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Effect of structural economic vulnerability on the participation in international trade

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Abstract

This paper has investigated the effect of countries' structural economic vulnerability (EVI) on their participation in international trade, using an unbalanced 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 several findings. Higher EVI leads to a lower participation in international trade, and this negative effect is more pronounced in countries that face higher trade costs. This is, in particular, the case for landlocked developing countries and 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.

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1. Introduction

Does addressing economic and environmental vulnerability of developing countries would 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 how high is the vulnerability of these countries to external shocks². The literature³ has documented that developing countries are more exposed to environmental shocks and external economic and financial shocks than advanced economies, with the frequency of shocks being higher in the former than in the latter⁴.

The recognition of the peculiar vulnerability of developing countries dates back to 1971 when the United Nations General Assembly has established the category of Least developed countries⁵ (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 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: p195). 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).

² 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).

³ WTO (2021a) has provided a survey on the impact of shocks on international trade and economic development.

⁴ See for example, Aguiar and Gopinath (2007); Almansour et al. (2015); Azomahou et al. (2021); Barrot et al. (2018); Dabla-Norris and Gündüz (2014); Essers (2013); Guillaumont (2009, 2010); Kim et al. (2020); Koren and Tenreyro (2007); Ruch (2020) and WTO (2021a).

⁵ 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>

Some studies in the literature have explored the macroeconomic effects⁶ of EVI, including on economic growth (e.g., Guillaumont and Wagner, 2012; Gnanngnon, 2021a; Cordina, 2004; Wagner, 2014), economic growth volatility (e.g., Gnanngnon, 2021a), public debt (Gnanngnon, 2013; 2014), public revenue (e.g., Gnanngnon, 2019a; Yohou and Goujon, 2017), the utilization of non-reciprocal trade preferences (Gnanngnon, 2021b), development aid (e.g., Gnanngnon, 2017) and foreign direct investment (FDI) inflows and outflows (e.g., Gnanngnon, 2018; Gnanngnon 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 to mitigate the negative effect 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 theoretically how structural economic vulnerability can 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 model specification, and section 4 provides an analysis of data related to key variables of interest in the analysis. Section 5 considers the suitable econometric approach, and section 6 interprets empirical results. Section 7 deepens the analysis, and section 8 concludes.

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 experience a downward trend. Bems et al. (2013) have shown that in the wake of the 2008-2009 global recession, trade collapsed due in particular to the collapse in aggregate expenditure on trade-intensive durable goods. The negative effect of these expenditure 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 (2020) 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

⁶ In general, these studies have uncovered adviser effects of EVI on macroeconomic outcomes.

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 lead to a tightening of global financial conditions, and a reversal of capital inflows, which constrain 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 in particular to the depreciation of the exchange rate and the impaired credit conditions that are induced by the financial crisis. The imports fall can be persistent up to 10 years. However, countries' exports fell modestly.

Likewise, the recent COVID-19 pandemic (which is an exogenous external shocks to all countries in the world) has had 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 lower output is likely to be more pronounced if the crisis lasts longer as 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 depreciates. 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 imports decline by developing countries can last more than five 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 commodities prices have significantly fluctuated. Di Pace et al. (2020) have documented that export price shocks that result 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 face with 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 fears 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 trade restrictive 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 than ever critical for global food security, especially in developing countries.

On another note, environmental shocks (e.g., natural disasters⁷ 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: p36). 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, or human and physical capital, or on the eventual interruptions of transport. This rise in trade costs reduce imports, and undermine firms' export competitiveness in the international trade market, thereby deterring export flows. In addition, as a consequence of higher unemployment and 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 trade effects of natural disasters tend to dominate the positive ones (here notably on imports). For example, Gassebner et al. (2010) and Oh and Reuveny (2010) have obtained empirically 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 reduce substantially trade, with the magnitude of this negative impact being more pronounced in countries that face high political risks. Meanwhile, other studies such as Skidmore and Toya (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 rather 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 investigated empirically 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 exports effect of 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 from the needed financial resources to supply the requisite trade-related infrastructure that would enhance firms' competitiveness in international trade.

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

⁷ 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).

2.2. Effect of exposure to shocks on the participation in international trade

Elements of countries' exposure to shocks include here 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 population living in low elevated 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 bilateral trade (e.g., Bleaney and Neaves, 2013; Egger, 2008; Guttman and Richards, 2006; Limão and Venables, 2001). Also, smaller countries tend to trade more than larger countries because the smallness of the population provides the population with less opportunities within their countries. Therefore, the countries cannot benefit from access to larger market 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 products⁸ (including primary products) are likely to experience a lower degree of participation in international trade⁹ than countries with well diversified exports, including towards 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 obtained that exporting firms of products that enjoy 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 towards sophisticated goods) and enjoy a higher share of manufactured production in GDP.

Finally, countries with a high share of population living in low elevated coastal zone 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 population living in a low-elevation coastal zone. As a result, they would face a reduced level of participation in international trade. In other words, a rise in the share of population living in low elevated coastal zone can be associated with lower participation in international trade.

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

⁸ This may also reflect an undiversified domestic production featured by a high share of agriculture, forestry and fisheries in GDP.

⁹ 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).

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 3**).

Besides, given that the increase in exposure to shocks can amplify the effect of shocks on economies, and in particular 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 they face concurrently a higher exposure to shocks and a greater magnitude of shocks (**Hypothesis 4**).

3. 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; Guttman and Richards, 2006; Milner and Kutoba, 2005; Svaleryd and Vlachos, 2002).

The baseline model (1) takes the following form:

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

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 data availability. 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 have used 8 non-overlapping sub-periods of 3-year, which are 1996-1998; 1999-2001; 2002-2004; 2005-2007; 2008-2010; 2011-2013; 2014-2016; 2017-2018 (this sub-periods 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 1, and their related standard descriptive statistics are presented in Appendix 3. Appendix 2 contains the lists countries used in the analysis (i.e, 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: p1758) have shown that this indicator does not genuinely reflect the level of countries' participation in international trade, and proposed another indicator, which reflects countries' level of integration into the global trade market (see Gnangnon, 2019b). This indicator is for a given country, 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: p1758). The primary indicator of countries' participation in international trade in the present analysis is the Squalli and Wilson (2011)'s indicator of trade openness, denoted here "TRADE". However, for 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 for robustness check 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" that 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 indexes 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 1 for details on the computation and source of EVI).

The variable "TRCOST" is the trade costs indicator. Anderson and van Wincoop (2004: p691) 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 nontariff 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 1 for more details on the computation of this 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.

Trade costs

It has been well documented in the literature that higher trade costs deter countries' participation in international trade¹⁰. 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. 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 (*Hypothesis 5*).

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 a better education (e.g., Birchler and Michaelowa, 2016; Riddell and Niño-Zarazúa, 2016) and health (e.g., Kotsadam et al., 2016; 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 promote 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 imports relatively to export flows. If higher development aid inflows (of which the non-AfT part) result in an appreciation of the real exchange rate in the recipient country - the so-called Dutch disease effect (e.g., Addison and Balamoune-Lutz, 2017; Ouattara and Strobl, 2008) - then it would affect positively imports, and negatively 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 would reflect the combination of all, or some of these effects discussed above, and is therefore an empirical issue.

