 failures⁹. 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

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

stimulates, not impedes, export diversification (Svensson, 2003; and Brach & 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 & Weinhold, 2002; Clarke, 2008; Kowalski et al., 2015; Fernandes et al., 2019; Cusolito et al., 2020; De Melo & Solleder, 2022a, b), especially for developing countries (Clarke & 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.

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, whereas 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.

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 initial assessment of the association between RER undervaluation and GVC participation¹⁰.

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-Samuel-

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

son effect (see Appendix B). The main advantage of this index is its comparability between 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 C). Table 1 shows that almost 49% and 75% of low/ lower-middle income and upper middle-income countries, respectively, have an undervalued RER. However, this is the case for only 30% of high-income countries. Overall, almost 48% of countries have an undervalued RER, corroborating Steinberg (2016)'s arguments discussed earlier.

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 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 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 (Fig. 2a and b), and the foreign value added (FVA) embodied in the exports of a specific country (Fig. 2c and d). In both cases, GVC participation is positively correlated with undervaluation in developing countries (mainly Africa and Asia), but not for developed ones.

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

Table 1 Descriptive statistics of RER undervaluation (log units) 1995–2018. *Source:* Authors' own calculations

	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

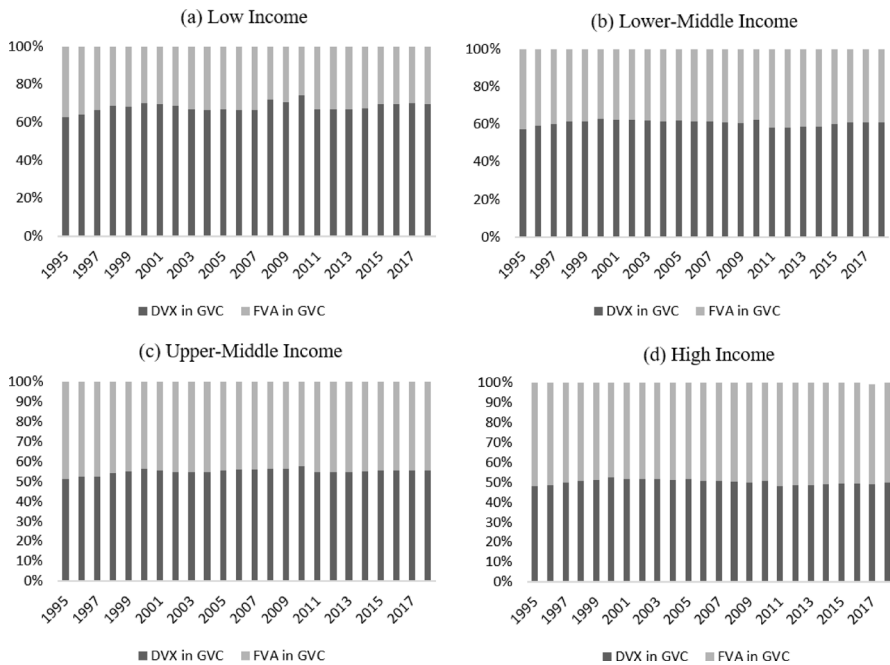


Fig. 1 The share of domestic and foreign value added in GVC. *Source:* Constructed by the authors using UNCTAD-EORA dataset

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 undervaluation¹¹.

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 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 partici-

¹¹ Figure A1 in Appendix A illustrates the association between the moderating variables and GVC participation.

