Journal of
Risk and Financial Management

MDPI

Article

Effect of Structural Economic Vulnerability on the Participation in International Trade

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Abstract: This paper investigates the effect of countries' structural economic vulnerability (EVI) on their participation in international trade using an unbalanced panel dataset of 118 countries from 1996 to 2018 and the two-step system generalized method of moments estimator. It has revealed several findings. Higher EVI leads to lower participation in international trade, and this negative effect is more pronounced in countries that face higher trade costs. This is particularly the case for landlocked developing countries and the least developed countries. Development aid contributes to dampening the negative effect of EVI on countries' participation in international trade. Moreover, this negative impact may turn out to be positive for high amounts of development aid. The policy implications of this analysis have been discussed.

Keywords: structural economic vulnerability; participation in international trade; development aid; trade costs

JEL Classification: F13; F15

Citation: Gnangnon, Sena Kimm. 2022. Effect of Structural Economic Vulnerability on the Participation in International Trade. *Journal of Risk and Financial Management* 15: 417. https://doi.org/10.3390/jrfm15090417

Academic Editors: Xiaoming Li and George Wu

Received: 10 August 2022
Accepted: 14 September 2022
Published: 19 September 2022

1. Introduction

Would addressing the economic and environmental vulnerability of developing countries help promote their participation in international trade? This issue merits empirical investigation because economic and environmental vulnerability undermines countries' economic growth and development prospects (e.g., Dabla-Norris and Gündüz 2014; Wagner 2014), while in the meantime, greater participation in international trade could foster economic growth and development under certain conditions (e.g., Atkin and Donaldson 2022; Chang et al. 2009; Singh 2010).

The COVID-19 pandemic has shed further light on the structural weaknesses of developing economies and revealed the extent of the vulnerability of these countries to external shocks[1]. The literature[2] has documented that developing countries are more exposed to environmental shocks and external economic and financial shocks than advanced economies, with the frequency of such shocks being higher in the former than in the latter[3].

The recognition of the peculiar vulnerability of developing countries dates back to 1971 when the United Nations General Assembly established the category of the Least Developed Countries[4] (LDCs). This group of countries represents the poorest and most vulnerable countries in the world to environmental and external economic shocks. The United Nations Committee for Development Policy is mandated to review the list of LDCs every three years and to make recommendations on the inclusion in and graduation of countries from the LDC category, using three main criteria, namely the per capita income, human assets (which measures health and education outcomes), and the economic and environmental vulnerability. The latter is also referred to as structural economic vulnerability (EVI) and reflects the extent (i.e., degree or magnitude) of countries' vulnerability to environmental and external economic shocks. Structural economic vulnerability is defined as the "risk of a (poor) country seeing its development hampered by the natural or external shocks it faces" (Guillaumont 2009, p. 195). It arises from endogenous factors that are independent

of a country's current political will. As such, it is different from the concept of 'economic resilience', which is linked to a country's political choices that are easily reversible, and, therefore, reflects the capacity of a country to react to shocks (e.g., Guillaumont 2009, 2010; Naudé et al. 2009). The indicator of EVI has two components, which are the exposure to shocks and the extent (magnitude) of shocks. The latter indicates the size and frequency of the exogenous shocks, either observed (ex-post vulnerability) or anticipated (ex-ante vulnerability) (Guillaumont 2009). The 'Fondation pour les Etudes et Recherches sur le Développement International' (FERDI) has developed, on a retrospective basis, data on the EVI over a set of 145 developing countries (including 48 LDCs) over the period from 1990 to 2018 (see Feindouno and Goujon 2016).

Some studies in the literature have explored the macroeconomic effects[5] of EVI, including economic growth (e.g., Guillaumont and Wagner 2012; Gnangnon 2021a; Cordina 2004; Wagner 2014), economic growth volatility (e.g., Gnangnon 2021a), public debt (Gnangnon 2013, 2014), public revenue (e.g., Gnangnon 2019a; Yohou and Goujon 2017), the utilization of non-reciprocal trade preferences (Gnangnon 2021b), development aid (e.g., Gnangnon 2017), and foreign direct investment (FDI) inflows and outflows (e.g., Gnangnon 2018; Gnangnon and Iyer 2017; Razafindravaosolonirina 2018). However, to our knowledge, the effect of EVI on countries' participation in international trade has not been explored in the literature. The present paper aims to fill this gap in the literature by addressing this question.

The analysis has been performed using a panel dataset of 118 countries over the period from 1996 to 2018, and the two-step system generalized method of moments estimator. It has revealed that structural economic vulnerability reduces countries' participation in international trade, including when the latter face higher trade costs. This is particularly the case for landlocked developing countries and LDCs. It has also emerged from the study that development aid helps mitigate the negative effects of structural economic vulnerability on countries' participation in international trade, and for high amounts of such aid, the negative effect becomes a positive one.

The rest of the paper is structured as follows. Section 2 discusses how structural economic vulnerability can theoretically affect countries' participation in international trade and lays out a number of hypotheses to be tested empirically in that regard. Section 3 presents the empirical strategy, including the empirical model, an analysis of data related to key variables of interest, and a discussion of the suitable econometric approach for performing the empirical analysis. Section 4 interprets the empirical results. Section 5 deepens the analysis, and Section 6 concludes the analysis.

2. Theoretical Discussion on the Effect of EVI on the Participation in International Trade

This section discusses how both shocks and exposure to shocks can affect firms' participation in international trade.

2.1. Effect of Environmental and External Economic and Financial Shocks on the Participation in International Trade

Several studies have considered the effect of external shocks on trade flows. Ductor and Leiva-León (2022) have shown that trade flows increase when global volatility experiences a downward trend. Bems et al. (2013) have shown that in the wake of the 2008–2009 global recession, trade collapsed particularly due to the collapse in aggregate expenditure on trade-intensive durable goods. The negative effect of these expenditures on trade was likely amplified by inventory adjustment, and the fall in trade flows was exacerbated by shocks to credit supply. Along the same line, Bonciani and Ricci (2020) have shown, inter alia, that shocks that raise global financial uncertainty reduce trade flows. Keefe (2021) has obtained that the susceptibility of emerging and developing countries to shocks in global monetary liquidity and global credit conditions from advanced economies has significantly increased after the 2008 global financial crisis. This had been detrimental to firms' participation in international trade insofar as access to finance plays a critical role in firms' ability (including

financially constrained ones) to overcome both fixed and variable trade costs (e.g., Becker et al. 2013; Chaney 2016; Foley and Manova 2015; Leibovici 2021; Manova 2013). In fact, trade finance is particularly critical for firms' effective participation in international trade (e.g., Auboin and Engemann 2014; Vaubourg 2016), and its decline during adverse global shocks (e.g., the 2008 global financial crisis and the COVID-19 pandemic) can substantially undermine trade flows (e.g., Auboin 2009, 2021). Adverse global shocks such as the COVID-19 pandemic led to a tightening of global financial conditions and a reversal of capital inflows, which constrains trading firms' ability to finance trade and participate effectively in international trade (e.g., IMF 2020).

Abiad et al. (2014) have uncovered that financial crises, including those arising from global financial shocks, have resulted in lower trade flows. Imports decline sharply due particularly to the depreciation of the exchange rate and the impaired credit conditions induced by the financial crisis. The decline in imports can be persistent for up to 10 years. However, countries' exports fell modestly.

Likewise, the recent COVID-19 pandemic (which is an exogenous external shock to all countries in the world) has decimated international trade flows (e.g., Ando and Hayakawa 2022; Barbero et al. 2021; Bekkers and Koopman 2022; de Lucio et al. 2022; Verbeke and Yuan 2021; World Bank 2020). For example, Bekkers and Koopman (2022) have found that the pandemic and containment measures would lead to a significant decline in output and trade flows, i.e., respectively, by 8% and 20%. Moreover, the authors have projected that the fall in trade in response to the lower output is likely to be more pronounced if the crisis lasts longer because, in such a scenario, spending on durable goods (that are highly tradable) would likely drop substantially. These projections are highly reliable because adverse global shocks tend to exert a lasting negative effect on domestic output and trade including imports. For example, according to IMF (2018), domestic output losses persisted 10 years after the 2007–2008 global financial crisis, regardless of whether a country suffered a banking crisis. Benguria and Taylor (2020) have shown that financial crises depress imports in both developing and advanced economies, while exports hold steady or even rise, including in the context of a depreciation of the real exchange rate. However, the rate of imports' decline in developing countries almost doubles that of advanced economies. Additionally, financial crises exert a more lasting effect on imports by developing countries than on advanced economies' imports: advanced economies' imports can recover within 3 years, while the decline in imports by developing countries can last more than 5 years.

Global shocks can also affect the cross-border movement of goods and services by heightening the volatility of commodity prices (e.g, Bredenkamp and Bersch 2012; IMF 2012). Ezeaku et al. (2021) have established that in the wake of the COVID-19 pandemic, agricultural and metal commodity prices have significantly fluctuated. Di Pace et al. (2020) have documented that export price shocks that stem from global economic activity shocks tend to generate larger and more persistent effects on macroeconomic variables, while the impact of import price shocks on these variables is more subdued. Giordani et al. (2016) have considered governments' responses through trade policy tools when the economy faces higher food prices arising from food price shocks that occur when individuals are averse to losses. Governments in exporting countries tend to impose restrictive trade policies, while importers wind down protection, thus exacerbating the initial shock and soliciting further trade policy activism. A case in point is the spikes in global food prices induced by the conflict between Russia and Ukraine. Many food exporting countries tend to implement restrictive trade policies in fear of shortages, and such policies often exacerbate supply shortfalls and price pressures (e.g., World Bank 2022). Anderson (2022) has, however, cautioned against the implementation of such restrictive trade measures. He has argued that in an increasingly uncertain global trading environment, combined with an increasingly warmer and volatile climate environment, keeping food markets open to trade is more critical for global food security than ever, especially in developing countries.

On another note, environmental shocks (e.g., natural disasters[6] and their related negative shocks, technological and operational incidents) can lead to higher trade costs

and affect the demand for imports and supply of exports (WTO 2021a, p. 36). In fact, the higher trade costs effect of disasters is explained by the damage caused by these negative shocks on physical assets (e.g., merchandise goods), infrastructure, human and physical capital, or the eventual interruptions of transport. This rise in trade costs reduces imports and undermines firms' export competitiveness in the international trade market, thereby deterring export flows. In addition, as a consequence of higher unemployment and the destruction of businesses, natural disasters can lead to lower import flows. Existing studies tend to report mixed effects of natural disasters on international trade, although the negative international trade effects of natural disasters tend to dominate the positive ones (notably on imports). For example, Gassebner et al. (2010) and Oh and Reuveny (2010) have empirically found that natural disasters, such as volcanic eruptions, earthquakes, or storm floods negatively affect countries' bilateral trade. According to Gassebner et al. (2010), an additional disaster reduces imports on average by 0.2% and exports by 0.1%, with less democratic and small countries tending to experience the highest losses. Oh and Reuveny (2010) have found that natural disasters substantially reduce trade, with the magnitude of this negative impact being more pronounced in countries that face high political risks. Meanwhile, other studies such as Toya and Skidmore (2007) and Noy (2009) have reported that greater financial and trade openness can strengthen countries' capacity to overcome natural disasters. According to Yang (2008), hurricanes lead to financial flows into developing countries and help them increase imports to buffer income losses. While the work of Felbermayr and Gröschl (2013) has not focused on the effect of natural disasters on trade but on per capita GDP, it has, nevertheless, reported a positive impact of natural catastrophes on imports, but a negative one on exports. More recently, El Hadri et al. (2019) have empirically investigated the effect of different families of disasters (storms, floods, earthquakes, and changes in temperatures) on exports from 1979 to 2000. They have observed that earthquakes and floods reduce exports by about 3%, while windstorm shocks (regardless of their intensity) exert no significant effect on exports. The effect on exports from changes in extreme temperatures is not clear-cut.

Finally, adverse shocks can affect international trade through their effect on public revenue. They reduce public revenue (Morrissey et al. 2016) and, therefore, deprive governments of the needed financial resources to supply the requisite trade-related infrastructure that would enhance firms' competitiveness in international trade.

Hypothesis 1. *Against this background, we expect that a high intensity of adverse external shocks will be associated with lower countries' participation in international trade.*

2.2. Effect of Exposure to Shocks on the Participation in International Trade

Elements of countries' exposure to shocks include the population size, the remoteness from world markets, the export product concentration, the share of agriculture, forestry and fisheries in GDP, and the share of the population living in a low-elevation coastal zone (e.g., Feindouno and Goujon 2016; Guillaumont 2009, 2010).

The international trade literature has well established that the population size and the remoteness from world markets are strong determinants of countries' participation in international trade. Especially, it has been shown that remoteness from the world markets negatively influences countries' participation in international trade, including in bilateral trade (e.g., Bleaney and Neaves 2013; Egger 2008; Guttmann and Richards 2006; Limão and Venables 2001). Additionally, smaller countries tend to trade more than larger countries because the smallness of the population provides the population with fewer opportunities within their countries. Therefore, the countries cannot benefit from access to larger markets unless they are open to trade (e.g., Alesina and Wacziarg 1998; Bleaney and Neaves 2013). Likewise, countries with a high degree of export concentration on low-value added products[7] (including primary products) are likely to experience a lower degree of participation in international trade[8] than countries with well-diversified exports, including toward sophisticated goods or services. One reason for this may be

that countries that export low-value-added products are likely to receive lower export revenue than countries that export sophisticated goods. For example, Minondo (2020) has found that firms that export products that enjoy a high price (including manufactured products) tend to receive larger export revenue than firms that export relatively low-price products (including primary commodities). Another reason is that firms that tend to export low-value-added and undiversified products experience higher volatility of sales (e.g., Hirsch and Lev 1971; Juvenal and Monteiro 2013; Kramarz et al. 2020; Vannoorenberghe et al. 2016). In light of the foregoing, we expect that countries with a higher export product concentration and a higher share of agriculture, forestry, and fisheries in GDP are likely to experience lower levels of participation in international trade than those that have diversified their export product baskets (including toward sophisticated goods) and enjoy a higher share of manufactured products in GDP.

Finally, countries with a high share of the population living in low-elevation coastal zones are highly vulnerable to sea level rise and other coastal hazards, such as storm surges, coastal erosion, and salt water intrusion (e.g., Barbier 2015). These countries are likely to experience higher economic losses and damages (e.g., Martyr-Koller et al. 2021) and higher trade costs than those with a lower share of the population living in a low-elevation coastal zone. As a result, they would experience a reduced level of participation in international trade. In other words, a rise in the share of population living in low-elevation coastal zones can be associated with lower participation in international trade.