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

¹⁰ 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); Limao and Venables (2001); Papalia and Bertarelli (2015); Portugal-Perez and Wilson (2012) and Shepherd (2022).

works have even suggested that EVI be used as a criteria for the allocation of development aid among beneficiary countries (e.g., Guillaumont, 2011, 2013; Guillaumont et al., 2017). Relatedly, Gnanngnon (2017) has provided empirical evidence that donors' bilateral aid supplied to LDCs increased when these countries faced higher EVI¹¹. 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 influence positively countries' participation in international trade (*Hypothesis 6*).

Institutional quality

Institutional quality is positively associated with countries' participation, 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 influences positively exports of manufactured goods, but not exports of nonmanufactured goods.

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 the firms participation in international trade, and hence countries' participation in international trade.

4. Data analysis

Before discussing the econometric approach used to perform the analysis, and presenting the estimations' outcomes, we find useful to examine graphically 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, we present in Figure 1 the development of EVI and TRADE over the full sample. Figure 2 presents the development of the same variables over the sub-samples of least 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 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 experience a high level of EVI without being necessarily classified as among 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

¹¹ The study by Gnanngnon (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.

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 without surprise, remains 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.

5. Econometric approach

Following previous works on the determinants of countries' participation in international trade (e.g., Gnanon, 2019b), we use the two-step system generalized method of moments (GMM) estimator of Blundell and Bond (1998). This estimator is appropriate for dynamic panel datasets characterized by a small time dimension and a large cross-section dimension, where series (including the dependent variable) exhibit a strong persistence over time (e.g., Bond, 2002). It allows handling several endogeneity concerns, including the one induced by the correlation between the lagged dependent variable and the 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 Gnanon (2019b), we consider 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 is also well established in the literature that participation in international trade (including greater trade openness) can expose countries to external shocks and, hence increases 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 improve 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., Gnanon, 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, is 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 bias. 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, 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 1 for details on the computation of this indicator). The latter is a proxy for export demand and foreign capital flows 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 [4] of Table 1.

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 to recall, 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 that captures the interaction 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 4 contains the outcomes that allow 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.

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.

6. 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, and whose outcomes are reported in Tables 1 to 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 0.5 (i.e., at the 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 underlines the state dependent nature of the indicators "TRADE", and "TS". All in all, we conclude that 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 at the 5% level, on average over the full sample, an increase in EVI influences negatively and significantly 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 that a higher intensity of export demand and foreign capital flows 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" are 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 results in Table 3. In terms of magnitude of the 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 flows 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, a greater participation in international trade is positively driven by lower trade costs, higher development aid inflows, a 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 a reduced participation in international trade.

The surprising negative effect of institutional quality on participation in international trade prompts us to examine whether such a result 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 on the fact that on the one hand, promoting a 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, ensues that the effect of the 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 that represents the interaction between EVI and the indicator of the institutional 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 the institutional quality on 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 3). Figure 4 provides, at the 95 per cent confidence intervals, the marginal impact of the 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's level rises, but is positive for levels of EVI lower than 13.8 (the lower the EVI's level, the higher is 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 the institutional quality on the participation in international trade, and for these countries, the greater the EVI's level, the higher is the negative effect of the institutional and governance quality on the participation in international trade. For levels of EVI comprising 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 these countries' level of EVI, and is in particular negative for countries with high EVI levels.

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 (" $\text{Log(EXPOS)} \times \text{Log(SHOCK)}$ ") is negative and significant at the 1% level. We, therefore, deduce that exposure to shocks consistently reduces countries' participation in international trade as countries experience a higher intensity of shocks, and the magnitude of this negative effect of exposure to shocks increases as the intensity of shocks rises. Figure 5 shows, at the 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, and notably for level of shocks higher than 14.5 (values of the variable "SHOCK" range between 4.38 and 88 - see Appendix 3). Hence, countries that face an 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.

We now turn to 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, to recall, 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 effect 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 this 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 influences negatively and significantly countries' trade share (as expected theoretically), but development aid also tends to reduce the trade share. There is no significant effect of financial development on the trade share at the 5% level. The institutional quality only affects positively 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 the Squalli and Wilson (2011)'s 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 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 " $\text{Log(EVI)} \times \text{Log(GDPC)}$ " 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 countries' level of 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.

At the same time, 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 the real per capita income) reveals 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 US\$ 12917.3 [= exponential (3.654/0.386)] (values of the variable "GDPC" range from US\$ 212.5 to US\$ 63193.4). For the other countries (including for lower and middle income countries and poorest countries), greater exposure shocks is negatively associated with participation in international trade, and among them, the lower the real per capita income, the higher is 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 US\$ 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 participation in international trade than those with a relatively lower real per capita income. Countries with a real per capita income lower than US\$ 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 is 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 concurrently a positive effect of shocks on their participation in international trade. 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 a 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 contained 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 US\$ 22670.7. For countries whose level of real per capita income is lower than US\$ 8133, exposure to shocks negatively influences their participation in international trade. Finally, for countries whose real per capita ranges from US\$ 8133 to US\$ 22670.7, there is no significant effect of the exposure to shocks on the participation in international trade. Figure 8 reveals an opposite pattern to the one in Figure 7, as the marginal impact of shocks on the 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 US\$ 4601.7 (i.e., for poor and lower middle income countries): shocks induce a 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 US\$ 28470.7. Countries whose real per capita income is comprised between US\$ 4601.7 and US\$ 28470.7 experience no significant effect of shocks on their participation in international trade.

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 concurrently a negative and significant coefficient (at the 1% level) of the interaction variable (" $\text{Log}(\text{EVI}) * \text{Log}(\text{TRCOST})$ "). These outcomes suggest that EVI reduces countries' participation in international trade when these countries' trade costs exceeds 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 3). For these countries, the higher the trade costs, the greater is the negative effect of EVI on the 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 is the positive effect of EVI on the participation in international trade. These outcomes are essentially driven by the effect of 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 (" $\text{Log}(\text{EXPOS}) * \text{Log}(\text{TRCOST})$ ") 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 is the negative effect of the exposure to shocks on the 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 declining.

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 higher is 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 is 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 by Figures 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.

Summing-up, 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.