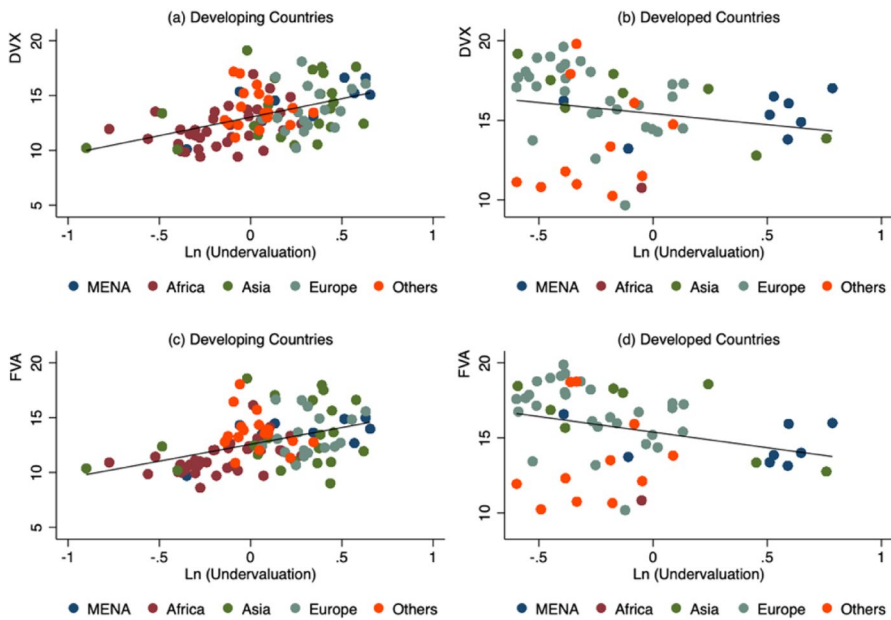


Fig. 2 The relation between GVC participation and RER undervaluation. *Note* Positive (negative) values of $\ln(\text{Undervaluation})$ correspond to RER undervaluation (overvaluation). *Source:* Constructed by the authors

pation 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 & 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 of total population from the WDI. Figure A1 in Appendix A confirms the positive association between GVC participation and digital adoption, especially for Asia (Fig. 3).

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

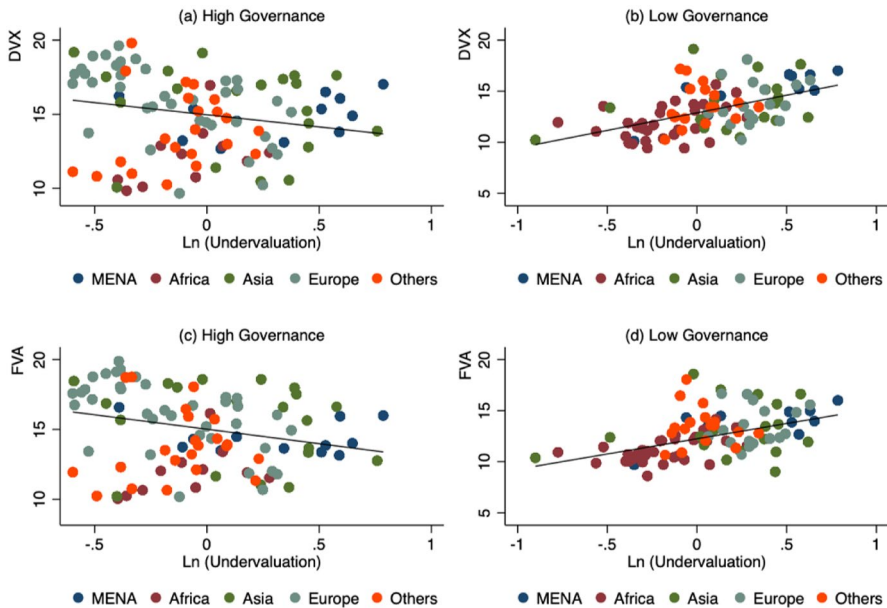


Fig. 3 The Relation between GVC participation and institutional quality. *Note* Institutional quality is measured using the Government Effectiveness Index from the WGI. Countries below the sample median are classified as “low governance” and those above as “high governance.” *Source:* Constructed by the authors

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.

4.1 Baseline setup

Regarding the baseline setup, to assess the stationarity of the series, we employ three widely used unit-root tests¹² (Harris & Tzavalis, 1999; Choi, 2001; Im et al., 2003). The results confirm that some variables are stationary, and others are integrated of

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

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 A4 and A5 in Appendix D). 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 & 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 & Chiang, 2001; Mark & 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 (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

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

mented. 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; DAVIS & Zaki, 2020; Ehab & 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 characteristics to provide a credible counterfactual. Second, we compute the average RER undervaluation across countries within the same propensity score block¹⁴, omitting the observation of country i . By following this empirical procedure, we strengthen causal inference by mitigating concerns of reverse causality in the relationship between RER undervaluation and GVC participation.

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 regressions¹⁵.

4.2 Baseline regressions

Examining the relationship between RER undervaluation and GVC participation, Table 2 presents the results¹⁶ for both forward (columns a and b) and backward link-

¹⁴A comprehensive description of blocks is available upon request.

¹⁵The results of the first stage regressions as well as the endogeneity and validity tests are reported in Table A8 in Appendix E.

¹⁶The marginal effects of the interaction terms are reported in Table A10 of Appendix E.

