

Effect of Productive Capacities on Economic Resilience in Developing Countries

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COVID-19 has generated renewed interest in strengthening economic resilience to future shocks. Developing countries are disproportionately affected by adverse shocks and lack the resources to weather them. This paper contributes to this debate by investigating the effect of productive capacities on economic resilience in a panel dataset of 118 developing countries over the period 2000-2018. It constructs a regression-based economic resilience indicator, and makes use of the indicator of productive capacities recently developed by the UNCTAD. The development of productive capacities is associated with greater economic resilience. This is particularly the case for countries with greater trade openness, greater capital account openness, and those that promote a stable macroeconomic environment. Interestingly, development aid appears to matter for the effect of productive capacities on economic resilience. On the one hand, the magnitude of the positive economic resilience effect of productive capacities increases as countries receive higher Aid for Trade (AfT) flows. On the other hand, NonAfT flows (i.e., other development aid flows that AfT flows) hinder the possible positive contribution of productive capacities to economic resilience. These findings have important policy implications.

Keywords: productive capacities, economic resilience, developing countries

Received May 10, 2021

Accepted January 17, 2022

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JEL Classification: D24, F35, O1

INTRODUCTION

The COVID-19 pandemic has renewed interest in how countries recover from shocks and strengthen their economic resilience for the future (e.g., OECD, 2020; IMF, 2017, 2021). Developing countries are important in this discussion, as the frequency of shocks is much higher in developing countries (e.g., Aguiar and Gopinath, 2007; Dabla-Norris and Gündüz, 2014; Guillaumont, 2009), and they disproportionately affect developing countries (e.g., Barrot et al., 2018; Keefe, 2021; Meierrieks, 2021).

To date, factors underpinning macro-economic resilience to shocks have been mostly analysed from a regional perspective (e.g., Chacon-Hurtado et al., 2020; Bristow and Healy, 2018; Hundt and Holtermann, 2020; Martin and Sunley 2015; Martini, 2020). Studies at the national (i.e., country) level have not relied on an indicator of economic resilience, but rather assessed resilience by comparing macroeconomic performance before and after crises (e.g., Alfani et al., 2015; Barthélémy et al., 2020; Gupta et al., 2007; Hong and Tornell, 2005). The two studies that are closest in spirit to this one are Jolles et al. (2018) and Sondermann (2018). Both constructed an indicator of common shocks, which is introduced in an equation where output gap (or GDP growth) depends on a set of structural economic and financial characteristics. The interaction between the shock indicator and

variables capturing countries' structural features allow assessing countries' economic resilience. The present analysis differs in two main respects. It focuses on developing countries, and it develops an indicator of economic resilience.

To do this, we build on Guillaumont's (2009) concept of structural economic vulnerability to compute an indicator of economic resilience. This is then used to examine the effect of productive capacities. The empirical analysis utilizes a panel dataset of 118 developing countries over the period 2000-2018, and the two-step system Generalized Method of Moments (GMM). We find that greater productive capacities are associated with higher economic resilience. Additionally, the development of productive capacities contributes to strengthening economic resilience in countries that further open-up to trade and capital flows, as well as those that achieve greater macroeconomic stability (through lower inflation rates). The analysis also reveals that development aid flows also matter for the effect of productive capacities. Particularly, the magnitude of the positive effect of productive capacities on economic resilience consistently increases as countries receive higher amounts of Aid for Trade (AfT) flows. In contrast, productive capacities affect negatively economic resilience as countries receive higher Non-AfT flows.

The rest of the analysis is structured around eight sections. Section 2 discusses how productive capacities could influence economic resilience. Section 3 provides a brief discussion on the definition and assessment of economic resilience in the relevant literature. Section 4 presents the indicator of economic resilience used in the analysis. Section 5 lays out the model specification upon which we rely to conduct the empirical analysis, as well as the econometric approach used to perform this analysis. Section 6 presents the estimations' outcomes. Section 7 investigates whether countries' economic and financial features matters for the effect of productive capacities on economic resilience. Section 8 undertakes a further analysis by exploring whether development aid flows that accrue to developing countries matter for the effect of productive capacities on economic resilience. Section 9 concludes.

PRODUCTIVE CAPACITIES AND ECONOMIC RESILIENCE

According to UNCTAD (2006: 61, 2020), productive capacities are “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”. The indicator UNCTAD built based this definition covers eight areas: human capital; physical capital (energy infrastructure; transport infrastructure; information and communication technology, i.e., ICT); private sector; institutions; structural change in production and natural resources (UNCTAD, 2020). Discussing how the overall productive capacities could influence economic resilience entails discussing each of these components.

Human Capital

A brief literature review shows we can expect the development of human capital to contribute to improving economic resilience. Briguglio et al. (2009) argue that human capital development through educational advancement and better health, improve a country's ability to withstand external shocks, and improve economic resilience. Mirza et al. (2020) underlined the critical role played by human capital efficiency in financial services like funds management during high turbulence times, such as the COVID-19 pandemic. They found that equity funds (performance in these funds is driven by investment strategies devised by the portfolio managers) featured by higher human capital efficiency significantly outperformed those with lower levels of human capital efficiency. The authors concluded that equity funds should enhance their human capital efficiency to endure resilience amid macroeconomic shocks. Pereira et al. (2020) looked at business clusters in pre-recession (2005-2007) and recession (2008-2009) periods, and obtained that human capital played a leading role in ensuring the success of organizations in a business cluster during the crisis. Cappelli et al. (2021) explored, for 248 European Union regions, the role played by technological resilience in economic resilience to the 2008 crisis. Their findings suggest a strong

positive effect of technological resistance (that is, past ability of regions to sustain the production of knowledge) on the capacity of regional economic system (in term of unemployment rates) to resist to the 2008 crisis. Only in combination with the ability to re-orient innovative resources and technologies was human capital able to shape a new growth path. According to Bowen et al. (2012), investment in skills and access to finance reduce vulnerability to climate change. Mayunga (2007) has stressed that human capital enhances the capacity to develop and implement an effective risk reduction strategy, and thereby increase resilience to climate change. Other recent studies have also demonstrated empirically that human capital development is essential for ensuring greater economic resilience (e.g., Lagravinese, 2015; Martini, 2020).

Physical Infrastructure

The literature has emphasized the critical importance of hard infrastructures (energy, transport), in particular their structure and quality, for the building-up and strengthening of resilience to economic and financial shocks as well as natural disasters (e.g., Berche et al., 2009; Di Caro and Fratesi, 2018; United Nations, 2016). Fried and Lagakos (2021) found that rural electrification facilitated structural transformation of villages economies in Ethiopia. Chacon-Hurtado et al. (2020) found that rail density, access to intermodal services, and access to local and regional markets have exerted a positive effect on regional performance (measured as competitive effect) during the 2008 US recession, concluding that transportation infrastructure was critical in determining resilience.

By promoting economic transformation, infrastructure can dampen output volatility (e.g., Moro, 2015), and hence be associated with greater economic resilience. In addition, economic transformation creates job opportunities and decent jobs, as well as high productivity gains, notably in poor countries (e.g., Diao et al., 2018; McMillan et al., 2014), which could help recovery following negative shocks. Jiya et al. (2020) demonstrated that energy and telecommunication related infrastructure is critical to achieve economic transformation.

The effect of ICT on economic resilience can take place through the innovation channel. On the one hand, countries that have endeavoured to develop ICTs have enjoyed a higher innovation performance than countries with lower levels (e.g., Bas, 2020; Higón, 2012; Paunov and Rollo, 2016). For example, Bas (2020) has demonstrated that communication and energy-services liberalization enhance investment in Research and Development (R&D) and exert a strong positive effect on innovation, including manufacturing firms' innovation.

On the other hand, innovation has been instrumental in promoting economic resilience.¹ For example, Tambo and Wünscher (2017) found that innovations have contributed significantly to enhancing the resilience to climate shocks of northern Ghana's rural farm households that adopted externally driven technologies to develop their very own innovations. Bristow and Healy (2018) have obtained that the European regions that were leaders in innovation at the time of the 2007 to 2008 economic crisis were significantly more likely to have either resisted the crisis or recovered quickly from it. The current COVID-19 pandemic has further demonstrated how technology-driven innovation can lessen the impact of shocks (e.g., Farrugia and Plutowski, 2021; Paunov and Planes-Satorra, 2021).

Overall, we expect that the development of ICT would contribute to enhancing economic resilience through greater innovation performance.

Private Sector Development

A strong private sector reflects competitive and well-functioning product markets. Factors that can affect the degree of competition in product markets include barriers to entrepreneurship, barriers to trade and investment,

¹Bahadur and Doczi (2016) have provided an extensive discussion on how innovation and autonomous innovation can help communities reduce risk and enhance resilience to shocks.

as well as state control (e.g., Jolles et al., 2018; Seidu and Maciej, 2020). A well-developed private sector may signal market efficiency at the microeconomic level. In this case, the private sector would allow for the markets to adjust to shocks (e.g., Briguglio et al., 2009). Sánchez et al. (2016) have highlighted some possible channels through which pro-competitive product market regulations can enhance resilience. These include price and wage flexibility, including by limiting the oligopolistic behaviour of firms and disciplining mark-ups (Canova et al., 2012), resources reallocation, and innovation. For example, Geroski (1992) has shown that enhancing competition among industries allows for a fast response of prices to both supply and demand shocks. According to Álvarez and Hernando (2007), product market regulations that encourage competition, make prices more flexible, and allow firms in more competitive markets to adjust quickly prices in response to demand and supply shocks.

Flexible product markets contribute to a better improvement of the labour market functioning by speeding the pace of adjustment (e.g., Bassanini and Duval, 2007). Andrews and Saia (2017) have shown that the conditions associated with entrepreneurship framework influence directly the entry and exit of firms, and therefore affect the reallocation of resources during recovery after negative shocks. According to Anderton et al. (2020), policies that enhance competition in product markets facilitate business churning. As for the resources reallocation avenue, pro-competitive product market regulations allow for easier entry and exit from the market. In turn, this could help dampen the impact and speed up the recovery from shocks by enabling a quicker and more efficient reallocation of resources within and across sectors and firms (e.g., Sánchez et al., 2016). Lastly, pro-competitive product market regulations can provide strong incentives to firms to innovate when faced by an adverse shock. It is worth noting that the relationship between competition and innovation performance takes a curvilinear form, i.e., the form² of an inverted-U. Sondermann (2018) has found, *inter alia*, that sound labor and product markets, and conditions for doing business improve the resilience of the euro area towards adverse shocks. Also, countries with weak labour and product markets, and unfavourable business environments can, on average, suffer up to twice the output loss. Aarstad and Kvitastein (2021) found that better access to resources released in affected regions (associated with increased competition) allows enterprises that were not innovative previously to exhibit a strong innovation performance after an unexpected external shock. Finally, a high degree of product market competition facilitates the transmission of monetary and fiscal impulses, including after adverse shocks (e.g., Aghion et al., 2019; Duval and Furceri, 2018).

Against this background, we can expect that the development of the private sector to associate with greater economic resilience.

Institutional and Governance Quality

According to Acemoglu et al. (2003), a weak institutional quality exposes a country to higher levels of social unrest, disrupting growth, and hence limits significantly its ability to cope in an appropriate manner external economic shocks. They also argue that institutions are in a constant state of flux, even though past institutional choices may affect their trajectory. It may also be possible to design them to bolster economic stability.