Hypothesis 2. *Overall, we postulate that a high level of exposure to shocks would reduce countries' level of participation in international trade.*

Hypothesis 3. *By combining hypotheses 1 and 2, we postulate that countries that face a higher level of structural economic vulnerability (i.e., both a high intensity of shocks and greater exposure to shocks) are likely to experience a lower level of participation in international trade.*

Hypothesis 4. *Furthermore, given that the increase in exposure to shocks can amplify the effect of shocks on economies, particularly on countries' participation in international trade (through the channels described above), we can expect that the fall in countries' degree of participation in international trade will be more pronounced when these countries face a higher exposure to shocks and a greater magnitude of shocks concurrently.*

3. Empirical Strategy

This section presents the empirical model (Section 3.1), a preliminary analysis of the data (Section 3.2), and discusses the econometric approach used to perform the empirical analysis (Section 3.3).

3.1. Model Specification

The empirical model used to investigate the effect of EVI on participation in international trade builds on previous works on the macroeconomic determinants of trade openness (e.g., Fukumoto and Kinugasa 2017; Gnangnon 2019b; Guttmann and Richards 2006; Milner and Kubota 2005; Svaleryd and Vlachos 2002).

The baseline model (1) takes the following form:

$$\begin{aligned} Log(PART)_{it} &= \alpha_1 Log(PART)_{it-1} + \alpha_2 \text{Log(EVI)}_{it} + \alpha_3 Log(TRCOST)_{it} + \alpha_4 Log(ODA)_{it} \\ &+ \alpha_5 Log(GDPC)_{it} + \alpha_6 Log(FD)_{it} + \alpha_7 INST_{it} + \alpha_8 Log(TERMS)_{it} \\ &+ \alpha_9 DUMOUT_{it} + \mu_i + \delta_t + \epsilon_{it} \end{aligned} \quad (1)$$

I is the subscript associated with a country, and t represents a time period. An unbalanced panel dataset of 118 countries over the period from 1996 to 2018 has been constructed on the basis of the availability of data. Following the practice in the relevant empirical literature, we have used non-overlapping sub-periods data (of 3-year average) to avoid modelling business cycles. Hence, overall, we get eight non-overlapping sub-periods of 3 years, which

are 1996–1998, 1999–2001, 2002–2004, 2005–2007, 2008–2010, 2011–2013, 2014–2016, and 2017–2018 (this sub-period covers only 2 years).

α_1 to α_9 are coefficients to be estimated. μ_i are countries' time invariant specific effects, and δ_t are sub-period dummies included in model (1) to account for global temporal trends. These time dummies help remove time-related shocks (not captured by the EVI indicator) from the error term and, hence, avoid the problem of contemporaneous correlation in the error term. ϵ_{it} is a well-behaving error term. All variables contained in model (1) are described in Appendix A and their related standard descriptive statistics are presented in Appendix C. Appendix B contains the lists of countries used in the analysis, i.e., the full sample and sub-samples described later in the analysis.

The dependent variable "PART" is the indicator of a country's degree of participation in international trade. In the literature, countries' level of participation in international trade is traditionally measured by the ratio of the sum of exports and imports of goods and services to GDP (i.e., the so-called trade share indicator). However, Squalli and Wilson (2011, p. 1758) have shown that this indicator does not genuinely reflect the level of countries' participation in international trade and proposed another indicator that reveals countries' level of integration into the global trade market (see Gnangnon 2019b). This indicator is for a given country and in a given year, the trade share indicator adjusted by the proportion of that country's trade level relative to the average world trade (see Squalli and Wilson 2011, p. 1758). The primary indicator of countries' participation in international trade in the present analysis is Squalli and Wilson (2011)'s indicator of trade openness, denoted here as "TRADE". However, for the robustness check analysis, we have used the standard trade share indicator (denoted "TS") as the measure of countries' level of participation in international trade. Thus, the variable "PART" is primarily measured by "TRADE", and the robustness check is measured by "TS". The one-period lag of the dependent variable has been introduced as a regressor in model (1) in order to take into account the state-dependence nature of the variable "PART" (e.g., Gnangnon 2019b).

The regressor "EVI" is our main variable of interest in the analysis. In the empirical analysis, it has been replaced with its two major components "EXPOS" and "SHOCK" which are, respectively, the intensity of exposure to shocks and the magnitude (extent) of shocks. Each of these components of EVI has been computed as a weighted average of the different sub-component indices described in Section 2 while ensuring that the sum of components' weights amounts to 1. The values of the indicator "EVI" have been obtained as the simple arithmetic average of the two components "EXPOS" and "SHOCK" and range from 0 to 100 (see Feindouno and Goujon 2016) (see Appendix A for details on the computation and source of EVI).

The variable "TRCOST" is the trade costs indicator. Anderson and van Wincoop (2004, p. 691) have defined trade costs as all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself. These include transportation costs (both freight costs and time costs), policy barriers (tariffs and non-tariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail). The present study considers trade costs in the sense of Anderson and van Wincoop (2004). Our trade costs indicator, therefore, reflects all costs (in the sense of Anderson and van Wincoop 2004) involved in trading goods (agricultural and manufactured goods) internationally with another partner relative to the costs involved in trading goods domestically. It covers both tariff and nontariff costs and has been computed using the approach proposed by Novy (2013). Data on the overall bilateral trade costs were constructed by Arvis et al. (2012, 2016) (i.e., the UNESCAP-World Bank Trade Cost Database). Thus, our indicator of the overall trade costs is calculated, for a given country and in a given year, as the average of the bilateral overall trade costs on goods (agricultural and manufactured goods) across all trading partners of that country in that year (see Appendix A for more details on the computation of the indicator of trade costs).

The regressors "ODA", "GDPC", "FD", and "TERMS" stand, respectively, for the total development aid, the real per capita income, financial development, and the terms of trade. The variable "INST" represents the quality of institutions and governance. The dummy "DUMOUT" is a dummy variable that takes the value of 1 for outliers identified in the panel dataset and 0 otherwise. All variables in model (1) (with the exception of "INST" and "DUMOUT") have been transformed using the natural logarithm, not only to limit the skewed distribution of most of them but also to obtain estimates in terms of elasticity.

3.1.1. Effect of Trade Costs

It has been well documented in the literature that higher trade costs deter countries' participation in international trade[9]. Thus, we expect that higher trade costs would reduce countries' participation in international trade. Incidentally, in a recent paper, Gnangnon (2022a) has shown that higher EVI is associated with higher trade costs.

Hypothesis 5. *In this context, one could postulate that if higher EVI reduces countries' level of participation in international trade, then this adverse effect will be more pronounced in countries facing higher trade costs.*

3.1.2. Effect of Development Aid

Development aid (the so-called official development assistance) can affect countries' participation in international trade in various ways. First, it could contribute to enhancing such participation in international trade if a portion of such aid is used to accumulate human capital, including by ensuring better education (e.g., Birchler and Michaelowa 2016; Riddell and Niño-Zarazúa 2016) and health (e.g., Kotsadam et al. 2018; Yogo and Mallaye 2015). This is because human capital plays a critical role in countries' participation in international trade (e.g., Auer 2015; Bougheas and Riezman 2007; Unel 2015). The portion of development aid allocated for enhancing recipient countries' economic infrastructure and productive capacities (the so-called Aid for Trade) could also promote these countries' participation in international trade through its positive effect on exports (e.g., Calì and te Velde 2011; Vijil and Wagner 2012; Wang and Xu 2018) and imports (e.g., Hühne et al. 2014; Ly-My et al. 2021). Development aid can also spur countries' participation in international trade if it contributes to attracting foreign direct investment flows to recipient countries (e.g., Donaubauer et al. 2016; Gnangnon 2022b; Ly-My and Lee 2019; Selaya and Sunasen 2012).

Moreover, the effect of development aid on countries' participation in international trade can work through the real exchange rate channel, although the extent of this effect would depend on how it affects import flows relative to export flows. If higher development aid inflows (of which the non-AfT are a part) result in an appreciation of the real exchange rate in the recipient country—the so-called Dutch disease effect (e.g., Addison and Baliamoune-Lutz 2017; Ouattara and Strobl 2008)—then it would positively affect imports and negatively affect exports. However, as AfT flows are associated with a depreciation of the real exchange rate (Gnangnon 2022c), they can lead to an increase in exports but a decrease in imports. Finally, development aid (in particular, humanitarian food aid) can promote countries' participation in international trade by helping reduce the incidence of small-scale and large-scale civil conflicts and the onset and duration of civil conflicts (e.g., Mary and Mishra 2020). Foreign aid can also dampen the negative effect of transnational terrorism on trade (e.g., Asongu and Leke 2019). Overall, the net effect of development aid on countries' participation in international trade would reflect the combination of all or some of these effects discussed above and is, therefore, an empirical issue.

Hypothesis 6. *On the other side, some studies have pointed out that higher development aid inflows could be instrumental in dampening the adverse effects of EVI on economic growth in developing countries (in particular, the LDCs (e.g., Guillaumont and Wagner 2012; Wagner 2014)). Other works have even suggested that EVI be used as a criterion for the allocation of development aid among beneficiary countries (e.g., Guillaumont 2011, 2013; Guillaumont et al. 2017). Relatedly, Gnangnon*

(2017) has provided empirical evidence that donors' bilateral aid supplied to LDCs increased when these countries faced higher EVI[10]. Thus, one could expect that higher development aid will mitigate the eventual adverse effect of EVI on countries' participation in international trade if development aid itself appears to positively influence countries' participation in international trade.

3.1.3. Effect of the Institutional and Governance Quality

Institutional quality is positively associated with countries' participation in international trade, including through the promotion of bilateral trade flows (e.g., Levchenko 2007), although its effect is lower than other factors such as distance (Álvarez et al. 2018). Méon and Sekkat (2008) have found that a better quality of institutions positively influences exports of manufactured goods but not exports of nonmanufactured goods. We expect that an improvement in institutional and governance quality could be associated with greater participation in international trade.

3.1.4. Effect of Financial Development

As noted above, financial development is an important determinant of firms' participation in international trade. Trading firms' access to credit allows them to overcome both fixed and variable trade costs (e.g., Becker et al. 2013; Chaney 2016; Foley and Manova 2015; Leibovici 2021; Manova 2013; Svaleryd and Vlachos 2002). Trade finance is particularly important in this regard (e.g., Auboin and Engemann 2014). Thus, we expect that an increase in the financial development depth would be positively associated with firms' participation in international trade and, hence, countries' participation in international trade.

3.2. Data Analysis

Before discussing the econometric approach used to perform the analysis and presenting the estimations' outcomes, we find it useful to graphically examine the relationship between the key variables under analysis in the study, i.e., EVI and the indicators of participation in international trade. To that effect, in Figure 1 we present the development of EVI and TRADE over the full sample. Figure 2 presents the development of the same variables over the sub-samples of LDCs and landlocked developing countries (LLDCs). The rationale for focusing on LDCs is, as explained above, that LDCs are not only the poorest countries in the world, but they experience higher levels of EVI than other countries, including other developing counties. On the other hand, LLDCs are known to experience higher trade costs than other developing countries (e.g., Arvis et al. 2010; Pham and Sim 2020; WTO 2021c), which seriously impede their effective participation in international trade. In addition, some LLDCs are either LDCs or are confronted with a high level of EVI without being necessarily classified in the category of the poorest countries in the world. Figure 3 shows the correlation pattern between EVI and TRADE over the full sample (using the main indicator of participation in international trade "TRADE", and the alternative measure "TS").

We observe in Figure 1 that the indicator of structural economic vulnerability and the indicator of participation in international trade move in opposite directions, thereby suggesting that, as their EVI levels increase, countries experience a lower degree of participation in international trade. Figure 2 shows that EVI steadily declined in both LDCs and NonLDCs and, not surprisingly, remained higher in LDCs than in NonLDCs. On the other hand, LDCs' levels of participation in international trade are far lower than those of NonLDCs over the full period. Figure 3 shows a strong negative correlation pattern between EVI and TRADE over the full sample but a weak positive correlation between EVI and TS over the full sample. EVI and TRADE are negatively correlated in both LDCs and NonLDCs, with the slope of this negative correlation being stronger for NonLDCs than for LDCs.

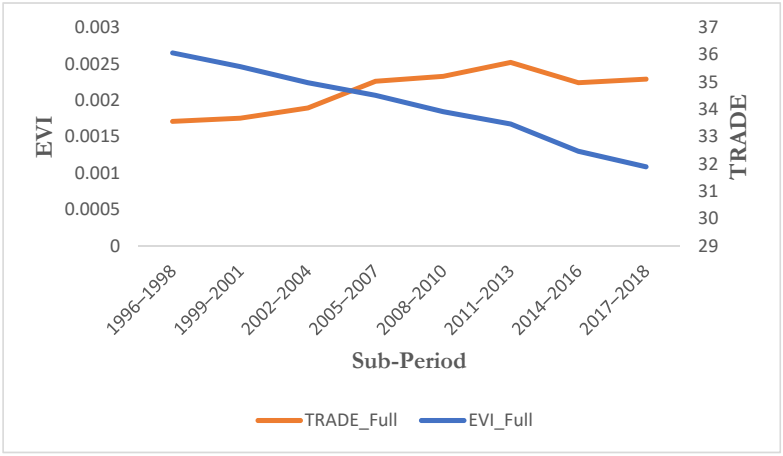

Figure 1. Development of EVI and "TRADE" over the full sample. Source: Author. Note: "FULL" means full sample.

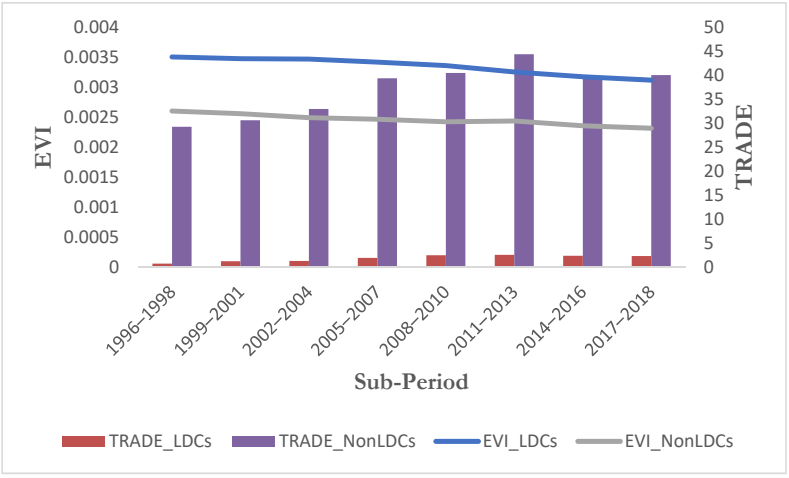

Figure 2. Development of EVI and "TRADE" over LDCs and NonLDCs. Source: Author.