Table 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*** (0.043)	0.449*** (0.061)	1.504** (0.610)	0.175*** (0.016)	0.578*** (0.049)	1.661*** (0.583)
[2] ln(GDPPC)	0.595*** (0.009)	0.540*** (0.009)	0.648*** (0.029)	0.560*** (0.003)	0.518*** (0.007)	0.516*** (0.034)
[1] * [2]	-0.072*** (0.005)	-0.114*** (0.007)	-0.215*** (0.071)	-0.033*** (0.002)	-0.121*** (0.006)	-0.241*** (0.068)
ln(Tariff+1)	-0.030*** (0.003)	-0.017*** (0.003)	-0.012* (0.007)	-0.026*** (0.001)	-0.024*** (0.003)	-0.011 (0.012)
ln(Rents)	-0.006*** (0.001)	-0.005*** (0.001)	-0.008* (0.004)	-0.004*** (0.000)	-0.002*** (0.001)	0.002 (0.005)
[3] Government Effectiveness	-0.002 (0.006)	-0.027*** (0.005)	-0.001 (0.017)	-0.031*** (0.002)	-0.050*** (0.004)	-0.020 (0.021)
[4] Financial Development	0.218*** (0.017)	0.217*** (0.016)	0.189*** (0.052)	0.112*** (0.006)	0.144*** (0.013)	0.151*** (0.057)
[5] ln(Internet Usage)	-0.001 (0.002)	-0.018*** (0.002)	-0.033** (0.012)	0.053*** (0.001)	0.044*** (0.002)	0.052*** (0.011)
[1] * [3]		-0.091*** (0.011)	0.292*** (0.102)		-0.023*** (0.008)	-0.165* (0.092)
[1] * [4]		-0.271*** (0.039)	-2.10*** (0.349)		-0.008 (0.031)	0.359 (0.344)
[1] * [5]		0.140*** (0.003)	0.392*** (0.046)		0.132*** (0.002)	0.167*** (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

(i) DOLS refers to dynamic OLS and IV refers to instrumental variable. (ii) 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

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

ages (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 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 trade¹⁷. 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 & 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 contributes 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.

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. More-

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

over, for a plausible range of RER undervaluation, the net effect of connectivity on GVC participation is positive even for the case of forward linkages¹⁸.

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 & 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 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 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.

¹⁸ The partial derivative of regressions b and c of Table 2 suggests that for RER undervaluation index larger than 0.12, the (combined) net effect of connectivity on GVC participation is positive.

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.

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 Eq. (2):

$$\ln(GVC_{it}) = \gamma_1 |Misalignment_{it}| + \gamma_2 (Misalignment_{it} * Dummy_{it}) + \gamma_3 Controls + \delta_i + \mu_t + \tau_{it} \quad (2)$$

where $|Misalignment_{it}|$ is the absolute value of misalignment and $(Misalignment_{it} * Dummy)$ 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 Eq. (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 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

Table 3 GVC participation and RER misalignment – undervaluation vs. overvaluation

	(a) Forward Linkage	(b) Backward Linkage
Misalignment	0.281*** (0.012)	0.027* (0.016)
Dummy (1 = Undervaluation)	0.025*** (0.004)	0.028*** (0.005)
[1] Misalignment * Dummy (1 = Undervaluation)	0.356*** (0.078)	1.412*** (0.104)
[2] ln(GDPPC)	0.651*** (0.009)	0.656*** (0.011)
[1] * [2]	-0.140*** (0.009)	-0.206*** (0.012)
ln(Tariffs + 1)	-0.008*** (0.002)	-0.014*** (0.004)
ln(Rents)	-0.006*** (0.001)	-0.006*** (0.001)
[1] * Government Effectiveness	-0.314*** (0.016)	-0.086*** (0.021)
[1] * Financial Development	-0.531*** (0.050)	-0.359*** (0.066)
[1] * ln(Internet Usage)	0.176*** (0.004)	0.143*** (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 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

linkages. The positive impact is therefore primarily driven by undervaluation¹⁹. Furthermore, the interaction terms between undervaluation and 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 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.

¹⁹ The T-test reported in the last row of Table 3 confirms that the difference in impact between RER undervaluation and RER overvaluation is statistically highly significant.

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 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.

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 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.

²⁰ The marginal effects of the interaction terms are reported in Table A10 of Appendix E.