Farrugia (2007) have argued that in light of their high exposure to external shocks, small island states should set-up institutions that promote economic resilience. Sound institutions promote macroeconomic and financial stability (e.g., Thorbecke and Pangestu, 1998; Bermpei et al., 2018). In addition, by allowing wages adjustment to changes in macroeconomic conditions, coordinated collective-bargaining institutions would exert a positive effect on economic resilience (e.g., Bassanini and Duval, 2007). In the same vein, Zeev and Ifergane (2022) have found that firing restrictions reduce economic resilience in OECD countries. According to OECD (2017),

²See for example, Aghion et al. (2005) and Aghion et al. (2015) who have built upon the seminal works of Arrow (1962) and (Schumpeter, 1994[1942]).

enhancing long term economic resilience requires the strengthening of pension and health systems to manage population aging. More generally, countries should reform social institutions to adjust gradually to secular changes (Fall et al., 2014). Stronger public administrations improve countries' ability to implement good quality policies, and solve coordination failures (e.g., OECD, 2017). Moreover, Olander (2019) has shown that a greater economic diversification reduces collusion among elites, and forces them to settle more impartial institutions. Hence, economic resilience is likely to be weaker in countries that specialize in less sophisticated goods (as in such countries, institutions would be weak) than in countries that produce sophisticated goods and services. Finally, by helping to mitigate the volatility of output (e.g., Balavac and Pugh, 2016), improved institutional quality can contribute to building greater economic resilience. Jolles et al. (2018) have found empirically that good governance exerts a positive effect on the economy's recovery capacity, but weakens the economy's absorption capacity. Overall, we can expect a better institutional quality to be associated with a greater economic resilience.

Structural Change in Production

According to Herrendorf et al. (2014: 857), structural change³ in the production of an economy is defined in a narrow sense as a reallocation of economic activity across three broad sectors (agriculture, manufacturing, and services) that accompanies the process of modern economic growth.

While some studies have examined the effect of structural change on output volatility, and therefore allow to infer on how structural change can affect economic resilience, the relationship between structural change and economic resilience has mainly been considered from a regional perspective. Davies and Tonts (2010) have argued that the greater the diversity of a region's economy (i.e., the larger its economic base), the more resilient to shocks the region is. Similarly, Martin and Sunley (2015: 26-27) postulate that a diverse economic structure should not only reduce the vulnerability of a region to shocks (a portfolio effect), but also allow it to recover more rapidly further to a shock (an innovation and market opportunity effect). It follows that a region specialized in a narrow range of activities will be both exposed to idiosyncratic sector-specific shocks, and have fewer opportunities to re-orientate its economy. Additionally, the type of specialization matters. A specialization in a sector (e.g., computer software or biotechnology) that has many implications for the region's economic resilience would be more beneficial than in a sector with fewer (e.g., steel production or heavy engineering). Briguglio et al. (2009) argue that the ability of an economy to recover from adverse shocks depends on its flexibility. Jolles et al. (2018) have postulated that the diversification of economic activity increase countries' level of flexibility in this sense. However, the authors obtained empirically that sectoral diversity in domestic production exerted a small impact on economic resilience in the euro area.

This argument, developed by Martin and Sunley (2015: 26-27), applies at the country level. We postulate that a country with a less diversified economic structure, particularly one relying on low value-added products or services, are likely to be more vulnerable, and have a weaker ability to recover. Although more resilient than a country that relies on primary commodities (with high price volatility and limited economic spillovers), a country that produces very few but highly sophisticated goods and services may also experience a low degree of economic resilience. Some studies carried out at the country level have shown that structural change is associated with lower output volatility (e.g., Moro, 2012, 2015; Ngouana, 2013; Tan et al., 2020). Moro (2012) reported a negative effect of structural change on the volatility of GDP as well as the volatility of each broad component of GDP. Furthermore, Moro (2015) has shown for example that an increase in the share of services in GDP dampens economic growth volatility. Tan et al. (2020) investigated how industrial structure affects regional economic resilience at different stages, using

³See Atolia et al. (2020) for a discussion on the potential benefits of structural transformation and the prospective future paths for structural transformation and development policies.

data on resource-based cities in China. They observed that diversification positively influenced economic resilience, whereas specialization weakened it, notably in mining cities.

Overall, we expect that a greater extent of structural change, including across many sectors of the economy, will lead to more economic resilience.

Natural Resources

Natural resource dependence or abundance can build economic resilience if resource revenues are used to create employment, develop the private sector, and transform the economy towards high value-added products (e.g., OECD et al., 2013; Muhamad et al., 2021). Alternatively, it can lower resilience through lowering levels of physical and human capital accumulated, increasing corruption, and reducing institutional and governance quality. It can be associated with the absence of policies and regulations to promote the development of the private sector, the lack of structural transformation, the absence of democracy, and greater political instability (e.g., Henri, 2019). Agüero et al. (2021) explored how natural resources affect human capital formation in a country with low quality of governance (i.e., Peru). They obtained that redistribution of mining taxes to local governments increases students learning substantially. These transfers helped to increase school expenditure and infrastructure, and to improve health outcomes of adults and children. However, the effect becomes negative for very large transfers. As a result, the distribution resource rents affects economic resilience through its effect on human capital.

Faha (2021) found that the effect of natural resources on internal conflicts depends on the type of natural resources, and might increase internal conflicts as the volume of natural resources increases. This signifies that if natural resources resulted in internal conflicts, it would erode economic resilience. Chenaf-Nicet (2020) obtained that the specialization on natural resource production by Sub-Saharan African (SSA) countries exerts a detrimental effect on structural change. It follows that a high dependence on natural resources can lead to a greater natural resource-based specialization in a country, inhibiting the process of structural change, including toward higher value-added production (see also Oyinlola et al., 2020). Overall, unless wisely utilized, natural resources could deter structural change and reduce economic resilience. Morck and Nakamura (2018) illustrated for the case of Japan that the government's attempt at initial industrialization (1880s-1930s) relied on natural resources, but failed because the state used mines to subsidize state-owned industrial firms. However, the successful post-World War II industrialization strategy relied little on natural resources and more on bank financing, as well as on free markets, openness and limited government.

Summing-up, the direction of the effect of natural resources endowment on economic resilience is *a priori* uncertain.

OUR MEASUREMENT OF ECONOMIC RESILIENCE

To assess countries' level of economic resilience, many studies at the country-level have examined the determinants of countries' economic recovery. To the best of our knowledge, there is no deep study carried out on the macroeconomic determinants of the level of overall economic resilience in a country. Even the recent work by Jolles et al. (2018) and Sondermann (2018) that have explored the macroeconomic determinants of economic resilience have not used an indicator of economic resilience as a dependent variable. Rather, the authors constructed an index of "common" shocks that affected all countries together in the euro area and then estimated an equation to assess the level of economic resilience.

The present study investigates the effect of productive capacities on economic resilience by developing an indicator of economic resilience. Inspired by Guillaumont (2017), we construct an indicator of macroeconomic resilience at the country level by regressing a measure of economic growth volatility on the index of structural economic vulnerability (EVI) (see Appendix 1 for details concerning the computation of this index). The residual

of this regression is considered as the indicator of economic resilience. The economic growth volatility indicator has been computed as the rolling window standard deviation of the economic growth rate over a three-year-window (see also Bekaert et al., 2006; Ebeke and Ehrhart, 2012; Museru et al., 2014). The real GDP growth (constant 2010 US\$) variable is collected from the World Bank Development Indicators (WDI). The estimation is performed using a panel dataset of 118 developing countries over the period 2000-2018, based on available data.

It is important to note that the regression of the volatility of the real GDP growth on EVI did not contain time dummies, as the latter were included in the model that helped to investigate the effect of productive capacities on economic resilience. This equation is primarily estimated by the two-step system Generalized Method of Moments (GMM) estimator of Blundell and Bond (1998). Utilizing this estimator involves estimating a system of equations, that is, an equation in first-differences and equation in the levels, where lagged first differences are used as instruments for the level equation, and lagged levels are used as instruments for the first-difference equation. There are three conditions for the validity of the two-step system GMM approach: the Arellano-Bond test of the presence of first-order serial correlation in the residuals of the equations in level (denoted AR(1)), the Arellano-Bond test of no second-order autocorrelation in the residual in the differenced equation (denoted AR(2)); and the Sargan/Hansen test of over-identifying restrictions (OID), the null hypothesis being here that the instruments used in the regression are jointly valid. To meet these requirements when regressing the economic growth volatility indicator on the EVI indicator, we used two lags of the dependent variable, as using only one lag of economic growth volatility indicator did not help meet the conditions associated with the consistency of the two-step system GMM estimator. We also made sure that the number of instruments is lower than the number of countries in the sample.

The usefulness of this estimator resides in its ability to help handle the possible endogeneity of the “EVI” indicator in the regression of economic growth volatility on EVI. In fact, a rise in a country’s level of EVI means that this country faces a higher degree of exposure to shocks and/or a greater intensity of shocks (either external or environmental shocks). It seems straightforward to expect that an increase in the EVI would raise domestic economic growth volatility. On the other hand, there may be a reverse causality from the economic growth volatility indicator to the indicator of EVI, because governments in countries that face a rising level of economic growth volatility because of an increasing in the EVI level may implement policies aiming at reducing the EVI level. At the same time, governments do not control all elements of the structural economic vulnerability indicator, thus reverse causality would not apply to all components. Specifically, governments have almost no control over the occurrence and frequency (and hence size) of external or environmental shocks. Additionally, not all sub-components of the exposure to shocks may be affected by the level of economic growth volatility in a given country. To recall (see Appendix1), the components of the sub-index of exposure to shocks are the population size, the remoteness from world markets, the degree of export product concentration, the share of population living in low elevated coastal zone, and the share of agriculture, forestry and fishery in GDP. Among these factors, national governments have no control over the country’s remoteness from world markets, and eventually (at least in the short run) over the population size and the share of population living in low elevated coastal zone. However, they can reduce (over the medium to long term) the share of agriculture, forestry and fishery in GDP, and influence the level of export product concentration by implementing policies that would promote the development of high value-added exportable products. Overall, the suspected reverse causality would likely run from economic growth volatility to the sub-indices capturing the share of agriculture, forestry and fishery in GDP, and the level of export product concentration in the indicator “EVI”. The two-step system GMM approach would help address this endogeneity concern.

Notwithstanding this, for a robustness check, we also used two other estimators:⁴ the within fixed effects (“FE”) with standard errors being corrected by means of the Driscoll and Kraay (1998) method, and the feasible

generalized least squares (FGLS). In so doing, we consider the variable “EVI” as weakly exogenous. The indicators of economic resilience computed based on the two-step system GMM, FE and FGLS estimators are respectively denoted “RESILGMM1”, “RESILFE1”, and “RESILFGLS1”. Lower values of each of these indices indicate greater economic resilience (as they implied lower values of output volatility), while higher values of each these indices reflect lower level of economic resilience.

Finally, it is important to emphasize that as the regression of economic growth volatility on EVI is performed in a panel data setting, the extracted indicator of economic resilience (using any of the estimators mentioned above) is an indicator of “relative” economic resilience across countries in the full sample, since the mean of the residuals equals zero. As a result, one could argue that the computed indicator of economic resilience would be sensitive to the choice of the sample. This is the case here because the indicator of “relative” economic resilience was originally computed using the whole universe of countries for which data is available, over the period 2000-2018.

Having constructed the indicator of economic resilience, we find useful to examine graphically how it has evolved over time, including comparing to the indicator of productive capacities (denoted “PCI”). As noted above, the indicator of productive capacities is developed by the UNCTAD and is the weighted index of eight components (see Appendix 1 for details on the computation of this indicator). Values of “PCI” range between 0 and 100, with higher values indicating higher levels of productive capacities.