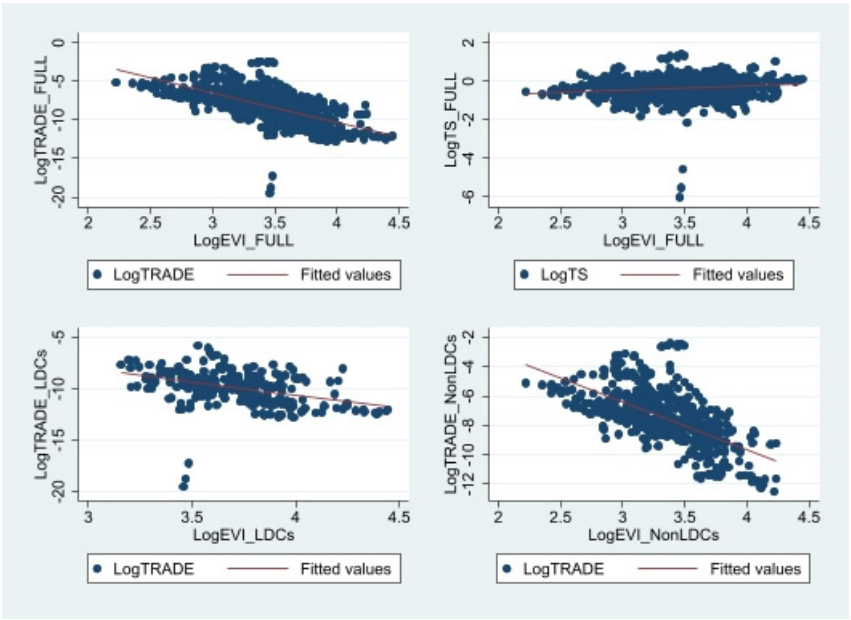

Figure 3. Correlation between EVI and participation in international trade over the full sample. Source: Author. Note: "FULL" means full sample.

3.3. Econometric Approach

Following previous work on the determinants of countries' participation in international trade (e.g., Gnangnon 2019b), we use the two-step system generalized method of moments (GMM) estimator of Blundell and Bond (1998) in the empirical analysis. This estimator is appropriate for dynamic panel datasets characterized by a small-time dimension and a large cross-section dimension, where the series (including the dependent variable) exhibit a strong persistence over time (e.g., Bond 2002). It allows for handling several endogeneity concerns, including the one induced by the correlation between the lagged dependent variable and countries' time invariant-specific effects in the error term and the ones arising from the bi-directional causality between the dependent variable and some regressors.

Building on the work by Gnangnon (2019b), the regressors "EVI" (and its two major components), "TRCOST", "ODA", "FD", and "INST" have been treated as endogenous. The rationale for the endogeneity (reverse causality) of these regressors is as follows. Regarding the structural economic vulnerability indicator, while we expect it to affect countries' participation in international trade, it has also been well established in the literature that participation in international trade (including greater trade openness) can expose countries to external shocks and, hence, increase their vulnerability to shocks (e.g., Montalbano 2011). Likewise, while trade costs undermine countries' participation in international trade, one can also envisage that countries with low levels of trade openness (due to high trade costs) would likely implement measures to reduce such costs so as to foster their participation in international trade. A country's level of participation in international trade can also determine the amount of development aid (in particular, the AfT portion of total ODA) that donors allocate to this country (e.g., Gnangnon 2016a; Younas 2008). Finally, in light of the importance of finance and the institutional and governance quality for trade development, countries with low levels of participation in international trade may facilitate the development of financial markets and improve the quality of institutions and governance.

The correctness of model (1) and its different specifications estimated later (see below) by the two-step system GMM estimator are assessed using the standard diagnostic tests, namely the Arellano–Bond test of the presence of first-order serial correlation in the first-differenced error term (AR (1)) (for which the p-values of the related statistic should be lower than 0.10 at the 10% level); the Arellano-Bond test of the absence of second-order autocorrelation in the first-differenced error term (denoted AR (2)) (for which the p-values of the related statistic should be higher than 0.10 at the 10% level); and the Sargan/Hansen test of over-identifying restrictions (OID) (for which the p-value of the associated statistic is expected to be higher than 0.10 at the 10% level if the instruments are to be considered as jointly valid). We also report the p-value of the statistic associated with the Arellano–Bond test of the absence of third-order autocorrelation in the first-differenced error term (AR (3)). While this test was not explicitly recommended, a related p-value higher than 0.10 (at the 10% level) may signal that the model specification does not suffer from the omitted variable problem. Finally, we make sure to fulfil the requirement that the number of instruments should be lower than the number of countries in the analysis (i.e., we avoid the proliferation of instruments in the regressions).

Using the two-step system GMM technique, we estimate the following regressions.

We first test hypotheses 1 to 3 by estimating specifications of the baseline model (1), including with EVI and, alternatively, with each of its two main components, namely the intensity of exposure to shocks, and the intensity of shocks. Here, the dependent variable is the variable "TRADE" (see results in columns (1) to (3) of Table 1), and for robustness check it is the variable "TS" (see results in columns (1) to (3) of Table 2). We also check the robustness of the findings reported in column (3) of Table 1 (concerning the effect of the intensity of shocks on countries' participation in international trade) by using another indicator of shocks, which is the exchange rate pressure (denoted "ERP"—see Appendix A for details on the computation of this indicator). The latter is a proxy for export demand

and foreign capital flow shocks (e.g., Aizenman and Hutchison 2012; Morrissey et al. 2016; Patnaik et al. 2017). It measures the total pressure on an exchange rate, which has been resisted through foreign exchange intervention or relieved through exchange rate change. The results of the estimation of the specification of model (1) that contains the variable "ERP" (in replacement of "EVI") are reported in column (4) of Table 1.

Next, we test hypothesis 4 by estimating a specification of model (1) that includes the multiplicative variable that captures the interaction between the two components of EVI. The outcomes of the estimation of this model specification are provided in column (5) of Table 1.

Table 1. Effect of EVI on participation in international trade. *Estimator*: Two-step system GMM.

Variables	Log(TRADE)	Log(TRADE)	Log(TRADE)	Log(TRADE)	Log(TRADE)	Log(TRADE)
	(1)	(2)	(3)	(4)	(5)	(6)
$Log(TRADE)_{t-1}$	0.690 ***	0.667 ***	0.703 ***	0.645 ***	0.656 ***	0.716 ***
	(0.0260)	(0.0238)	(0.0249)	(0.0184)	(0.0153)	(0.0214)
Log(EVI)	−0.256 **					−0.653 ***
	(0.126)					(0.119)
Log(EXPOS)		−0.440 ***			0.334	
		(0.104)			(0.207)	
Log(SHOCK)			−0.0191		0.477 **	
			(0.0546)		(0.210)	
ERP				−0.540 ***		
				(0.0691)		
[Log(EXPOS)]×Log(SHOCK)]					−0.166 ***	
					(0.0620)	
[Log(EVI)]×INST						−0.209 ***
						(0.0376)
Log(TRCOST)	−0.665 ***	−0.589 ***	−0.519 ***	−0.784 ***	−0.682 ***	−0.426 ***
	(0.168)	(0.164)	(0.162)	(0.122)	(0.106)	(0.149)
Log(ODA)	0.105 ***	0.137 ***	0.167 ***	0.170 ***	0.123 ***	0.114 ***
	(0.0306)	(0.0287)	(0.0314)	(0.0220)	(0.0168)	(0.0266)
Log(GDPC)	0.0112	0.267 ***	0.108	0.0507	0.155 ***	−0.0232
	(0.0704)	(0.0539)	(0.0660)	(0.0510)	(0.0377)	(0.0556)
Log(FD)	0.342 ***	0.0991	0.483 ***	0.672 ***	0.314 ***	0.339 ***
	(0.108)	(0.0812)	(0.106)	(0.0601)	(0.0519)	(0.0940)
INST	−0.104 ***	−0.0823 ***	−0.119 ***	−0.0855 ***	−0.149 ***	0.637 ***
	(0.0242)	(0.0227)	(0.0275)	(0.0208)	(0.0131)	(0.141)
Log(TERMS)	0.325 ***	0.329 ***	0.317 ***	0.365 ***	0.294 ***	0.265 ***
	(0.0664)	(0.0638)	(0.0652)	(0.0471)	(0.0409)	(0.0514)
DUMOUT	0.542 ***	0.615 ***	0.646 ***	0.793 ***	0.448 ***	0.687 ***
	(0.0989)	(0.101)	(0.105)	(0.0823)	(0.0595)	(0.0918)
Observations–Countries	652–118	683–118	654–118	617–108	652–118	652–118
AR1 (*p*-Value)	0.0307	0.0273	0.0344	0.0116	0.0428	0.0282
AR2 (*p*-Value)	0.8779	0.9582	0.8161	0.4862	0.9099	0.8367
AR3 (*p*-Value)	0.6088	0.7975	0.6617	0.7244	0.6429	0.6425
OID (*p*-Value)	0.3024	0.1819	0.2970	0.4253	0.3106	0.5757

Note: ** *p*-value < 0.05; *** *p*-value < 0.01. Robust standard errors are in parenthesis. The variables, "EVI", "EXPOS", "SHOCK", "ERP", "TRCOST", "ODA", "GDPC", "FD", "INST", and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions. The variable "DUMOUT" represents the outlier dummy and takes the value of 1 for identified outliers in the panel dataset.

Table 2. Robustness check on the effect of EVI on participation in international trade. *Estimator*: Two-step system GMM.

Variables	Log(TS)	Log(TS)	Log(TS)
	(1)	(2)	(3)
$Log(TS)_{t-1}$	0.682 ***	0.584 ***	0.662 ***
	(0.0256)	(0.0192)	(0.0245)
Log(EVI)	−0.0163		
	(0.0484)		
Log(EXPOS)		0.263 ***	
		(0.0493)	
Log(SHOCK)			−0.106 ***
			(0.0230)
Log(TRCOST)	−0.220 ***	−0.423 ***	−0.264 ***
	(0.0787)	(0.0784)	(0.0770)
Log(ODA)	−0.0532 ***	−0.0247	−0.0595 ***
	(0.0132)	(0.0162)	(0.0112)
Log(GDPC)	−0.0667 *	−0.0579 *	−0.102 ***
	(0.0376)	(0.0344)	(0.0331)
Log(FD)	−0.00740	0.0746 *	−0.0543
	(0.0434)	(0.0442)	(0.0416)
INST	0.0133	−0.0106	0.0311 ***
	(0.0110)	(0.0128)	(0.0107)
Log(TERMS)	−0.0411	−0.0495 **	−0.0409
	(0.0255)	(0.0232)	(0.0263)
DUMOUT	0.620 ***	0.454 ***	0.491 ***
	(0.0749)	(0.0627)	(0.0652)
Observations–Countries	652–118	683–118	654–118
AR1 (*p*-Value)	0.0014	0.0023	0.0014
AR2 (*p*-Value)	0.9460	0.6750	0.8447
AR3 (*p*-Value)	0.1189	0.10	0.1786
OID (*p*-Value)	0.4660	0.2900	0.2662

Note: * *p*-value < 0.1; ** *p*-value < 0.05; *** *p*-value < 0.01. Robust standard errors are in parenthesis. The variables, "EVI", "EXPOS", "SHOCK", "TRCOST", "ODA", "GDPC", "FD", "INST", and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions. The variable "DUMOUT" represents the outlier dummy and takes the value of 1 for identified outliers in the panel dataset.

Table 2 contains the outcomes arising from the estimation of three specifications of model (1) where the dependent variable is "TS", and where our main regressor of interest is EVI and each of its two components, introduced once in the model.

From now onwards, the dependent variable is always our primary measure of countries' participation in international trade, namely "TRADE".

We then move on to examine how the effect of EVI (or each of its two components) on the variable "TRADE" depends on countries' real per capita income, which is a proxy for countries' development level. To achieve this objective, we estimate three different other specifications of model (1) (with the variables "EVI" and alternatively with "EXPOS" and "SHOCK") in which we introduce the interaction variable between EVI (or one of its components) and the real per capita income variable. The estimates arising from these regressions are presented in Table 3.

Table 3. Effect of EVI on participation in international trade. *Estimator*: Two-step System GMM.

Variables	Log(TRADE)	Log(TRADE)	Log(TRADE)
	(1)	(2)	(3)
$Log(TRADE)_{t-1}$	0.637 ***	0.593 ***	0.686 ***
	(0.0244)	(0.0216)	(0.0244)
[Log(EVI)]×Log(GDPC]	0.0374		
	(0.0664)		
[Log(EXPOS)]×[Log(GDPC]		0.386 ***	
		(0.0497)	
Log(EXPOS)		−3.654 ***	
		(0.421)	
[Log(SHOCK)]×[Log(GDPC]			−0.143 ***
			(0.0355)
Log(SHOCK)			1.299 ***
			(0.290)
Log(EVI)	−0.491		
	(0.524)		
Log(TRCOST)	−0.774 ***	−0.991 ***	−0.609 ***
	(0.139)	(0.118)	(0.135)
Log(ODA)	0.227 ***	0.195 ***	0.243 ***
	(0.0215)	(0.0197)	(0.0241)
Log(GDPC)	0.0977	−1.007 ***	0.830 ***
	(0.252)	(0.184)	(0.146)
Log(FD)	0.311 ***	0.0800	0.369 ***
	(0.0775)	(0.0730)	(0.0611)
INST	−0.132 ***	−0.120 ***	−0.151 ***
	(0.0194)	(0.0149)	(0.0214)
Log(TERMS)	0.345 ***	0.412 ***	0.262 ***
	(0.0538)	(0.0506)	(0.0561)
DUMOUT	0.874 ***	0.601 ***	1.133 ***
	(0.130)	(0.104)	(0.119)
Observations–Countries	652–118	683–118	654–118
AR1 (*p*-Value)	0.0234	0.0269	0.0260
AR2 (*p*-Value)	0.9710	0.7756	0.8569
AR3 (*p*-Value)	0.5479	0.5830	0.8549
OID (*p*-Value)	0.3270	0.3954	0.6195

Note: *** *p*-value < 0.01. Robust standard errors are in parenthesis. The variables, "EVI", "EXPOS", "SHOCK", "TRCOST", "ODA", "GDPC", "FD", "INST", and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions. The variable "DUMOUT" represents the outlier dummy and takes the value of 1 for identified outliers in the panel dataset.

