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Productive Capacities, Structural Economic Vulnerability and Fiscal Space Volatility in Developing Countries†

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The current article has explored the effect of productive capacities (as defined by the United Nations Conference on Trade and Development) and of structural economic vulnerability (as defined by the United Nations) on fiscal space volatility in developing countries. It relies on the definition and measure of fiscal space proposed by Aizenman and Jinjarak (2010; 2011) and Aizenman et al. (2019). To compute the indicator of fiscal space and hence that of fiscal space volatility, fiscal space is considered as the ratio of outstanding public debt to the 'de facto tax base', the latter being the number of years of tax revenues needed for a country to repay its debt. Results based on a sample of 116 countries from 2000 to 2018 have revealed that the enhancement of productive capacities is associated with lower fiscal space volatility, while higher structural economic vulnerability heightens fiscal space volatility. On another note, highly vulnerable countries tend to experience a higher negative effect of productive capacities on fiscal space volatility than relatively less vulnerable countries.

Key Word: Productive capacities, Structural economic vulnerability, Fiscal space volatility
JEL Code: D24, O10, E60

I. Introduction

The COVID-19 pandemic has shown how developing countries are vulnerable to shocks, and even more so than developed countries. The vulnerability of developing countries at the macroeconomic level is not a new issue in the economic development literature (e.g., Barrot *et al*., 2018; Briguglio *et al*., 2009; Dabla-Norris

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and Gündüz, 2014; Essers, 2013; Guillaumont, 2009; 2017; Harjoto *et al*., 2020; Keefe, 2021; Montalbano, 2011; Lee, 2018).

Recognizing the greater extent of macroeconomic vulnerability experienced by least developed countries[1] (LDCs) among developing countries, the United Nations Committee for Development Policy (UN-CDP) has developed the concept of "structural economic vulnerability." Structural economic vulnerability is the structural component of a country's overall level of economic vulnerability, the latter being "the risk of a (poor) country seeing its development hampered by environmental or natural shocks as well as external shocks" (Guillaumont, 2009). Therefore, structural economic vulnerability indicates a country's extent of exposure to exogenous shocks as well as the size and frequency of these shocks. It is important to note that the conjunctural component of the overall economic vulnerability is referred to as "economic resilience," reflecting the country's capacity to react to shocks, as measured through the policies that it implements (Guillaumont, 2009).

In addition to being exposed to a high degree of structural economic vulnerability, developing countries, and in particular LDCs among them, suffer from low or insufficient levels of productive capacities that could enable them to reduce their exposure to negative shocks and mitigate the adverse effects of such shocks on their economies. According for example to the United Nations Conference on Trade and Development (UNCTAD, 2006, p.61), "productive capacities" refers to "the productive resources, entrepreneurial capabilities and production linkages which together determine the capacity of a country to produce goods and services, and enable it to grow and develop." To help researchers undertake policy analyses and make appropriate policy recommendations concerning countries' performance outcomes with regard to their productive capacities, UNCTAD launched in February of 2021 a comprehensive index of productive capacities (UNCTAD, 2020). This indicator helps to fill a void in the literature given that an indicator of productive capacities that could help with comparative analyses across countries did not exist. Many analyses have emphasized the importance of productive capacities for promoting economic growth and development as well as enhancing economic resilience in developing countries (e.g., Cornia and Scognamillo, 2016; Gnangnon, 2022; Shiferaw, 2017; UN, 2017; UNIDO, 2001).

While development aid inflows, remittances inflows and foreign direct investment inflows could help build productive capacities in developing countries, these countries should rely first and foremost on their own financial resources as a sustainable means of financing their development needs, including the strengthening of their productive capacities. Thus, securing greater fiscal space is an ultimate objective for governments in developing countries. At the same time, the volatility of fiscal policy, likely reflecting greater fiscal space volatility, is a source of major concern to policymakers, as it can significantly undermine economic growth (e.g., Afonso and Jalles, 2012; Fatás and Mihov, 2013; Fernández-Villaverde *et al*., 2015). For example, public spending volatility, which could lead to greater fiscal space volatility, heightens output volatility and hampers economic growth (e.g., Afonso

[1]According to the United Nations, LDCs are the poorest countries in the world and are those most vulnerable to external and environmental shocks. The category of LDCs was established for the first time by the United Nations in 1971. Detailed information about this category of countries can be obtained online at https://www.un.org/ohrlls/content/least-developed-countries (Access date: 10 January 2022).

and Furceri, 2010; Afonso and Jalles, 2012; Fatás and Mihov, 2013; Fernández-Villaverde *et al*., 2015). Likewise, with the exacerbation of the instability of both public investment and government consumption, the instability of tax revenue becomes detrimental to economic growth (e.g., Bleaney *et al*., 1995; Ebeke and Ehrhart, 2012).

How do productive capacities and structural economic vulnerability affect fiscal space volatility in developing countries? How does the strengthening of productive capacities affect fiscal space volatility in developing countries that face a higher degree of structural economic vulnerability? The present paper aims to address these two issues.

There are several definitions of the concept of fiscal space in the literature[2] (e.g., Botev *et al.*, 2016; Gnangnon, 2019a; 2019b; Nerlich and Reuter, 2016; Roy *et al*., 2007; Schick, 2009). For example, Heller (2005) considers fiscal space as the room in a government's budget that allows it to provide resources for a desired purpose without jeopardizing the sustainability of its financial position or the stability of the economy. More practically, Aizenman and Jinjarak (2010; 2011) define fiscal space as the ratio of public debt to public revenue. In other words, the authors propose the indicator of "de facto fiscal space[3]" as the ratio of outstanding public debt to the 'de facto tax base'. De facto fiscal space is the number of years of tax revenues needed for a country to repay its debt. In the present analysis, we define fiscal space in order to facilitate the interpretation of empirical outcomes: fiscal space is the ratio of the current total public revenue to the outstanding public debt. It reflects for a given country the ability and willingness of the country to fund fiscal expenditures and transfers using the current public revenues.

To investigate the effects of productive capacities and structural economic vulnerability on fiscal space volatility in developing countries and to examine how both factors interact in influencing fiscal space volatility in these countries, we rely on the indicator of fiscal space defined above, the indicator of productive capacities proposed by the UNCTAD (2020), and on the indicator of structural economic vulnerability as defined by the United Nations.

While a number of studies have explored the determinants of fiscal space (e.g., Botta *et al*., 2023; Gnangnon, 2018; 2019b; Gnangnon and Brun, 2020; Nerlich and Reuter, 2016), studies of the determinants of fiscal space volatility are scarce. This may be due to the lack of consensus among economists on how to measure "fiscal space." To the best of our knowledge, one of the few studies of the factors underpinning fiscal space volatility is that by Gnangnon (2020b), who used the indicator of fiscal space defined above to examine the effect of export product diversification on fiscal policy volatility through the avenue of economic growth volatility. He found that export product concentration enhances fiscal space volatility in countries that face greater economic growth volatility.

From a theoretical perspective, we argue, on the one hand, that by reducing economic growth volatility (e.g., Gnangnon, 2021) and enhancing economic resilience (e.g., Cornia and Scognamillo, 2016; Gnangnon, 2022; Shiferaw, 2017),

[2]Cheng and Pitterle (2018) provide a literature survey on the definition and measurement of fiscal space.

[3]Recent studies such as Aizenman *et al.* (2019), Gnangnon (2018, 2019a; 2019b; 2020a; 2020b) and Gnangnon and Brun (2020) have also utilized this operational definition of fiscal space in their respective analyses.

the strengthening of productive capacities would help dampen the effects of shocks on economies and hence reduce fiscal space volatility. On the other hand, it can be intuitive to consider that an increase in structural economic vulnerability, which reflects an increase in the level of exposure to shocks and/or a higher extent of shocks, is likely to result in greater volatility of fiscal space in developing countries. In addition, we expect that the development of productive capacities would dampen the heightening effect of structural economic vulnerability on fiscal space volatility on developing countries. Specifically, productive capacities would exert a greater negative effect on fiscal space volatility in countries that experience a higher degree of structural economic vulnerability.

The empirical analysis has confirmed these hypotheses. It used the feasible generalized least squares (FGLS) estimator and relied on a panel dataset of 116 developing countries over the period of 2000 to 2018.

The remainder of the paper is organized around five sections. Section II presents a theoretical discussion of the effects of productive capacities and structural economic vulnerability on fiscal space volatility. Section III lays down the empirical strategy. Section IV interprets the empirical results, and Section V concludes the paper.

II. Theoretical discussion of the effects of productive capacities and structural economic vulnerability on fiscal space volatility

On the one hand, we argue that by reducing economic growth volatility (e.g., Gnangnon, 2021) and enhancing economic resilience (e.g., Cornia and Scognamillo, 2016; Gnangnon, 2022; Shiferaw, 2017), the strengthening of productive capacities would help dampen the effects of shocks on economies and hence reduce fiscal space volatility. Thus, we formulate the following hypothesis.

Hypothesis 1. The strengthening of productive capacities is likely to be associated with a lower volatility of fiscal space.

On the other hand, it is intuitive to expect that an increase in structural economic vulnerability, which reflects an increase in the level of exposure to shocks and/or a higher extent of shocks, is likely to result in greater volatility of fiscal space in developing countries. In fact, the indicator of structural economic vulnerability has two main components, which are the exposure sub-index and the shocks sub-index (see for example Feindouno and Goujon, 2016). The former has five component indexes, while the latter encompasses three component indexes.