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 the 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 its two components on the participation in international trade becomes positive (otherwise, these effects are negative). These turning points are reported at the bottom of Table 5, and are US\$ 449.5 million; US\$ 2012 million; and US\$ 122.3 million, respectively for the effect of EVI on the participation in international trade, the effect of exposure to shocks on the participation in international trade, and the effect of the intensity of shocks on the participation in international trade. These amounts of development aid represent 'average' amounts across countries in the full sample. However, we could obtain with a greater precision, the amounts of development aid that could help turn out the negative effect of EVI on the participation in international trade into a positive one. Figures 12 to 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 US\$ 801.4 million; US\$ 4404 million; and US\$ 341.9 million. As per statistics reported in Appendix 3, the values of the variable "ODA" are comprised between 160000 US\$ and million US\$ 6740. We conclude that development aid mitigates the negative effect of structural economic vulnerability (or its exposure and shocks 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 US\$ 276.3 million; US\$ 991.6 million; and US\$ 40.64 million. Overall, the messages conveyed by Figures 12 to 14 lend support to hypothesis 6.

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

7. 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-constrained (in terms of financial, human capital and technological resources) and face high trade costs (e.g., OECD/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 reducing sufficiently 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/WTO, 2015). More recently, Gnanngnon (2022a) has shown that EVI induces higher trade costs in LLDCs than in other countries. 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 (*hypothesis 7*).

To test empirically 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 in LLDCs) and with the dummy "LDC" (for the analysis of the joint effect of EVI and trade costs in LDCs). The dummy "LLDC" takes 1 for landlocked developing countries¹², and 0, otherwise. The dummy "LDC" takes 1 for least-developed countries¹³, 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 from columns [1] to [3] that 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 in LDCs 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 LDC), which are consistently negative and significant at the 1% level in columns [4] to [6] of the Table.

¹² The list of LLDCs used in the analysis is contained in Appendix 2, and the full list of existing LLDCs is accessible online at: <https://www.un.org/ohrrls/content/list-lldc>

¹³ The list of LDCs used in the analysis is contained in Appendix 2, and the full list of countries included in the category of LDCs is accessible online at: <https://www.un.org/ohrrls/content/profiles-ldc>

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 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 apply also here for LDCs.

8. Conclusion

This paper has investigated the effect of EVI on the 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 a higher exposure to shocks, and 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 a 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 (LLDCs and LDCs) with a high exposure to shocks than for countries (LLDCs and LDCs) with a greater magnitude 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.

Reducing trade costs in developing countries requires a joint effort by national policymakers and the international institutions (including the trade-related ones such as the WTO and UNCTAD). The role of international community involves for example, the provision of higher 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) are critical in this regard.

Reducing structural economic vulnerability could entail for a developing country, a shift of its production (and hence exports) structure towards high value-added goods. This would help not only reduce the exposure to shocks but also enjoy a high price-products in the international trade market (e.g., Minondo, 2020).

Measures aiming at reducing trade costs would certainly contribute to fostering export diversification and export sophistication, and consequently enhancing the resilience of economies to shocks. Reducing structural economic vulnerability also involves reducing the intensity (and frequency) of shocks that adversely affect countries' participation in international trade, including through greater participation and cooperation among countries in the world. Such cooperation could help limit the frequency of external shocks and reduce the negative spillovers from such shocks to domestic economies (WTO, 2021a).

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TABLES and APPENDICES

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 < 0,1; **p-value < 0,05; ***p-value < 0,01. Robust Standard errors are in parenthesis. The variables, "EVT", "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 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 < 0,1; **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 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.

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 US\$) 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 < 0,1; **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 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, "EVT", "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.*

Appendix 1: 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 is calculated as the share of 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 Wilson, 2011: p1758).	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 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	<p>This is indicator of structural economic vulnerability, also referred to as the Economic Vulnerability Index. It has been set up at 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 computed 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 equals 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).</p> <p>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 population living in low elevated coastal zone. The components of the shocks sub-index are the agricultural production instability; the export instability; and the index of the victims of natural disasters.</p>	Data on EVI is 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
ERP	<p>The variable "ERP" represents the transformed measure of the exchange rate pressure. This transformation goes as follows (see also Morrissey et al., 2016)</p> $ERP = \text{sign}(PI) * \log(1 + PI),$ <p>where PI refers to the absolute value of the Exchange Rate Pressure, denoted "PI", and where $PI_{it} = w_{E,i} \frac{\Delta E_{it}}{E_{it-1}} - w_{RES,i} \frac{\Delta RES_{it}}{RES_{it-1}}$</p>	Author's calculation based on data from the WDI.

	<p>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 $w_{RES,i} = \frac{\sigma_{E,i}}{\sigma_{RES,i} + \sigma_{E,i}} \cdot \sigma_{RES,i}$ 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).</p> <p>The variable "PI" has been computed using the annual data over the period 1996-2018.</p>	
TRCOST	<p>This is the indicator of the average comprehensive (overall) trade costs. The average overall trade costs (including both tariff and nontariff costs) has 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.</p> <p>Data on bilateral overall trade costs has been computed by Arvis et al. (2012, 2016) following the approach proposed by Novy (2013). Arvis et al. (2012, 2016) have built on the definition of trade costs by Anderson and van Wincoop (2004), 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.</p>	<p>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</p> <p>Detailed information on the methodology used to compute the bilateral comprehensive trade costs could be found in Arvis (2011, 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</p>
ODA	This is the real gross disbursements of total Official Development Assistance (ODA), expressed in constant prices 2019, US dollar.	OECD (Organization for Economic Cooperation and Development) database on development indicators.
GDPC	Real per capita Gross Domestic Product (constant 2010 US\$).	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 (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).

TERMS	This is the indicator of the terms of trade, measured by the net barter terms of trade index (2000 = 100).	WDI
INST	<p>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.</p> <p>Higher values of the index "INST" are associated with better governance and institutional quality, while lower values reflect worse governance and institutional quality.</p>	<p>Data on the components of "INST" variables has been extracted from World Bank Governance Indicators developed by Kaufmann et al. (2010) and updated recently.</p> <p>See online at: https://info.worldbank.org/governance/wgi/ </p>

Appendix 2: 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	

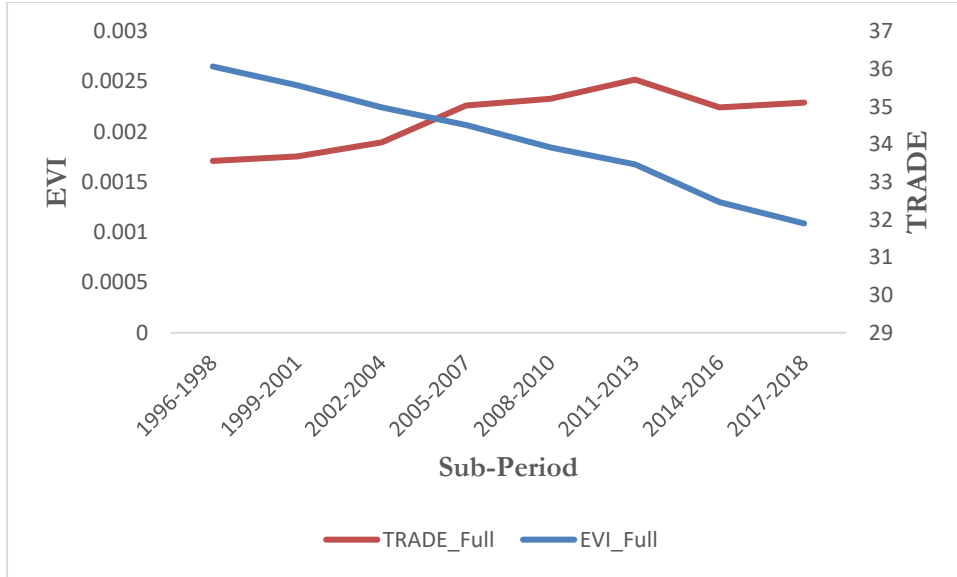
Note: Landlocked developing countries (LLDCs) are marked with a "**".