Figure 1 presents the evolution of economic resilience and productive capacities over the full sample, and Figure 2 shows the cross-plot between these two variables over the full sample. Note that the two figures show non-overlapping sub-periods⁵ of 3-year average data for each of the three indicators of economic resilience (i.e., the one based on the two-step system GMM approach). Additionally, Figure 1 is constructed using the indicators “RESILGMM1”, “RESILFGLS1” and “RESILFE1”, while Figure 2 relies on the indicators “RESILGMM”, “RESILFGLS” and “RESILFE”,

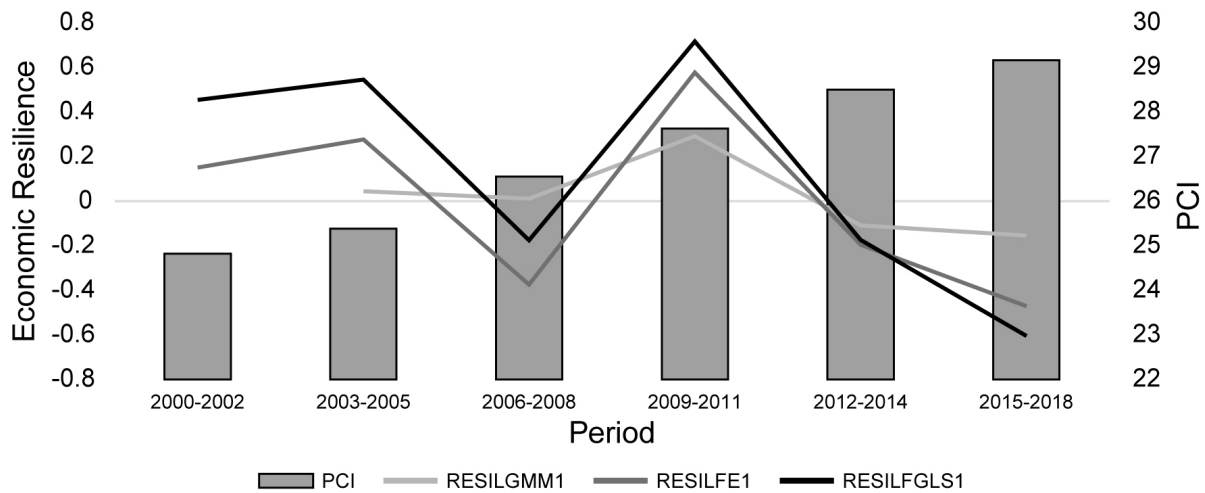


Fig. 1. Development of productive capacities and economic resilience over the full sample

Source: Author

Note: These graphs rely on the original values of the indicators of economic resilience, and not on their transformed values as described in Appendix 1.

⁴The cluster-robust Hausman test proposed by Kaiser (2015) allows choosing between a regression based on random effects or fixed effects. It shows a p-value higher than the 10% level indicating that there could be a priori a preference for one estimator over the other, although we may be inclined to opt for the random effects based estimator (here the FGLS approach) given the large dominance of the between-country variation (it amounts to 11.2 in the full sample) over the within-country variation (which amounts to 2.95).

⁵As we will see later in the analysis, these sub-periods are 2000-2002; 2003-2005; 2006-2008; 2009-2011; 2012-2014 and 2015-2018 (the latter covers 4 years).

which are the transformation of respectively “RESILGMM1”, “RESILFGLS1” and “RESILFE1” using the method of Yeyati et al. (2007) (see Appendix 1) so as to limit the skewness of the originally computed indicators.

We note from Figure 1 that the two indices of economic resilience “RESILFGLS1” and “RESILFE1” have moved in parallel over the full period. To a large extent, the main indicator “RESILGMM1” also evolved in a similar fashion, although with a lower magnitude of fluctuations.

Let us start with the development of the indicator “RESILGMM” over the period. Values of this indicator slightly declined from 0.045 in 2003-2005 to 0.01 2006-2008, which indicates that, on average, countries improved their level of economic resilience between these two sub-periods. The indicator then increased substantially to reach the value 0.3 in 2009-2011, thereby suggesting that countries experienced lower economic resilience over this period. This may be due to the occurrence of the 2008 financial crisis, which might have weakened the economic resilience of developing countries, notably those that were less prepared to cushion the adverse effects of this unexpected crisis. From 2009-2011 to 2015-2018, the indicator “RESILGMM1” exhibited a strong downward trend, as its values substantially declined to reach the value -0.15 in 2015-2018. One interpretation of this development of the economic resilience indicator from 2009-2011 to 2015-2018 can be that both developed and developing countries drew lessons from 2008 financial crisis, and through greater international cooperation (i.e., with the assistance of regional and international institutions), they adopted adequate measures and policies to reduce the risk of occurrence of future financial shocks, and tried to bolster their resilience to shocks.

As for the resilience indicators “RESILFGLS1” and “RESILFE1”, we observe that countries exhibited lower economic resilience between 2000-2002 and 2003-2005 (as the values of these indicators increased from 2000-2002 to 2003-2005). However, between 2003-2005 and 2006-2008, countries showed, on average, a strengthening of economic resilience (as the values of “RESILFGLS” and “RESILFE” declined). Countries then experienced lower economic resilience between 2006-2008 and 2009-2011. From 2009-2011 to the end of the period (i.e., 2015-2018), countries significantly increased their level of economic resilience as values of the indicators RESILFGLS and RESILFE declined significantly. The explanation provided above concerning the development of “RESILGMM” applies here as well.

At the same time, the average value of the indicator “PCI” consistently increased over the full period, from 24.8 in 2000-2002 to 29.2 in 2015-2018. This suggests that countries strengthened their productive capacities over time, though this “average” development over the full sample might hide differentiated developments across the full sample.

Figure 2 shows a positive correlation pattern between economic resilience indicators RESILGMM and RESILFE and the indicator of productive capacities over the full sample. This positive correlation pattern does not imply a causality, as many other factors may affect the relationship between productive capacities and economic resilience. Only an equation estimated by an appropriate economic estimator would inform about the genuine direction of the effect of productive capacities on economic resilience. Finally, the correlation pattern between PCI and RESILFGLS is not clear.

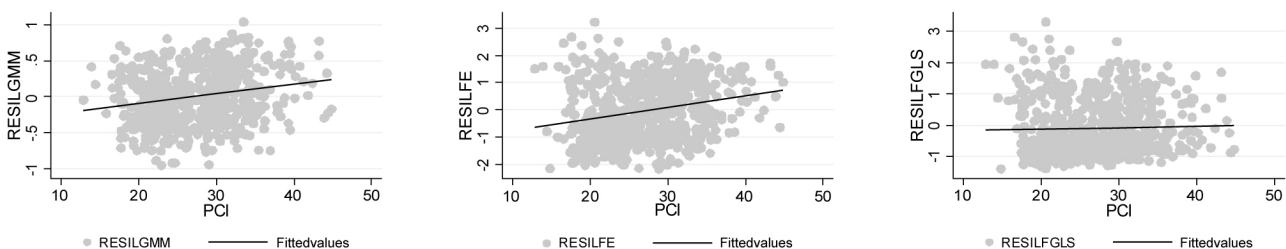


Fig. 2. Scatter plot between productive capacities and economic resilience over the full sample

Source: Author

Note: These graphs rely on the transformed values of the indicators of economic resilience, as described in Appendix 1.

MODEL SPECIFICATION AND ECONOMETRIC APPROACH

Model Specification

Closely following Jolles et al. (2018) and Sondermann (2018), we lay out a model that relates productive capacities to our indicator of economic resilience.⁶

We consider the following dynamic model specification (1):

$$\text{RESIL}_{it} = \beta_1 \text{RESIL}_{it-1} + \beta_2 \text{PCI}_{it} + \beta_3 \text{Log}(\text{GDPC})_{it} + \beta_4 \text{OPEN}_{it} + \beta_5 \text{FINPOL}_{it} + \beta_6 \text{INFL}_{it} + \beta_7 \text{FINDEV}_{it} + \mu_i + \gamma_t + \omega_{it} \quad (1)$$

Model (1) has been estimated using a sample of 118 developing countries, with data spanning the period 2000-2018. This panel dataset has been constructed on the basis of data availability. As per the practice in the macroeconomic literature, we use sub-periods, in particular non-overlapping sub-periods of 3-year intervals to dampen the effect of business cycles on the variables. The sub-periods are 2000-2002; 2003-2005; 2006-2008; 2009-2011; 2012-2014 and 2015-2018 (which covers 4 years). The subscripts i and t are respectively associated with a country, and each time-period. β_1 to β_7 are parameters that will be estimated. μ_i are countries' specific effects and γ_t are time dummies acting for global shocks that impact together all countries' economic resilience. These time dummies are included in this equation because they were not included in the regression that helped to calculate the economic resilience indicator. ω_{it} are random error terms.

The dependent variable "RESIL" is the indicator of economic resilience. It is primarily measured by "RESILGMM", and for robustness checking, by the indicators "RESILFGLS" and "RESILFE". Note that as mentioned in Appendix 1, the dependent variable "RESIL" is here the transformation of the originally computed indicator of economic resilience using the method suggested by Yeyati et al. (2007) (see Appendix 1). This is due to the high skewness of the distribution of "RESILGMM1". To recall, the originally computed indicators of economic resilience are denoted "RESILGMM1", "RESILFGLS1" and "RESILFE1".

We have introduced the one-period lag of "RESIL" as a regressor in model (1) with a view to accounting for the possible inertia in countries' level of economic resilience. In fact, there is no reason to believe that the level of economic resilience in period $t-1$ would not be related to the level of economic resilience in period t .

The variable "PCI" represents the indicator of productive capacities, which we defined above. Each of its eight components are denoted "HUMCAP" (human capital), "ENERG" (energy infrastructure), "TRANSP" (transport infrastructure), "ICT" (information and communication technologies), "INST" (institutional and governance quality), "PRIVATE" (private sector) "SCI" (structural change in production) and "NATCAP" (natural capital). The values of each sub-component of "PCI" range between 0 and 100, with higher values indicating an improvement in the indicator in question.

The control variables "GDPC", "OPEN", "FINPOL", and "FINDEV" are respectively the real per capita income (which is a proxy for the development level), the trade openness level, the degree of capital account openness, and the overall depth of financial development. The natural logarithm has been applied to the real per capita income variable to reduce the high skewness of its distribution. The regressor "INFL" is the transformed measure of the inflation rate—also by the method of Yeyati et al. (2007) (see Appendix 1) - so as to reduce the skewed distribution of the inflation rate. The description of variables contained in model (1) (and all variables that will be used later in

⁶We have also drawn some insights from studies on the macroeconomic determinants of economic recovery at the country level (e.g., Barthélémy et al., 2020; Hong and Tornell, 2005; IMF, 2018, 2021; Kannan, 2012) or regional level (e.g., Brada et al., 2021; Hundt and Holtermann, 2020).

the analysis) along with their source are provided in Appendix 1. We also present in Appendix 2 the descriptive statistics on all these variables, and Appendix 3 contains the list of countries contained in the full sample.

Theoretical Effects of Variables in Model (1) on Economic Resilience

Real per capita income

We expect the real per capita income, which provides an indication of a country's development level, to influence positively economic resilience. This is because a high real per capita income may reflect greater economic sophistication, and hence a greater capacity of countries in question to weather shocks. Wealthier countries usually have much more resources (e.g., human and financial resources) to manage the fallout of crises than less developed countries do.

Inflation

Low and stable inflation rates reflect the stance of monetary and fiscal policies, in particular prudent monetary policies, and contained fiscal deficits (e.g., Catão and Terrones, 2005; Zhang and Dai, 2019). Lower inflation rates, therefore, provide an indication of a stable macroeconomic environment, which could help countries enhance their economic resilience. Countries with low and stable inflation rate can withstand shocks without excessive welfare costs (e.g., Briguglio et al., 2009). We expect lower inflation to be associated with greater economic resilience.