Table 4 contains the outcomes that allow for testing hypothesis 5. The latter aims to investigate how trade costs matter for the effect of EVI (or its components) on countries' participation in international trade. These outcomes are obtained by estimating three different variants of model (1) that include the interaction between the variable "EVI" (or each of its two components) and the indicator of overall trade costs.

Table 4. Effect of EVI on participation in international trade for varying levels of trade costs. *Estimator*: Two-step System GMM.

Variables	Log(TRADE)	Log(TRADE)	Log(TRADE)
	(1)	(2)	(3)
Log(TRADE)_{t-1}	0.635 ***	0.582 ***	0.687 ***
	(0.0183)	(0.0180)	(0.0168)
[Log(EVI)]×[Log(TRCOST)]	−0.615 ***		
	(0.218)		
Log(EVI)	3.132 **		
	(1.266)		
[Log(EXPOS)]×[Log(TRCOST)]		−0.962 ***	
		(0.123)	
Log(EXPOS)		4.938 ***	
		(0.665)	
[Log(SHOCK)]×[Log(TRCOST)]			0.118
			(0.116)
Log(SHOCK)			−0.721
			(0.661)
Log(TRCOST)	1.588 **	2.573 ***	−0.582 *
	(0.704)	(0.447)	(0.335)
Log(ODA)	0.118 ***	0.181 ***	0.178 ***
	(0.0237)	(0.0216)	(0.0240)
Log(GDPC)	−0.0157	0.337 ***	0.105 **
	(0.0500)	(0.0457)	(0.0425)
Log(FD)	0.449 ***	0.215 ***	0.572 ***
	(0.0658)	(0.0664)	(0.0645)
INST	−0.106 ***	−0.110 ***	−0.0912 ***
	(0.0212)	(0.0179)	(0.0252)
Log(TERMS)	0.386 ***	0.322 ***	0.369 ***
	(0.0551)	(0.0467)	(0.0490)
DUMOUT	0.287 ***	0.484 ***	0.648 ***
	(0.0844)	(0.0700)	(0.0929)
Observations–Countries	652–118	683–118	654–118
AR1 (*p*-Value)	0.0365	0.0365	0.0333
AR2 (*p*-Value)	0.9225	0.7843	0.8305
AR3 (*p*-Value)	0.4776	0.5534	0.6870
OID (*p*-Value)	0.2106	0.3430	0.4943

Note: * *p*-value < 0.1; ** *p*-value < 0.05; *** *p*-value < 0.01. Robust standard errors are in parenthesis. The variables, "EVI", "EXPOS", "SHOCK", "TRCOST", "ODA", "GDPC", "FD", "INST", and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions. The variable "DUMOUT" represents the outlier dummy and takes the value of 1 for identified outliers in the panel dataset.

Finally, Table 5 reports estimates that help test hypothesis 6, i.e., the extent to which the effect of EVI (or its components) on countries' participation in international trade is altered by the amounts of development aid that accrue to countries. These results are obtained by estimating three other variants of model (1) that include the interaction between the variable "EVI" (or each of its two components) and the indicator of development aid.

Table 5. Effect of EVI on participation in international trade for varying amounts of development aid. *Estimator*: Two-step System GMM.

Variables	Log(TRADE)	Log(TRADE)	Log(TRADE)
	(1)	(2)	(3)
$Log(TRADE)_{t-1}$	0.706 ***	0.577 ***	0.773 ***
	(0.0180)	(0.0222)	(0.0163)
[Log(EVI)]×[Log(ODA)]	0.288 ***		
	(0.0220)		
Log(EVI)	−5.738 ***		
	(0.428)		
[Log(EXPOS)]×[Log(ODA)]		0.277 ***	
		(0.0256)	
Log(EXPOS)		−5.934 ***	
		(0.543)	
[Log(SHOCK)]×[Log(ODA)]			0.0711 ***
			(0.0157)
Log(SHOCK)			−1.324 ***
			(0.300)
Log(TRCOST)	−0.831 ***	−0.921 ***	−0.446 ***
	(0.0985)	(0.147)	(0.0981)
Log(ODA)	−0.838 ***	−0.777 ***	−0.127 **
	(0.0730)	(0.0955)	(0.0523)
Log(GDPC)	0.138 ***	0.387 ***	0.0503
	(0.0445)	(0.0451)	(0.0318)
Log(FD)	0.343 ***	0.190 **	0.481 ***
	(0.0739)	(0.0749)	(0.0748)
INST	−0.101 ***	−0.122 ***	−0.0933 ***
	(0.0210)	(0.0187)	(0.0209)
Log(TERMS)	0.0930 **	0.150 ***	0.209 ***
	(0.0471)	(0.0511)	(0.0508)
DUMOUT	0.840 ***	0.388 ***	0.979 ***
	(0.0867)	(0.0874)	(0.0787)
Observations–Countries	652–118	683–118	654–118
Turning point of "ODA" (in million USD) above which the effect of EVI (or its components) is positive	449.5 = exponential (5.738/0.288)	2012 = exponential (5.934/0.277)	122.3 = exponential (1.324/0.0711)
AR1 (*p*-Value)	0.0294	0.0223	0.0346
AR2 (*p*-Value)	0.8250	0.7676	0.7162
AR3 (*p*-Value)	0.6795	0.6562	0.8491
OID (*p*-Value)	0.4362	0.4527	0.6182

Note: ** *p*-value < 0.05; *** *p*-value < 0.01. Robust standard errors are in parenthesis. The variables, "EVI", "EXPOS", "SHOCK", "TRCOST", "ODA", "GDPC", "FD", "INST", and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions. The variable "DUMOUT" represents the outlier dummy and takes the value of 1 for identified outliers in the panel dataset.

4. Results' Interpretation

Before interpreting the estimations' outcomes, it is important to check the correctness of the various specifications of model (1) estimated by means of the two-step system GMM estimator, the outcomes of which are reported in Tables 1–5. The results of the diagnostic tests that help check the correctness of these model specifications are presented at the bottom of each of these tables. They show that all requirements for the validity of the two-step system GMM estimator are met. The *p*-values of the statistics related to the AR(1) test are always lower than 0.05 (i.e., at 5%), the *p*-values of the statistics related to the AR(2) and AR(3) tests are always higher than (or equal to) 0.10, and the *p*-values of the OID test are all higher than 0.10. In addition, the coefficients of the lagged dependent variable are all positive and significant at the 1% level across all columns of the five tables. This shows the state-dependent nature of the indicators "TRADE" and "TS". All in all, all variants of

model (1) estimated are correctly specified, and the two-step system GMM approach is suitable for performing the empirical analysis.

Estimates in column (1) of Table 1 reveal that on average over the full sample, and at the 5% level, an increase in EVI negatively and significantly influences countries' participation in international trade. This outcome reflects a negative and significant effect (at the 1% level) of a higher intensity of exposure to shocks on countries' participation in international trade (see column (2)) but a statistically nil (average) effect of the intensity of shocks on countries' participation in international trade (see column (3)). At the same time, we notice from column (4) of the same Table 1 that a higher intensity of export demand and foreign capital flow shocks exerts a negative and significant effect (at the 1% level) on countries' participation in international trade. The difference between this outcome and the one in column (3) of the same table may be attributed to the way the indicators "SHOCK" and "ERP" have been measured. The former encompasses economic (as well as financial) and environmental shocks, while the latter focuses essentially on economic and financial shocks. Nonetheless, the statistically nil effect of the intensity of shocks (the component of EVI) on countries' participation in international trade may hide different effects across countries in the full sample. This is what we will check later in the analysis when considering the results in Table 3. In terms of the magnitude of the international trade impact of EVI, we obtain that a 1 per cent increase in the values of EVI is associated with a 0.25% decrease in the level of countries' participation in international trade. Likewise, a 1 per cent increase in the values of the index of exposure to shocks induces a 0.44% fall in the level of countries' participation in international trade. From column (4), we find that a 1 per cent increase in the intensity of export demand and foreign capital flow shocks leads to a decline in countries' level of participation in international trade by 0.54%.

With few exceptions, estimates related to control variables are quite similar across columns (1) to (4) of Table 1. Taking up estimates presented in column (1) of the table, we obtain that at the 1% level, greater participation in international trade is positively driven by lower trade costs, higher development aid inflows, greater financial development, and an improvement in terms of trade. At the same time, at the conventional significance levels, we find no significant effect of the real per capita income on countries' level of participation in international trade, although, in other columns of the table, the effect turns out to be significant (yet positive). We also note across all columns of the table that an improvement in the institutional and governance quality is negatively and significantly associated with reduced participation in international trade.

The puzzling negative effect of institutional quality on participation in international trade prompts us to examine whether this effect does not depend on the level of EVI in a given country. Putting it differently, we can question whether the effect of EVI on countries' participation in international trade does not depend on the quality of institutions that prevails in the concerned country. The relevance of this question lies in the fact that, on the one hand, promoting good institutional and governance quality is critical for reducing countries' EVI (e.g., Farrugia 2007; Gnangnon 2016b). On the other hand, as noted in Section 2, improved governance and institutions are essential for promoting countries' participation in international trade. It, therefore, ensures that the effect of institutional and governance quality is likely to be less positive (or more negative) on countries' participation in international trade as these countries face higher levels of EVI. We check this assumption by estimating a variant of the baseline model (1) in which we introduce the interaction variable between EVI and the indicator of institutional and governance quality. The results of the estimation of this model are reported in column (6) of Table 1. We observe from this table that the coefficient of the variable "INST" is positive and significant at the 1% level, while the interaction term related to the variable ("[Log(EVI)]×INST") is negative and significant at the 1% level. These two outcomes suggest that on average over the full sample, the effect of institutional and governance quality on the participation in international trade depends on the level of EVI and is, in particular, positive only when countries' level of EVI is below 21.07 [=exponential(0.637/0.209)]. Otherwise, the institutional quality exerts a

negative effect on countries' participation in international trade, and the magnitude of this negative effect becomes higher for higher EVI (i.e., than 21.07) (values of EVI range between 9.2 and 85.3—see Appendix C). Figure 4 provides, at the 95 per cent confidence intervals, the marginal impact of institutional and governance quality on countries' participation in international trade for varying degrees of EVI. It appears that this marginal impact decreases as the EVI level rises, but it is positive for levels of EVI lower than 13.8 (the lower the EVI's level, the higher the magnitude of the positive effect of the institutional quality on countries' participation in international trade). In contrast, countries whose level of EVI exceeds 26.8 experience a negative effect of institutional quality on participation in international trade, and for these countries, the greater the EVI level, the higher the negative effect of institutional and governance quality on participation in international trade. For levels of EVI between 13.8 and 21.07, there is no significant effect of the institutional and governance quality on countries' participation in international trade. On the basis of this analysis, we conclude that the effect of the institutional and governance quality on countries' level of participation in international trade genuinely depends on their level of EVI and is, in particular, negative in countries with high EVI levels.

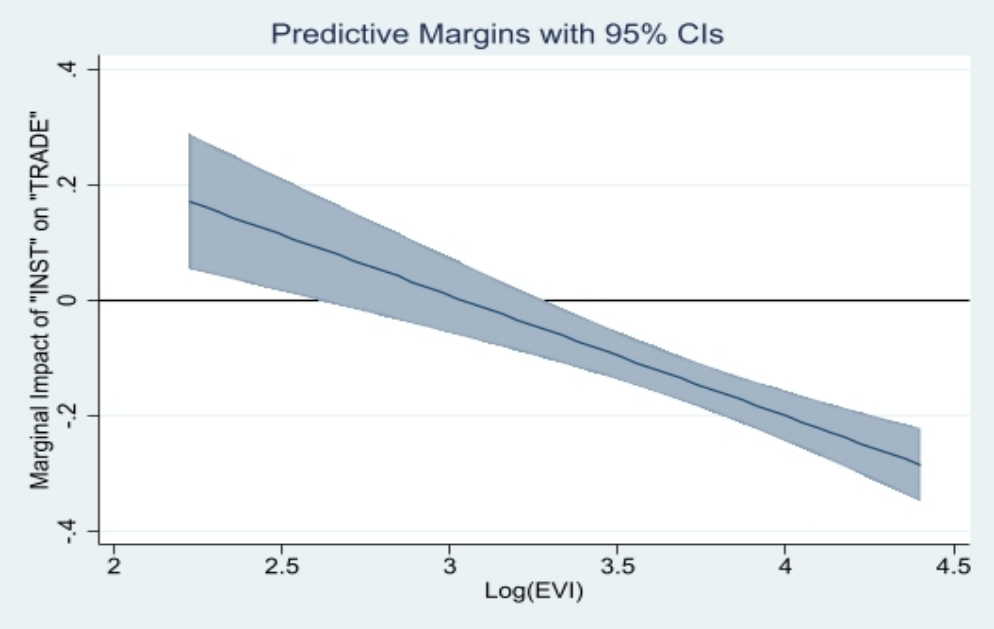

Figure 4. Marginal impact of "INST" on "TRADE" for varying levels of EVI. Source: Author.

Outcomes in columns (1) to (4) of Table 1 lend credence to hypotheses 1 to 4 despite the statistically nil effect of the intensity of shocks on participation in international trade (see column (3)), which likely reflects differentiated impacts across countries in the full sample (as we will see later).

We now take up outcomes in column (5) of Table 1 that help test hypothesis 4. At the outset, we note that controls' estimates are broadly consistent with those in other columns of the table. On the other hand, the coefficient of the variable "EXPOS" (in Logs) is not significant at the conventional significance levels, while the coefficient of the interaction variable ("[Log(EXPOS)]×[Log(SHOCK)]") is negative and significant at the 1% level. We, therefore, deduce that exposure to shocks consistently reduces countries' participation in international trade as they experience a higher intensity of shocks, and the magnitude of this negative international trade effect of exposure to shocks increases as the intensity of shocks rises. Figure 5 shows, at 95 per cent confidence intervals, the marginal impact of the exposure to shocks on participation in international trade for varying intensities of shocks. This marginal impact falls as the intensity of shocks increases and is statistically significant when it takes negative values, notably for levels of shocks higher than 14.5

(values of the variable "SHOCK" range between 4.38 and 88—see Appendix C). Hence, countries that face intensity of shocks higher than 14.5 experience a negative effect of the exposure to shocks on their participation in international trade, with the magnitude of this negative effect increasing as the intensity of shocks becomes higher. This outcome definitely supports hypothesis 4.