Appendix 3: 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	63193.380
ODA	652	609,000,000	754,000,000	160000	6,740,000,000
FD	652	0.219	0.131	0.034	0.751
INST	652	-0.886	1.504	-4.671	3.693

FIGURES

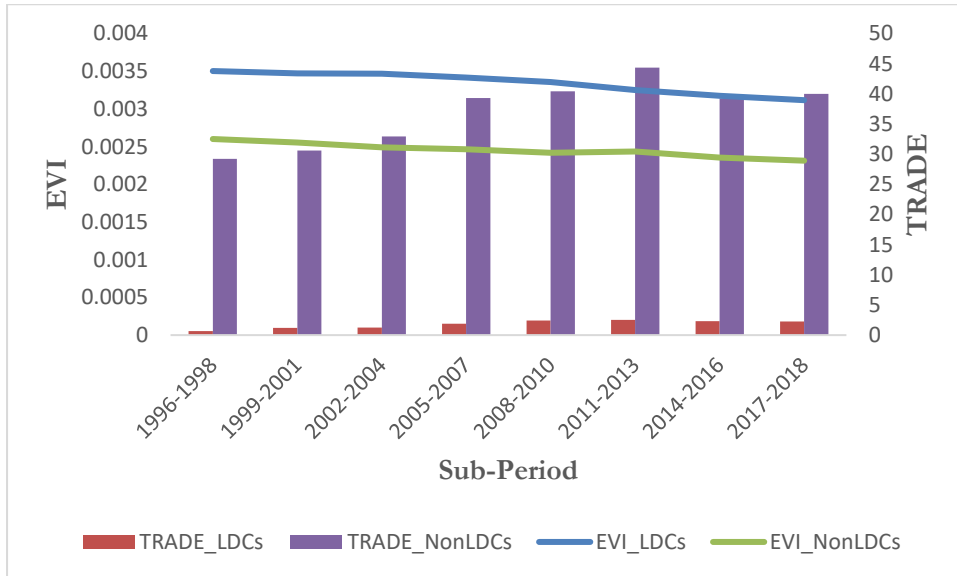
Figure 1: Development of EVI and "TRADE"_over the full sample



Source: Author

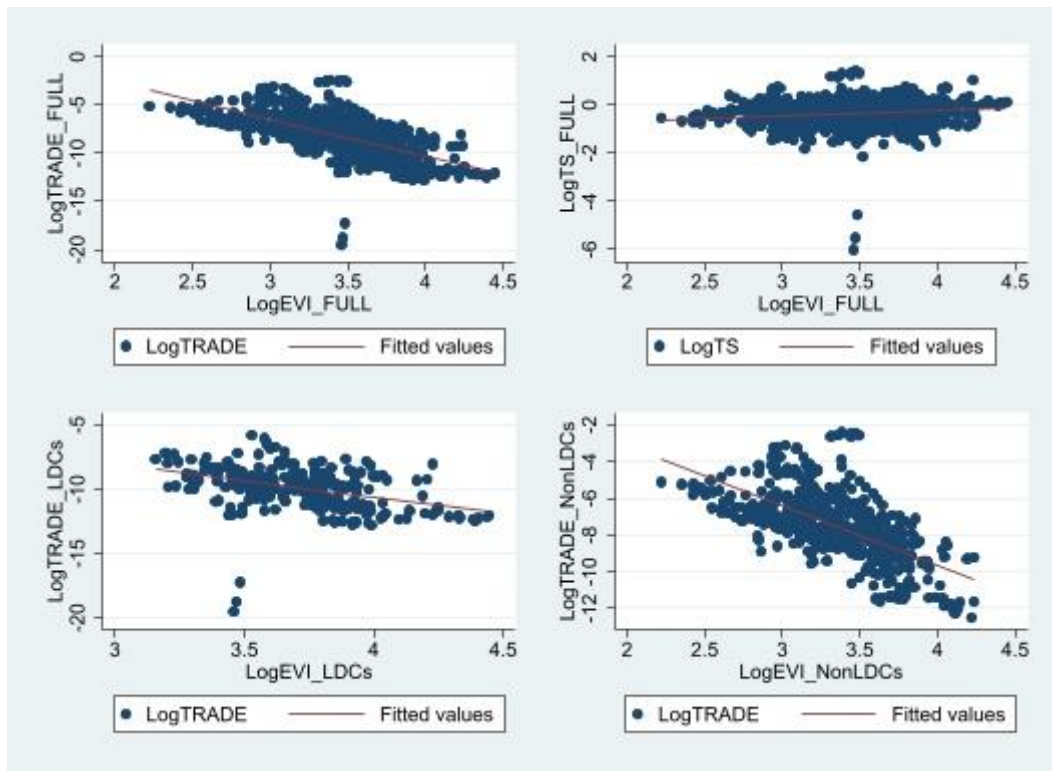
Note: "FULL" means full sample.

Figure 2: Development of EVI and "TRADE"_over LDCs and NonLDCs



Source: Author

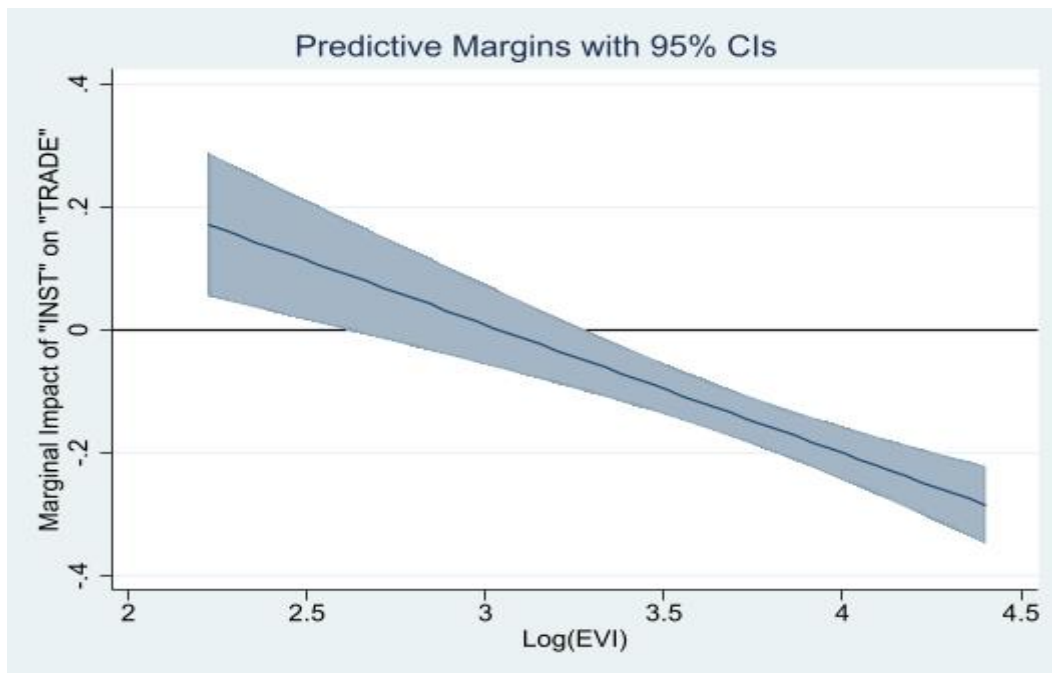
Figure 3: Correlation between EVI and participation in international trade_over the full sample