Trade openness

As the COVID-19 pandemic erupted and escalated, some analysts (e.g., Shih, 2020) called for rethinking the shape of global value chains, and in this regard, expressed the view that some countries, including those where firms' resilience weaken due to reliance on a few suppliers, should start exploring ways to reduce their reliance on international supply chains so as to build more resilient economies. In contrast, other analysts put forth the insurance role of global value chains as well as their capacity to bolster economic resilience during the pandemic (e.g., National Board of Trade Sweden, 2020). Meyer et al. (2020) have argued that disruptions of supply chains in early 2020 were of a temporary nature, and Miroudot (2020) has stated that solutions being proposed were not consistent with the conclusions of the supply chain literature, where reshoring did not lead to resilience. He has, therefore, suggested that it would be wise to identify the concrete issues faced by firms during the crisis and the policies that can solve them, before redesigning global supply chains.

The literature on the relationship between trade openness and economic resilience is mixed. Trade openness can expose countries to shocks, increase their vulnerability to external shocks (e.g., Bekaert and Harvey, 2000; Montalbano, 2011), and result in higher output volatility. This is particularly the case for countries with a high degree of trade specialization, including on low value-added products (e.g., Di Giovanni and Levchenko, 2009, 2012; Haddad et al., 2013) or when there is a high degree of global financial uncertainty (e.g., Bonciani and Ricci, 2020). On the other hand, a higher level of trade openness may not affect developing countries' size of shocks, and may even reduce their size of exposure to shocks (e.g., Gnangnon, 2016; Montalbano, 2011). As a result, trade openness could lead to lower output volatility when countries diversify their export product baskets or their economic structure (e.g., Balavac et al., 2016; Calderón et al., 2005). In this context, trade openness can be associated with a higher level of economic resilience.

On another note, trade openness can enhance competition, and may foster innovation by reducing the search of monopoly rents and incentivizing incumbent firms to improve their innovation performance, for example thanks to their interaction with more knowledgeable foreign buyers (Aghion et al. 1997, 2005). Trade openness can also facilitate the diffusion of knowledge, and the transfer of technology if it allows importing firms to improve their

“domestic” technology by incorporating into their production processes the technology embedded in the imported capital goods or inputs (e.g., Grossman and Helpman, 2015). Through its effect on innovation (and technology adoption), trade openness can contribute to fostering economic resilience in light of the possible positive effect of innovation on economic resilience (see Section 2). In a nutshell, it is difficult to anticipate the direction of the effect of trade openness on economic resilience, and only the empirical analysis could provide guidance on this.

Financial openness

Financial (i.e., capital account) openness can foster economic resilience by allowing firms and economic agents to diversify the risks they face and to have access to funding at lower costs in the international markets. These would help firms and even economic agents to better withstand shocks. Indeed, financial openness provides opportunities for firms to expand the range of financial instruments to which they can have access, and hence allow them to better diversify risks and improve the efficiency in resources allocation (e.g., Acemoglu and Zilibotti, 1997; Reese and Weisbach, 2002). It also enables access to more liquidity, and helps to obtain funding at lower capital costs and longer maturities compared to funding from domestic markets (e.g., Ball et al., 2018; Schmukler and Vesperoni, 2006). Additionally, financial openness can result in a higher level of economic resilience if it leads to lower output volatility. A number of studies have shown evidence that financial openness can be associated with lower output volatility, especially in the context of a high depth of domestic financial development (e.g., Ahmed and Suardi, 2009; Calderón and Schmidt-Hebbel, 2008), when the domestic financial system is not in the transitional turmoil (Calderón et al., 2005) or in the context of global financial uncertainty (e.g., Bonciani and Ricci, 2020). Meanwhile, greater financial openness can also amplify financial distortions that may outweigh its benefits (e.g., Eichengreen and Leblang, 2003). This would particularly be the case if the openness of the capital account enhanced competition in the domestic financial sector such that local banks become adversely affected by the financial policies (this is the case in poor countries – Claessens et al., 2001). In this context, financial openness would ultimately be associated with greater economic instability (e.g., Agénor, 2003; Wei, 2018).

Overall, the direction of the effect of financial openness on economic resilience is *a priori* indetermined.

Financial development

A well-working financial system can play a key role in fostering economic growth and development (e.g., Beck et al. 2000; Levine and Zervos, 1998). In the presence of shocks, well-functioning domestic financial markets can help smooth out consumption and investment (e.g., Gertler et al. 2009; Islam and Maitra, 2012; Jack and Suri, 2014; Kinnan and Townsend, 2012; Somville and Vandewalle, 2019; Pomeroy et al., 2020; Somville and Vandewalle, 2019). For example, Somville and Vandewalle (2019) documented that rural Indian households with access to a bank account were able to smooth consumption much better than those without. Xue (2020) reported a negative effect of financial development on aggregate growth volatility in the global perspective, though the size of the negative effect is smaller for developing countries than for advanced countries. Pomeroy et al. (2020) contended that financial inclusion can help improve economic resilience among poor fishing households and rural communities.

Against this background, we could be tempted to postulate that a well-functioning domestic financial sector could help bolster economic resilience. However, vulnerabilities in the financial system can threaten the stability of the system and limit the ability of the domestic financial markets to play their role of smoothing consumption and investment in the face of shocks. Such vulnerabilities are the under-pricing of (measured) risk and the associated excessive leverage, maturity and currency mismatches, as well as the interconnectedness and common exposures of the financial sector that can make individual financial institutions systematically important (e.g., Sánchez and Röhn, 2016). The existence of these vulnerabilities, if not appropriately addressed, would result in lower economic resilience.

Finally, financial development may not lead to greater economic resilience if it results in higher output volatility.

The empirical evidence on the effect of financial development on output volatility is mixed (e.g., Beck et al., 2006; Ibrahima and Alagidede, 2017; Wang et al., 2018). For example, Beck et al. (2006) have obtained that well-developed financial intermediaries dampen (magnify) the effect of real sector shocks (monetary shocks) on output fluctuations. Wang et al. (2018) uncovered that by facilitating better credit allocations, well developed financial markets tend to lead to lower aggregate volatility. Ibrahima and Alagidede (2017) have found for sub-Saharan African countries that while well-developed domestic financial markets help dampen economic volatility, monetary shocks appeared to have large positive effects on economic volatility, in contrast with real shocks that had large negative effects on economic volatility.

Summing-up, the direction of the effect of financial development on economic resilience is a priori unknown.

Econometric Approach

We now discuss the econometric approach(es) used to estimate model (1) or other specifications of this model described below.

We commence the empirical analysis by estimating a static specification of model (1) that excludes the lagged dependent variable as regressor, and where “RESIL” is measured by “RESILGMM”, and for a robustness check, by “RESILFGLS” and “RESILFE”. The estimation is performed using the FE and FGLS estimators, and results are reported in Table 1. It is noteworthy that in this static specification, all regressors have been introduced with a one period lag in order to mitigate the possible endogeneity concern, in particular the reverse causality from the dependent variable to each regressor.

The use of the one period lag of regressors in the static form of model (1) might not fully address the endogeneity problems. Additionally, the absence of the one-period lag of the dependent variable in the model to account for the eventual state dependence path in the level of economic resilience may result in biased estimates. At the same time, the presence of the lag of the dependent variable in model (1) is likely to raise another endogeneity problem if in its dynamic form, model (1) was estimated using the FE or FGLS approaches (or alternatively the pooled ordinary least squares estimator). This is because of the correlation between the lagged dependent variable and countries’ specific (time invariant) effects, which leads to biased estimates, notably in panel datasets with small time dimension and large cross-sections (see Nickell, 1981).

To tackle the endogeneity concerns, we use the two-step system GMM estimator (described above). We report the outcomes of the tests that help to evaluate the validity of this estimator, while also avoiding over-instrumentation. We consider all regressors as endogenous due to the potential bi-directional causality between the dependent variable and each of these regressors. The rationale for this is as follows. While the improvement of productive capacities is expected to influence economic resilience, it is also possible that the level of economic resilience may incentivize countries to foster their productive capacities. For example, countries with a weak economic resilience may make efforts to enhance their productive capacities so as to reduce their exposure to shocks, and be able to withstand easily adverse shocks that would occur. Also, countries that have a low level of economic resilience and that wish to strengthen it may be inclined to reduce their levels of trade openness and financial openness if they realize that the latter exposes them to external shocks, and weakens their economic resilience to future shocks. However, if these countries’ open up to international trade and capital flows brings more benefits than it generates costs, they will likely further open-up their economies to trade and capital flows so as to enhance their economic resilience. The level of economic resilience (in particular if it is low) can also affect the willingness of countries to adopt policies (e.g., fiscal, monetary and financial policies) that would help achieve greater macroeconomic stability. Finally, countries with a low degree of economic resilience, and that wish to foster it may endeavour to develop their domestic financial markets as well as appropriate regulations that would ensure greater financial stability.

We use the two-step system GMM estimator to estimate a number of specifications of the dynamic model (1).

The first specification of model (1) is, in fact, model (1) itself (i.e., in its dynamic form), including with each of three indicators of economic resilience, given that our primary indicator of economic resilience is “RESILGMM” and the other two indicators are used for robustness check analysis. The outcomes of these estimations are displayed in Table 2.

From now onwards, all specifications of model (1) described below rely solely on the indicator “RESILGMM” as the measure of the dependent variable “RESIL”.

The second specification of model (1) is the one that allows investigating whether there is a differentiated effect of productive capacities on economic resilience in LDCs versus NonLDCs within the full sample. To that end, we estimate a variant of model (1) in which we add the dummy “LDC”, and its interaction with the variable “PCI”. The dummy “LDC” takes the value “1” for LDCs, and “0”, otherwise. The list of LDCs used in the analysis is presented in Appendix 3, and the results of this estimation are presented in column [1] of Table 3.

The third variant of model (1) allows exploring how, more generally, productive capacities affect economic resilience across countries in the full sample. This variant of model (1) takes the form of model (1) that includes the interaction between the variable “PCI” and the real per capita income. The estimates arising from the estimation of this variant of model (1) are reported in column [2] of Table 2.

Table 4 contains outcomes stemming from the estimation of various other specification of model (1) that help to examine the effect of each of the components of the index of productive capacities on economic resilience. These different specifications of model (1) are in fact model (1) in which we introduce (once) each of the above-mentioned eight components of “PCI”.

INTERPRETATION OF EMPIRICAL RESULTS

We note across all six columns of Table 1 that the coefficients of “PCI” are negative. They are significant at the 1% level in all columns, except for column [3] where the significance is only at the 5% level. However, the magnitudes of these coefficients are not the same across the six columns. These outcomes suggest that developing productive capacities in period $t-1$ influences positively economic resilience in period t in developing countries. With regard to control variables, it appears that across the six columns of the table, the real per capita income holds coefficients that are positive and significant at the 1% level, indicating that countries with a higher real per capita income have a lower level of economic resilience than countries with a lower real per capita income. This finding runs counter to expectation, but it may be masking the fact that the effect of the real per capita income on economic resilience is dependent on the level of productive capacities (or eventually other variables included in the model). Trade openness tends to exert a positive effect on economic resilience, but only for results based on the FGLS approach, notably the ones in columns [4] and [6]. Greater liberalization of the capital account influences negatively and significantly economic resilience, but only for results based on the FE approach (as for the FGLS-based outcomes, there is no significant effect of capital account openness on economic resilience). A rise in the inflation rate (which reflects a higher macroeconomic instability) exerts a negative and significant effect on economic resilience (see only the FE-based results, as there is no significant effect of inflation on economic resilience for the FGLS-based outcomes). Finally, in all columns but column [5] of, deepening financial development induces a lower level of economic resilience.

As pointed out above, these outcomes should be taken with caution, given the endogeneity concerns raised above.