The five component indexes of the exposure sub-index (with their weights in brackets) are as follows: population size (25%); remoteness from world markets (25%); export product concentration (12.5%); share of agriculture, forestry, and fishery in GDP (12.5%); and the share of population living in low elevated coastal zones (25%). Thus, it is likely that a higher degree of exposure to shocks will enhance fiscal space volatility. For example, Gnangnon (2020b) found that an increase in the level of export product concentration results in higher fiscal space volatility. Similarly, countries whose production structure reflects a high share of agriculture, forestry, and fishery in their GDP are exposed to shocks, especially

environmental and external economic and financial shocks. Such shocks would adversely affect these economies and heighten the fiscal space volatility.

The three component indexes of the shocks sub-index (with their weights in brackets) are as follows: victims of natural disasters (25%), instability in agricultural production (25%), and instability in exports of goods and services (50%). It can be straightforward to expect that an increase in the extent of shocks faced by a country will heighten their fiscal space volatility. In other words, countries that face higher magnitudes of shocks will experience greater fiscal space volatility than countries that experience lower magnitudes of shocks.

On another note, Gnangnon (2021) showed that higher structural economic vulnerability is associated with greater economic growth volatility in developing countries. Therefore, we formulate the following hypothesis.

Hypothesis 2. A rise in structural economic vulnerability is likely to be positively associated with fiscal space volatility.

In light of hypotheses 1 and 2, we can postulate that through its positive economic resilience effect, the strengthening of productive capacities is likely to dampen the positive effect of structural economic vulnerability on fiscal space volatility. In light of the potential positive effect of economic growth volatility on the volatility of fiscal space, this theoretical expectation is further exemplified by the findings of Gnangnon (2021), who showed that the development of productive capacities contributes to dampening economic growth volatility in countries that face a higher level of structural economic vulnerability.

Therefore, we can postulate hypothesis 3, as follows.

Hypothesis 3. The strengthening of productive capacities is likely to result in lower fiscal space volatility in countries that face a rise in the level of structural economic vulnerability.

The next sections will test empirically each of these hypotheses.

III. Empirical Strategy

This section includes three sub-sections. First, we present the baseline model specification that helps address the questions at the heart of the analysis (sub-section III.A). Second, we briefly present some data analysis, notably concerning the key variables of interest in the analysis, specifically fiscal space volatility, productive capacities, and structural economic vulnerability (sub-section III.B). Third, we present the estimator used to carry out the empirical analysis and explain the different variants of the baseline model that will be estimated using this estimator (see sub-section III.C).

A. *Model specification*

As noted above, studies of the determinants of fiscal space volatility are scarce.

To explore the effects of productive capacities and structural economic vulnerability on fiscal space volatility, we draw from the work of Gnangnon (2020b). We postulate the following model:

$$FSVOL3_{it} = \alpha_0 + \alpha_1 PCI_{it-3} + \alpha_2 EVI_{it-3} + \alpha_3 \text{Log}(GDPC)_{it-3} + \alpha_4 \text{Log}(OPEN)_{it-3} + \alpha_5 INFLVOL_{it-3} + \alpha_6 DUMOUT_{it} + \mu_i + \gamma_t + \omega_{it} \quad (1)$$

Here, the subscripts i and t denote respectively a country and a year. Based on available data, an unbalanced panel dataset of 116 developing countries, of which 38 are LDCs and 78 are non-LDCs (i.e., countries not classified as LDCs in the full sample) over the period of 2000-2018, was constructed.

To save space here, we have defined the variables used in model (1) and their sources in Table A1. The dependent variable "$FSVOL3$" is our main indicator of fiscal space volatility. To compute it, first we calculate the index of fiscal space as the ratio of total public revenue (including grants and social contributions) to total public debt. The index of fiscal space volatility is subsequently computed as the ratio of the standard deviation of the indicator of fiscal space (over three-year rolling windows, that is, from $t-2$ to t) to the mean of the indicator of fiscal space over three-year rolling windows. Higher values of the indicator of fiscal policy volatility reflect greater fiscal space volatility.

Likewise, "PCI" is the indicator of productive capacities. This is the overall productive capacity index, which measures the level of productive capacities along the three pillars of the "productive resources, entrepreneurial capabilities and production linkages which together determine the capacity of a country to produce goods and services and enable it to grow and develop" (UNCTAD, 2006). It is computed as a geometric average of the following eight domains or categories: information communication and technologies, structural change, natural capital, human capital, energy, transport, the private sector and institutions. Each category index is obtained using the principal components extracted from the underlying indicators, weighted by their capacity to explain the variance in the original data. The category indices are normalized into 0-100 intervals (see UNCTAD, 2020).

"EVI" is the indicator of structural economic vulnerability. This is a measure of a country's level of structural economic vulnerability. The EVI indicator, referred to as the Economic Vulnerability Index, was established at the United Nations by the Committee for Development Policy (CDP) and is used by the latter as one of the criteria for identifying LDCs. It is 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)". EVI is computed as the simple arithmetic average of two sub-indexes, namely the intensity of exposure to shocks (exposure sub-index) and the intensity of exogenous shocks (shocks sub-index). These two sub-indexes are calculated using the weighted average of different component indexes, with the sum of the components' weights equals to 1 so that the values of EVI are between 0 and 100. As described above, the exposure sub-index has five component indexes, and the shocks sub-index has three component indexes. A rise in the EVI value indicates greater structural economic vulnerability.

The real per capita gross domestic product (constant 2010 US$) is denoted as "*GDPC*." The variable "*OPEN*" is the indicator of trade openness. It is the share of the sum of exports and imports of goods and services in GDP adjusted by the proportion of a country's trade level relative to the average world trade (see Squalli and Wilson, 2011, p.1758). Both "*GDPC*" and "*OPEN*" are transformed using the natural logarithm in order to reduce skewness in their distributions.

The variable "*INFLVOL3*" is here the indicator of inflation rate volatility. It is computed as the ratio of the standard deviation of the indicator of the inflation rate (over three-year rolling windows, that is, from $t-2$ to t) to the mean of the indicator of the inflation rate over three-year rolling windows. Higher values of the inflation volatility reflect greater volatility of the inflation rate. Finally, the variable "*DUMOUT*" is a dummy variable that captures outliers identified in the sample (see sub-section III.B).

Table A2 presents the descriptive statistics of the variables used in model (1). The lists of countries used in the analysis are provided in Table A3.

α_0 to α_6 are parameters that will be estimated. μ_i denotes countries' specific effects and the γ_t variables are temporal dummies that aim to capture global shocks that affect all countries together. ω_{it} is a random error term.

It is important to note that all variables in model (1) (except for the dummy-outlier) are considered at year $t-3$, with a view to ensuring their exogeneity with respect to the dependent variable. For example, considering the variable "*PCI*" at year $t-3$ means that we are examining the effect of the development of productive capacities in year $t-3$ on the volatility of fiscal space from year $t-2$ to year t. Likewise, introducing the variable "*EVI*" at year $t-3$ in model (1) indicates that we are examining the effect of structural economic vulnerability in year $t-3$ on the volatility of fiscal space from year $t-2$ to year t.

It should also be noted that while the initial period of analysis is from 2000 to 2018, in the end we actually have a period that goes from 2001 to 2018 given how we compute the indicator of fiscal space volatility and that of inflation volatility.

Let us now discuss the expected effects of the control variables contained in model (1). These control variables are included in model (1) because they are likely to influence the effects of productive capacities and structural economic vulnerability on fiscal space volatility. The real per capita income – which is a proxy for economic development – aims to capture differences across countries in the level of fiscal space volatility. Gnangnon (2021) found that advanced developing countries tend to experience higher volatility of fiscal space than do relatively less advanced countries. It is straightforward to expect that greater inflation volatility would be associated with higher fiscal space volatility. The effect of trade openness on fiscal space volatility can be ambiguous. On the one hand, trade openness can increase countries' exposure to shocks (e.g., Montalbano, 2011) and hence potentially increase fiscal space volatility as well. On the other hand, trade openness can promote innovation, including that which arises through exchanges of intangible ideas (e.g., Akcigit and Melitz, 2022; Grossman and Helpman, 1995; Melitz and Redding, 2022; Shu and Steinwender, 2018). In turn, innovation can enhance countries' resilience to shocks, including climate shocks (e.g., Matos *et al*., 2022), economic and financial shocks (e.g., Cappelli *et al*., 2021), and health shocks (e.g., Paunov and Planes-Satorra, 2021).

In this scenario, trade openness could contribute to lowering fiscal space volatility.

B. *Data Analysis*

Before turning to the estimation method employed to conduct the empirical analysis, we find it useful to provide some insights into the developments of our key variables of interest (i.e., fiscal space volatility, productive capacities, and structural economic vulnerability) over the full sample. Figure 1 shows how these variables have evolved over time over the full sample. We observe that fiscal space volatility rose from 2001 to 2006, reached its peak in 2006, and then declined up to 2012. It then rebound from 2012 to 2016 and subsequently declined from 2016 to 2018. In the meantime, Figure 1 shows a declining trend of structural economic vulnerability over time and an increasing trend of productive capacities, on average, over the full sample.

