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Financial Deepening, Terms of Trade Shocks, and Growth Volatility in Low-Income Countries

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Abstract

This paper contributes to the literature by looking at the possible relevance of the structure of the financial system—whether financial intermediation is performed through banks or markets—for macroeconomic volatility, against the backdrop of increased policy attention on strengthening growth resilience. With low-income countries (LICs) being the most vulnerable to large and frequent terms of trade shocks, the paper focuses on a sample of 38 LICs over the period 1978-2012 and finds that banking sector development acts as a shock-absorber in poor countries, dampening the transmission of terms of trade shocks to growth volatility. Expanding the sample to 121 developing countries confirms this result, although this role of shock-absorber fades away as economies grow richer. Stock market development, by contrast, appears neither to be a shock-absorber nor a shock-amplifier for most economies. These findings are consistent across a range of econometric estimators, including fixed effect, system GMM and local projection estimates.

JEL Classification Numbers: F40, G20, O10

Keywords: Banks, stock markets, terms of trade shocks, growth volatility

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I. INTRODUCTION

While financial development and its effects on economic growth have attracted considerable attention in the literature, far less work has been done on the relationship between financial deepening and macroeconomic volatility. Is the financial system a shock-absorber or a shock-amplifier? Is there something like too much finance?[2] The 2008 financial crisis has brought back these questions to the front. Few studies have also examined the possible importance of the structure of the financial system, i.e. whether financial intermediation is performed through banks or markets, for macroeconomic volatility. Theory provides conflicting predictions. Empirically, the results have been equally mixed.

Yet, macroeconomic stability is a prerequisite for durable, sustainable and inclusive growth. Furthermore, it has been observed that faster growing economies on average do not necessarily grow faster than others in good times but manage to be more resilient and limit the extent of a downturn in bad times. Between 1950 and 2011, most of the relatively faster growth of high-income countries has resulted not from experiencing faster growth but rather from shrinking less, and less often, compared to lower-income countries (World Bank, 2017). Therefore, understanding what contributes to macroeconomic volatility and identifying options to improve global resilience of economies become critical.

On average, most of the explained growth volatility stems from external factors, which in turn are the result mainly of terms of trade volatility (World Bank, 2018). This is particularly the case in countries where trade is concentrated on a narrow range of products, such as small states (Easterly and Kraay, 2000) and resource-rich countries. Positive shocks increase domestic demand, which translates into higher economic growth as domestic supply reacts to higher domestic demand. In contrast, negative shocks lead to domestic demand contraction and ultimately lower economic growth. The channel of transmission can also arise through domestic production costs with a more direct impact on the supply side.

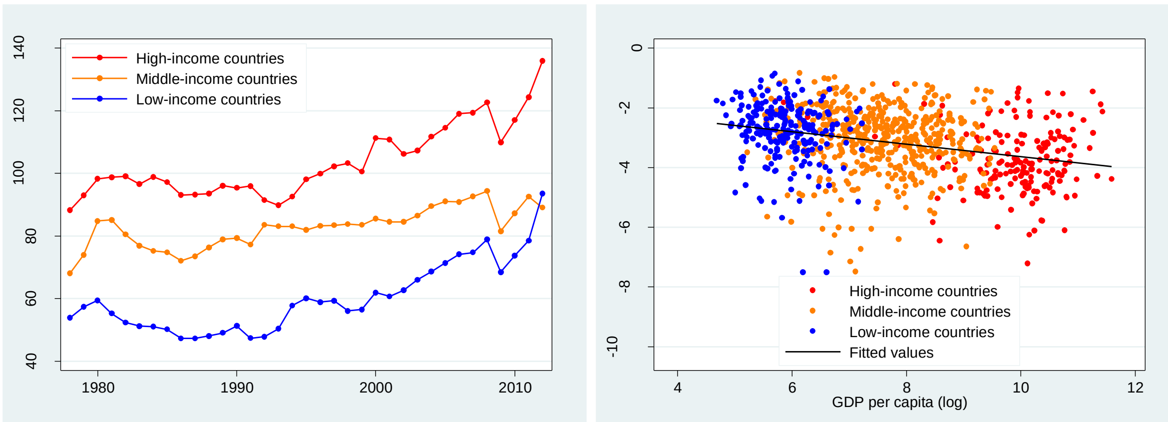
Against this background, examining the case of low-income countries (LICs) is of particular importance. LICs have been increasingly integrating into the world economy (Figure 1), suggesting that the economic effect of terms of trade fluctuations is amplified as diversification continues to be lackluster. On average, LICs also exhibit higher terms of trade volatility. Yet, their financial sectors remain shallow and their development has stagnated over time (Figure 2). Should we be concerned about this mismatch? Should greater effort be paid in developing financial sectors in LICs to make them more resilient to external shocks and allow them to reap the benefits of greater globalization while containing its downside risks?