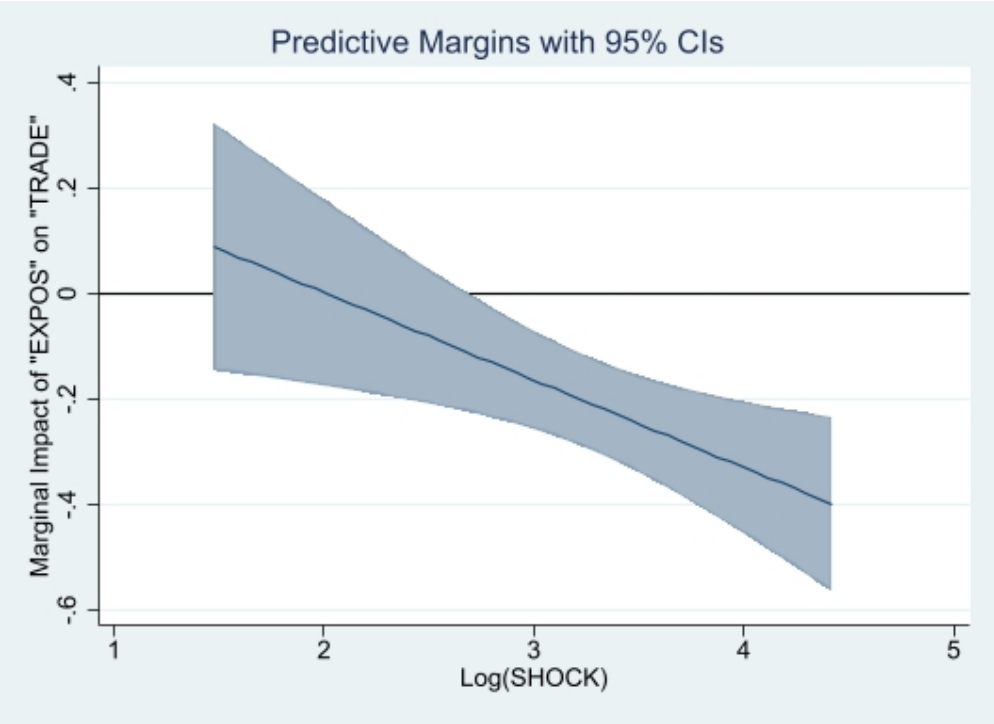

Figure 5. Marginal Impact of "EXPOS" on "TRADE" for varying levels of shocks. Source: Author.

We now turn to the results reported in Table 2. Outcomes in column (1) of this table indicate that at the conventional significance levels, there is no significant effect of EVI on the variable "TS" (which is the trade share). Meanwhile, the results in the two other columns of the table indicate, on the one hand, a positive and significant effect (at the 1% level) of the intensity of exposure to shocks on the trade share, and on the other hand, a negative and significant effect (at the 1% level) of the intensity of shocks on the trade share. Thus, the findings from Table 2 reveal that the lack of significant effects of EVI on the trade share over the full sample reflects a positive effect of the exposure to shocks on the trade share and a negative effect of the intensity of shocks on the trade share. These outcomes are different from the ones in Table 1 and show that the way one measures countries' participation in international trade matters for the effect of EVI on participation in international trade. Furthermore, estimates of control variables in Table 2 are not always in line with those in Table 1. They show, for example, that trade costs negatively and significantly influence countries' trade share (as expected theoretically), but development aid tends to reduce the trade share. There is no significant effect of financial development on the trade share at the 5% level. The institutional and governance quality only positively affects the trade share in column (3). Terms of trade improvements are negatively associated with the trade share, which contradicts our theoretical expectation. These outcomes suggest that Squalli and Wilson's (2011) indicator of trade openness, which is our main measure of countries' participation in international trade, is the most appropriate one in the present analysis.

Estimates in Table 3 allow for exploring how the effect of EVI (and its two components) on countries' participation in international trade varies across countries in the full sample. We note from column (1) of this table that neither the coefficient of the variable "EVI" nor the interaction term of the variable "[Log(EVI)]×[Log(GDPC]" are significant at the

conventional significance levels. These outcomes suggest that the effect of EVI on countries' participation in international trade does not depend on their real per capita income. Figure 6 validates this conclusion. It depicts, at the 95 per cent confidence intervals, the marginal impact of EVI on the participation in international trade for varying levels of the real per capita income. It shows that this marginal impact is not significant for different levels of EVI.

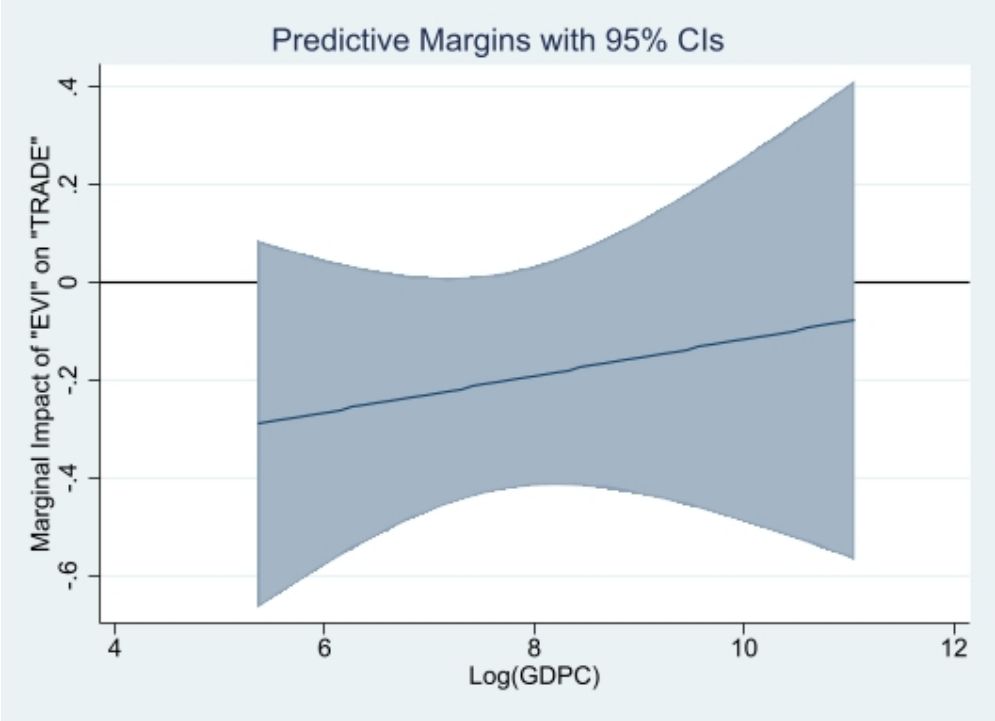

Figure 6. Marginal impact of "EVI" on "TRADE" for varying levels of the real per capita income. Source: Author.

At the same time, the outcomes in columns (2) and (3) of Table 3 (concerning the effects of the components of EVI on countries' participation in international trade for varying levels of real per capita income) reveal opposite patterns. Estimates in column (2) of the table show that exposure to shocks exerts a positive and significant effect on the participation in international trade only for countries whose real per capita income exceeds USD 12,917.3 [=exponential (3.654/0.386)] (values of the variable "GDPC" range from USD 212.5 to USD 63,193.4). For the other countries (including for lower- and middle-income countries and poorest countries), greater exposure to shocks is negatively associated with participation in international trade, and among them, the lower the real per capita income, the higher the negative effect of the intensity of exposure to shocks on the participation in international trade. On the other side, estimates in column (3) of Table 3 indicate that the effect of the intensity of shocks reduces the participation in international trade for countries whose real per capita income exceeds USD 8812.4 [=exponential (1.299/0.143)]. Among these countries, those with a higher real per capita income experience a higher negative effect of shocks on the participation in international trade than those with a relatively lower real per capita income. Countries with a real per capita income lower than USD 8812.4 experience a positive effect of the intensity of shocks on their participation in international trade, and the lower the real per capita income (among countries of this sub-group), the higher the positive effect of shocks on the participation in international trade. In a nutshell, this analysis reveals that less developed countries tend to experience a negative effect of exposure to shocks on their participation in international trade and a positive effect of the intensity of shocks on their participation in international trade concurrently. Relatively advanced economies experience a reduced level of participation in international trade

when they face a higher intensity of shocks but tend to participate more in international trade when they experience greater exposure to shocks. One possible explanation of these findings is that development aid may have helped less developed countries mitigate the negative effect of EVI on their participation in international trade or eventually turn this negative effect into a positive one, including in countries that receive high amounts of such aid. The positive effect of exposure to shocks on participation in international trade by relatively advanced economies may be attributed to the fact that, even though they have a high level of export product concentration, the basket of export products usually contains high value-added goods, i.e., sophisticated goods.

Figures 7 and 8 illustrate, at the 95 per cent confidence intervals, the effect of the two components of EVI on countries' participation in international trade for varying levels of real per capita income. Figure 7 shows that the marginal impact of exposure to shocks increases as the real per capita income becomes higher. Exposure to shocks enhances the participation in international trade in countries whose real per capita income is higher than USD 22,670.7. For countries whose level of real per capita income is lower than USD 8133, exposure to shocks negatively influences their participation in international trade. Finally, for countries whose real per capita ranges from USD 8133 to USD 22,670.7, there is no significant effect of the exposure to shocks on participation in international trade. Figure 8 reveals an opposite pattern to the one in Figure 7, as the marginal impact of shocks on participation in international trade decreases as the real per capita income increases. It is positive and significant for countries whose real per capita income is lower than USD 4601.7 (i.e., for poor and lower-middle-income countries). Shocks induce higher participation in international trade in poor countries than in less poor countries among this set of countries. This marginal impact is negative for very high-income countries, in particular those with a real per capita income higher than USD 28,470.7. Countries whose real per capita income is comprised between USD 4601.7 and USD 28,470.7 experience no significant effect of shocks on their participation in international trade.

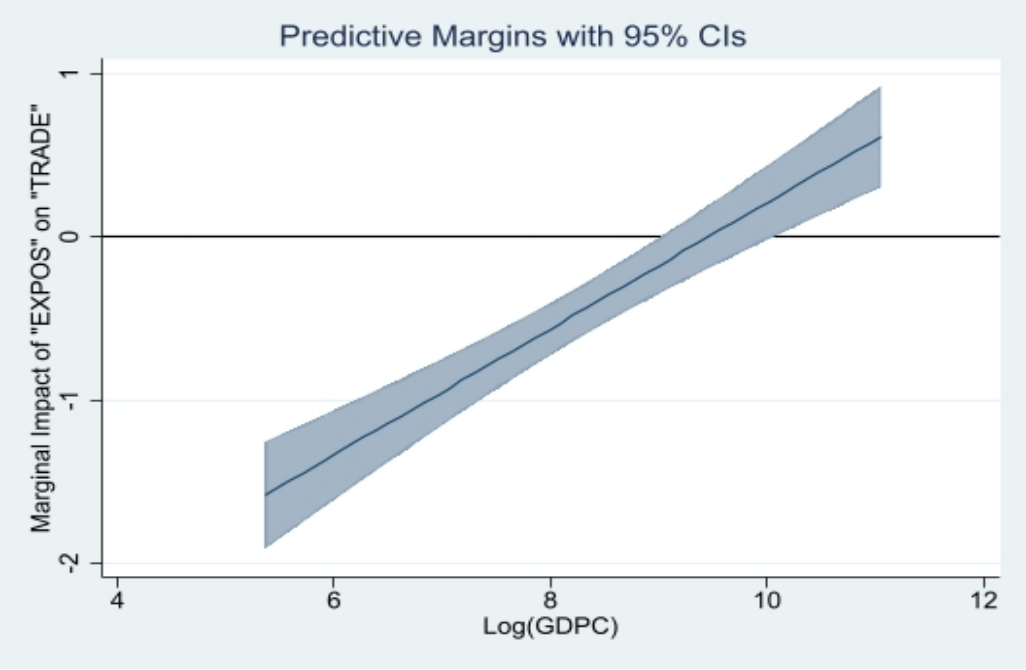

Figure 7. Marginal impact of "EXPOS" on "TRADE" for varying levels of the real per capita income. Source: Author.

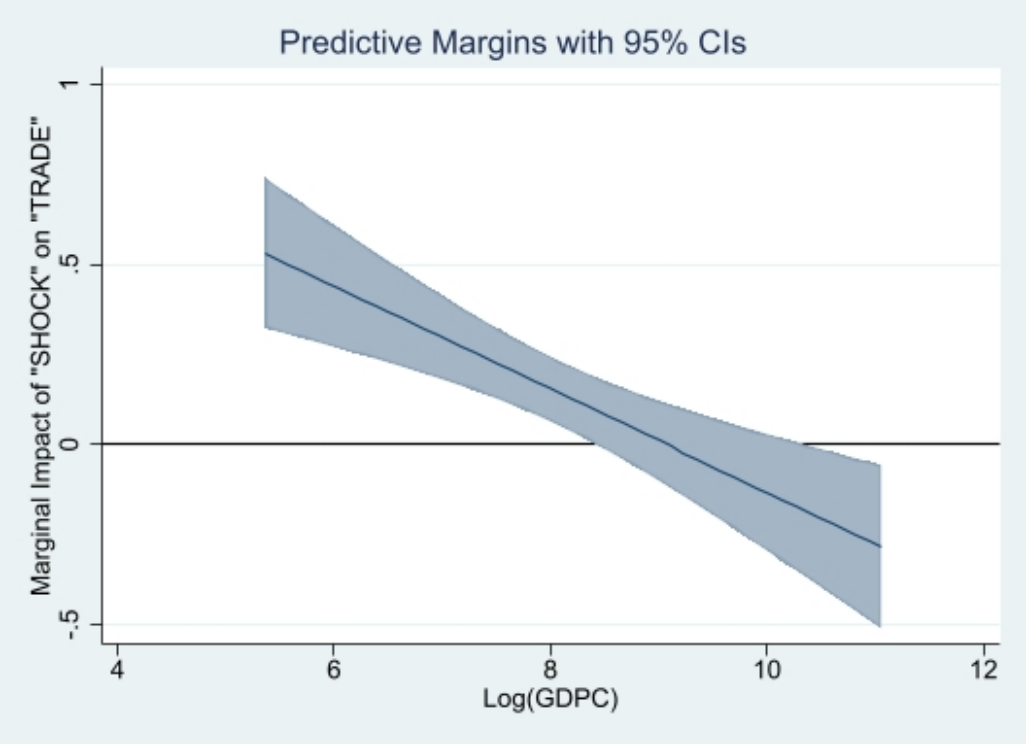

Figure 8. Marginal impact of "SHOCK" on "TRADE" for varying levels of the real per capita income. Source: Author.