Figure 2 presents the correlation pattern (in the form of a scatter plot) between productive capacities and fiscal space volatility on the one hand and between structural economic vulnerability and fiscal space volatility on the other hand, over the full sample. It shows that the indicator of productive capacities is negatively correlated with fiscal space volatility while the indicator of structural economic vulnerability is positively correlated with fiscal space volatility. In addition, we note the presence of outliers concerning instances where the values of the indicator of fiscal space volatility exceed 0.5. We take into account these outliers in the regression by introducing the dummy outlier "*DUMOUT*," which takes a value of 1 for these outliers, and 0 otherwise. The same patterns are observed for the sub-samples of LDCs and non-LDCs (see Figure 3). The empirical analysis will provide further guidance as to whether these correlation patterns indeed reflect causality.

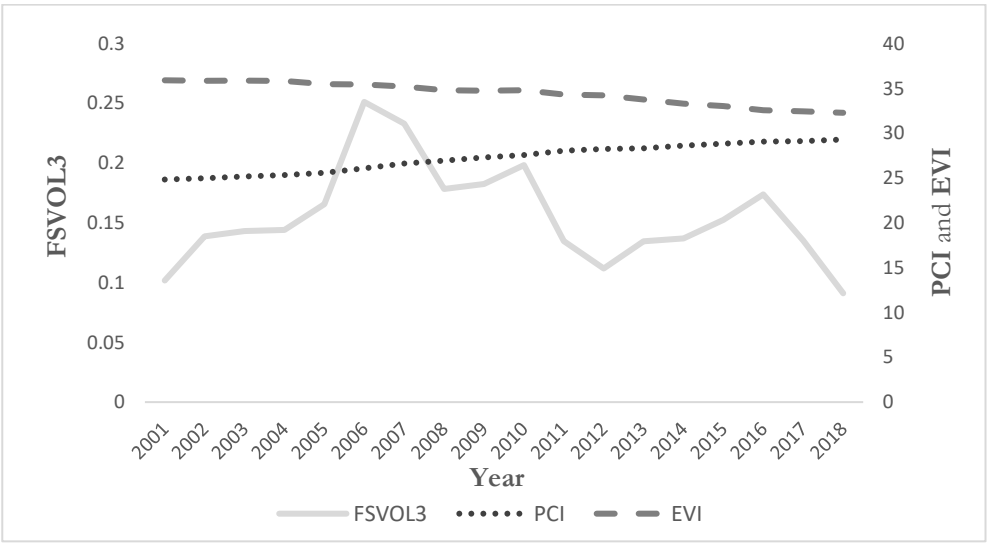

FIGURE 1. PRODUCTIVE CAPACITY, STRUCTURAL ECONOMIC VULNERABILITY AND FISCAL SPACE VOLATILITY OVER THE FULL SAMPLE

Source: Author.

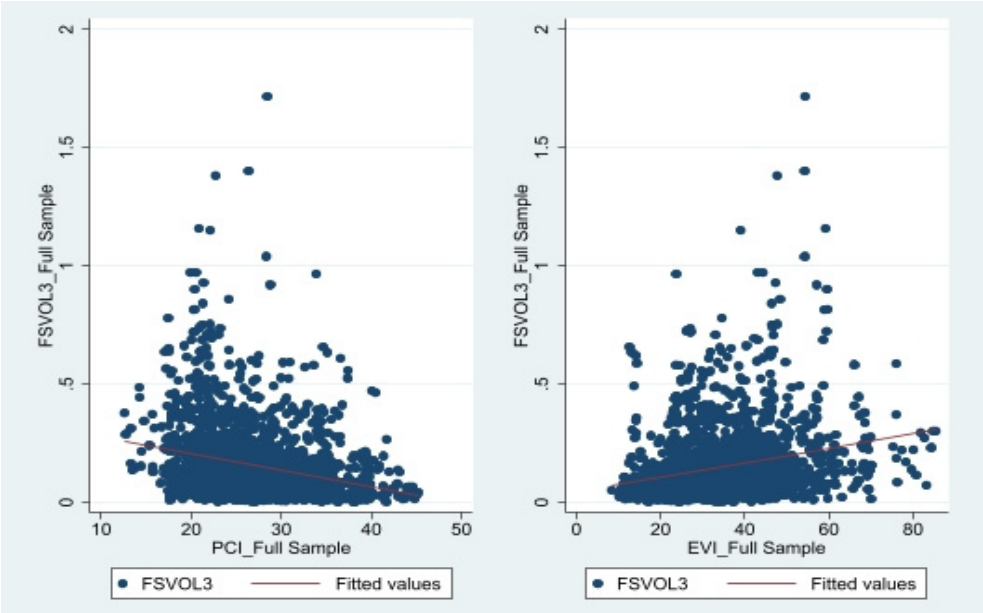

FIGURE 2. CROSS PLOT BETWEEN PRODUCTIVE CAPACITY, STRUCTURAL ECONOMIC VULNERABILITY AND FISCAL SPACE VOLATILITY OVER THE FULL SAMPLE

Source: Author.

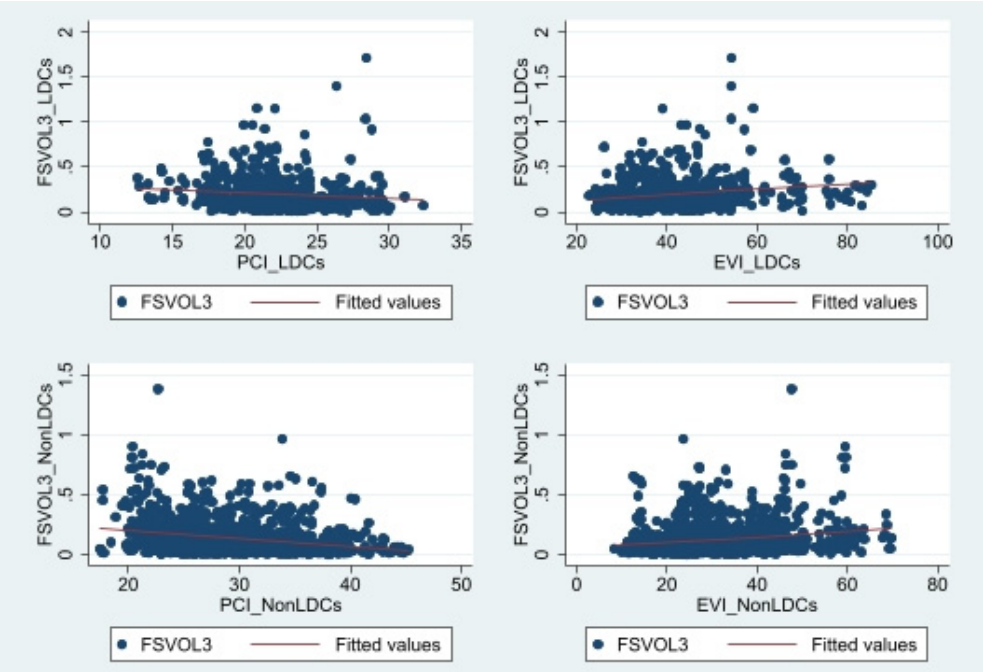

FIGURE 3. CROSS PLOT BETWEEN PRODUCTIVE CAPACITY, STRUCTURAL ECONOMIC VULNERABILITY AND FISCAL SPACE VOLATILITY OVER THE SUB-SAMPLES OF LDCS AND NON-LDCS

Source: Author.

C. *Econometric Approach*

To test hypotheses 1 to 3, we estimate the baseline model (1) by means of the feasible generalized least squares (FGLS) estimator. This estimator generates more efficient estimates than those obtained from the ordinary least squares estimator, notably in the presence of heteroskedasticity, as well as serial and cross-sectional correlations (e.g., Bai *et al*., 2021; Zellner, 1962).

First, we test hypotheses 1 and 2 (notably the effects of productive capacities and structural economic vulnerability on fiscal space volatility) by estimating the baseline model (1) over the full sample and the sub-samples of LDCs and non-LDCs. The outcomes of these estimations are presented in Table 1.

Next, we examine how the effects of productive capacities and structural economic vulnerability vary across countries in the full sample. To that effect, we estimate in the first instance a variant of model (1) in which we introduce the interaction between the indicator of productive capacities and the real per capita income. The outcomes of this regression are presented in column [1] of Table 2. We then estimate another variant of model (1) that includes the interaction variable between the indicator of structural economic vulnerability and the real per capita income. The estimates arising from this regression are reported in column [2] of Table 2.

We test hypothesis 3 by estimating another variant of model (1) in which we interact the variables "*PCI*" and "*EVI*." The outcomes of this estimation are presented in Table 3.