This paper aims to contribute to the literature in several ways. First, it examines the impact of financial sector development on growth volatility, and looks specifically at terms of trade shocks to see how the financial sector dampens or amplifies these shocks. Second, it focuses on LICs, reaching more conclusive results on the potential shock-absorber role of the financial sector, and compares the results with a wider sample. Third, it tries to capture the role of the structure of the

[2] See Law and Singh, 2014; and Arcand et al., 2015.

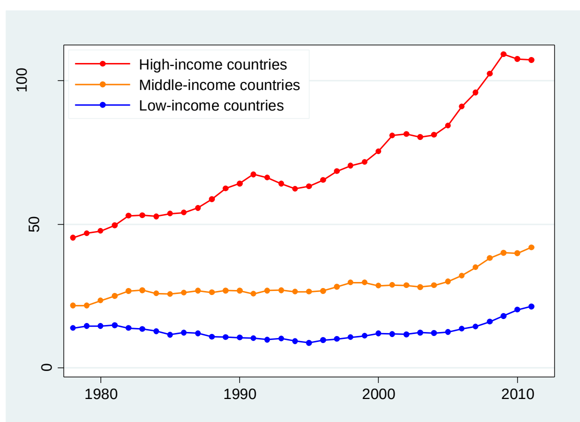
financial system by examining to what extent both banking and stock market development play out in the transmission of external shocks.

Figure 1. Trade Openness and Terms of Trade Volatility by Income Groups, 1978-2012



Notes. Trade openness is the ratio of the sum of exports and imports to GDP. Terms of trade volatility is the standard deviation of the residual of the log of terms of trade relative to its long-term trend (see section 3).
Sources. World Development Indicators and authors' calculations.

Figure 2. Trends in Private Credit Ratio to GDP by Income Groups, 1978-2012



Sources. Financial Development and Structure Dataset (Beck et al., 2000), and authors' calculations.

The results from different econometric methodologies (fixed effect, system GMM, and local projections) with a sample of 38 LICs during 1978-2012 provide support to the hypothesis that banking sector development acts as a shock-absorber, including through dampening the transmission of terms of trade shocks to growth volatility in LICs. Nevertheless, this role fades away as economies grow richer. Stock market development, by contrast, appears neither to be a shock-absorber nor a shock-amplifier for most cases. Financial deepening achieved through the expansion of banks would thus be associated not only with the usual arguments of better access to finance, but also be more resilient in the face of external shocks, especially at early stages of economic development.

In what follows, Section II reviews the literature; Section III discusses the data and describes the methodology; Section IV presents the results; and Section V concludes with policy implications.

II. Theoretical Background and Review of the Literature

On the one hand, financial deepening provides opportunities to diversify risks, manage volatility and insure against unexpected events (Stiglitz, 1974; Newberry, 1977; Atkinson and Stiglitz, 1980; Townsend, 1982; and Bardhan et al., 2000). Furthermore, it could be argued that more developed financial systems could make monetary policy more effective in carrying out counter-cyclical policies. These arguments would lead to think that deeper financial markets would absorb external shocks and make an economy more resilient.

On the other hand, financial institutions operate in settings where complete information is often not available. Entrepreneurs seeking financing normally have more information about their projects than their banks do. In this setting, from the viewpoint of a financial institution projects that may have different probabilities of success are indistinguishable. This information asymmetry requires banks to screen applications to grant loans only to the most promising projects (Singh, 1992).