Source: Author

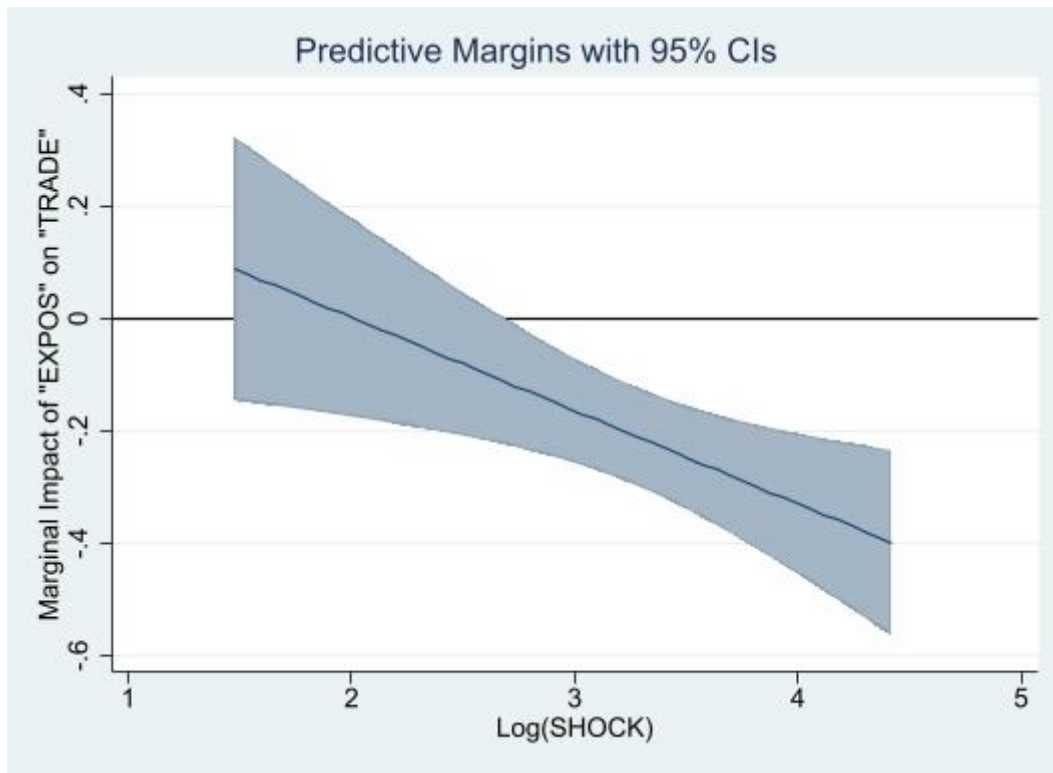
Note: "FULL" means full sample.