TABLE 1—EFFECTS OF PRODUCTIVE CAPACITY AND STRUCTURAL ECONOMIC VULNERABILITY ON FISCAL SPACE VOLATILITY (ESTIMATOR: FGLS (WITH PANEL-SPECIFIC FIRST-ORDER AUTOCORRELATION))

	Full Sample	LDCs	Non-LDCs
Variables	FSVOL3	FSVOL3	FSVOL3
	(1)	(2)	(3)
PCI_{t-3}	-0.0107***	-0.00687***	-0.0120***
	(0.000942)	(0.00176)	(0.00110)
EVI_{t-3}	0.00188***	0.00194***	0.00147***
	(0.000272)	(0.000497)	(0.000387)
Log($GDPC$)$_{t-3}$	0.0370***	0.0165	0.0557***
	(0.00478)	(0.0120)	(0.00566)
Log($OPEN$)$_{t-3}$	-0.000168	0.00472	-0.000391
	(0.00185)	(0.00397)	(0.00215)
$INFLVOL_{t-3}$	5.13e-05	0.000337	0.000133
	(0.000249)	(0.00137)	(0.000256)
DUMOUT	0.477***	0.480***	0.430***
	(0.0145)	(0.0227)	(0.0167)
Constant	0.0324	0.156*	-0.0846**
	(0.0316)	(0.0804)	(0.0369)
Observations - Countries	1,526 - 116	539 - 38	987 - 78
Pseudo R-squared	0.7703	0.7792	0.7614
Wald Chi2 statistic (p-value)	1779.85 (0.000)	690.89 (0.000)	1080.37 (0.000)

Note: 1) *p-value<0.1, **p-value<0.05, ***p-value<0.01; 2) Robust standard errors are in parenthesis, as they are clustered at the country level; 3) The Pseudo R^2 is calculated as the correlation coefficient between the dependent variable and its predicted values; 4) Time dummies are included in the FGLS-based regressions.

TABLE 2—EFFECT OF PRODUCTIVE CAPACITY AND STRUCTURAL ECONOMIC VULNERABILITY ON FISCAL SPACE VOLATILITY FOR VARYING LEVELS OF REAL PER CAPITA INCOME OVER THE FULL SAMPLE (ESTIMATOR: FGLS (WITH PANEL-SPECIFIC FIRST-ORDER AUTOCORRELATION))

Variables	FSVOL3 (1)	FSVOL3 (2)
PCI_{t-3}	-0.0242***	-0.0111***
	(0.00322)	(0.000886)
EVI_{t-3}	0.00202***	0.0106***
	(0.000284)	(0.00153)
$[PCI_{t-3}]$*[Log($GDPC$)$_{t-3}$]	0.00161***	
	(0.000371)	
$[EVI_{t-3}]$*[Log($GDPC$)$_{t-3}$]		-0.00112***
		(0.000186)
Log($GDPC$)$_{t-3}$	-0.00367	0.0778***
	(0.0111)	(0.00802)
Log($OPEN$)$_{t-3}$	0.000386	-0.000772
	(0.00191)	(0.00178)
$INFLVOL_{t-3}$	4.53e-05	0.000115
	(0.000244)	(0.000249)
$DUMOUT$	0.474***	0.476***
	(0.0142)	(0.0135)
Constant	0.363***	-0.287***
	(0.0869)	(0.0607)
Observations - Countries	1,526 - 116	1,526 - 116
Pseudo R-squared	0.7735	0.7768
Wald Chi2 statistic (p-value)	1904.40 (0.000)	2140.22 (0.000)

Note: 1) *p-value<0.1, **p-value<0.05, ***p-value<0.01; 2) Robust standard errors are in parenthesis; 3) The Pseudo R^2 is calculated as the correlation coefficient between the dependent variable and its predicted values; 4) Time dummies are included in the FGLS-based regressions.

TABLE 3—INTERACTION EFFECT OF PRODUCTIVE CAPACITY AND STRUCTURAL ECONOMIC VULNERABILITY ON FISCAL SPACE VOLATILITY OVER THE FULL SAMPLE (ESTIMATOR: FGLS (WITH PANEL-SPECIFIC FIRST-ORDER AUTOCORRELATION))

Variables	FSVOL3 (1)
PCI_{t-3}	-0.00498***
	(0.00149)
EVI_{t-3}	0.00634***
	(0.00110)
$[PCI_{t-3}]$*$[EVI_{t-3}]$	-0.000167***
	(3.83e-05)
Log($GDPC$)$_{t-3}$	0.0385***
	(0.00470)
Log($OPEN$)$_{t-3}$	-0.00154
	(0.00182)
$INFLVOL_{t-3}$	8.81e-05
	(0.000251)
$DUMOUT$	0.479***
	(0.0140)
Constant	-0.145***
	(0.0502)
Observations - Countries	1,526 - 116
Pseudo R-squared	0.7728
Wald Chi2 statistic (p-value)	1868.82 (0.000)

Note: 1) *p-value<0.1, **p-value<0.05, ***p-value<0.01; 2) Robust standard errors are in parenthesis; 3) The Pseudo R^2 is calculated as the correlation coefficient between the dependent variable and its predicted values; 4) Time dummies are included in the FGLS-based regressions.

TABLE 4—INTERACTION EFFECT OF PRODUCTIVE CAPACITY AND STRUCTURAL ECONOMIC VULNERABILITY ON FISCAL SPACE VOLATILITY OVER THE FULL SAMPLE (ESTIMATOR: FGLS (WITH PANEL-SPECIFIC FIRST-ORDER AUTOCORRELATION))

Variables	FSVOL4	FSVOL4	Variables	FSVOL5	FSVOL5
	(1)	(2)		(3)	(4)
PCI_{t-4}	-0.0135***	-0.00600***	PCI_{t-5}	-0.0178***	-0.00768***
	(0.00116)	(0.00215)		(0.00136)	(0.00262)
EVI_{t-4}	0.00196***	0.00775***	EVI_{t-5}	0.00220***	0.0101***
	(0.000354)	(0.00150)		(0.000465)	(0.00163)
$[PCI_{t-4}]*[EVI_{t-4}]$		-0.000220***	$[PCI_{t-5}]*[EVI_{t-5}]$		-0.000296***
		(5.41e-05)			(6.13e-05)
$\text{Log}(GDPC)_{t-4}$	0.0509***	0.0539***	$\text{Log}(GDPC)_{t-5}$	0.0720***	0.0764***
	(0.00598)	(0.00601)		(0.00697)	(0.00671)
$\text{Log}(OPEN)_{t-4}$	0.000531	-0.00242	$\text{Log}(OPEN)_{t-5}$	0.00152	-0.00275
	(0.00243)	(0.00245)		(0.00284)	(0.00268)
$INFLVOL_{t-4}$	-1.03e-05	-1.68e-05	$INFLVOL_{t-5}$	-0.000122	-4.30e-05
	(7.15e-05)	(7.25e-05)		(0.000235)	(0.000278)
DUMOUT	0.497***	0.486***	*DUMOUT*	0.440***	0.416***
	(0.00888)	(0.0106)		(0.0107)	(0.0123)
Constant	0.0238	-0.222***	Constant	0.00856	-0.334***
	(0.0416)	(0.0690)		(0.0476)	(0.0760)
Observations - Countries	1,431 - 114	1,431 - 114	Observations - Countries	1,335 - 114	1,335 - 114
Pseudo R-squared	0.7025	0.7055	Pseudo R-squared	0.6593	0.6601
Wald Chi2 statistic	20717.80	9208.13	Wald Chi2 statistic	12865.18	6409.49
(p-value)	(0.000)	(0.000)	(p-value)	(0.000)	(0.000)

Note: 1) *p-value<0.1, **p-value<0.05, ***p-value<0.01; 2) Robust standard errors are in parenthesis; 3) The Pseudo R^2 is calculated as the correlation coefficient between the dependent variable and its predicted values; 4) Time dummies are included in the FGLS-based regressions.

Finally, we carry out a robustness check of the outcomes reported in column [1] of Tables 1 and 3 by measuring fiscal space volatility using four-year rolling windows and five-year rolling windows. In other words, the first other measure of fiscal space volatility is denoted as "*FSVOL4*" and is computed as the ratio of the standard deviation of the indicator of fiscal space (over four-year rolling windows, that is, from $t-3$ to t) to the mean of the indicator of fiscal space over four-year rolling windows. The second alternative measure of fiscal space volatility (denoted as "*FSVOL5*") is computed as the ratio of the standard deviation of the indicator of fiscal space (over five-year rolling windows, that is, from $t-5$ to t) to the mean of the indicator of fiscal space over five-year rolling windows. Higher values of these two indicators of fiscal space volatility reflect greater volatility of fiscal space.

The results in columns [1] and [3] of Table 4 are obtained by estimating the baseline model (1), where the dependent variables are respectively "*FSVOL4*" and "*FSVOL5*." Likewise, the results in columns [2] and [4] of Table 4 are uncovered by estimating the specifications of model (1) that include the interaction between the variables "*PCI*" and "*EVI*," and where the dependent variables are respectively "*FSVOL4*" and "*FSVOL5*."

IV. Estimation Outcomes

We note across columns [1] to [3] of Table 1 that at the 1% level, productive capacities reduce fiscal space volatility and that structural economic vulnerability heightens it, respectively, over the full sample, as well as the sub-samples of LDCs and non-LDCs. **These findings confirm hypotheses 1 and 2 set out above.** Interestingly, the magnitude of productive capacities exerts a stronger negative effect on fiscal space volatility in non-LDCs than in LDCs. Concurrently, structural economic vulnerability exerts a stronger positive effect on fiscal space volatility in LDCs than in non-LDCs. In terms of magnitude, we find that over the full sample, an increase in the value of the index of productive capacities by one point is associated with a reduction of fiscal space volatility by 0.011 points. In other words, an increase in the index of productive capacities by one standard deviation is associated with a reduction of fiscal space volatility of 0.065 points (= 6.052*0.0107). Similarly, over the full sample, an increase in the value of the index of structural economic vulnerability by one point is associated with a rise in fiscal space volatility by 0.00188 points. For LDCs and non-LDCs, the magnitude of the effect of productive capacities on fiscal space volatility amounts respectively to -0.00687 and -0.012. Likewise, for LDCs and non-LDCs, the magnitude of the effect of structural economic vulnerability on fiscal space volatility amounts to 0.00194 and 0.00147, respectively for LDCs and non-LDCs.