The lender cannot rely simply on increasing the interest rate, however. As Stiglitz and Weiss (1981) demonstrated, increases in the interest rate charged on loans may adversely affect the composition of the pool of borrowers. The expected return to the lender depends on the probability of repayment, so the lender would like to be able to identify borrowers who are more likely to repay. Those who are willing to borrow at high interest rates, however, may be riskier: they are willing to borrow at high interest rates because they perceive their probability of repaying the loan to be low. For a given expected return, an increase in interest rates will induce low-risk projects to drop out first, leaving only the riskier ones in the pool.

Lenders could require collateral, which imposes a cost if the entrepreneur defaults. As the probability of failure is greater for high-risk projects, the same amount of collateral will reduce the expected profit of these projects by more than that of less risky ones. Bester (1985) demonstrated that lenders could design attractive contracts adapted to the various qualities of borrowers, leading to perfect sorting.

In this setting, adverse shocks to the net worth of borrowers would amplify macroeconomic fluctuations (Bernanke and Gertler, 1990; Greenwald and Stiglitz, 1991). According to the "financial accelerator" theory as spelled out in Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), for instance, during booms, borrowers net worth improves, increasing their access to finance, boosting investment and output beyond levels that their cash flow or internal financing ability would have allowed. On the contrary, during busts, borrowers net worth declines, limiting their access to finance and hampering investment and output. Terms of trade shocks through these channels would directly affect borrowers' ability to access financing.

Alternatively, loan providers could invest in gathering additional information on projects that would lead to a better perception of the probability of success for a given project (Devinney, 1986; Singh, 1994, 1997). In this regard, several authors have argued that banks would be better placed than markets in alleviating these informational problems. For instance, Diamond (1984), Boot and Thakor (1997), Boyd and Prescott (1986), and Ramakrishnan and Thakor (1984) stress the critical role banks play in easing information asymmetries and thereby improving resource allocation.

Furthermore, banks frequently establish close, long-term relations with firms and ease cash-flow constraints on existing firm expansion with positive ramifications on economic growth (Hoshi et al., 1991). By contrast, markets have been argued not to produce the same improvements (Bhide, 1993; Stiglitz, 1985). Stiglitz (1985), for instance, argues that well-developed markets quickly and publicly reveal information, which reduces the incentives for individual investors to acquire information. When confronted with a terms of trade shock eroding borrowers' net worth, banks would be better able to contain the negative effect on access to external financing. A bank-based financial system would thus be more resilient than a market-based one.

Not all borrowers are affected in the same way by a terms of trade shock and banks could be better able to share risks. Banks may have comparative advantages in the provision of liquidity, particularly in the early stage of development. In low-income countries, firms in the export sector are likely to be more creditworthy than others, and hence may have better access to external finance. Adverse terms of trade stocks could cause a contraction in firms' output in the export sector, potentially exacerbating financial constraints. Banks, by providing short-term loans, enable those firms to smooth output fluctuations, as the contraction in output would be less than what it would have been if the firms only relied on internal cash flows for their working capital. As pointed out by Raddatz (2006), banks are more important for the provision of liquidity (for instance in the form of credit lines) than arms-length markets, especially in less financially developed countries. The provision of counter-cyclical lending by banks reflect their ability to pool resources and allow risk-sharing with other sectors not subject to the same business cycle. This mechanism also applies to firms' investment. Since large investment projects require both internal and external financing, better access to credit enables firms involved in exports to become less dependent on internal cash flows for investment decisions, therefore protecting critical investment from terms of trade fluctuations.

The importance of a market-based versus bank-based financial system may depend on existing institutions. According to this view, economies will benefit from becoming more market-based only as their institutional framework strengthens (Levine, 2002). Gerschenkron (1962), Boyd and Smith (1998), and Rajan and Zingales (1999) stress that banks can more effectively force firms to honor their contracts than atomistic markets and would thus be especially important in countries at early stages of development and with weak contract enforcement capabilities. As institutions in countries mature, the exchange of information becomes more efficient, reducing the cost of screening borrowers, and eroding the comparative advantage of banks versus markets.