Figure 4: Marginal Impact of "INST" on "TRADE" for varying levels of EVI



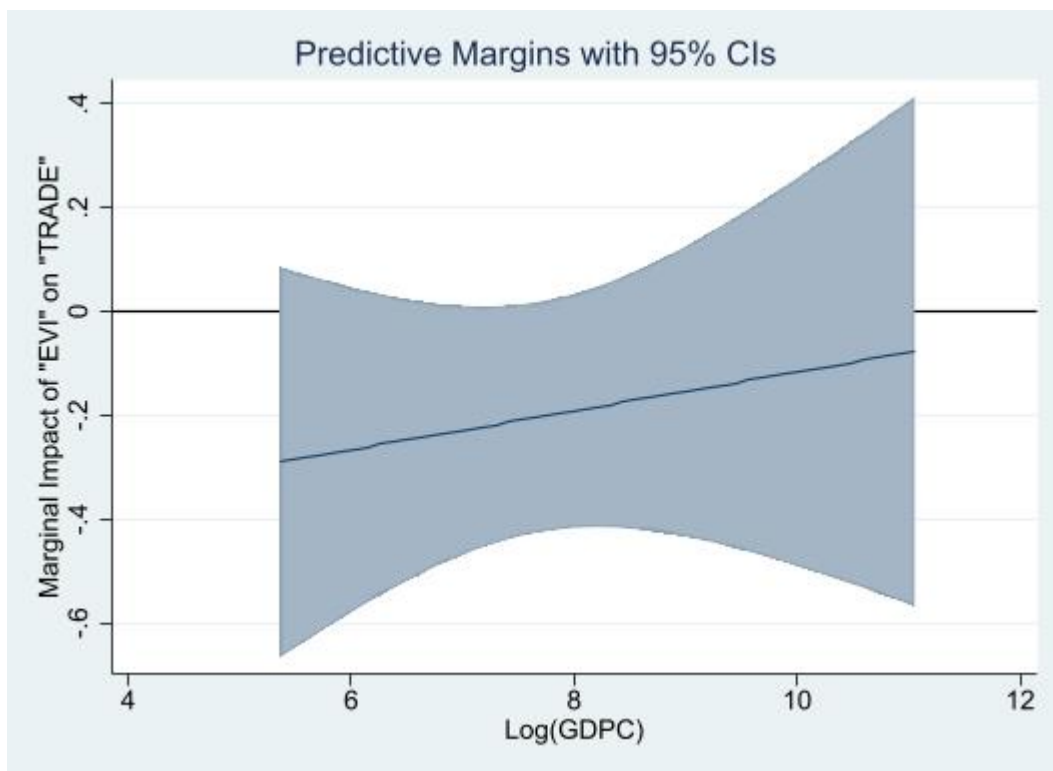
Source: Author

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



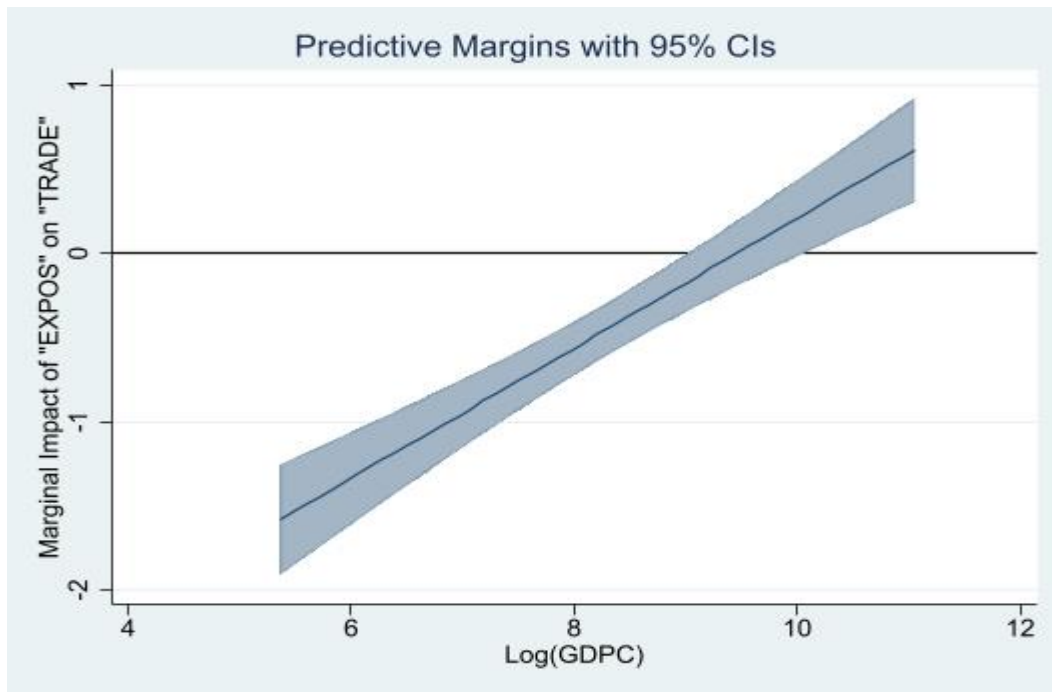
Source: Author

Figure 6: Marginal Impact of "EVI" on "TRADE" for varying levels of the real per capita income



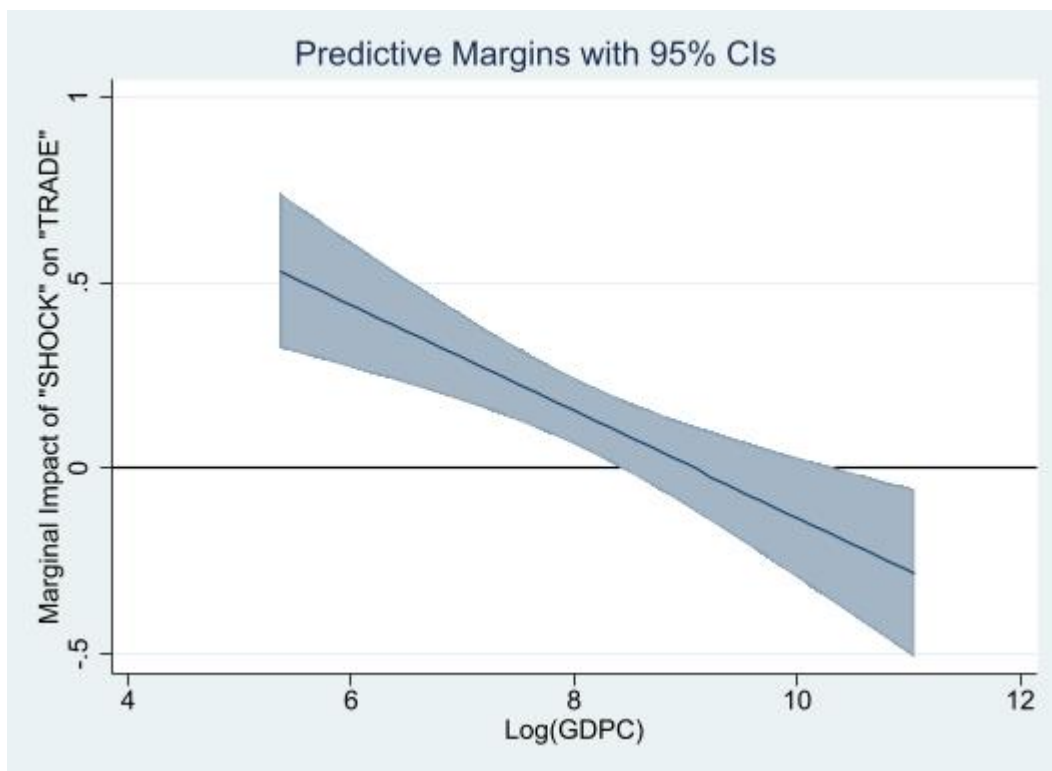
Source: Author

Figure 7: Marginal Impact of "EXPOS" on "TRADE" for varying levels of the real per capita income



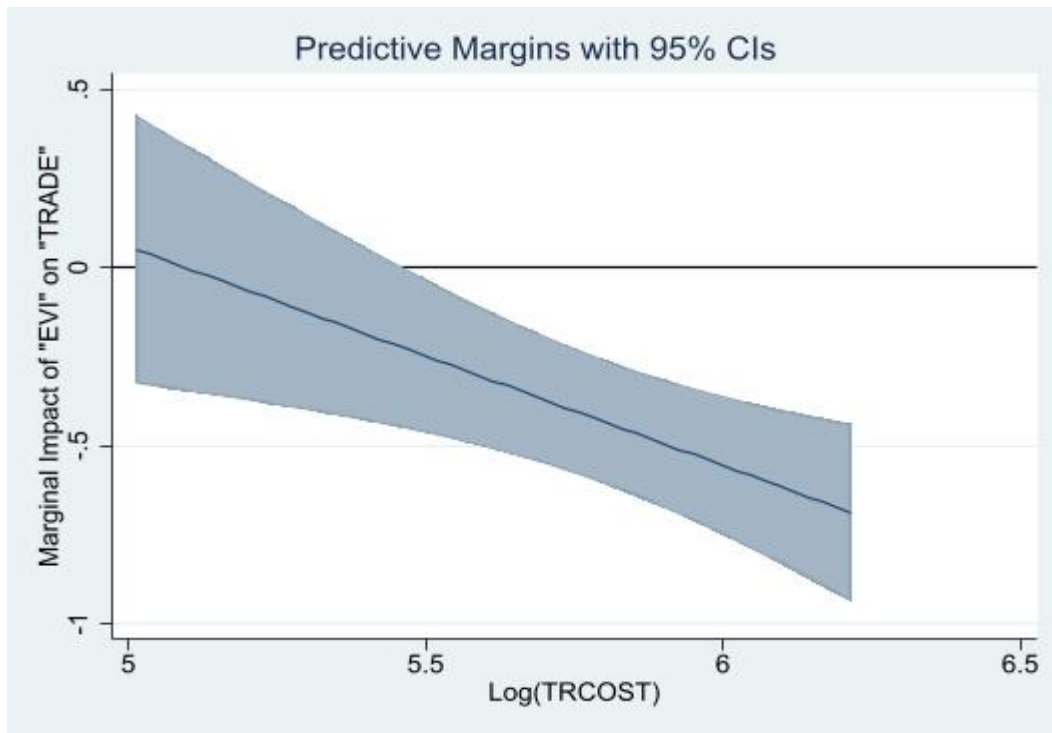
Source: Author

Figure 8: Marginal Impact of "SHOCK" on "TRADE" for varying levels of the real per capita income