Regarding the control variables, we find over the full sample a positive effect of the real per capita income on fiscal space volatility, at the 1% level. Put differently, developing countries with higher incomes tend to exhibit higher fiscal space volatility than developing countries with relatively lower incomes. Trade openness and volatility of the inflation rate are not significantly associated with fiscal space volatility, at the 10% level. Finally, and without surprise, we find that fiscal space volatility is higher for outlier countries than for non-outlier countries, as the coefficient of the indicator "*DUMOUT*" is positive and significant at the 1% level across the three columns of Table 1. These findings concerning the control variables are confirmed in Tables 2 to 4.

Turning to the outcomes in Table 2, we find from column [1] of this table that the coefficient of the variable "PCI_{t-3}" is negative and significant at the 1% level, while the interaction term associated with the variable "$[PCI_{t-3}]$*[Log$(GDPC)_{t-3}$]" is positive and significant at the 1% level. These outcomes tend to suggest that, on average, over the full sample, productive capacities negatively affect fiscal space volatility but only up to a level of the real per capita income; beyond that level, the effect of productive capacities on fiscal space volatility becomes positive. This level of real per capita income above which the effect of productive capacities on fiscal space volatility changes amounts to US$ million 3.372 [= exponential (0.0242/0.00161)]. The latter is far higher than the maximum value of real per capita income in the full sample, which is US$ 69679.1. We conclude that on average, over the full sample, productive capacities always exert a negative effect on fiscal space volatility (that

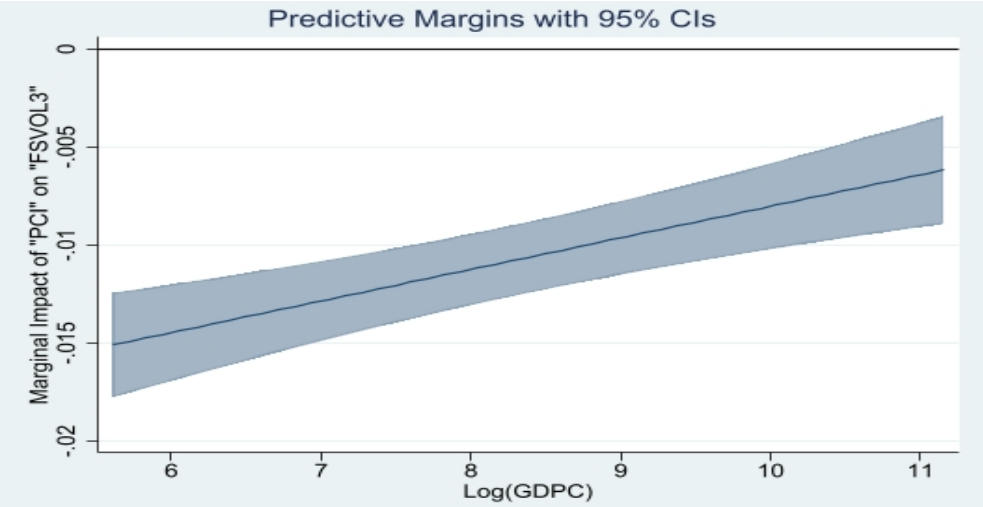

FIGURE 4. MARGINAL IMPACTS OF "*PCI*" ON "*FSVOL3*" FOR VARYING LEVELS OF REAL PER CAPITA INCOME

Note: The variable "Log(*GDPC*)" is considered at year *t*-3.

Source: Author.

is, regardless of the countries' real per capita income), but the magnitude of this negative effect is higher withthe lower the real per capita income levels. In other words, less developed countries among developing countries experience a stronger negative effect of productive capacities on fiscal space volatility compared to relatively advanced developing countries. These findings are confirmed in Figure 4, which displays, at 95% confidence intervals, the marginal impact of productive capacities on fiscal space volatility, conditioned on real per capita income. This figure shows that productive capacities always negatively affect fiscal space volatility, with the magnitude of this negative effect becoming lower as countries experience higher real per capita income.

We now turn to affect outcomes in column [2] of Table 2. These results indicate that the coefficient of the variable "*EVI*" is positive and significant at the 1% level, while the interaction term of the variable ("$[EVI_{t-3}]$*[Log$(GDPC)_{t-3}$]") is negative and significant at the 1% level. We therefore conclude that over the full sample, the effect of structural economic vulnerability on fiscal space volatility is negative for countries whose real per capita incomes are lower than US$ 12891 [= exponential (0.0106/0.00112)] and positive for countries whose real per capita incomes exceed US$ 12891. Figure 5 tends to confirm these findings. It shows at the 95% confidence intervals the marginal impact of structural economic vulnerability on fiscal space volatility, conditioned on real per capita income. It appears that this marginal impact is positive for countries whose real per capita incomes are lower than US$ 8481.25 [= exponential(9.045613)], with the magnitude of the positive effect of structural economic vulnerability on fiscal space volatility increasing as real per capita income decreases. At the same time, countries whose real per capita incomes range from US$ 8481.25 to US$ 28707.1 [= exponential(10.2649)] experience no significant effect of structural economic vulnerability. Note that the numbers "9.045613" and

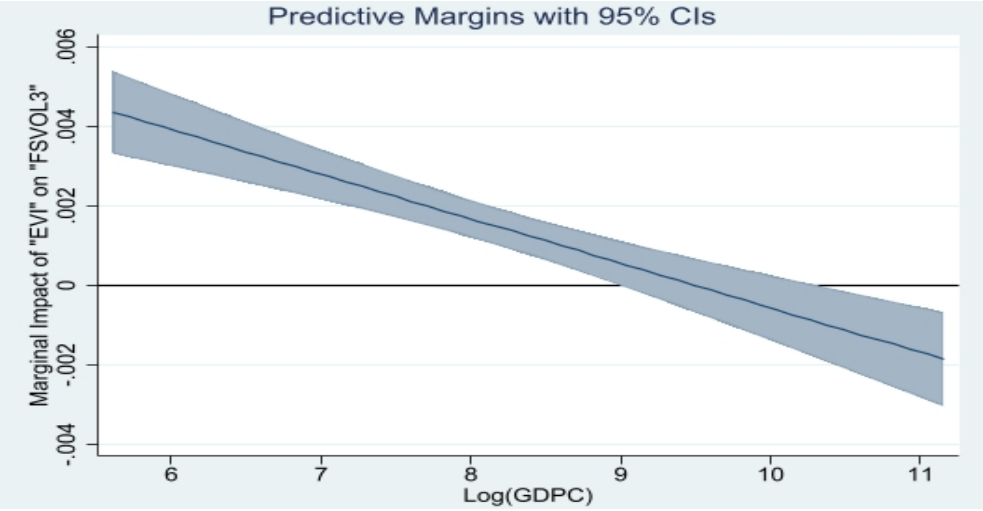

FIGURE 5. MARGINAL IMPACTS OF "*EVT*" ON "*FSVOL3*" FOR VARYING LEVELS OF REAL PER CAPITA INCOME

Note: The variable "Log(*GDPC*)" is considered at year *t*-3.

Source: Author.

"10.2649" are obtained when constructing Figure 5 using the software Stata. They represent respectively the minimum and maximum values of the variable "Log(*GDPC*)" at which the marginal impact of structural economic vulnerability on fiscal space volatility becomes statistically nil at the 95% confidence interval. Finally, for countries whose real per capita incomes exceed US$ 28707.1, the effect of structural economic vulnerability on fiscal space volatility is negative, and the higher the real per capita income is (i.e., above US$ 28707.1), the greater the magnitude is of the negative effect of structural economic vulnerability on fiscal space volatility. This latter outcome suggests that more advanced developing countries are better equipped (for example in terms of financial and human capital resources, as well as capital stock) than relatively less advanced countries (including LDCs) to cope with the adverse economic and social effects of structural economic vulnerability that would translate into greater fiscal space volatility.