Hence, theoretically, given a certain level of economic and institutional development, banks may have an advantage in dealing with information asymmetries compared to markets. If this is true, a bank-based financial system would be better able to handle adverse terms of trade shocks on its clients' net worth and prevent – or at least limit – the extent to which they are cut off from financing or even be able to provide them with needed liquidity. The more a financial structure would be bank-oriented the more it would be able to absorb rather than amplify shocks. This relationship could be, however, non-linear: as the institutions of a country get stronger and its economy richer, the role of banks as shock-absorbers could fade away.

The theoretical ambiguity is reflected in the divergence of empirical results. Looking at aggregate panel data, Denizer et al. (2002) and Ferreira da Silva (2002) show that financial depth, especially bank development, is associated with lower output, investment and consumption volatility. Tiryaki (2003) and Beck et al. (2006), by contrast, do not find any robust relation between banking development and growth volatility.

Other empirical analyses provide evidence of a non-linear, U-shaped, relationship between banking sector development and macroeconomic volatility. Some authors argue that macroeconomic volatility first diminishes until a certain threshold of banking development is reached and increases thereafter (Easterly et al., 2001; Dabla-Norris and Srivisal, 2013). Evidence from the recent global financial crises would support this view that while financial depth can be associated with lower volatility related to real sector shocks, it can also be positively correlated with financial sector shocks and thus macroeconomic volatility. This threshold tends to be relatively high, however, observed in advanced economies only. Kunieda (2015), by contrast, reaches the opposite conclusion, namely that when the banking sector is poorly developed or well advanced, it contributes to economic stability, while in the middle it contributes to volatility.

Empirical studies looking at industry level data have tended to support the stabilization role banks could play, especially for firms highly dependent on external financing or requiring large amounts of liquidity. Larrain (2006) uses firm data and find that short-term debt is less correlated with sales and inventories as financial depth increases, thus supporting the shock-absorber role of banking sector development. Although the author finds that a well-functioning stock market has a dampening effect on output fluctuations, the effect of banks is larger and more significant. Similarly, Raddatz (2006) shows that, in contrast with stock market development, banking development is associated with lower industry output volatility—particularly in the case of industrial sectors facing high liquidity needs—, mainly through a reduction in the relative variance of growth in output per firm. Similar results are reached by Huang and al. (2012).

Fewer studies have focused on the question whether the financial sector amplifies or dampens the effects terms of trade shocks on output volatility. Using aggregate panel data, Beck et al. (2006) and Dabla-Norris and Srivisal (2013) examine the interaction term between financial depth and terms of trade volatility. Dabla-Norris and Srivisal (2013) looking at a large sample of advanced and developing economies find strong evidence that deeper banking systems serve as shock-absorbers, mitigating the negative effects of terms of trade on macroeconomic volatility. Beck et al. (2006), however, examining a smaller sample of low-, middle-, and high-income countries find generally insignificant coefficients on the interaction of financial intermediary development and terms of trade volatility, suggesting weak evidence for a dampening effect of financial intermediary development on the impact of terms of trade volatility.

Finally looking at the structure of the financial system, Denizer et al. (2002) provide evidence that the structure of the financial system matters in explaining macroeconomic volatility. Looking at a panel of advanced and developing economies, the authors suggest that financial sectors more reliant on stock markets are positively associated with greater consumption volatility. Similarly, Yeh et al. (2013), observe that more market-based countries enjoy faster economic growth but suffer more from economic fluctuations in the long run than economies where the financial system is more bank-based. At a country level, Wei and Kong (2016) show that in the case of China, bank-based financial depth decreases real per capita GDP volatility, while the development of a stock market has no consistent effect. None of these studies examine, however, whether the structure of the financial system amplifies or dampens the impact of terms of trade shocks.