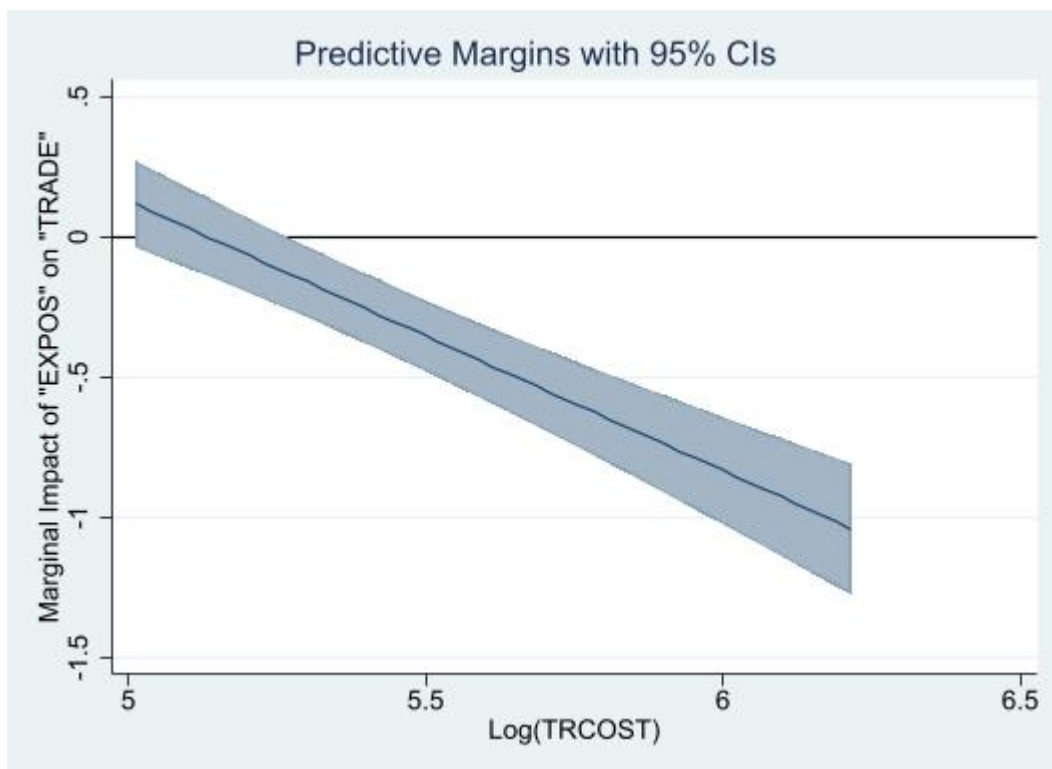
Source: Author

Figure 9: Marginal Impact of "EVI" on "TRADE" for varying levels of trade costs



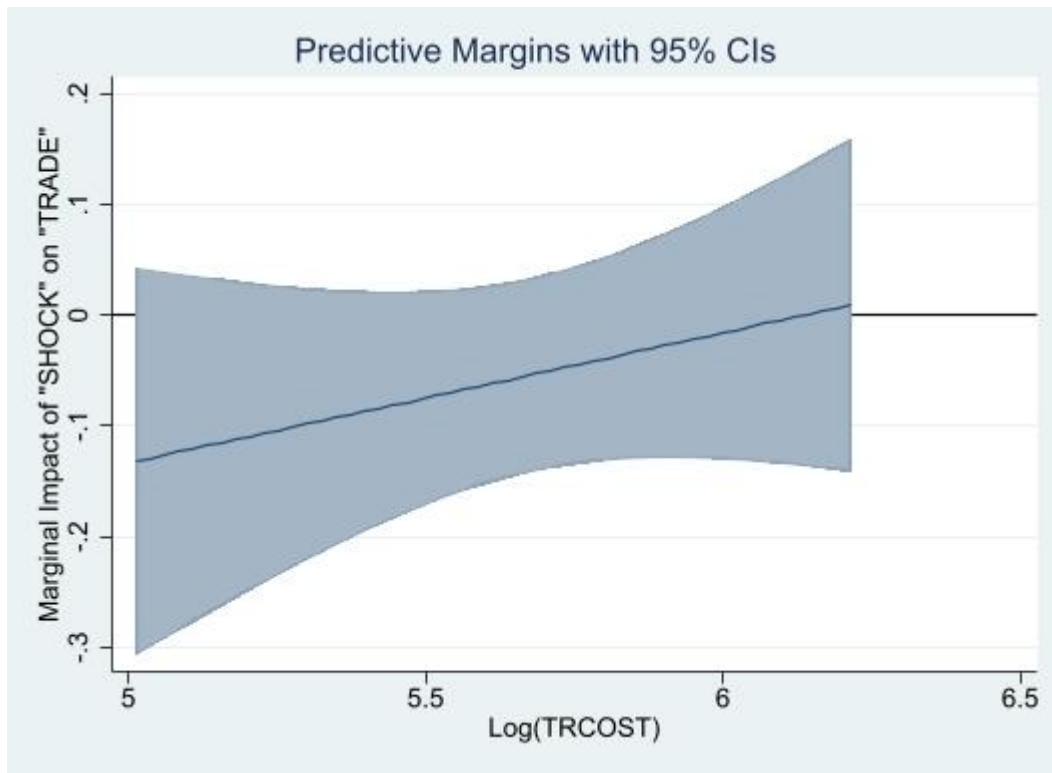
Source: Author

Figure 10: Marginal Impact of "EXPOS" on "TRADE" for varying levels of trade costs