We now consider the outcomes reported in Table 3. To recall, these outcomes serve primarily to test the hypothesis 3 set out in section 2, that is, to examine the extent to which productive capacities affect fiscal space volatility for varying degrees of structural economic vulnerability. It appears from this table that the coefficients of the variables "PCI_{t-3}" and "$[PCI_{t-3}]$*$[EVI_{t-3}]$" are negative and significant at the 1% level. These estimates suggest that productive capacities always influence negatively and significantly fiscal space volatility, regardless of the degree of structural economic vulnerability. In addition, the higher the level of structural economic vulnerability is, the greater is the magnitude of the negative effect of productive capacities on fiscal space volatility. These findings are confirmed in Figure 6, which presents, at 95% confidence intervals, the marginal impact of productive capacities on fiscal space volatility, conditioned on the degree of structural economic vulnerability. It appears from this figure that this marginal

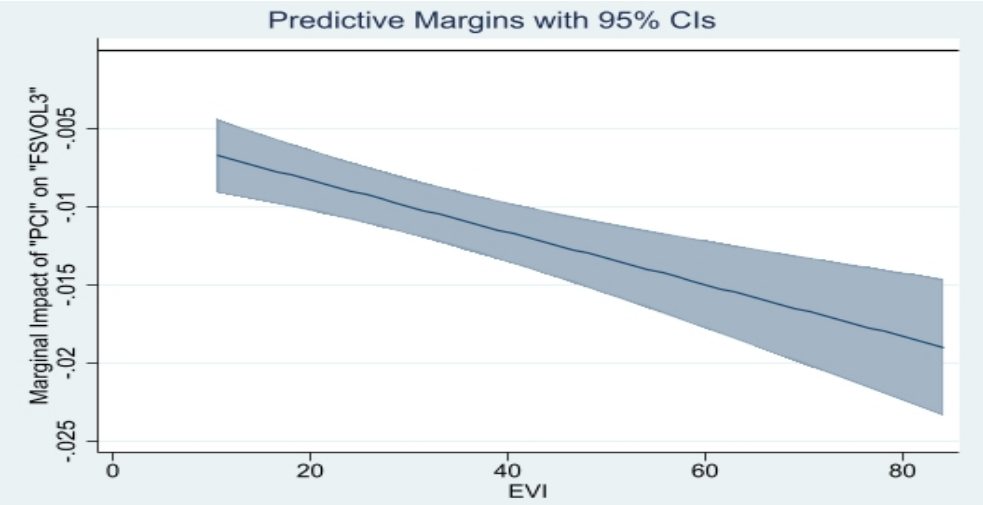

FIGURE 6. MARGINAL IMPACTS OF "*PCI*" ON "*FSVOL3*" FOR VARYING DEGREES OF STRUCTURAL ECONOMIC VULNERABILITY

Note: The variable "*EVI*" is considered at year *t*-3.

Source: Author.

impact is always negative and significant and that it decreases as the level of structural economic vulnerability rises.

The key message conveyed by the outcomes reported in Table 3 (along with Figure 6) is that productive capacities exert a stronger negative effect on fiscal space volatility in countries that face a higher degree of structural economic vulnerability than in counties with a relatively low level of structural economic vulnerability. **These findings confirm hypothesis 3**.

Finally, we take up the results in Table 4 regarding the robustness of the outcomes in column [1] of Tables 1 and 3. We note from columns [1] and [3] of Table 4 that over the full sample, productive capacities exert a negative and significant effect (at the 1% level) on fiscal space volatility, while structural economic vulnerability exerts a positive and significant effect (also at the 1% level) on fiscal space volatility. These findings confirm hypotheses 1 and 2 and align with those obtained in column [1] of Table 1. Interestingly, the magnitudes of these effects are higher in terms of absolute values for "*FSVOL5*" than for "*FSVOL4*," and then for "*FSVOL3*."

Furthermore, in both columns [2] and [4] of Table 4, we obtain findings that align with those in Table 3. Specifically, we find that the coefficients of the variables "PCI_{t-4}" and "$[PCI_{t-4}]$*$[EVI_{t-4}]$" are all negative and significant at the 1% level, as shown in column [2] of Table 4. Similarly, the estimates associated with the variables "PCI_{t-5}" and "$[PCI_{t-5}]$*$[EVI_{t-5}]$" are also all negative and significant at the 1% level, as shown in column [4] of Table 4. We therefore reach conclusions identical to those derived from Table 3, whereby productive capacities always influence negatively and significantly fiscal space volatility, with the magnitude of this negative effect increasing as the degree of structural economic vulnerability rises. Figures 7 and 8 confirm these findings. These two figures present at 95%

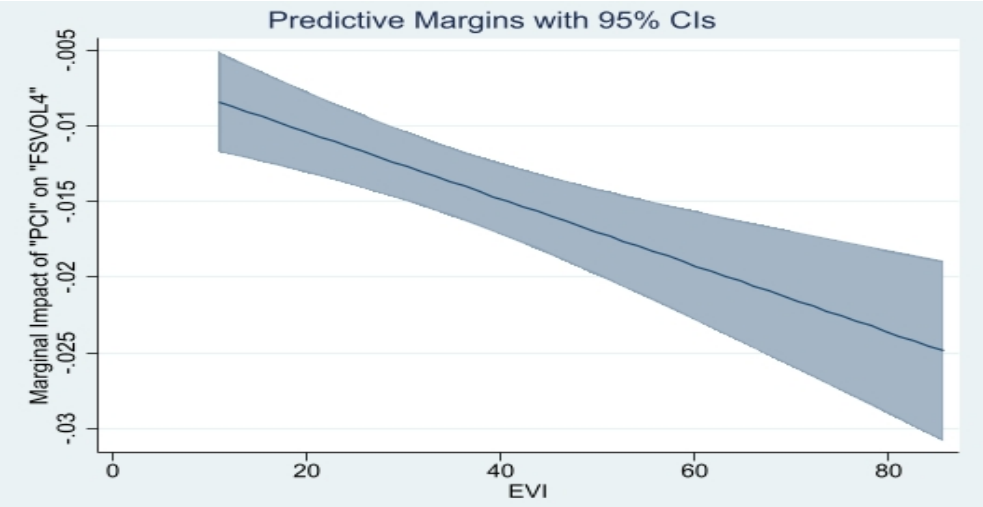

FIGURE 7. MARGINAL IMPACTS OF "*PCI*" ON "*FSVOL4*" FOR VARYING DEGREES OF STRUCTURAL ECONOMIC VULNERABILITY

Note: The variable "*EVI*" is considered at year *t*-4.

Source: Author.

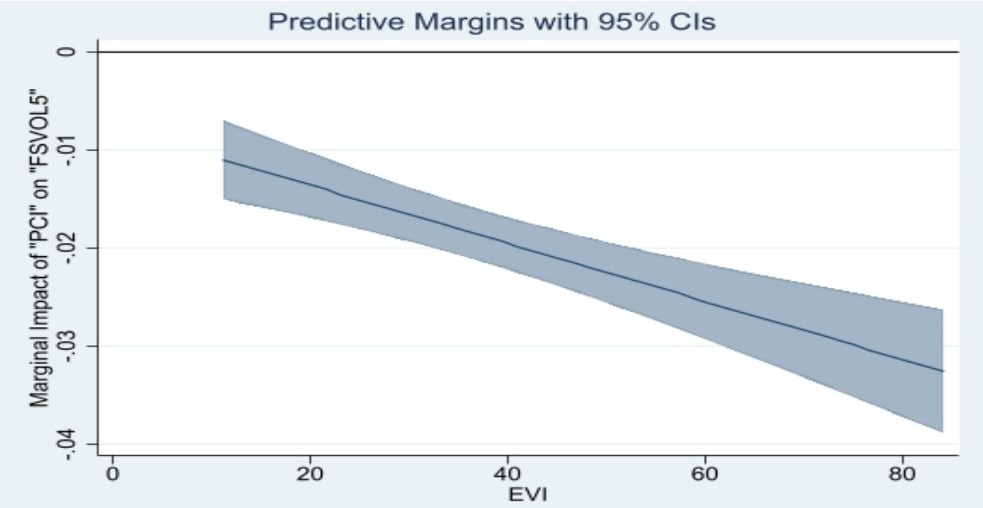

FIGURE 8. MARGINAL IMPACTS OF "*PCI*" ON "*FSVOL5*" FOR VARYING DEGREES OF STRUCTURAL ECONOMIC VULNERABILITY

Note: The variable "*EVI*" is considered at year *t*-5.

Source: Author.

confidence intervals the marginal impact of productive capacities respectively on fiscal space volatility indicators FSVOL4 and FSVOL5, conditioned on the degree of structural economic vulnerability. In both figures, the marginal impact of productive capacities respectively on fiscal space volatility is always negative and significant, and decreases as the degree of structural economic vulnerability rises. In

other words, highly structurally vulnerable countries tend to experience a stronger negative effect of productive capacities on fiscal space volatility than relatively less structurally vulnerable countries.

V. Conclusion

This article investigated the effects of productive capacities and structural economic vulnerability on fiscal space volatility in developing countries using a panel dataset of 116 countries over the period of 2000 to 2018. The results indicate that the development of productive capacities is associated with lower fiscal space volatility, while higher structural economic vulnerability is associated with greater fiscal space volatility. While the strengthening of productive capacities exerts a stronger negative effect on fiscal space volatility in non-LDCs than in LDCs, the increase in structural economic vulnerability induces greater fiscal space volatility in LDCs than in non-LDCs. The analysis of the extent to which the effects of productive capacities and structural economic vulnerability on fiscal space volatility vary across countries in the full sample provides a better picture of these effects. We found that regardless of countries' real per capita income, the development of productive capacities is always associated with lower fiscal space volatility. However, the lower the real per capita income is, the higher the magnitude of the negative effect of productive capacities on fiscal space volatility becomes. These findings do not contradict those observed over LDCs versus non-LDCs, as the latter represent average effects over each of these sub-samples while the former are marginal effects for varying levels of real per capita income. We also find that for less developed countries, i.e., those whose real per capita incomes are lower than US$ 8481.25 (this set of countries includes LDCs), structural economic vulnerability enhances fiscal space volatility, while countries whose real per capita incomes are higher than US$ 28707.1 tend to experience a negative effect of structural economic vulnerability on fiscal space volatility.