III. THE DATA, MODEL AND ECONOMETRIC APPROACH

A. Data and sample

This study focuses on a sample of 38 LICs over the period 1978-2012.[3] The definition of LICs follows that of the World Bank based on the level of Gross National Income (GNI) per capita. We expand the sample to 121 developing countries in some specifications to assess whether the results are specific to the LICs or also apply more widely to other income groups. The period of study, dictated by data availability, is split in seven subperiods of five years each. Given the small size of the country sample, the panel structure allows to obtain a higher number of observations than in a cross-country setting, while averaging the data over sub-periods helps smooth out noises.

B. Model specification

The basic idea is to examine to what extent financial development, both banking and stock market development, plays out in the transmission of external shocks, controlling for other factors that may affect growth volatility. Given that the theory does not offer a clear-cut answer, the empirical analysis could help uncover the direction and magnitude of the impact. To this effect, this paper adopts a linear model with the following specification, drawing on Kpodar and Imam (2016):

$$Vgrowth_{i,t} = \alpha_0 + \beta Vtot_{i,t} + \varphi Findev_{i,t} + \delta Vtot_{i,t} * Findev_{i,t} + AX_{i,t} + u_i + \varepsilon_{i,t} \qquad (1)$$

where the subscripts i and t respectively denote country and time period, *Vgrowth* represents real GDP growth volatility, *Vtot* is the volatility of terms of trade, *Findev* is the indicator of financial development, *X* is a set of control variables including the level of GDP per capita, trade openness (measured by the sum of exports and imports divided by GDP), financial volatility, inflation volatility, political stability (an index constructed by the World Bank) and the share of agricultural value added in GDP, *u* is the country-specific effect and ε is the error term.

[3] The size of the sample is driven by data availability.

In measuring financial development, we use indicators of banking development but also stock market development to see if there is a differentiated association with growth volatility. For banking sector development, the private credit ratio and the liquidity ratio are used as indicators, while stock market development is proxied by the market capitalization ratio and the total value traded ratio. Financial volatility is measured by the volatility in the private credit ratio or the liquidity ratio.

The variables of interest are the standalone financial depth variable and its interaction with terms of trade volatility. A negative coefficient on the interaction variable would lend support to the hypothesis that financial development acts as a shock-absorber, while a positive sign would indicate that financial depth in fact exacerbates external shocks. A similar interpretation applies to the standalone financial depth variable, but with the difference that this effect is not conditioned to the nature of the shock.

For the other variables, and consistent with previous findings in the literature, we expect terms of trade shocks to be positively correlated to growth volatility, in particular in LICs where economic diversification is scant. Similarly, GDP per capita could be negatively correlated with growth volatility, reflecting high sectoral concentration in high-risk sectors during early stages of development as underscored in Koren and Tenreyro (2007). Trade openness may have an ambiguous effect on output volatility as it provides opportunities for diversification and international risk sharing, but also triggers greater exposure to external shocks. The share of agricultural value added in GDP (a proxy of weather-related shocks), as well as financial volatility, inflation volatility, and a lack of political stability are expected to be positively associated with higher output volatility, in part due to their direct impact on economic activities but also because they are likely to disrupt investment decisions and create economic uncertainties. Table A1 presents the summary statistics of the correlation matrix, with the sign of the correlation coefficients broadly in line with expectations.[4]

How is volatility measured? The traditional approach in the literature has been to use the standard deviation of the growth rate of the given variable during a specific period. However, this approach relies on strong assumptions regarding the functional form of the long-term component. Following Kpodar and Imam (2016) and Chauvet et al. (2018), we use instead a more flexible approach, assuming that the long-term component follows an AR (1) process with a trend as follows:

$$\ln(y_{i,t}) = \alpha_i + \beta_i \ln(y_{i,t-1}) + \gamma_i t + \varepsilon_{i,t} \qquad (2)$$

$y_{i,t}$ is the real GDP for country i at time t, and $\varepsilon_{i,t}$ is the error term.