The outcomes in Table 4 are equally interesting. Results in column (1) of this table show a positive and significant coefficient (at the 5% level) of the variable "EVI" and a negative and significant coefficient (at the 1% level) of the interaction variable concurrently ("[Log(EVI)][Log(TRCOST)]"). These outcomes suggest that EVI reduces countries' participation in international trade when these countries' trade costs exceed 162.8 [=exponential (3.132/0.615)] (values of the trade costs indicator range between 150.24 and 500.8 in the full sample—see Appendix C). For these countries, the higher the trade costs, the greater the negative effect of EVI on participation in international trade. Countries that face trade costs lower than 162.8 experience a positive effect of EVI on participation in international trade, and for these countries, the lower the trade costs, the greater the positive effect of EVI on participation in international trade. These outcomes are essentially driven by the effect of the exposure to shocks on countries' participation in international trade, as the effect of shocks on countries' participation in international trade does not appear to be dependent on trade costs (see results in column (3)). Especially, regarding estimates in column (2) of Table 4, we observe (like in column (1) of the same table) that the coefficient of "EXPOS" is positive and significant (at the 1% level), and the interaction term of the interaction variable ("[Log(EXPOS)]×[Log(TRCOST)]") is negative and significant at the 1% level. Against this background, we deduce that, on average, countries facing trade costs higher than 169.5 [=exponential (4.938/0.962)] experience a negative effect of the intensity of exposure to shocks on their participation in international trade, and the higher the trade costs, the greater the negative effect of the exposure to shocks on participation in international trade. Conversely, countries with trade costs lower than 169.5 experience a positive effect of exposure to shocks on their participation in international trade, with the magnitude of this positive effect rising as the level of trade costs declines.

Figure 9 depicts, at the 95 per cent confidence intervals, the marginal impact of EVI on countries' participation in international trade for different trade costs. This marginal impact decreases as trade costs rise and is significant for trade costs higher than 243.2. The higher the trade costs, the larger the negative effect of EVI on the participation in international trade. Countries whose trade costs are lower than 243.2 experience no significant effect of EVI on their participation in international trade. This graph confirms hypothesis 5 and shows that trade costs enhance the negative effect of EVI on countries' participation in international trade. Figure 10 presents, at the 95 per cent confidence intervals, the marginal impact of exposure to shocks on countries' participation in international trade for different trade costs. The pattern in this figure is similar to the one observed in Figure 9. Figure 10 indicates that exposure to shocks significantly reduces countries' participation in international trade when the latter face trade costs higher than 195.8, and the greater the trade costs, the higher the negative effect of exposure to shocks on countries' participation in international trade. Countries with trade costs lower than 195.8 experience no significant effect of exposure to shocks on their participation in international trade. The message conveyed in Figure 10 also supports hypothesis 5. Conversely, Figure 11 does not support hypothesis 5. It displays, at the 95 per cent confidence intervals, the marginal impact of the intensity of shocks on countries' participation in international trade for different levels of trade costs. The marginal impact here is not statistically significant (i.e., it is always statistically nil) for all levels of trade costs.

The findings from Table 4 tend to support hypothesis 5 and reveal that high trade costs exacerbate the adverse effects of EVI (including the exposure to shocks, but not the intensity of shocks) on countries' participation in international trade.

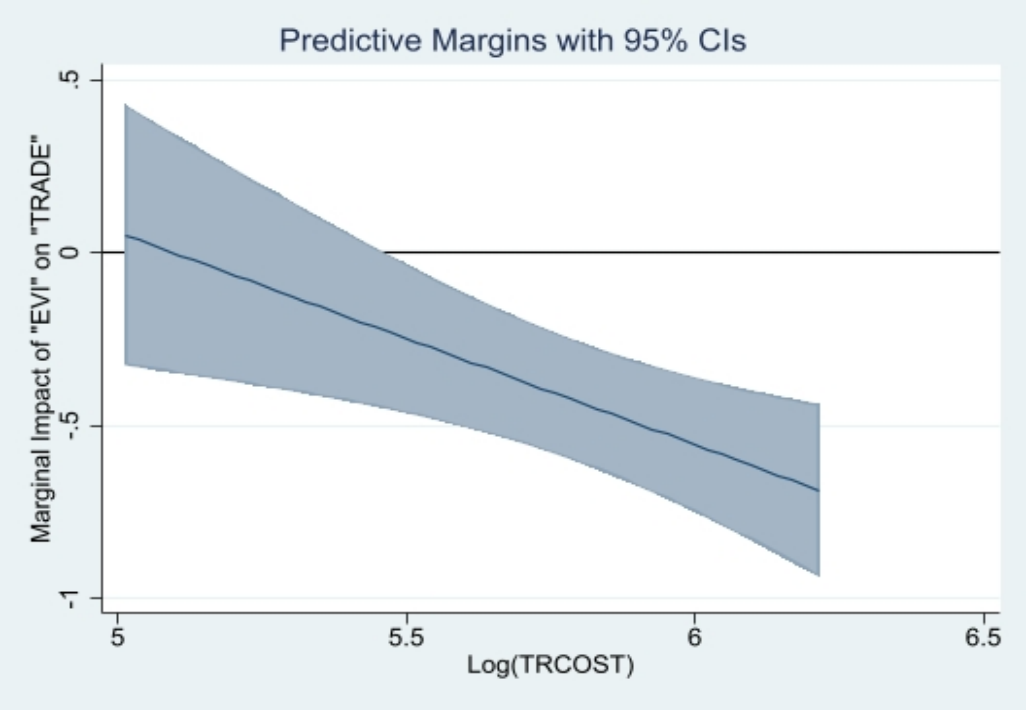

Figure 9. Marginal impact of "EVI" on "TRADE" for varying levels of trade costs. Source: Author.

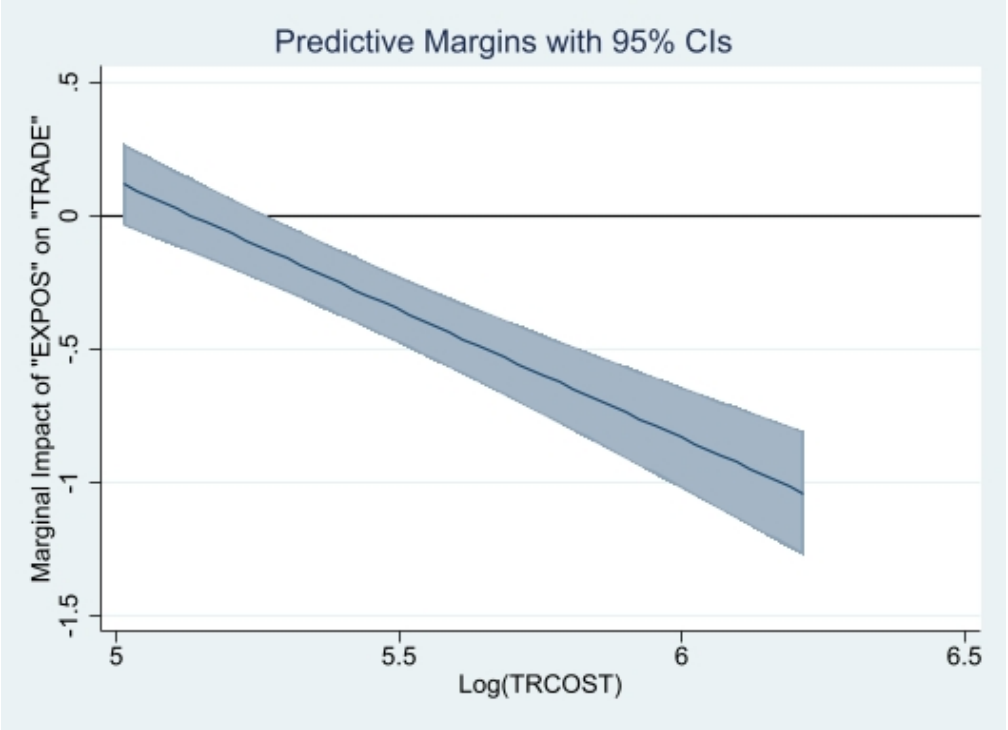

Figure 10. Marginal impact of "EXPOS" on "TRADE" for varying levels of trade costs. Source: Author.

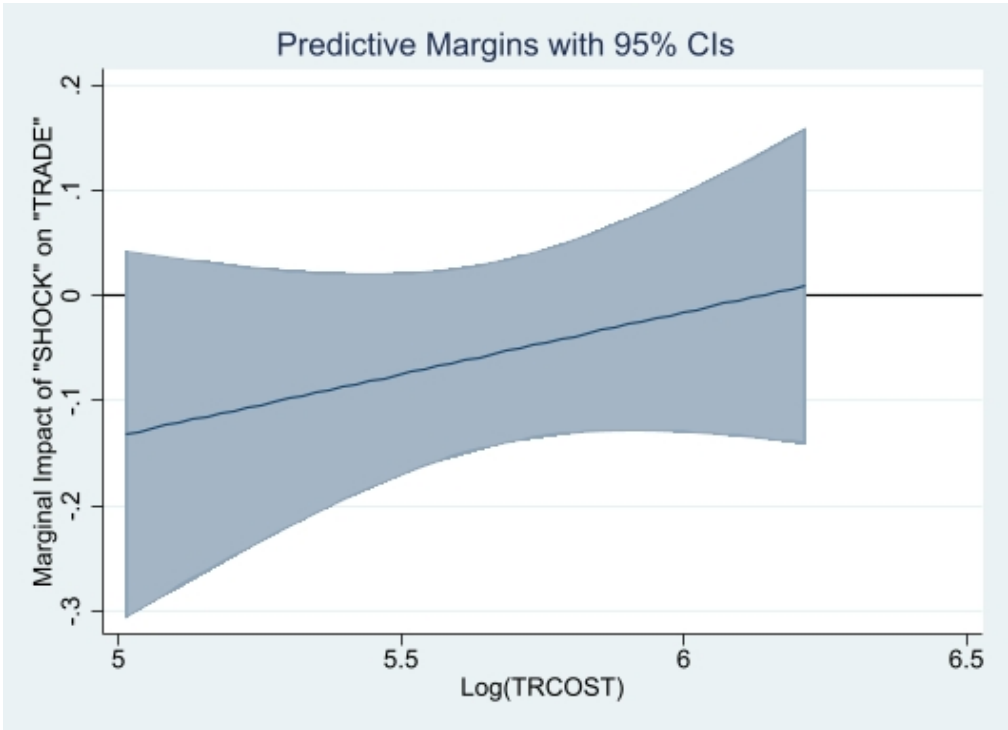

Figure 11. Marginal impact of "SHOCK" on "TRADE" for varying levels of trade costs. Source: Author.

Outcomes in the three columns of Table 5 show similar patterns of the estimates concerning the extent to which the effect of EVI (and its components) on participation in international trade depends on the amounts of development aid that accrue to countries. The coefficients of the variables capturing either the structural economic vulnerability (see column (1)) or its components (see columns (2) and (3)) are negative and significant at the 1% level, while the interaction term of the variables that capture the interaction between the variable "ODA" and

each of the vulnerability indicators are all positive and significant at the 1% level. We, therefore, infer that there is a turning point (i.e., an amount) of development aid above which the effect of EVI (and of its two components) on participation in international trade becomes positive (otherwise, these effects are negative). These turning points are reported at the bottom of Table 5, and are USD 449.5 million, USD 2012 million, and USD 122.3 million, respectively, for the effect of EVI on the participation in international trade, the effect of exposure to shocks on participation in international trade, and the effect of the intensity of shocks on participation in international trade. These amounts of development aid represent 'average' amounts across countries in the full sample. However, we could obtain with greater precision the amounts of development aid that could help turn out the negative effect of EVI on participation in international trade into a positive one. Figures 12–14 provide, at the 95 per cent confidence intervals, the marginal impact of EVI and each of its two components on countries' participation in international trade, for varying amounts of development aid. All three figures have the same patterns and indicate that these marginal impacts increase as the amounts of development aid rise. Specifically, the marginal impact of EVI, the intensity of exposure to shocks, and the intensity of shocks on countries' participation in international trade are positive when the amounts of development aid are higher, respectively, than USD 801.4 million, USD 4404 million, and USD 341.9 million. As per the statistics reported in Appendix C, the values of the variable "ODA" are comprised of between USD 160,000 million and USD 6740 million. We conclude that development aid mitigates the negative effect of structural economic vulnerability (or its exposure and shock components) on countries' participation in international trade when it reaches a minimum level. For countries that receive lower amounts of development aid, structural economic vulnerability, and its two components negatively influence countries' participation in international trade or, at best, exert no significant effect on their participation in international trade. EVI, exposure to shocks, and the intensity of shocks exert negative effects on countries' participation in international trade when the development aid amounts that accrue to countries are, respectively, lower than USD 276.3 million, USD 991.6 million, and USD 40.64 million. Overall, the messages conveyed in Figures 12–14 lend support to hypothesis 6.

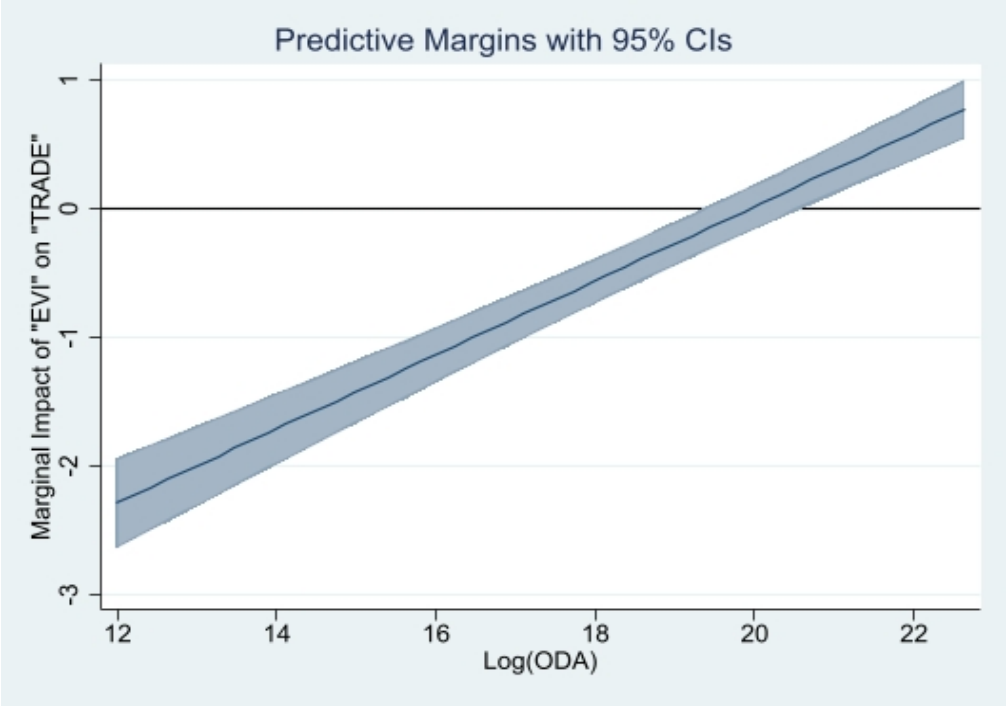

Figure 12. Marginal impact of "EVI" on "TRADE" for varying amounts of development aid. Source: Author.