We now consider results presented in Tables 2 to 4, which are based on the two-step system GMM estimator. We first note that in all columns of the three tables, all conditions for the validity of this estimator are met. Indeed, the p-values of the AR(1) and AR(2) tests show that we cannot reject the null hypothesis of each of these tests. Additionally, the p-values related to the over-identifying restrictions test are higher than the 10% level of statistical significance, thereby suggesting the joint validity of instrumental variables. Finally, we notice that in all columns

Table 1. Effect of productive capacities on economic complexity
Estimators: FEDK and FGLS

Variables	FEDK			FGLS		
	RESILGMM	RESILFGLS	RESILFE	RESILGMM	RESILFGLS	RESILFE
	(1)	(2)	(3)	(4)	(5)	(6)
PCI _{t-1}	-0.0615*** (0.0138)	-0.126*** (0.0420)	-0.0753** (0.0328)	-0.0322*** (0.00316)	-0.0662*** (0.00921)	-0.104*** (0.00819)
Log(GDPC) _{t-1}	0.247*** (0.0660)	0.595*** (0.162)	0.592*** (0.144)	0.193*** (0.00833)	0.394*** (0.0285)	0.497*** (0.0298)
OPEN _{t-1}	0.0713 (0.0984)	-0.225 (0.453)	-0.0525 (0.432)	-0.142*** (0.0212)	0.0857 (0.0556)	-0.345*** (0.0603)
FINPOL _{t-1}	0.288** (0.124)	0.441*** (0.149)	0.436*** (0.105)	0.0146 (0.0284)	-0.0403 (0.0567)	0.0873 (0.0535)
INFL _{t-1}	0.0718*** (0.0236)	0.145*** (0.0417)	0.139*** (0.0350)	0.0131 (0.0110)	0.0263 (0.0246)	0.0318 (0.0287)
FINDEV _{t-1}	0.825** (0.318)	2.013*** (0.572)	0.977*** (0.347)	0.759*** (0.0593)	0.170 (0.230)	3.235*** (0.185)
Constant	-0.818 (0.642)	-2.241 (1.505)	-3.378*** (1.232)	-0.727*** (0.0586)	-1.656*** (0.178)	-1.778*** (0.152)
Observations - Countries	547 - 118	547 - 118	547 - 118	546 - 117	546 - 117	546 - 117
Within R-squared	0.0793	0.0580	0.0377			
Pseudo R-squared				0.5594	0.4532	0.5764

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. The Pseudo R2 has been calculated for FGLS-based regressions, as the correlation coefficient between the dependent variable and its predicted values.

Table 2. Effect of productive capacities on economic resilience over the full sample
Estimator: Two-Step System GMM

Variables	RESILGMM	RESILFGLS	RESILFE
	(1)	(2)	(3)
One Period Lag of the Dependent Variable	0.110*** (0.0334)	0.221*** (0.0182)	0.298*** (0.0136)
PCI	-0.0321*** (0.00763)	-0.0851*** (0.0103)	-0.0838*** (0.0109)
Log (GDPC)	0.316*** (0.0387)	0.701*** (0.0498)	0.596*** (0.0432)
OPEN	-0.222*** (0.0444)	-0.00690 (0.0738)	-0.435*** (0.0735)
FINPOL	0.233*** (0.0693)	0.382*** (0.109)	0.379*** (0.0991)
INFL	0.0720*** (0.0251)	0.113*** (0.0397)	0.191*** (0.0327)
FINDEV	-0.153 (0.261)	-1.746*** (0.316)	1.297*** (0.467)
Observations - Countries	433 - 118	536 - 118	536 - 118
Number of Instruments	76	89	89
AR1 (P-Value)	0.0000	0.0000	0.0000
AR2 (P-Value)	0.3143	0.1908	0.4055
OID (P-Value)	0.1397	0.2601	0.2517

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables "PCI", "FINPOL", "OPEN", "INFL" and "FINDEV" have been treated as endogenous.

of the tables, the lagged dependent variable holds a positive and significant coefficient at least at the 5% level. This confirms the inertia in the dependent variable, and indicates that a lower level of economic resilience in period $t-1$ is associated with greater economic resilience in period t . Based on all these outcomes, we conclude that the two-system GMM estimator is appropriate to perform the empirical analysis.

Turning to our key variable of interest, we find that across the three columns of Table 2, the coefficients of “PCI” are yet different but negative and significant at the 1% level. Therefore, we can conclude that the enhancement of productive capacities leads to greater economic resilience. Specifically, results based on our main indicator of economic resilience, namely “RESILGMM” (see column [1] of Table 2), we conclude that a 1-point increase in the index of productive capacities raises economic resilience by 0.3 points. For the indicators “RESILFGLS” and “RESILFE” as dependent variable, we obtain that a 1-point increase in the index of productive capacities raises economic resilience respectively by 0.7 and 0.6 point. Turning to column [1], we obtain for control variables that the real per capita income exerts a negative and significant effect (at the 1% level) on economic resilience. While once again, this outcome does not reflect our theoretical expectation, the interpretation provided just above applies here as well. The coefficient of the trade openness variable is negative and significant at the 1% level, and indicates that greater trade openness improves the level of economic resilience. At the same time, greater financial openness is negatively associated with economic resilience (as the coefficient of the financial openness indicator is positive and significant at the 1% level). This finding may indicate that the financial distortions associated with greater

Table 3. Effect of productive capacities on economic resilience in LDCs versus NonLDCs
Estimator: Two-Step System GMM

Variables	RESILGMM	RESILGMM
	(1)	(2)
RESILGMM _{t-1}	0.0684** (0.0285)	0.0993*** (0.0275)
PCI	-0.0472*** (0.00950)	0.0286* (0.0163)
PCI*LDC	0.0338*** (0.0104)	
LDC	-0.883*** (0.254)	
PCI*[Log(GDPC)]		-0.00737*** (0.00159)
Log(GDPC)	0.323*** (0.0451)	0.512*** (0.0496)
OPEN	-0.149*** (0.0377)	-0.145*** (0.0366)
FINPOL	0.232*** (0.0635)	0.235*** (0.0596)
INFL	0.0632** (0.0250)	0.0564*** (0.0211)
FINDEV	-0.197 (0.227)	-0.146 (0.221)
Observations - Countries	433 - 118	433 - 118
Number of Instruments	86	86
AR1 (P-Value)	0.0000	0.0000
AR2 (P-Value)	0.2986	0.3282
OID (P-Value)	0.2627	0.2492

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables “PCI”, “FINPOL”, “OPEN”, “INFL”, “FINDEV” and the interaction variables have been treated as endogenous.

liberalization of the capital account outweigh the positive effects that it would bring to developing countries, notably in terms of output volatility, and hence economic resilience. Higher inflation rates erode economic resilience, as the coefficient of the inflation variable is positive and significant at the 1% level. Finally, we obtain that greater financial development exerts no significant on economic resilience. Note that the outcomes concerning control variables in all columns of Tables 3 and 4 align, to a large extent, with those in column [1] of Table 2.

Outcomes reported in column [1] of Table 3 show a positive and significant coefficient (at the 1% level) of the interaction variable [$PCI \times LDC$]. This suggests that the positive effect of productive capacities on economic resilience is higher in non-LDCs than in LDCs. This is consistent with our argument above that the positive coefficient of the real per capita income in column [1] of Table 2 might reflect the fact that the effect of the real per capita income on productive capacities is dependent upon the level of productive capacities. As the coefficient of “PCI” in column [1] of Table 3 is negative and also significant at the 1% level, we conclude that the net effect of productive capacities on economic resilience in LDCs and non-LDCs is given respectively by -0.013 ($= -0.0472 + 0.0338$) and -0.047 .

As for estimates presented in column [2] of Table 3, we find that the interaction term related to the variable $(PCI \times [\text{Log}(GDPC)])$ is negative and significant at the 1% level, while the estimate associated with “PCI” is yet positive, but significant only at the 10% level. These outcomes confirm once again our argument put forth above that the effect of the real per capita income on economic resilience is genuinely dependent on countries’ level of productive capacities. At the 1% level, productive capacities consistently lead to a higher level of economic resilience as the level of the real per capita income rises. In other words, countries with a higher level of real per capita income enjoy a higher degree of economic resilience than relatively less developed countries.

Results in Table 4 suggest that among the components of the overall productive capacities index, five components hold a significant coefficient at the conventional significance levels (in particular here at least at the 5% level). Additionally, all these significant coefficients are negative. These components are human capital, energy infrastructure, transport infrastructure, information communication technologies, and the institutional and governance quality. Specially, human capital development, the development of energy and transport infrastructure, the promotion of access to ICT tools, and an improvement in the institutional and governance quality are all associated with greater economic resilience. At the same time, natural resources, the development of the private sector, and structural change in production do not exert a significant impact on economic resilience in developing countries.

Overall, results in Tables 2 to 4 convey that greater productive capacities are associated with a higher level of economic resilience. Additionally, this positive effect of productive capacities on economic resilience is higher in more advanced developing countries. Finally, this positive effect of productive capacities on economic resilience is essentially driven by human capital development, the development of energy and transport infrastructure, the promotion of ICT tools, and better institutional and governance quality.

THE INFLUENCE OF DEVELOPMENT AID

Given the nature of Official Development Assistance (ODA) and productive capacities, ODA may enhance productive capacities in developing countries. The present section aims to examine whether the effect of productive capacities on economic resilience depends on the amount of ODA.

For the purpose of the present analysis, we decompose ODA into two major categories: Aid for Trade (AfT), and all other development aid (NonAfT). The category of AfT was created to help developing countries, particularly LDCs, to build the supply-side capacity and trade-related infrastructure to implement and benefit from WTO Agreements (WTO, 2005). It has three major components: AfT for economic infrastructure (“AfTINFRA”), which includes transport and storage, communications, and energy generation and supply; AfT for building productive capacity (“AfTPROD”) whose components are banking and financial services, business and other services,

Table 4. Effect of productive capacities on economic resilience over the full sample
Estimator: Two-Step System GMM

Variables	RESILGMM (1)	RESILGMM (2)	RESILGMM (3)	RESILGMM (4)	RESILGMM (5)	RESILGMM (6)	RESILGMM (7)	RESILGMM (8)
RESILGMM _{t-1}	0.0607** (0.0247)	0.0892*** (0.0343)	0.0737** (0.0330)	0.0535** (0.0228)	0.115*** (0.0348)	0.0591** (0.0248)	0.0892*** (0.0282)	0.0867*** (0.0333)
HUMCAP	-0.00658** (0.00288)							
NATURAL		0.00115 (0.00244)						
ENERG			-0.00775*** (0.00207)					
TRANSP				-0.00633*** (0.00233)				
ICT					-0.0180** (0.00737)			
INST						-0.00618*** (0.00221)		
PRIVATE							-0.00405 (0.00354)	
SCI								-0.00584 (0.00816)
Log(GDP)	0.223*** (0.0186)	0.326*** (0.0288)	0.301*** (0.0381)	0.324*** (0.0284)	0.291*** (0.0329)	0.339*** (0.0247)	0.292*** (0.0270)	0.245*** (0.0248)
OPEN	-0.134*** (0.0341)	-0.103*** (0.0342)	-0.129*** (0.0437)	-0.0999*** (0.0371)	-0.223*** (0.0425)	-0.101*** (0.0354)	-0.204*** (0.0469)	-0.208*** (0.0443)
FINPOL	0.0650 (0.0478)	0.0361 (0.0759)	-0.0542 (0.0691)	0.155*** (0.0560)	0.176*** (0.0620)	0.206*** (0.0535)	0.293*** (0.101)	0.0703 (0.0747)
INFL	0.154*** (0.0223)	0.121*** (0.0305)	0.0684** (0.0286)	0.101*** (0.0199)	0.0980*** (0.0277)	0.109*** (0.0192)	0.0982*** (0.0240)	0.113*** (0.0269)
FINDEV	-0.0910 (0.251)	-1.050*** (0.247)	-0.511* (0.267)	-1.173*** (0.240)	-0.713*** (0.212)	-1.033*** (0.250)	-1.252*** (0.270)	-0.333 (0.332)
Observations - Countries	433 - 118 88	433 - 118 76	433 - 118 76	433 - 118 88	433 - 118 76	433 - 118 88	433 - 118 76	433 - 118 76
Number of Instruments								
AR1 (P-Value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AR2 (P-Value)	0.2876	0.3349	0.2885	0.2711	0.3608	0.2892	0.3252	0.3121
OID (P-Value)	0.1402	0.10	0.1138	0.1149	0.1295	0.1242	0.1030	0.1561

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables "PCI" (and its components), "FINPOL", "OPEN", "INFL", "FINDEV" and the interaction variables have been treated as endogenous.

agriculture, forestry, fishing, industry, mineral resources and mining, and tourism; and AfT related to trade policy and regulations (“AfTPOL”). The latter includes trade policy and regulations and trade-related adjustment. The non-AfT category includes for example humanitarian aid, aid for education, and aid for health. Note that total ODA flows (denoted “ODA”) is the sum of total AfT flows and total NonAfT flows.