Fitting equation (2) for each country individually with annual data over the period 1978-2012 allows estimating the error term $\widehat{\varepsilon_{i,t}}$, which captures the cyclical component of the logarithm of real GDP given the assumed functional form of the long-term component:

[4] For the definition of the variables and their sources, see Table A2.

$$\widehat{\varepsilon_{\iota,t}} = \ln(y_{i,t}) - \ln(\widehat{y_{\iota,t}}) \qquad (3)$$

$\ln(\widehat{y_{\iota,t}})$ is the fitted value of $\ln(y_{i,t})$ derived from equation (2)

For each sub-period of 5 years, growth volatility $Vgrowth$ is calculated as the standard error of the cyclical component $\widehat{\varepsilon_{\iota,t}}$, as shown below:

$$Vgrowth = \sqrt{\sum_{j=1}^{5} \frac{(\widehat{\varepsilon_{\iota,t}} - \overline{\widehat{\varepsilon_{\iota,t}}})}{4}} \qquad (4)$$

$\overline{\widehat{\varepsilon_{\iota,t}}}$ is the average of $\widehat{\varepsilon_{\iota,t}}$ over the sub-period

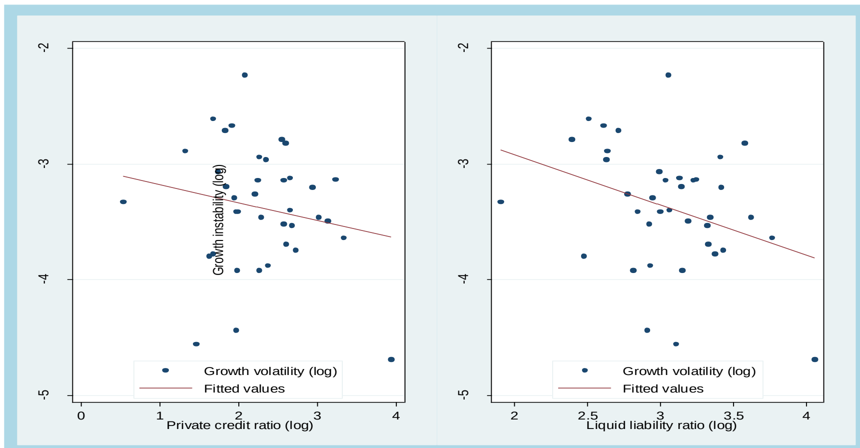
This approach has the advantage to allow for country-specific coefficients in equation (2) as well as to control for the presence of a time trend in the series. In contrast, the standard approach of using the standard deviation of the growth rate as a measure of growth volatility implicitly assumes that in equation (2): $\alpha_i = \gamma_i = 0$ and $\beta_i = 1$ for all countries.

To estimate the model, three econometric estimators are used: the fixed effect estimator, the system GMM estimator and the local projection approach. The fixed-effect estimator allows to control for time-invariant country-specific factors that may affect growth volatility, thereby reducing the risk of omitted variables. However, endogeneity issues may arise due to omitted variables (not addressed by the inclusion of country-specific effects), measurement errors and reverse causality. For instance, growth instability might lead to lower credit to the private sector when banks are risk-averse and scale back credits in the face of economic uncertainties. Similarly, output volatility could dampen long-term per capita growth, as evidenced in Ramey and Ramey (1995). As an attempt to tackle potential endogeneity issues, we use the system GMM estimator developed by Blundell and Bond (1998) to instrument the right-hand side variables with the appropriate lags. Blundell and Bond (1998) find that the system GMM estimator, which uses both the difference panel data and the level specification, improves significantly the consistency and efficiency of the estimates compared to the first-differenced GMM developed by Arellano and Bond (1991). The rationale for the local projection approach will be discussed in a subsequent section as it involves a slightly different model specification and relies on annual data.