Finally, the analysis reveals that highly structurally vulnerable countries tend to experience a stronger negative effect of productive capacities on fiscal space volatility than relatively less structurally vulnerable countries.

From a policy perspective, these findings have shown that if highly vulnerable countries are to reduce their fiscal space volatility, they need to foster their productive capacities. Strengthening productive capacities in developing countries would surely require efforts by both national policymakers and international institutions, in a coordinated manner.

We recognize that the concept of "fiscal space" and hence that of "fiscal space volatility" are complex and difficult to measure. The present study aims to shed the first light on the effect of productive capacities and structural economic vulnerability on fiscal space volatility by relying on a simple measure of fiscal space. An avenue for future research could involve using other possible indicators of fiscal space (and hence of fiscal space volatility) and eventually other indicators of productive capacities to conduct such an analysis.

APPENDIX

TABLE A1—DEFINITIONS AND SOURCES OF VARIABLES

Variables	Definition	Source
FSVOL3	This is the indicator the fiscal space volatility computed over three-year rolling windows. To compute this indicator, first we compute an index of fiscal space. The indicator of the fiscal space is measured by the ratio of total public revenue (including grants and social contributions) to total public debt. The index of fiscal space volatility is computed as the ratio of the standard deviation of the indicator of fiscal space (over three-year rolling windows, that is, from t-2 to t) to the mean of the indicator of fiscal space over three-year rolling-windows. Higher values of the indicator of fiscal space volatility reflect greater volatility of fiscal space.	The indicator of fiscal space was computed by the author using data on total government public debt extracted from the World Economic Outlook, October 2020. Data on public revenue are extracted from the UNU-WIDER Public Revenue Dataset. See online: https://www.wider.unu.edu/project/government-revenue-dataset (Access date: 8 December 2021). The indicator of fiscal space volatility was computed by the author using data concerning the indicator of fiscal space.
FSVOL4	This is the indicator the fiscal space volatility over four-year rolling windows. It is computed as the ratio of the standard deviation of the indicator of fiscal space (over four-year rolling windows, that is, from t-3 to t) to the mean of the indicator of fiscal space over four-year rolling-windows. Higher values of this indicator of fiscal space volatility reflect greater volatility of fiscal space.	Author's computation using data on the indicator of fiscal space whose computation is described above.
FSVOL5	This is the indicator the fiscal space volatility over five-year rolling windows. It is computed as the ratio of the standard deviation of the indicator of fiscal space (over five-year rolling windows, that is, from t-5 to t) to the mean of the indicator of fiscal space over five-year rolling-windows. Higher values of this indicator of fiscal space volatility reflect greater volatility of fiscal space.	Author's computation using data on the indicator of fiscal space whose computation is described above.
PCI	This is the overall productive capacity index. It measures the level of productive capacities along three pillars: "the productive resources, entrepreneurial capabilities and production linkages which together determine the capacity of a country to produce goods and services and enable it to grow and develop" (UNCTAD, 2006). It is computed as a geometric average of the following eight domains or categories: information communication and technologies, structural change, natural capital, human capital, energy, transport, the private sector and institutions. Each category index is obtained using the principal components extracted from the underlying indicators, weighted by their capacity to explain the variance of the original data. The category indices are normalized into 0-100 intervals (see UNCTAD, 2020).	United Nations Conference on Trade and Development (UNCTAD) Statistics portal: https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en (Access date: 8 December 2021).

TABLE A1—DEFINITIONS AND SOURCES OF VARIABLES (CONT'D)

Variables	Definition	Source
EVI	This is the measure of countries' levels of structural economic vulnerability. The EVI indicator is referred to as the Economic Vulnerability Index. It was established at the United Nations by the Committee for Development Policy (CDP) and is used by the latter as one of the criteria for identifying LDCs. It is 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 is computed as the simple arithmetic average of two sub-indexes, the intensity of exposure to shocks (exposure sub-index) and the intensity of exogenous shocks (shocks sub-index). These two sub-indexes are calculated using a weighted average of different component indexes, with the sum of the components' weights equal to 1 so that the values of EVI range from 0 to 100. The exposure sub-index has five component indexes, and the shocks sub-index has three component indexes. The five component indexes of the exposure sub-index (with their weights in brackets) are as follows: population size (25%); remoteness from world markets (25%); exports concentration (12.5%); share of agriculture, forestry and fishery in GDP (12.5%); and the share of population living in low elevated coastal zones (25%). The three component indexes of the shocks sub-index (with their weights in brackets) are as follows: victims of natural disasters (25%), instability in agricultural production (25%), and instability in the exports of goods and services (50%). A rise in the EVI values indicates greater structural economic vulnerability. For further details on the computation of the EVI, see for example Feindouno and Goujon (2016).	Data on EVI are extracted from the database of the Fondation pour les Etudes et Recherches sur le Developpement International (FERDI) - see online at: https://ferdi.fr/donnees/un-indicateur-de-vulnerabilite-economique-evi-retrospectif (Access date: 8 December 2021).
GDPC	Per capita gross domestic product (constant 2010 US$).	World Bank Indicators (WDI)
OPEN	This is the indicator of trade openness. It is the share of the sum of exports and imports of goods and services in GDP adjusted by the proportion of a country's trade level relative to the average world trade (see Squalli and Wilson, 2011, p.1758).	Author's calculation using data on exports and imports of goods and services from WDI.
INFLVOL3	This is the index of inflation volatility over three-year rolling windows. It is computed as the ratio of the standard deviation of the indicator of the inflation rate (over three-year rolling windows, that is, from t-2 to t) to the mean of the indicator of the inflation rate over three-year rolling-windows. Higher values of this indicator of inflation volatility reflect greater volatility of the inflation rate.	Author's calculation based on inflation rate data extracted from WDI.
INFLVOL4	This is the index of inflation volatility over four-year rolling windows. It has been computed as the ratio of the standard deviation of the indicator of the inflation rate (over four-year rolling windows, that is, from t-3 to t) to the mean of the indicator of the inflation rate over four-year rolling-windows. Higher values of this indicator of inflation volatility reflect greater volatility of the inflation rate.	Author's calculation based on inflation rate data extracted from WDI.
INFLVOL5	This is the index of inflation volatility over five-year rolling windows. It is computed as the ratio of the standard deviation of the indicator of the inflation rate (over five-year rolling windows, that is, from t-4 to t) to the mean of the indicator of the inflation rate over five-year rolling-windows. Higher values of this indicator of inflation volatility reflect greater volatility of the inflation rate.	Author's calculation based on inflation rate data extracted from the WDI.

TABLE A2—DESCRIPTIVE STATISTICS OF THE VARIABLES USED IN THE MODEL OF FISCAL SPACE VOLATILITY

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
FSVOL3	1,526	0.156	0.163	0.001	1.717
FSVOL4	1,526	0.190	0.185	0.001	1.984
FSVOL5	1,526	0.218	0.204	0.007	2.218
PCI	1,523	27.539	6.052	12.577	45.210
EVI	1,526	33.930	12.465	8.347	84.313
GDPC	1,523	6564.637	10482.740	282.647	69679.090
OPEN	1,501	0.0027	0.00997	3.03e-09	0.0946
INFLVOL3	1,526	0.484	4.297	-90.427	28.492
INFLVOL4	1,526	0.415	15.376	-541.897	215.961
INFLVOL5	1,526	0.464	6.719	-247.732	10.641

TABLE A3—LISTINGS OF THE 116 COUNTRIES CONTAINED IN THE FULL SAMPLE AND THE 38 COUNTRIES IN THE SUB-SAMPLE OF LDCS

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

References

Afonso, A. and D. Furceri. 2010. "Government size, composition, volatility and economic growth," *European Journal of Political Economy*, 26(4): 517-532.

Afonso, A. and J. T. Jalles. 2012. "Fiscal volatility, financial crises, and growth," *Applied Economics Letters*, 20(1): 1821-1826.

Aizenman, J. and Y. Jinjarak. 2010. "De facto Fiscal Space and Fiscal Stimulus: Definition and Assessment," NBER Working Paper No. 16539, Cambridge, MA.

Aizenman, J. and Y. Jinjarak. 2011. "The Fiscal Stimulus of 2009-10: Trade Openness, Fiscal Space and Exchange Rate Adjustment," NBER Working Paper 17427.

Aizenman, J., Y. Jinjarak, Hien Thi Kim Nguyen, and D. Park. 2019. "Fiscal space and government-spending and tax-rate cyclicality patterns: A cross-country comparison, 1960-2016," *Journal of Macroeconomics*, 60: 229-252.

Akcigit, U. and M. J. Melitz. 2022. "International Trade and Innovation," Chapter 6 in G. Gopinath, E. Helpman, and K. Rogoff (eds.) *Handbook of International Economics*, 5: 377-404.

Bai, J., S. H. Choi, and Y. Liao. 2021. "Feasible generalized least squares for panel data with cross-sectional and serial correlations," *Empirical Economics*, 60: 309-326.