Table 4 GVC participation and RER undervaluation – alternative measures

	Forward Linkage	Backward Linkage
[1] ln(Undervaluation)	0.882*** (0.050)	0.864*** (0.028)
[2] ln(GDPPC)	0.510*** (0.010)	0.543*** (0.005)
[1] * [2]	-0.114*** (0.006)	-0.064*** (0.003)
[1] * Government Stability	-0.053*** (0.003)	-0.060*** (0.001)
[1] * ln(Mobile Cellular Subs.)	0.099*** (0.004)	0.095*** (0.002)
[1] * Financial Development	-0.320*** (0.046)	-0.441*** (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, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 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* (0.182)	0.141** (0.066)	-0.095 (0.258)	0.016 (0.061)
[2] ln(GDPPC)	0.600*** (0.057)	0.529*** (0.010)	0.459*** (0.049)	0.438*** (0.009)
[1] * [2]	-0.096*** (0.028)	-0.081*** (0.008)	-0.027 (0.035)	-0.044*** (0.007)
[1] * Government Effectiveness	-0.049*** (0.016)	-0.077*** (0.012)	-0.109*** (0.026)	-0.095*** (0.011)
[1] * Financial Development	-0.290* (0.158)	-0.056 (0.041)	0.177 (0.121)	0.090*** (0.003)
[1] * ln(Internet Usage)	0.120*** (0.010)	0.123*** (0.004)	0.080*** (0.016)	0.234*** (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	-

^aln(Undervaluation) in columns b and d is the lagged value

Driscoll-Kraay Robust Standard errors in parentheses (columns a and c), *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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.

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.

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 & Tille, 2009). Notably, Gopinath and Itshhoki (2022) report that over half of global

exports are invoiced in U.S. dollars, despite the United States accounting for only about 10% 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 classification²¹ (Ilzetzi 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 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 A7 in Appendix E).

6.2 GVC position & RER undervaluation

To comprehensively assess the impact of undervaluation on GVC participation, it is crucial to account for a country's position within the value chain. Although two countries may exhibit similar levels of GVC participation, their position within the

²¹ Table A6 and Figure A3 in appendix E 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% of the countries do not have a separate legal tender and 43% have a fixed exchange rate regime.

Table 6 GVC participation and RER undervaluation – no separate legal tender

	Forward Linkage		Backward Linkage	
	(a)	(b)	(c)	(d)
[1] ln(Undervaluation)	0.561*** (0.066)	0.550*** (0.066)	0.932*** (0.064)	0.929*** (0.063)
[2] ln(GDPPC)	0.470*** (0.009)	0.469*** (0.009)	0.530*** (0.009)	0.530*** (0.009)
[1] * [2]	-0.125*** (0.008)	-0.125*** (0.008)	-0.164*** (0.007)	-0.164*** (0.007)
ln(Tariff+1)	-0.015*** (0.003)	-0.017*** (0.003)	-0.025*** (0.003)	-0.025*** (0.003)
ln(Rents)	-0.003** (0.001)	-0.002 (0.001)	0.004*** (0.001)	0.004*** (0.001)
[1] * Government Effectiveness	-0.102*** (0.011)	-0.110*** (0.011)	0.003 (0.011)	0.002 (0.011)
[1] * ln(Internet Usage)	0.146*** (0.004)	0.142*** (0.004)	0.128*** (0.003)	0.127*** (0.003)
[1] * Financial Development	-0.216*** (0.042)	-0.213*** (0.042)	0.118*** (0.039)	0.117*** (0.039)
[3] No separate legal tender (dummy = 1)	0.062*** (0.006)	0.070*** (0.007)	0.066*** (0.006)	0.068*** (0.006)
[1] * [3]		0.145*** (0.019)		0.011 (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, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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 & Zeman, 2022; Fišera & 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 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 undervalu-

Table 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* (0.086)	0.695*** (0.149)	-0.814*** (0.098)	2.861*** (0.239)
[2] ln(GDPPC)	0.443*** (0.014)	0.459*** (0.015)	0.337*** (0.016)	0.585*** (0.024)
[1] * [2]	-0.073*** (0.010)	-0.127*** (0.017)	0.067*** (0.011)	-0.430*** (0.027)
ln(Tariffs + 1)	-0.005 (0.004)	-0.001 (0.004)	-0.083*** (0.006)	0.109*** (0.009)
ln(Rents)	-0.003** (0.002)	0.009*** (0.002)	0.010*** (0.002)	0.007** (0.003)
[1] * Government Effectiveness	-0.211*** (0.017)	-0.129*** (0.020)	-0.236*** (0.019)	0.247*** (0.031)
[1] * Financial Development	-0.293*** (0.053)	-0.599*** (0.070)	-0.291*** (0.060)	0.461*** (0.112)
[1] * ln(Internet Usage)	0.118*** (0.005)	0.207*** (0.008)	0.120*** (0.005)	0.214*** (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 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

ation in downstream countries, across both forward and backward linkages, further support this interpretation.

Comparing these coefficients with those reported in the baseline regressions (Table 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 terms²², 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.