In a forthcoming paper, Gnanngnon (2021)⁷ has discussed theoretically the effect of both AfT flows and NonAfT flows on productive capacities, and obtained empirically that both types of aid flows influence positively productive capacities in developing countries. Therefore, one can expect development aid flows to affect the influence of productive capacities on economic resilience.

To address empirically the question as to whether the effect of productive capacities on economic resilience depends on the amount of development aid that accrued to countries, we commence by estimating a variant of model (1) that includes the variable “ODA”. The purpose of doing so is to check whether the statistical significance of the variable “PCI” is sensitive to the inclusion of the total development aid flows variable in the model. In principle, if the effect of development aid on economic resilience works essentially through the productive capacity channel, then the coefficient of either “PCI” or “ODA” in the estimated model should be statistically non-significant at the conventional significance levels, while the coefficient of the other variable would be statistically significant at the conventional significance levels. The outcomes of the estimation of this variant of model (1) are reported in column [1] of Table 5.

Next, we estimate another specification of model (1) that includes the interaction between the index of overall productive capacities and the total ODA flows variable. This specification of model (1) helps to address our main question, i.e., whether the effect of the overall productive capacities on economic resilience depends on the total ODA flows received by countries. The outcomes of this estimation are reported in column [2] of Table 5.

We then move on to consider the extent to which the effect of productive capacities on economic resilience depends on each of the two main components of total ODA, namely total AfT flows and total NonAfT flows. This assessment is performed by estimating another form of model (1) that incorporates both variables, and their respective interaction with the index of the overall productive capacities. The outcomes are presented in column [3] of Table 5. It is worth noting at this stage of the analysis that these results remain unchanged when we estimated the same specification of model (1) but separately for total AfT flows along with its interaction with the index of the overall productive capacities, and for total NonAfT flows along with its interaction with the index of the overall productive capacities.

Finally, we push the analysis forward by examining how each component of the variable capturing the total AfT flows matters for the effect of productive capacities on economic resilience. To address this issue, we simply estimate three different other specifications of model (1) that include the interaction between the index of the overall productive capacities with each of the three components of the variable capturing total AfT flows, which is introduced once in the relevant model. In all these three variants of model (1), we control for both the variable representing the total NonAfT flows and its interaction with the index of productive capacities. The estimates arising from the estimation of each of these three variants of model (1) are presented in columns [4] to [6] of Table 5.

Let us now interpret all estimates reported in Table 5. We first note that the conditions for the validity of the two-step system GMM estimator are met (see the bottom of all columns of Table 5). Moreover, we obtain, once again, that across all columns of this table, that the indicator of economic resilience exhibits a state dependence path. Taking up the estimates themselves, we find that in column [1], total development aid exerts no significant effect on economic resilience, while the variable “PCI” holds a negative and significant coefficient at the 5% level. Therefore, it seems that in this specification of model (1), the indicator of productive capacities have absorbed the effect of total development aid on economic resilience, which may signify that the effect of productive capacities on

⁷Due to limited space here, readers should refer to Gnanngnon (2021) for the theoretical discussion.

Table 5. Effect of productive capacities on economic resilience for varying levels of development aid flows_Over the full sample
Estimator: Two-Step System GMM

Variables	RESILGMM	RESILGMM	RESILGMM	RESILGMM	RESILGMM	RESILGMM
	(1)	(2)	(3)	(4)	(5)	(6)
RESILGMM _{t-1}	0.0877** (0.0373)	0.0641** (0.0303)	0.0933*** (0.0315)	0.0957*** (0.0257)	0.109*** (0.0301)	0.0495** (0.0218)
PCI	-0.0271** (0.0126)	-0.251*** (0.0603)	-0.237*** (0.0476)	-0.358*** (0.0462)	-0.266*** (0.0391)	-0.245*** (0.0439)
Log(ODA)	-0.0435 (0.0270)	-0.319*** (0.0823)				
PCI*Log(ODA)		0.0115*** (0.00307)				
PCI*[Log(AfTTOT)]			-0.0114*** (0.00253)			
Log(AfTTOT)			0.310*** (0.0851)			
PCI*[Log(AfTINFRA)]				-0.00847*** (0.00184)		
Log(AfTINFRA)				0.277*** (0.0620)		
PCI*[Log(AfTPROD)]					-0.0100*** (0.00236)	
Log(AfTPROD)					0.248*** (0.0755)	
PCI*[Log(AfTPOL)]						-0.00430*** (0.00107)
Log(AfTPOL)						0.104*** (0.0317)
PCI*[Log(NonAfTTOT)]			0.0210*** (0.00331)	0.0237*** (0.00234)	0.0216*** (0.00259)	0.0140*** (0.00236)
Log(NonAfTTOT)			-0.559*** (0.0915)	-0.671*** (0.0740)	-0.571*** (0.0724)	-0.347*** (0.0718)
Log(GDPC)	0.313*** (0.0743)	0.315*** (0.0618)	0.377*** (0.0462)	0.401*** (0.0451)	0.282*** (0.0425)	0.357*** (0.0362)
OPEN	-0.0519 (0.0816)	-0.0972 (0.0648)	0.0467 (0.0628)	0.0175 (0.0474)	0.0589 (0.0508)	-0.133*** (0.0479)
FINPOL	0.204*** (0.0783)	0.131* (0.0745)	0.0990* (0.0581)	0.173*** (0.0533)	0.0980* (0.0517)	0.202*** (0.0647)
INFL	0.166*** (0.0356)	0.131*** (0.0321)	0.113*** (0.0249)	0.0965*** (0.0224)	0.195*** (0.0305)	0.0591** (0.0249)
FINDEV	-0.183 (0.351)	-0.208 (0.355)	-0.413** (0.203)	-0.591*** (0.209)	-0.362 (0.226)	-0.401* (0.237)
Observations - Countries	394 - 109	394 - 109	393 - 109	393 - 109	393 - 109	391 - 109
Number of Instruments	65	72	86	86	86	86
AR1 (P-Value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AR2 (P-Value)	0.2927	0.3392	0.5472	0.5860	0.4151	0.2916
OID (P-Value)	0.1876	0.1839	0.1635	0.1356	0.2006	0.2425

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables "PCI", aid variables, "FINPOL", "OPEN", "INFL", "FINDEV" and the interaction variables have been treated as endogenous. .

economic resilience may genuinely work through the development aid channel. This is confirmed by the estimates presented in column [3] of the table, where the coefficient of the interaction variable [$\text{PCI} \times \text{Log}(\text{ODA})$] is positive and significant at the 1% level, while both variables “PCI” and “ODA” have negative and significant coefficients at the 1% level. Based on these outcomes, we can deduce that the effect of productive capacities on economic resilience depends on the amount of total development aid that countries received. However, the lower the amount of ODA, the higher the positive effect of productive capacities on economic resilience. In other words, productive capacities tend to increase economic resilience in countries that receive low amounts of total development aid, and the lower these amounts, the greater is the magnitude of the positive effect of productive capacities on economic resilience. The turning point of total development aid (amount) above which productive capacities lead to lower economic resilience is US\$ million 3,013 [=exponential (0.251/0.0115)] (note that values of “ODA” in the full sample range between US\$ 290,000 and US\$ million 5,850 - see Appendix 2). Another interpretation of the outcomes is that development aid induces greater economic resilience in countries with low levels of the overall productive capacities. This meant that by helping to enhance productive capacities in countries that suffer from low levels of productive capacities, development aid would help to improve the level of economic resilience in these countries.

We illustrate graphically these findings by plotting in Figure 3, at the 95 percent confidence intervals, how the marginal effect of productive capacities on economic resilience evolves for different amounts of total development aid. It appears from that this marginal impact increases as the values of total ODA flows rise, although it is always negative (i.e., it always affects positively economic resilience, but the magnitude of this positive effect diminishes as the amount of total aid rises). However, this marginal impact is not significant for values of total development aid flows higher than US\$ million 444.8. As a consequence, countries that received a total amount of development aid lower than US\$ million 444.8 experience a positive effect of productive capacities on economic resilience, and the lower the amount of development aid, the higher the size of the positive effect of productive capacities on economic resilience.

The key message is that development aid is effective in enhancing economic resilience if it is provided to countries with low levels of productive capacities.

Estimates in column [3] of Table 5 show that the pattern observed in Figure 3 concerning the effect of productive capacities on economic resilience reflects opposite directions of the effect of productive capacities on economic

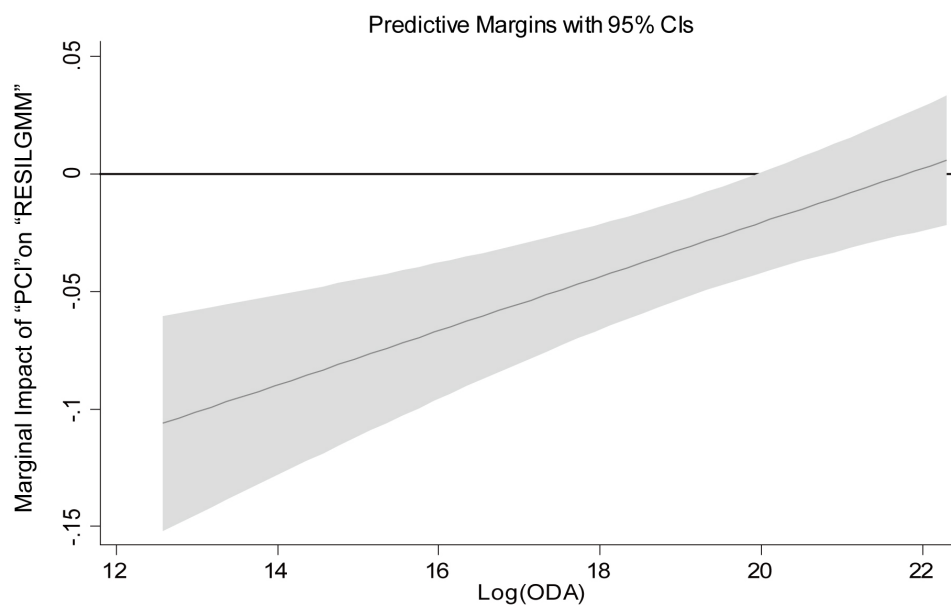


Fig. 3. Marginal Impact of “PCI” on “RESILGMM”, for varying amounts of total ODA flows
Source: Author

resilience for varying levels of AfT flows versus NonAfT flows. In fact, we note from this column that both the coefficient of “PCI” and the interaction term of the variable (“PCI*[Log(AfTTOT)]”) are negative and significant at the 1% level. In contrast, the interaction term of the variable (“PCI*[Log(NonAfTTOT)]”) is positive and significant at the 1% level. We conclude that the effects of productive capacities on economic resilience depends on both the amount of total AfT flows and NonAfT flows. On the one hand, productive capacities always exert a positive effect on economic resilience (i.e., regardless of the amount of total AfT flows), but the magnitude of this positive effect consistently increases as the amount of total AfT flows rises. On the other hand, the effect of productive capacities on economic resilience changes sign when total NonAfT flows exceeds the amount of US\$ 79675.3 [=exponential (0.237/0.0210)]. As this amount is lower than the minimum value of total NonAfT flows in the full sample (values of the variable “NonAfTTOT” range between US\$ 4133839 and US\$ billion 5.15), we definitely conclude that strengthening productive capacities always results in lower levels of economic resilience, but the magnitude of this negative effect diminishes for lower amounts of total NonAfT flows. These findings in column [3] of Table 5 certainly explains the outcomes in column [2] of Table 5 concerning the effect of productive capacities on economic resilience for varying amounts of total ODA.