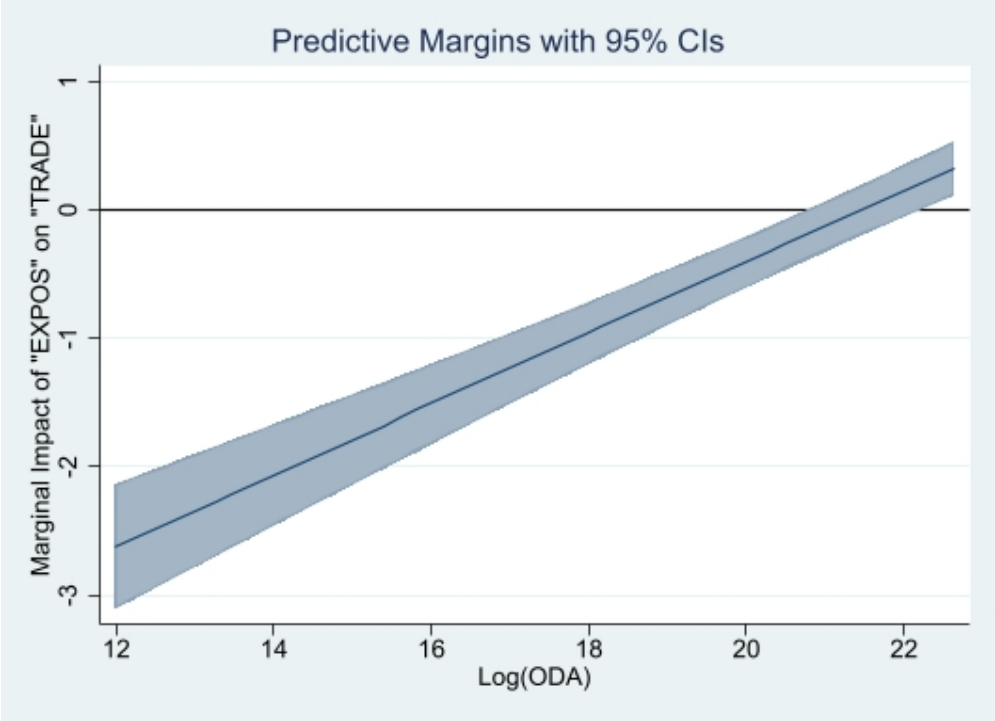

Figure 13. Marginal impact of "EXPOS" on "TRADE" for varying amounts of development aid. Source: Author.

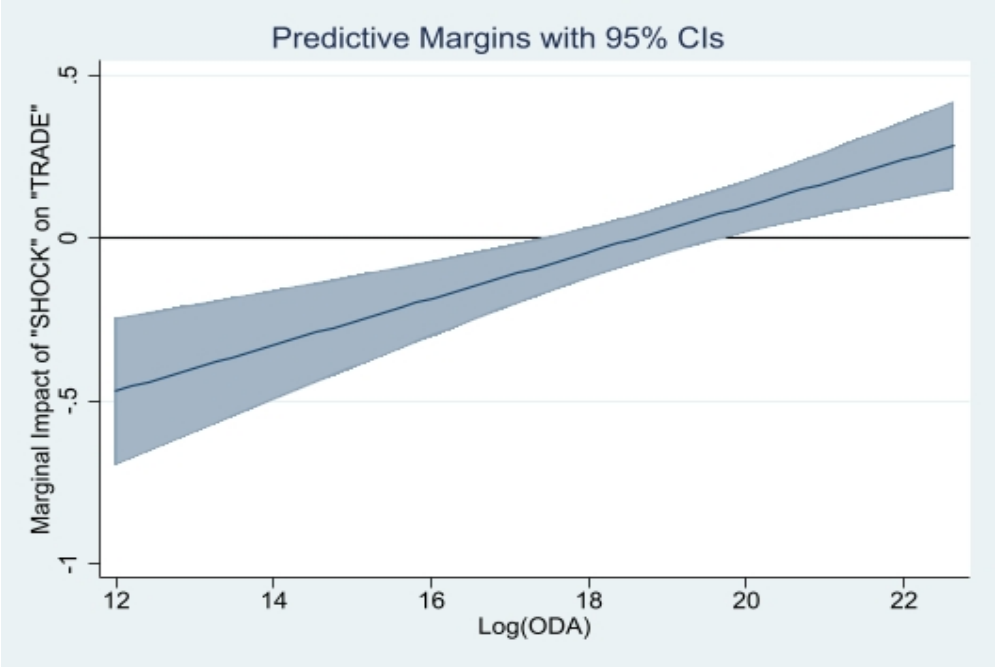

Figure 14. Marginal impact of "SHOCK" on "TRADE" for varying amounts of development aid. Source: Author.

It is worth noting that to a large extent, the results of the control variables in Tables 3–5 align with those in Table 1.

5. Further Analysis

This section deepens the analysis performed thus far by examining how EVI and trade costs jointly affect the participation in international trade by LLDCs and LDCs. The

rationale for addressing this question is as follows. Shocks are likely to exert a higher negative effect on the participation in international trade by LDCs and LLDCs than in other countries, including developing ones, because these countries are resource constraints (in terms of financial, human capital, and technological resources) and face high trade costs (e.g., OECD and WTO 2015; WTO 2021a). Unless compensated at least partially by high amounts of development aid, these limited resources prevent these two groups of countries from sufficiently reducing trade costs and, consequently, their exposure to shocks (for example, through export diversification). It is, therefore, likely that structural economic vulnerability would exert a higher negative effect on the participation of LDCs and LLDCs in international trade than the participation of other countries in international trade. It is important to recall here that some LDCs are also landlocked countries. The negative effect of EVI on these countries' participation in international trade is likely to be more pronounced when they face higher trade costs. As noted above, LLDCs face higher trade costs than other countries (e.g., Arvis et al. 2010; Pham and Sim, 2020; WTO 2021c), and LDCs (including those that suffer from isolation from the world) face structural deficiencies in trade-related infrastructure that significantly raise their trade costs (e.g., OECD and WTO 2015). More recently, Gnangnon (2022a) has shown that EVI induces higher trade costs in LLDCs than in other countries.

Hypothesis 7. *In light of the foregoing, we postulate that LLDCs and LDCs are likely to experience a higher negative joint effect of EVI (or its components) and trade costs on participation in international trade than other countries.*

To empirically test hypothesis 7, we estimate several variants of model (1), each of them including the interaction variable between EVI (or its components) and the indicator of trade costs. The interaction variable is, in turn, interacted with the dummy "LLDC" (for the analysis of the joint effect of EVI and trade costs on LLDCs' participation in international trade) and with the dummy "LDC" (for the analysis of the joint effect of EVI and trade on LDCs' participation in international trade). The dummy "LLDC" takes 1 for landlocked developing countries[11] and 0 otherwise. The dummy "LDC" takes 1 for least-developed countries[12] and 0 otherwise. The outcomes of these different estimations are presented in Table 6. We note, at the outset, that estimates of control variables are consistent with those in Table 1. Regarding the coefficients of key interest here, we find that, from columns (1) to (3), LLDCs experience a higher positive joint effect of EVI (or its components) on participation in international trade than in other countries. This is exemplified by the coefficients of the triple interaction variable (i.e., between EVI or its components, trade costs, and the dummy LLDC), which are consistently positive and significant at the 1% level in columns (1) and (2) and at the 5% level in column (3). On the other side, we observe from columns (4) to (6) that the joint negative effect of EVI (or its components) on participation in international trade is higher for LDCs than for other countries. This is exemplified by the coefficients of the triple interaction variable (i.e., between EVI or its components, trade costs, and the dummy LDC), which are consistently negative and significant at the 1% level in columns (4) to (6) of the table.

At the 5% level, the net joint effects of EVI and trade costs, exposure to shocks and trade costs, and shocks and trade costs on LLDCs' participation in international trade amount, respectively, to −1.097 (=0.102–1.199), −1.165 (=0.128–1.293), and −0.338 (=0.0383–0.376). These results indicate that taken jointly, structural economic vulnerability (and each of its two major components) and trade costs exert a negative effect on LLDCs' participation in international trade, with the joint negative effect of the exposure component and trade costs on countries' participation in international trade being higher than the joint negative effect of the shock component and trade costs on these countries' participation in international trade.

At the 5% level, the net joint effects of EVI and trade costs, exposure to shocks and trade costs, and shocks and trade costs on LDCs' participation in international trade are, respectively, given by −0.0678, −0.711 (=−0.660–0.0512), and −0.0421. The conclusion derived above for LLDCs also apply here for LDCs.

Table 6. Joint effect of EVI and trade costs on the participation in international trade in LDCs and LLDCs. *Estimator*: Two-step system GMM.

Variables	Log(TRADE)	Log(TRADE)	Log(TRADE)	Log(TRADE)	Log(TRADE)	Log(TRADE)
	(1)	(2)	(3)	(4)	(5)	(6)
$Log(TRADE)_{t-1}$	0.635 ***	0.580 ***	0.679 ***	0.659 ***	0.589 ***	0.701 ***
	(0.0148)	(0.0156)	(0.0139)	(0.0150)	(0.0162)	(0.0157)
Log(EVI)	6.477 ***			1.784		
	(1.070)			(1.109)		
[Log(EVI)]×[Log(TRCOST)]	−1.199 ***			−0.374 *		
	(0.188)			(0.195)		
[Log(EVI)]×[Log(TRCOST)]×LLDC	0.102 ***					
	(0.0266)					
[Log(EVI)]×[Log(TRCOST)]×LDC				−0.0678 ***		
				(0.0157)		
Log(EXPOS)		6.808 ***			3.153 ***	
		(0.607)			(0.419)	
[Log(EXPOS)]×[Log(TRCOST)]		−1.293 ***			−0.660 ***	
		(0.113)			(0.0774)	
[Log(EXPOS)]×[Log(TRCOST)]×LLDC		0.128 ***				
		(0.0280)				
[Log(EXPOS)]×[Log(TRCOST)]×LDC					−0.0512 ***	
					(0.0180)	
Log(SHOCK)			2.129 ***			0.114
			(0.636)			(0.530)
[Log(SHOCK)]×[Log(TRCOST)]			−0.376 ***			−0.0241
			(0.114)			(0.0929)
[Log(SHOCK)]×[Log(TRCOST)]×LLDC			0.0383 **			
			(0.0188)			
[Log(SHOCK)]×[Log(TRCOST)]×LDC						−0.0421 ***
						(0.0102)
LLDCs	−2.340 ***	−2.623 ***	−0.877 **			
	(0.570)	(0.576)	(0.414)			
LDCs				1.521 ***	1.289 ***	0.987 ***
				(0.342)	(0.371)	(0.233)
Log(TRCOST)	3.695 ***	3.825 ***	0.976 ***	1.005	1.475 ***	−0.00502
	(0.628)	(0.425)	(0.340)	(0.623)	(0.284)	(0.259)
Log(ODA)	0.182 ***	0.200 ***	0.236 ***	0.151 ***	0.114 ***	0.236 ***
	(0.0199)	(0.0171)	(0.0238)	(0.0179)	(0.0132)	(0.0181)
Log(GDPC)	0.189 ***	0.391 ***	0.314 ***	0.162 ***	0.339 ***	0.277 ***
	(0.0337)	(0.0358)	(0.0335)	(0.0374)	(0.0380)	(0.0369)
Log(FD)	0.318 ***	0.225 ***	0.357 ***	0.369 ***	0.236 ***	0.444 ***
	(0.0567)	(0.0586)	(0.0509)	(0.0466)	(0.0435)	(0.0468)
INST	−0.134 ***	−0.122 ***	−0.129 ***	−0.104 ***	−0.107 ***	−0.121 ***
	(0.0112)	(0.0154)	(0.0137)	(0.0134)	(0.0175)	(0.0154)
Log(TERMS)	0.254 ***	0.256 ***	0.271 ***	0.250 ***	0.267 ***	0.257 ***
	(0.0336)	(0.0370)	(0.0385)	(0.0235)	(0.0301)	(0.0376)
DUMOUT	0.359 ***	0.605 ***	0.614 ***	0.271 ***	0.346 ***	0.447 ***
	(0.0764)	(0.0704)	(0.0822)	(0.0828)	(0.0812)	(0.0768)
Observations–Countries	652–118	683–118	654–118	652–118	683–118	654–118
AR1 (*p*-Value)	0.0370	0.0349	0.0316	0.0335	0.0395	0.0302
AR2 (*p*-Value)	0.9566	0.8249	0.9007	0.8850	0.8960	0.8483
AR3 (*p*-Value)	0.4766	0.6010	0.6069	0.5957	0.6556	0.6357
OID (*p*-Value)	0.4055	0.4777	0.5541	0.2677	0.3668	0.5639

Note: * *p*-value < 0.1; ** *p*-value < 0.05; *** *p*-value < 0.01. Robust Standard errors are in parenthesis. The variables, "EVI", "EXPOS", "SHOCK", "TRCOST", "ODA", "GDPC", "FD", "INST", and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions. The variable "DUMOUT" represents the outlier dummy and takes the value of 1 for identified outliers in the panel dataset.

6. Conclusions

This paper has investigated the effect of EVI on participation in international trade using an unbalanced panel dataset of 118 countries over the period from 1996 to 2018. It has established many outcomes. EVI reduces countries' participation in international trade, but this negative effect reflects the fact that less developed countries tend to participate less in international trade when facing higher exposure to shocks, while relatively advanced countries experience a lower level of participation in international trade when facing a higher intensity of shocks. Concurrently, participation in international trade is enhanced in less developed countries that face a higher intensity of shocks (probably because they receive higher development aid in such instances to cope with shocks) and in relatively advanced economies that experience higher exposure to shocks (possibly because these countries tend to export high value-added, i.e., sophisticated goods).

Trade costs exacerbate the negative effect of EVI (including the exposure to shocks) on countries' participation in international trade as there is no significant combined effect of trade costs and countries' intensity of shocks on their participation in international trade. Nonetheless, trade costs heighten the negative effects of EVI on the participation in international trade by LLDCs and LDCs, with this negative effect being more pronounced for countries (among LLDCs and LDCs) with high exposure to shocks than for countries (among LLDCs and LDCs) that face higher intensities of shocks.