Barrot, L. D., C. Calderón, and L. Servén. 2018. "Openness, specialization, and the external vulnerability of developing countries," *Journal of Development Economics*, 134: 310-328.

Bleaney, M., N. Gemmell, and D. Greenaway. 1995. "Tax revenue instability, with particular reference to Sub-Saharan Africa," *Journal of Development Studies*, 31: 883-902.

Botev, J., J. Fournier, and A. Mourougane. 2016. *A Re-assessment of Fiscal Space in OECD Countries*, OECD Economics Department Working Papers, No. 1352, OECD Publishing, Paris.

Botta, A., G. Porcile, D. Spinola, and G. T. Yajima. 2023. "Financial integration, productive development and fiscal policy space in developing countries," *Structural Change and Economic Dynamics*, 66: 175-188.

Briguglio, L., G. Cordina, N. Farrugia, and S. Vella. 2009. "Economic Vulnerability and Resilience: Concepts and Measurements," *Oxford Development Studies*, 37(3): 229-247.

Cappelli, R., F. Montobbio, and A. Morrison. 2021. "Unemployment resistance across EU regions: The role of technological and human capital," *Journal of Evolutionary Economics*, 31: 147-78.

Cheng, H. W. J. and I. Pitterle. 2018. *Towards a more comprehensive assessment of fiscal space*, DESA Working Paper No. 153, ST/ESA/2018/DWP/153. United Nations Department of Economic & Social Affairs, New York.

Cornia, G.A. and A. Scognamillo. 2016. *Clusters of Least-developed Countries, their evolution between 1993 and 2013, and policies to expand their productive capacity,* CDP Background Paper No. 33, ST/ESA/2016/CDP/33. United Nations Department of Economics and Social Affairs, New York, N.Y., USA.

Dabla-Norris, E., and Y. B. Gündüz. 2014. "Exogenous Shocks and Growth Crises in Low-Income Countries: A Vulnerability Index," *World Development*, 59: 360-378.

Ebeke, C. and H. Ehrhart. 2012. "Tax Revenue Instability in Sub-Saharan Africa: Consequences and Remedies," *Journal of African Economies*, 21(1): 1-27.

Essers, D. 2013. "Developing country vulnerability in light of the global financial crisis: Shock therapy?" *Review of Development Finance*, 3(2): 61-83.

Fatás, A. and I. Mihov. 2013. "Policy Volatility, Institutions, and Economic Growth," *The Review of Economics and Statistics*, 95(2): 362-376.

Feindouno, S. and M. Goujon. 2016. "The retrospective economic vulnerability index," 2015 update. Working paper n°147, Fondation pour les Etudes et Recherches sur le Developpement International (FERDI), Clermont-Ferrand, France.

Fernández-Villaverde, J., P. Guerrón-Quintana, K. Kuester, and J. Rubio-Ramírez. 2015. "Fiscal volatility shocks and economic activity," *American Economic Review*, 105(11): 3352-3384.

Gnangnon, S. K. 2018. "Export Product Concentration and De Facto Fiscal Space: Does Openness to International Trade matter?" *Global Economy Journal, De Gruyter*, 18(1): 1-12.

Gnangnon, S. K. 2019a. "De Facto Fiscal Space in Donor-countries and Their Aid Supply: To What Extent is Trade-related Aid Supply Affected?" *South Asian Journal of Macroeconomics and Public Finance*, 8(1): 11-25.

Gnangnon, S. K. 2019b. "Fiscal Space for Trade: How Could the International Trade Community Help?" *Journal of International Commerce, Economics and Policy*, 10(1): 1-42.

Gnangnon, S. K. 2020a. "Remittances Inflows and Fiscal Space in Receiving Countries," *Remittances Review*, 5(2): 115-141.

Gnangnon, S. K. 2020b. "Export Product Diversification and Fiscal Space Volatility in Developing Countries: Exploring the Economic Growth Volatility Channel," *Economics Bulletin*, 40(3): 1837-1854.

Gnangnon, S. K. 2021. "Productive Capacities, Economic Growth and Economic Growth Volatility in Developing Countries: Does Structural Economic Vulnerability Matter?" *Journal of International Commerce, Economics and Policy* (Accessible online at: https://doi.org/10.1142/S1793993325500012).

Gnangnon, S. K. 2022. "Effect of Productive Capacities on Economic Resilience in Developing Countries," *Asian Development Perspectives*, 13(1): 1-35.

Gnangnon, S. K. and J. F. Brun. 2019. "Tax Reform and Public Revenue Instability in Developing Countries: Does the Volatility of Development Aid Matter?" *Journal of International Development*, 31(8): 764-785.

Gnangnon, S. K. and J. F. Brun. 2020. "Tax reform and fiscal space in developing countries," *Eurasian Economic Review*, 10: 237-265.

Grossman, G. and E. Helpman. 1995. "Technology and Trade," in Gene Grossman and Kenneth Rogoff (eds.), *Handbook of International Economics*, 3: 1279-1337.

Guillaumont, P. 2009. "An Economic Vulnerability Index: Its Design and Use for International Development Policy," *Oxford Development Studies*, 37(3): 193-228.

Guillaumont, P. 2017. "Vulnerability and Resilience: A Conceptual Framework Applied to Three Asian Countries - Bhutan, Maldives, and Nepal," ADB South Asia Working Paper No. 53, Asian Development Bank, Philippines.

Harjoto, M. A., F. Rossi, R. Lee, and B. S. Sergi. 2020. "How do equity markets react to COVID-19? Evidence from emerging and developed countries," *Journal of Economics and Business*, Available online 3 December 2020, 105966 (https://doi.org/10.1016/j.jeconbus.2020.105966).

Heller, P. 2005. "Understanding Fiscal Space," IMF Policy Discussion Paper No. PDP/05/4. International Monetary Fund, Washington, DC.

Keefe, H. G. 2021. "The transmission of global monetary and credit shocks on exchange market pressure in emerging markets and developing economies," *Journal of International Financial Markets, Institutions and Money*, 72, 101320 (https://doi.org/10.1016/j.intfin.2021.101320).

Lee, I. H. 2018. "Industrial output fluctuations in developing countries: General equilibrium consequences of agricultural productivity shocks," *European Economic Review*, 102: 240-279.

Matos, S., E. Viardot, B. K. Sovacool, F. W. Geels, and Y. Xiong. 2022. "Innovation and climate change: A review and introduction to the special issue," *Technovation*, 117, 102612.

Melitz, M. J. and S. J. Redding. 2022. "Trade and Innovation," NBER Working Paper 28945, National Bureau of Economic Research, Cambridge, MA 02138, United States (http://www.nber.org/papers/w28945).

Montalbano, P. 2011. "Trade Openness and Developing Countries' Vulnerability: Concepts, Misconceptions, and Directions for Research," *World Development*, 39(9), 1489-1502.

Morrissey, O., C. Von Haldenwang, A. Von Schiller, M. Ivanyna, and I. Bordon. 2016. "Tax revenue performance and vulnerability in developing countries," *Journal of Development Studies*, 52(12), 1689-1703.

Nerlich, C. and W. H. Reuter. 2016. "Fiscal Rules, Fiscal Space, and the Procyclicality of Fiscal Policy," *FinanzArchiv: Public Finance Analysis*, 72(4): 421-452.

Paunov, C. and S. Planes-Satorra. 2021. "Science, Technology and Innovation in the Time of COVID-19," OECD Science, Technology and Industry Policy Papers, No. 99. Paris: OECD.

Roy, R., A. Heuty, and E. Letouzé. 2007. "Fiscal Space for What? Analytical Issues from a

Human Development perspective," Paper prepared for the G20-Workshop on Fiscal Policy, June-July 2007, UNDP, New York.

Schick, A. 2009. "Budgeting for Fiscal Space," *OECD Journal on Budgeting*, 9(2) (http://www.oecd.org/gov/budgetingandpublicexpenditures/45361746.pdf).

Shiferaw, A. 2017. "Productive Capacity and Economic Growth in Ethiopia," CDP Background Paper No. 34, ST/ESA/2017/CDP/34. United Nations, Department of Economics and Social Affairs, New York, N.Y., USA.

Shu, P. and C. Steinwender. 2018. "The Impact of Trade Liberalization on Firm Productivity and Innovation," *Innovation Policy and the Economy*, 19: 39-68.

Squalli, J. and K. Wilson. 2011. "A New Measure of Trade Openness," *The World Economy*, 34(10), 1745-1770.

UN. 2017. "Expanding Productive Capacity - Lessons Learned from Graduating Least Developed Countries," Committee for Development Policy, United Nations publication, Sales No.: E.18.II.C.3, 59 pages.

UNCTAD. 2006. *The Least Developed Countries Report 2006: Developing Productive Capacities*, United Nations publication. Sales No. E.06.II.D.9. New York and Geneva.

UNCTAD. 2020. *The Least Developed Countries Report 2020: Productive Capacities for the New Decade*, United Nations publication. Sales No. E.21.II.D.2 New York and Geneva.

UNIDO. 2001. "Building Productive Capacity for Poverty Alleviation in Least Developed Countries (LDCs) - The Role of Industry," United Nations Industrial Development Organization, Vienna (https://www.unido.org/sites/default/files/2006-10/ldciii08_0.pdf).

Zellner, A. 1962. "An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias," *Journal of the American Statistical Association*, 57(298), 348-368.