We present in Figures 4 and 5, at the 95 per cent confidence intervals, the development of the marginal effect of productive capacities on economic resilience respectively for varying amounts of total AfT flows and total NonAfT flows. Both figures confirm the findings above that the effect of productive capacities on economic resilience depends on both flows. However, the patterns of these marginal effects move in the opposite direction. In particular, Figure 4 shows that the magnitude of the positive economic resilience effect of productive capacities rises as the amount of total AfT flows increases. This finding highlights the importance of the overall package of AfT flows in enhancing the positive effect of productive capacities on economic resilience. On the other side, Figure 5 indicates that the magnitude of the negative effect of productive capacities on economic resilience becomes lower as the amount of total NonAfT flows falls.

Summing-up, AfT flows contribute to enhancing the positive economic resilience effect of productive capacities, while NonAfT flows tend to hinder the effect of productive capacities on economic resilience. At this stage of the analysis, we could not identify among the components of total NonAfT flows, which ones (if any at all) may have contributed to enhancing the positive influence of productive capacities on economic resilience, and which ones

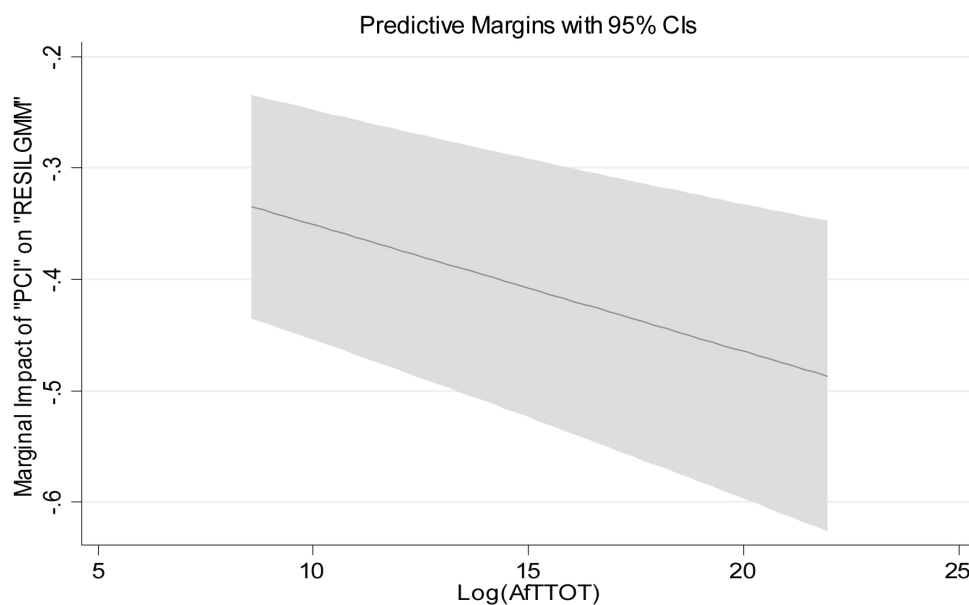


Fig. 4. Marginal impact of "PCI" on "RESILGMM", for varying amounts of total AfT flows
Source: Author

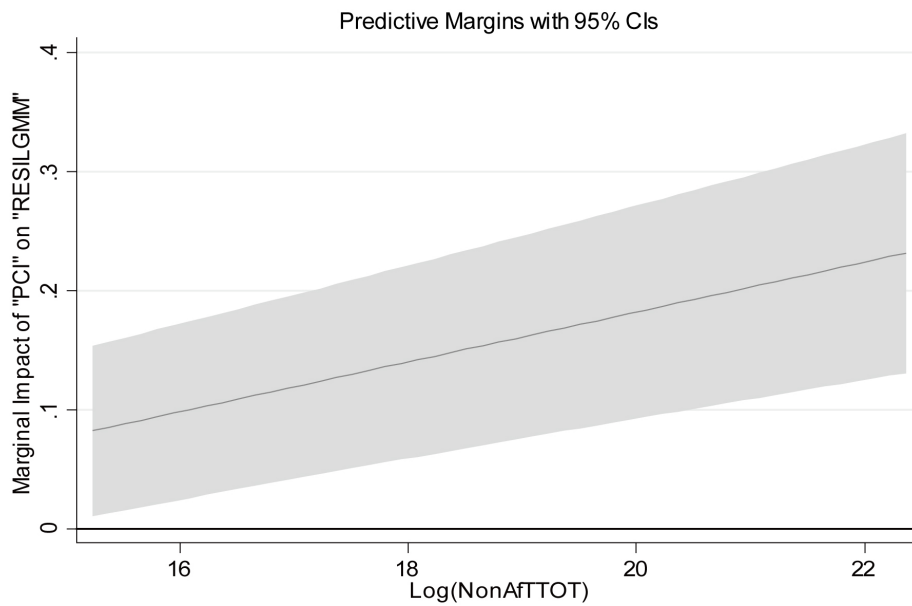


Fig. 5. Marginal impact of "PCI" on "RESILGMM", for varying amounts of total NonAfT flows
Source: Author

may have worked in the opposite direction. This can be an interesting topic for future research. Meanwhile, given the direct matching between the majority of the components of total AfT flows and some components of the index of overall productive capacities, we find useful to deepen the analysis by investigating how each of the components of total AfT flows matters for the effect of productive capacities on economic resilience.

We note from all columns [4] to [6] of Table 5 that the interaction terms related to the variable capturing the interaction between the index of the overall productive capacities and each of the three components of total AfT flows are all negative and significant at the 1% level. Concurrently, the estimates associated with the index of productive capacities are also negative and significant at the 1% level. These outcomes confirm the finding in column [3] regarding the economic resilience effect of productive capacities for different amounts of total AfT flows. We conclude that the development of productive capacities always leads to greater economic resilience, and the size of this positive effect increases as the amount of each of the components of total AfT variable (including AfT for economic infrastructure, AfT for productive capacities, and AfT for trade policy and regulation) rises. These findings, once again, confirm the relevance of greater amounts of AfT flows in particular for developing countries that have low levels of productive capacities if donor-countries were to help them to bolstering economic resilience through the strengthening of productive capacities in recipient-countries.

FURTHER ANALYSIS

This section deepens the previous analysis regarding the effect of productive capacities on economic resilience by investigating whether this effect depends on countries' economic characteristics, that is, the level of trade openness, the degree of capital account openness, the inflation rate, and the depth of financial development. In performing this empirical analysis, the present section aims to build on the theoretical discussion provided above (in section 2) so as to provide an insight into how productive capacities interact with the countries' economic features in affecting economic resilience.

We undertake this empirical exercise by estimating several variants of model (1) that include for each, an interaction between the index of productive capacities and each of the four control variables in model (1). Thus, we start by estimating a specification of model (1) that includes the interaction between the index of productive

capacities and the trade openness variable. The outcomes of the estimation of this model specification are presented in column [1] of Table 6. However, we notice from a graphical analysis that countries whose trade openness level is higher than 2 (to recall the trade openness indicator is not expressed in percentage) represent outliers in the full sample. We, therefore, remove these four countries (Liberia, Malaysia, Seychelles and Singapore), and re-estimate the specification of model (1) described just above, results of which are reported in column [2] of Table 6.

Second, we estimate another specification of model (1) that contains the interaction between the index of productive capacities and the financial openness variable. The results of this specification of model (1) are displayed in column [3].

Finally, columns [4] and [5] of Table 6 contain estimates arising from the estimation of two different other specifications of model (1): the first one contains the interaction between the index of productive capacities and the inflation rate variable (see results in column [4]), and the second one includes the interaction between the index of productive capacities and the financial development variable (see results in column [5]).

It is interesting to note that all requirements for the consistency of the two-step system GMM estimator are met, and additionally the coefficients of the lagged dependent variable are positive and significant in all six columns. Taking up the estimates in column [1], we find that the coefficient of the interaction between the index of productive capacities

Table 6. Effect of the interaction between productive capacities and countries' features on economic resilience_Over the full sample
Estimator: Two-step system GMM

Variables	RESILGMM	RESILGMM	RESILGMM	RESILGMM	RESILGMM
	(1)	(2)	(3)	(4)	(5)
RESILGMM _{t-1}	0.118*** (0.0272)	0.113*** (0.0321)	0.0842** (0.0385)	0.0927*** (0.0298)	0.101*** (0.0267)
PCI	-0.0304*** (0.00737)	-0.0125 (0.00880)	-0.0188* (0.0111)	-0.0426*** (0.00695)	-0.0340*** (0.00860)
PCI*OPEN	-0.000836 (0.00189)	-0.0257*** (0.00794)			
PCI*FINPOL			-0.0613*** (0.0126)		
PCI*INFL				0.00641*** (0.00232)	
PCI*FINDEV					0.00382 (0.0111)
Log(GDPC)	0.302*** (0.0303)	0.200*** (0.0289)	0.343*** (0.0610)	0.284*** (0.0263)	0.327*** (0.0337)
FINPOL	0.231*** (0.0537)	0.333*** (0.0481)	2.047*** (0.411)	0.266*** (0.0526)	0.217*** (0.0539)
OPEN	-0.150** (0.0714)	0.659*** (0.248)	-0.315*** (0.0750)	-0.187*** (0.0334)	-0.203*** (0.0361)
INFL	0.0799*** (0.0172)	0.0262 (0.0250)	-0.0348 (0.0359)	-0.134* (0.0796)	0.0686*** (0.0185)
FINDEV	-0.0969 (0.206)	0.196 (0.216)	-0.0369 (0.344)	-0.0591 (0.233)	-0.195 (0.399)
Constant	-1.686*** (0.158)	-1.444*** (0.269)	-2.001*** (0.360)	-1.133*** (0.210)	-1.739*** (0.174)
Observations - Countries	433 - 118	417 - 114	433 - 118	433 - 118	433 - 118
Number of Instruments	86	86	65	86	86
AR1 (P-Value)	0.0000	0.0000	0.0000	0.0000	0.0000
AR2 (P-Value)	0.3393	0.2779	0.2729	0.3682	0.2886
OID (P-Value)	0.2988	0.1994	0.1293	0.1332	0.3694

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables "PCI", "FINPOL", "OPEN", "INFL", "FINDEV" and the interaction variables have been treated as endogenous.

and trade openness is not significant at the conventional levels. However, the estimates in column [2] show that this coefficient becomes negative and significant at the 1% level. At the same time, the coefficient of “PCI” is not significant at the 10% level. These outcomes suggest that outliers have driven estimates in column [1], which show the absence of a statistically significant joint effect of productive capacities and trade openness on economic resilience. However, based on estimates in column [2], we conclude that the productive capacities further enhance economic resilience as countries improve their level of openness to international trade. Hence, the possible positive effects of trade openness outweigh its possible negative effects (see section 5) in driving the positive effect of productive capacities on economic resilience. Similar findings are observed for the joint effect of productive capacities and financial openness on economic resilience (see column [3]). Results in this column show a negative and significant coefficient (at the 1% level) of the interaction term, and a significant coefficient of “PCI”, but only at the 10% level. We conclude that at the 5% level, the greater the level of financial openness, the higher is the positive contribution of productive capacities to the enhancement of economic resilience. Likewise, we obtain from column [4] that the effect of productive capacities on economic resilience depends on the prevailing inflation rate in the country concerned. This is because both the coefficient of “PCI” and the interaction term of “(PCI*INFL)” are significant at the 1% level, with the former being negative, and the latter being positive. It follows that the lower the inflation rate, the greater is the size of the positive effect of productive capacities on economic resilience. Finally, as per results in column [5], there is no joint effect of productive capacities and financial development on economic resilience. This is because the coefficient of the interaction variable “(PCI*FINDEV)” is not significant at the conventional significance levels, while the coefficient of “PCI” is negative and significant at the 1% level.