Finally, the analysis reveals that development aid mitigates the negative effect of structural economic vulnerability on countries' participation in international trade. Additionally, this negative effect of structural economic vulnerability on countries' participation in international trade becomes positive when countries receive high amounts of development aid, and the magnitude of this positive effect rises as the amount of development aid increases.

Several domestic policies and measures (partly shaped by WTO rules and countries' participation in bilateral and regional trade agreements) determine a given country's level of participation in international trade. This paper sheds light on the relationship between countries' structural economic vulnerability and their participation in international trade and shows that structural economic vulnerability and trade costs should be reduced if countries (including the developing ones and LDCs) were to enhance their participation in international trade and derive the maximum benefits from the latter. In this regard, the paper aims to draw the attention of national policymakers and the international community to the importance of addressing both trade costs and structural economic vulnerability issues in developing countries.

Reducing trade costs in developing countries requires a joint effort by national policymakers and international institutions (including trade-related institutions such as the WTO and UNCTAD). The role of the international community involves, for example, the provision of higher development aid flows (including Aid for Trade flows) to help developing countries overcome the structural trade-related factors that undermine their firms' competitiveness in the global trade markets. The implementation of the WTO Trade Facilitation Agreement, along with the development of hard infrastructure (roads, railways, etc.), is critical in this regard. In addition, stronger cooperation among WTO members could help limit the frequency of external shocks and reduce the negative spillovers from such shocks to domestic economies (WTO 2021a).

Reducing structural economic vulnerability is a much more complex issue and involves both shifting the production (and hence exports) structure towards high value-added goods (i.e., through a structural transformation) and improving countries' resilience to environmental shocks. Discussing policies for structural transformation and improvement of resilience to environmental shocks goes beyond the scope of this paper (see for example Atolia et al. 2020; Caves et al. 2020; Hidalgo 2022; Nissanke 2019; Shamout et al. 2021; Verschuur et al. 2020). Such policies are likely specific to each developing country, even though common regional policies might be envisaged. It is important to note that measures aiming at reducing trade costs would certainly contribute to fostering export diversification and sophistication and, consequently, enhancing the resilience of economies to shocks.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data that support the findings of this study are accessible online, as described in Appendix A of the manuscript, and could also be obtained upon request from the corresponding author.

Acknowledgments: This article represents the personal opinions of individual staff members and is not meant to represent the position or opinions of the WTO or its Members, nor the official position of any WTO staff members. The author thanks the four anonymous Reviewers for their constructive comments on the previous version of the article. Any errors or omissions are the fault of the author.

Conflicts of Interest: The author declares no conflict of interest.

Appendix A. Definition and Source of Variables

Variables	Definition	Source
TRADE	This is the measure of a country's level of participation in international trade. It is proxied by the indicator of trade openness proposed by Squalli and Wilson (2011). This indicator is calculated as the share of the sum of exports and imports of goods and services in GDP adjusted by the proportion of a country's trade level relative to the average world trade (see Squalli and Wilson 2011, p. 1758).	Author's calculation based on data extracted from the World Development Indicators (WDI) of the World Bank.
TS	This is the alternative indicator of countries' participation in international trade. It is measured by a country's share of the sum of exports and imports of goods and services to GDP. Note that as this variable is taken in logarithm in the analysis, it is not expressed in percentage.	WDI
EVI	This is the indicator of structural economic vulnerability also referred to as the Economic Vulnerability Index. It has been set up by the United Nations by the Committee for Development Policy (CDP) and used by the latter as one of the criteria for identifying LDCs. It has been computed on a retrospective basis for 145 developing countries (including 48 LDCs) by the "Fondation pour les Etudes et Recherches sur le Developpement International (FERDI)". The EVI has been calculated as the simple arithmetic average of two sub-indexes, namely the intensity of exposure to shocks (exposure sub-index) (denoted "EXPOS"), and the intensity of environmental and exogenous economic shocks (shocks sub-index) (denoted "SHOCK"). These two sub-indexes have been calculated using a weighted average of different component indexes, with the sum of components' weights equaling 1 so that the values of EVI range between 0 and 100. For further details on the computation of the EVI, see, for example, Feindouno and Goujon (2016). The components of the exposure sub-index are the population size. the remoteness from world markets; the export product concentration; the share of agriculture, forestry, and fisheries in GDP; and the share of the population living in low-elevation coastal zones. The components of the shocks sub-index are the agricultural production instability, the export instability, and the index of the victims of natural disasters.	Data on EVI are extracted from the database of the Fondation pour les Etudes et Recherches sur le Developpement International (FERDI)—see online at: https://ferdi.fr/donnees/un-indicateur-de-vulnerabilite-economique-evi-retrospectif (accessed on 4 July 2022)
ERP	The variable "ERP" represents the transformed measure of the exchange rate pressure. This transformation goes as follows (see also Morrissey et al. 2016) ERP $= sign(PI) * \log(1 + \lvert PI \rvert)$, where $\lvert PI \rvert$ refers to the absolute value of the Exchange Rate Pressure, denoted "PI", and where $\text{PI}_{it} = w_{E,i} \frac{\Delta E_{it}}{E_{i,t-1}} - w_{RES,i} \frac{\Delta RES_{it}}{RES_{i,t-1}}$ E is the exchange rate in local currency units per USD, RES is the size of reserves, $w_{E,i}$ and $w_{RES,i}$ are country-specific weights, $w_{E,i} = \frac{\sigma_{RES,i}}{\sigma_{RES,i}+\sigma_{E,i}}$, and $w_{RES,i} = \frac{\sigma_{E,i}}{\sigma_{RES,i}+\sigma_{E,i}}$. $\sigma_{RES,i}$ stands for the standard deviation of $\frac{\Delta RES_{it}}{RES_{i,t-1}}$ over the full period of the analysis (here, 1996–2018). Similarly, $\sigma_{E,i}$ is the standard deviation of $\frac{\Delta E_{it}}{E_{i,t-1}}$ over the full period of the analysis (here, 1996–2018). The variable "PI" has been computed using the annual data over the period of 1996–2018.	Author's calculation based on data from the WDI.
TRCOST	This is the indicator of the average comprehensive (overall) trade costs. The average overall trade costs (including both tariff and nontariff costs) have been calculated for a given country in a given year, as the average of the bilateral overall trade costs on goods across all trading partners of this country. Data on bilateral overall trade costs have been computed by Arvis et al. (2012, 2016) following the approach proposed by Novy (2013). Arvis et al. (2012, 2016) have built on Anderson and van Wincoop (2004)'s definition of trade costs and considered bilateral comprehensive trade costs as all costs involved in trading goods (agricultural and manufactured goods) internationally with another partner (i.e., bilaterally) relative to those involved in trading goods domestically (i.e., intranationally). Hence, the bilateral comprehensive trade costs indicator captures trade costs in its wider sense, including not only tariffs and international transport costs but also other trade cost components discussed in Anderson and van Wincoop (2004), such as direct and indirect costs associated with differences in languages, currencies, as well as cumbersome import or export procedures. Higher values of the indicator of average overall trade costs indicate higher overall trade costs.	Author's computation using the ESCAP-World Bank Trade Cost Database. Accessible online at: https://www.unescap.org/resources/escap-world-bank-trade-cost-database (accessed on 4 July 2022) Detailed information on the methodology used to compute the bilateral comprehensive trade costs could be found in Arvis et al. (2012, 2016), as well as in the short explanatory note accessible online at: https://www.unescap.org/sites/default/d8files/Trade%20Cost%20Database%20-%20User%20note.pdf (accessed on 4 July 2022)
ODA	This is the real gross disbursements of total Official Development Assistance (ODA), expressed in constant prices for 2019, USD.	OECD (Organization for Economic Cooperation and Development) database on development indicators.
GDPC	Real per capita Gross Domestic Product (constant prices for 2010, USD).	World Development Indicators (WDI)
FD	This is the financial development index, which summarizes how developed financial institutions and financial markets are in terms of their depth (size and liquidity), access (the ability of individuals and companies to access financial services), and efficiency (ability of institutions to provide financial services at low costs and with sustainable revenues, and the level of activity of capital markets). The values of this indicator range between 0 and 1, with higher values indicating greater financial development.	Data extracted from the IMF Financial Development Index Database (see online at: https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B)—See also Sahay et al. (2015) (accessed on 7 August 2022).
TERMS	This is the indicator of the terms of trade, measured by the net barter terms of trade index (2000 = 100).	WDI
INST	This is the variable capturing the institutional and governance quality. It has been computed by extracting the first principal component (based on factor analysis) of the following six indicators of governance. These indicators are, respectively, political stability and absence of violence/terrorism, regulatory quality, rule of law, government effectiveness, voice and accountability, and corruption. Higher values of the index "INST" are associated with better institutional and governance quality, while lower values reflect worse institutional and governance quality.	Data on the components of "INST" variables have been extracted from World Bank Governance Indicators developed by Kaufmann et al. (2010) and updated recently. See online at: https://info.worldbank.org/governance/wgi/ (accessed on 1 June 2022)

Appendix B. List of Countries Used in the Full Sample

Full Sample				LDCs	
Algeria	Costa Rica	Kiribati	Philippines	Angola	Tanzania
Angola	Cote d'Ivoire	Kyrgyz Republic **	Qatar	Bangladesh	Togo
Antigua and Barbuda	Cyprus	Lao PDR **	Rwanda **	Benin	Uganda
Argentina	Dominica	Lebanon	Samoa	Bhutan	Vanuatu
Armenia **	Dominican Republic	Lesotho **	Saudi Arabia	Burkina Faso	Zambia
Azerbaijan **	Ecuador	Liberia	Senegal	Burundi	
Bahamas, The	Egypt, Arab Rep.	Libya	Seychelles	Cambodia	
Bahrain	El Salvador	Madagascar	Sierra Leone	Central African Republic	
Bangladesh	Equatorial Guinea	Malaysia	Singapore	Chad	
Barbados	Eswatini **	Maldives	South Africa	Comoros	
Belize	Ethiopia **	Mali **	Sri Lanka	Congo, Dem. Rep.	
Benin	Fiji	Mauritania	St. Vincent and the Grenadines	Ethiopia	
Bhutan **	Gabon	Mauritius	Sudan	Gambia, The	
Bolivia **	Gambia, The	Mexico	Suriname	Guinea	
Botswana **	Georgia	Micronesia, Fed. Sts.	Tajikistan **	Guinea-Bissau	
Brazil	Ghana	Mongolia **	Tanzania	Kiribati	
Brunei Darussalam	Grenada	Morocco	Thailand	Lao PDR	
Burkina Faso **	Guatemala	Mozambique	Togo	Lesotho	
Burundi **	Guinea	Myanmar	Tonga	Liberia	
Cabo Verde	Guinea-Bissau	Namibia	Tunisia	Madagascar	
Cambodia	Guyana	Nepal **	Turkey	Mali	
Cameroon	Honduras	Nicaragua	Uganda **	Mauritania	
Central African Republic **	India	Niger **	Uruguay	Mozambique	
Chad **	Indonesia	Nigeria	Uzbekistan **	Myanmar	
Chile	Iran, Islamic Rep.	Oman	Vanuatu	Nepal	
China	Israel	Pakistan	Venezuela, RB	Niger	
Colombia	Jamaica	Panama	Vietnam	Rwanda	
Comoros	Jordan	Papua New Guinea	Zambia **	Senegal	
Congo, Dem. Rep.	Kazakhstan **	Paraguay **		Sierra Leone	
Congo, Rep.	Kenya	Peru		Sudan	

Note: Landlocked developing countries (LLDCs) are marked with a "**".

Appendix C. Descriptive Statistics on Variables Used in the Analysis

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
TRADE	652	0.0013	0.0045	0.000003	0.076
TS	652	0.767	0.381	0.117	3.762
EVI	652	33.431	11.754	9.224	85.274
EXPOS	652	34.838	13.509	3.352	86.622
SHOCK	652	32.027	14.735	4.378	87.964
PI	588	−0.187	0.565	−8.138	0.632
TRCOST	652	325.306	58.121	150.240	500.805
TERMS	652	1.180	0.398	0.281	4.537
GDPC	652	4586.193	6086.397	212.472	63,193.380
ODA	652	609,000,000	754,000,000	160,000	6,740,000,000
FD	652	0.219	0.131	0.034	0.751
INST	652	−0.886	1.504	−4.671	3.693

Notes

1 Such shocks can be commodity price shocks, shocks to export demand, volatility of capital inflows, natural disasters, and health shocks (e.g., Guillaumont 2009, 2010).

2 WTO (2021a) has provided a survey on the impact of shocks on international trade and economic development.

3 See for example, Aguiar and Gopinath (2007); Almansour et al. (2015); Azomahou et al. (2021); Barrot et al. (2018); Dabla-Norris and Gündüz (2014); Guillaumont (2009, 2010); Kim et al. (2020); Koren and Tenreyro (2007); Ruch (2020) and WTO (2021a).

4 Detailed information on LDCs is provided by the Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States (UNOHRLLS) and is accessible online at: https://www.un.org/ohrlls/content/least-developed-countries (accessed on 1 June 2022)

5 In general, these studies have uncovered adviser effects of EVI on macroeconomic outcomes.

6 These refer to extreme weather events such as droughts, earthquakes, insect infestations, pandemics, floods, extreme temperatures, avalanches, landslides, storms, volcanoes, fires, and hurricanes (e.g., Baker et al. 2022).

7 This may also reflect an undiversified domestic production featured by a high share of agriculture, forestry, and fisheries in GDP.

8 For example, a recent report by the WTO on market access for products and services of export interest to LDCs (WTO 2021b) has shown that the share of these countries' exports in world exports of goods and services remains below 1 per cent. This reflects a high share of primary products in total LDC exports (which has declined from 73% in 2011 to 48% in 2020).

9 See, for example, Ali and Milner (2016), Anderson and Marcouiller (2002), Diakantoni et al. (2017), Hendy and Zaki (2021), Hoekman and Nicita (2011), Hoekman and Shepherd (2015), Hummels (2007), Jacks et al. (2011), Limão and Venables (2001), Papalia and Bertarelli (2015), Portugal-Perez and Wilson (2012), and Shepherd (2022).

10 The study by Gnangnon (2017) has also revealed that the effect of EVI on the allocation of development aid could be dependent on beneficiaries' level of trade openness and financial openness.

11 The list of LLDCs used in the analysis is contained in Appendix B, and the full list of existing LLDCs is accessible online at: https://www.un.org/ohrlls/content/list-lldcs (accessed on 1 June 2022).

12 The list of LDCs used in the analysis is contained in Appendix B, and the full list of countries included in the category of LDCs is accessible online at: https://www.un.org/ohrlls/content/profiles-ldcs (accessed on 1 June 2022).

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