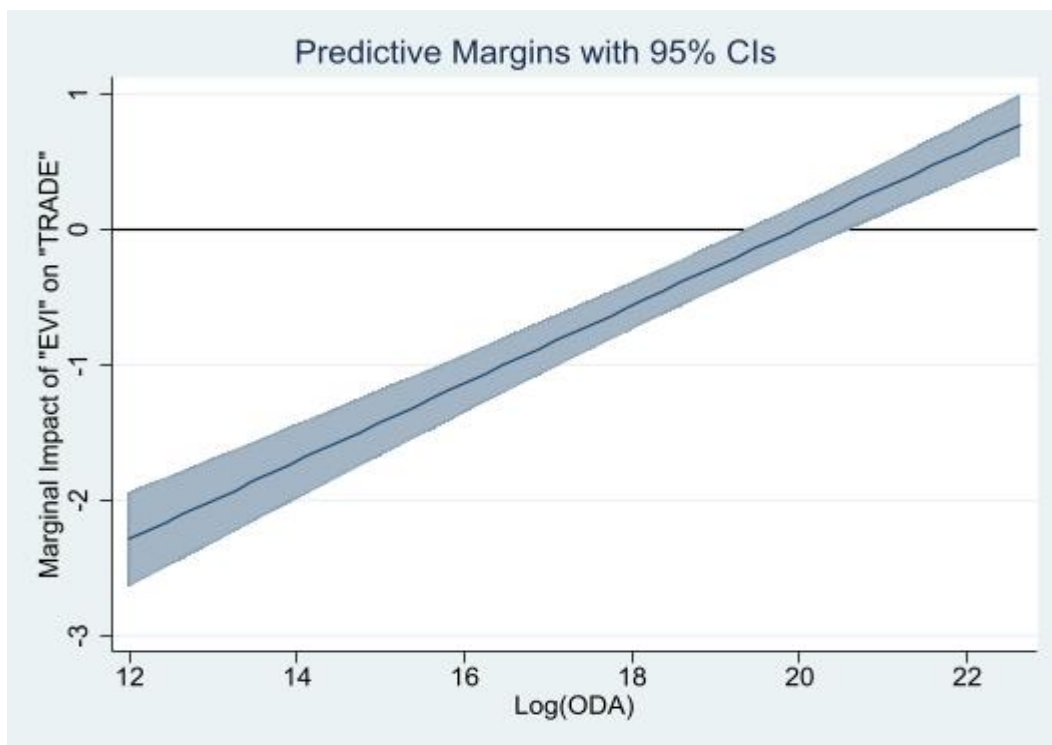
Source: Author

Figure 11: Marginal Impact of "SHOCK" on "TRADE" for varying levels of trade costs



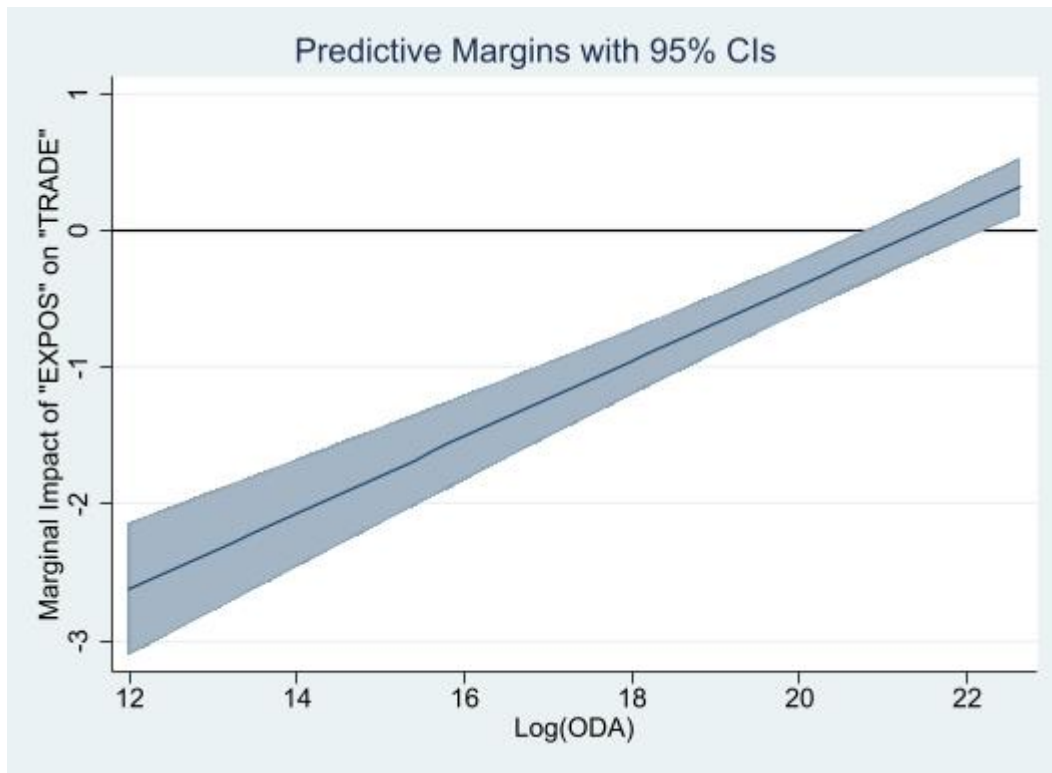
Source: Author

Figure 12: Marginal Impact of "EVI" on "TRADE" for varying amounts of development aid



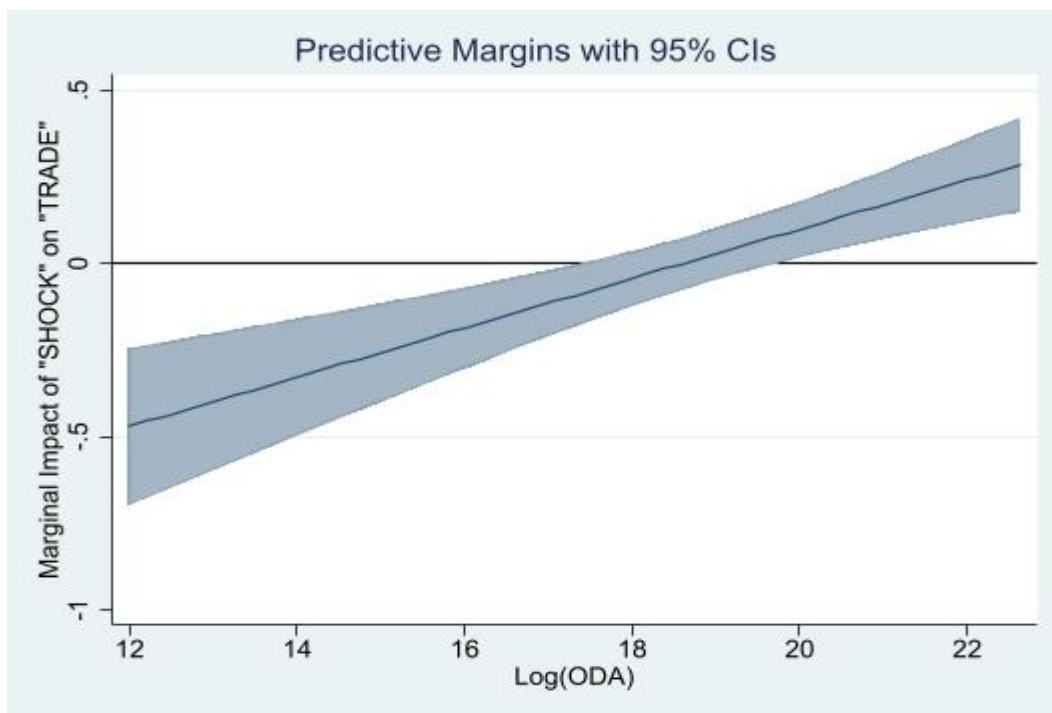
Source: Author

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