In a nutshell, Table 6 conveys a number of key messages. Productive capacities contribute significantly to fostering economic resilience in developing countries that experience greater trade openness, greater financial openness, and lower inflation rates. However, the depth of financial development does not appear to influence the effect of productive capacities on economic resilience in developing countries.

CONCLUSION

The frequency and size of shocks faced by developing countries is higher than the ones by developed countries. This is particularly the case for external shocks (i.e., for example economic and financial shocks that originate in developed countries such as the 2008 financial crisis and the current COVID-9 outbreak) that usually affect disproportionately developing countries. As such, we developed an indicator of economic resilience in developing countries, and makes use of the indicator of productive capacities. Findings show that the development of productive capacities is associated with greater economic resilience in developing countries. Productive capacities appear to exert a lower positive effect on economic resilience in LDCs compared to non-LDCs. The positive economic resilience effects of productive capacities are particularly enhanced in countries that further open-up their economies to both international trade and capital flows, as well as those that strive to maintain a stable macroeconomic environment. Interestingly, development aid, notably AfT flows, appear to enhance the positive effect of productive capacities on economic resilience. However, productive capacities lead to lower levels of economic resilience as countries receive higher inflows of other ODA.

These outcomes have several policy implications. Development aid remains essential for helping developing countries to foster their economic resilience to shocks through the development of productive capacities. A particular attention should be devoted to AfT flows, which in principle, target projects that directly contribute to the enhancement of productive capacities in recipient-countries and are, therefore, less fungible than the other development aid flows. The analysis shows that AfT should be provided to LDCs as they exhibit the lowest levels of productive capacities. Such AfT flows should be scaled up while working with recipients to achieve its intended

purposes. Efforts should also be made to ensure that non-AfT flows do not disrupt the development of recipient productive capacities.

At the same time, policymakers in developing countries should also implement policies that enhance the positive effect of productive capacities on economic resilience. These policies involve ensuring a stable macroeconomic environment, and promoting greater trade and financial openness.

As highlighted by Guillaumont (2017), like any other computed indicator, our indicator of economic resilience certainly has some limitations. Future research could involve trying to address the limitations of our economic resilience indicator, and possibly developing indicators of economic resilience, such as the one built on the basis of the reaction of social indicators to exogenous shocks and income volatility, as suggested by Guillaumont (2017).

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Appendix 1. Definition and source of variables

Variables	Definition	Sources
RESILGMM	This is the index of economic resilience computed using the two-step system GMM estimator (it is a relative indicator of economic resilience). It has been obtained using the following formula (e.g., Yeyati et al. 2007): $RESILGMM = \text{sign}(RESILGMM1) * \log(1 + RESILGMM1)$, where $RESILGMM1$ refers to the absolute value of the economic resilience indicator denoted "RESILGMM1", which has been obtained as the residual of the regression of the indicator of economic growth volatility on the index of structural economic vulnerability. We have transformed "RESILGMM1" into "RESILGMM" using the formula above because the distribution of "RESILGMM1" is highly skewed, and this variable additionally contains negative and positive values.	Author's computation (see Section 4). The economic growth volatility indicator has been computed as the rolling standard deviation over a 3-year-window of the economic growth rate (i.e., the growth rate of the Gross Domestic Product (GDP), constant 2010 US\$). The economic growth variable is extracted from the World Development Indicators (WDI) of the World Bank. The indicator of structural economic vulnerability (denoted "EVI") is described below.
RESILFE	This is the index of economic resilience computed using the within fixed effects estimator (it is a relative indicator of economic resilience). It has been obtained using the following formula (e.g., Yeyati et al. 2007): $RESILFE = \text{sign}(RESILFE1) * \log(1 + RESILFE1)$, where $RESILFE1$ refers to the absolute value of the economic resilience indicator denoted "RESILFE1", which has been obtained as the residual of the regression of the indicator of economic growth volatility on the index of structural economic vulnerability. We have transformed "RESILFE1" into "RESILFE" using the formula above because the distribution of "RESILFE1" is highly skewed, and this variable, additionally, contains negative and positive values.	Author's calculation (see above).
RESILFGLS	This is the index of economic resilience computed using the feasible generalized least squares estimator (it is a relative indicator of economic resilience). It has been obtained using the following formula (e.g., Yeyati et al. 2007): $RESILFGLS = \text{sign}(RESILFGLS1) * \log(1 + RESILFGLS1)$, where $RESILFGLS1$ refers to the absolute value of the economic resilience indicator denoted "RESILFGLS1", which has been obtained as the residual of the regression of the indicator of economic growth volatility on the index of structural economic vulnerability. We have transformed "RESILFGLS1" into "RESILFGLS" using the formula above because the distribution of "RESILFGLS" is highly skewed, and this variable, additionally, contains negative and positive values.	Author's calculation (see 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 eight domains or categories, namely, Information communication and technologies (ICTs), structural change, natural capital, human capital, energy, transport, the private sector and institutions. Each category index is obtained from 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. The components of "PCI" include ICTs (denoted "ICT"), structural change (denoted "SCI"), natural capital (denoted "NATURAL"), human capital (denoted "HUMCAP"), energy (denoted "ENERG"), transport (denoted "TRANSP"), the private sector (denoted "PRIVATE"), and institutions (denoted "INST").	United Nations Conference on Trade and Development (UNCTAD) Statistics portal: https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx See UNCTAD (2020) for a complete description of the methodology used to compute the indicator "PCI".

Variables	Definition	Sources
ODA, AftTOT, AftINFRA, AftPROD, AftPOL	"ODA" is the real gross disbursements of total Official Development Assistance (ODA) expressed in constant prices 2018, US Dollar. "AftTOT" is the total real gross disbursements of Aid for Trade. "AftINFRA" is the real gross disbursements of Aid for Trade allocated to the buildup of economic infrastructure. "AftPROD" is the real gross disbursements of Aid for Trade for building productive capacities. "AftPOL" is the real gross disbursements of Aid allocated for trade policies and regulation. All four AfT variables are expressed in constant prices 2018, US Dollar.	Author's calculation based on data extracted from the database OECD statistical database on development, in particular the OECD/DAC-CRS (Organization for Economic Cooperation and Development/Donor Assistance Committee)-Credit Reporting System (CRS). Aid for Trade data cover the following three main categories (the CRS Codes are in brackets): <u>Aid for Trade for Economic Infrastructure ("AftINFRA")</u>, which includes transport and storage (210), communications (220), and energy generation and supply (230); <u>Aid for Trade for Building Productive Capacity ("AftPROD")</u>, which includes banking and financial services (240), business and other services (250), agriculture (311), forestry (312), fishing (313), industry (321), mineral resources and mining (322), and tourism (332); and <u>Aid for Trade policy and regulations ("AftPOL")</u>, which includes trade policy and regulations and trade-related adjustment (331).
NonAftTOT	This is the measure of the development aid allocated to other sectors in the economy than the trade sector. It has been computed as the difference between the gross disbursements of total ODA and the gross disbursements of total Aid for Trade (both being expressed in constant prices 2018, US Dollar).	Author's calculation based on data extracting from the OECD/DAC-CRS database.
EVI	This is indicator of structural economic vulnerability, also referred to as the Economic Vulnerability Index. The "EVI" is developed by the United Nations Committee for Development Policy (CDP), and regularly updated on a retrospective and yearly basis by the FERDI (Foundation for Studies and Research on International Development) (e.g., Feindouno and Goujon, 2016). It is the simple arithmetic average of two sub-indexes, which are the intensity of exposure to shocks (exposure sub-index) and the intensity of exogenous shocks (shocks sub-index). In turn, these two sub-indexes have been computed using a weighted average of different component indexes, with the sum of components' weights being equal to 1 so that the values of EVI range between 0 and 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: 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 zone (25%). The three component indexes of the shocks sub-index (with their weights in brackets) are: the victims of natural disasters (25%), the instability in the agricultural production (25%), and the instability in exports of goods and services (50%). A rise in the values of EVI indicate greater structural economic vulnerability. For further details on the computation of the EVI, see for example Feindouno and Goujon (2016).	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
FINDEV	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).	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).
GDPC	Per capita Gross Domestic Product (constant 2010 US\$).	WDI

Variables	Definition	Sources
INFL	The variable "INFL" has been calculated using the following formula (e.g., Yeyati et al. 2007): $INFL = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} \times 100$, where refers to the absolute value of the annual inflation rate (%), denoted "INFLATION". The annual inflation rate (%) is based on consumer price index -CPI- (annual %) where missing values have been replaced with values of the GDP Deflator (annual %).	Author's calculation based on data from the WDI.
FINPOL	This is the measure of financial policy, i.e., de jure financial openness.	This index has been computed by Chinn and Ito (2006) and updated in July 2020. Its value ranges between 0 and 1. See: http://web.pdx.edu/~ito/Chinn-Ito_website.htm For the purpose of the present study, we have transformed this index by multiplying its values by 100. So, its values range here between 0 and 100.
OPEN	Measure of trade openness calculated as the share of sum of exports and imports of goods and services in GDP. This variable is not expressed in percentage.	Author's calculation based on data extracted from the WDI

Appendix 2. Descriptive statistics on variables used in the model over the full sample

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
RESILGMM1	547	0.011	0.528	-1.596	1.818
RESILFGLS1	547	-0.016	1.998	-2.779	15.674
RESILFE1	547	-0.061	2.590	-7.871	13.494
PCI	546	27.541	5.972	12.873	44.850
HUMCAP	546	43.155	10.138	20.341	87.523
NATURAL	546	53.830	8.679	32.952	92.075
ENERG	546	24.593	6.964	6.771	58.484
TRANSP	546	15.025	6.726	4.522	58.009
ICT	546	7.833	4.456	2.824	29.727
INST	546	47.660	14.631	16.587	92.289
PRIVATE	546	75.566	8.947	38.160	93.821
SCI	546	17.154	4.642	1.880	36.890
FINPOL	547	0.432	0.345	0.000	1.000
OPEN	544	0.811	0.458	0.002	4.190
INFLATION	547	6.542	9.871	-6.701	188.343
FINDEV	547	0.249	0.166	0.011	0.857
ODA	507	852	1010	0.29	5850
AfTTOT	499	212	365	0.067224	3380
AfTINFRA	499	125	243	0.013896	2530
AfTPROD	499	83	141	0.029398	1550
AfTPOL	487	4.103	11.9	0.000025	188
NonAfTTOT	499	651	753	4.133839	5150
GDPC	546	6654.459	10308.89	218.3344	67312.96

Note: The variables "ODA", "AfTTOT", "AfTINFRA", "AfTPROD", "AfTPOL" and "NonAfTTOT" are expressed in millions of US\$.

Appendix 3. List of countries contained in the full sample

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

Note: The symbol "**" refers to least developed countries (LDCs) in the full sample.