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 considering by per capita income group (Table 8), across different sub-periods reflecting major global chocks (Table 9), and by region to identify potential asymmetries (Table 10).

²² The marginal effects of the interaction terms are reported in Table A11 of Appendix E.

Table 8 GVC participation and RER undervaluation – by income level

Forward Linkage	(a) Low	(b) Lower-Middle	(c) Upper-Middle	(d) High Income
[1] ln(Undervaluation)	1.065 (0.758)	-0.625** (0.264)	0.334*** (0.093)	-0.881*** (0.017)
[1] * Government Effectiveness	0.555 (0.440)	0.038 (0.144)	0.042 (0.048)	-0.052*** (0.005)
[1] * Financial Development	-1.724 (1.096)	0.622 (0.487)	-1.489*** (0.174)	-0.750*** (0.023)
[1] * ln(Internet Usage)	0.378*** (0.102)	0.081** (0.033)	0.088*** (0.013)	0.250*** (0.002)
Backward Linkage	(a) Low	(b) Lower-Middle	(c) Upper-Middle	(d) High Income
[1] ln(Undervaluation)	0.386 (0.402)	-0.644*** (0.094)	-0.279 (0.471)	-0.666*** (0.095)
[1] * Government Effectiveness	1.249*** (0.224)	-0.060 (0.051)	0.137 (0.247)	0.107*** (0.031)
[1] * Financial Development	-0.448 (0.596)	0.781*** (0.166)	0.148 (0.877)	-1.170*** (0.131)
[1] * ln(Internet Usage)	0.383*** (0.060)	0.142*** (0.011)	0.0779 (0.067)	0.270*** (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 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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). Furthermore, these results help explain the negative correlation between RER undervaluation and GVC participation observed in developed countries (Fig. 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, an interact it with RER

Table 9 GVC participation & RER undervaluation –by period

	Forward Linkage		Backward Linkage	
	(a)	(b)	(c)	(d)
[1] ln(Undervaluation)	0.449*** (0.074)	0.438*** (0.074)	0.578*** (0.108)	0.575*** (0.108)
[2] ln(GDPPC)	0.540*** (0.010)	0.541*** (0.011)	0.518*** (0.015)	0.498*** (0.015)
[1] * [2]	-0.114*** (0.009)	-0.113*** (0.009)	-0.121*** (0.013)	-0.116*** (0.013)
ln(Tariff+1)	-0.017*** (0.003)	-0.018*** (0.003)	-0.024*** (0.006)	-0.021*** (0.006)
ln(Rents)	-0.005*** (0.001)	-0.005*** (0.001)	-0.002 (0.002)	-0.001 (0.003)
[1] * Government Effectiveness	-0.091*** (0.013)	-0.098*** (0.013)	-0.023 (0.019)	0.019 (0.019)
[1] * Ln (Internet Usage)	0.140*** (0.004)	0.144*** (0.005)	0.132*** (0.005)	0.096*** (0.007)
[1] * Financial Development	-0.271*** (0.047)	-0.283*** (0.047)	-0.008 (0.067)	0.038 (0.067)
[3] Post Financial Crisis (dummy = 1)	1.255*** (0.038)	1.625*** (0.035)	1.812*** (0.109)	1.593*** (0.091)
[1] * [3]		-0.006 (0.009)		0.124*** (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, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

undervaluation to assess differential effects²³. The results show that the post-crisis dummy is 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 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 supplying intermediate goods (mainly in automotive and machinery). Moreover, while GVC 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) integrated GVC around the US by supplying main commodities (oil, copper, etc.). Finally, Sub-Saha-

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.

Table 10 GVC participation & RER undervaluation: marginal effects – by region

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

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. Reference category is “ECA, Europe, and Central Asia”

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

ran Africa (SSA) are 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 group following the World Bank’s regional classification: SSA, MENA, Asia²⁴, LAC, and Europe and Central Asia (ECA). For brevity, only the marginal effects are reported in Table 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.

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.

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

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 paradox 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. This conclusion also applies with alternative empirical estimations distinguishing between episodes of undervaluation and overvaluation, using panel fixed effects with robust Driscoll-Kraay standard errors or different measures of institutional quality and digital adoption. Additional sensitivity tests confirm our main findings when we test for sensitivity to the post-2008 crisis, regional and income heterogeneities, or the presence of a dominant currency in international trade that potentially modifies the impact of real exchange rate variations.

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 participation.

From a policy perspective, RER 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 the same across countries and is contingent 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 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.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10290-025-00625-0>.

Declarations

Conflict of interest The authors have no conflicts of interest to declare.

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