IV. The Results from the Fixed-Effect and System GMM Estimations

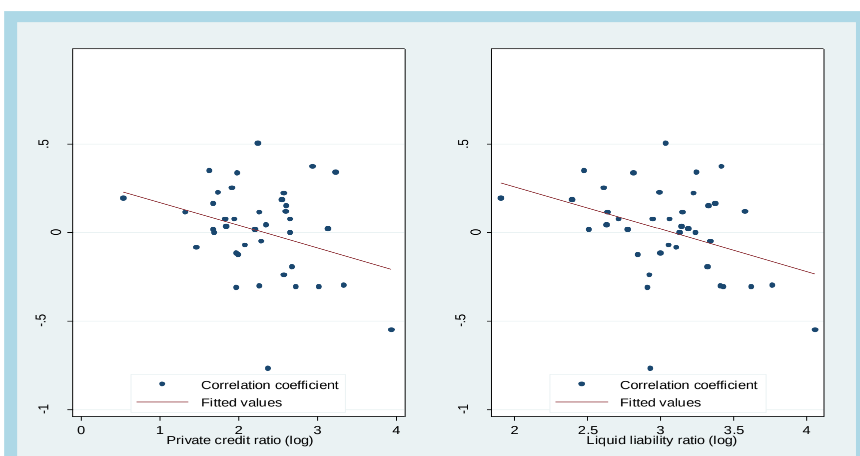
Before proceeding with the econometric estimations, a quick look at the data provides some interesting insights. Figure 3 shows that, in the sample of LICs considered, those with deeper banking systems tend to experience lower growth volatility, regardless of the measure of financial depth. More importantly, Figure 4 shows that the correlation between terms of trade shocks and growth volatility is weaker in countries with a more developed banking sector. These results point in favor of the hypothesis that financial development acts as a shock-absorber, particularly in mitigating the negative effects of real external shocks. However, the picture is less clear cut when considering stock market indicators (Figure 5), probably suggesting that in LICs banks are better at insulating the economy from shocks than stock markets. The absence of a stock market or its limited development in many LICs do not allow, however, to draw definite conclusions.

Figure 3. Banking Sector Development and Growth Volatility in LICs, 1978-2012



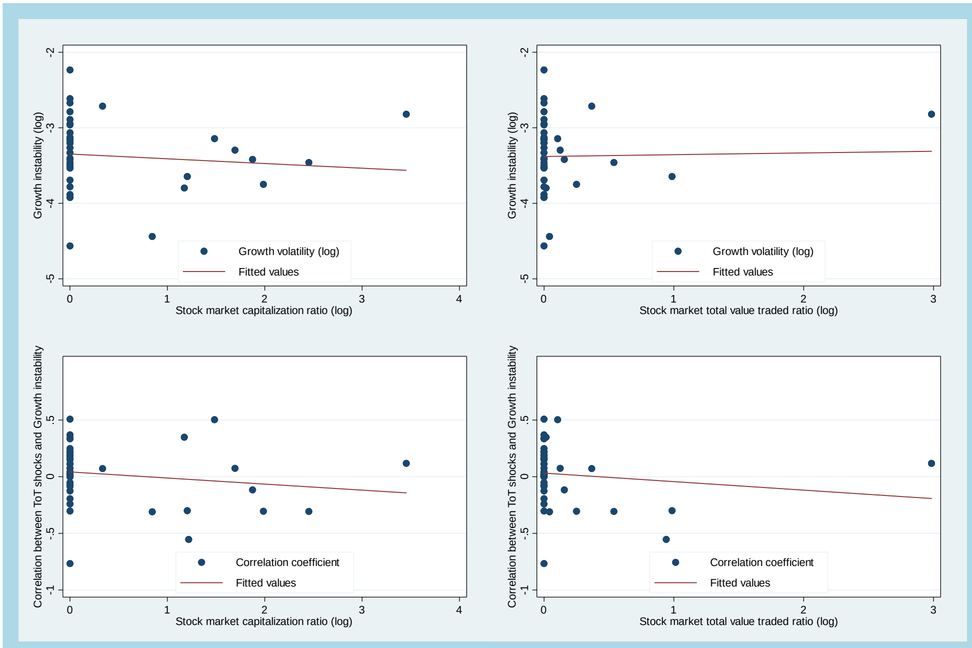
Sources. Financial Development and Structure Dataset (Beck et al., 2000), and authors' calculations.

Figure 4. Banking Sector Development and the Correlation between Growth Volatility and Terms of Trade Shocks in LICs, 1978-2012



Sources. Financial Development and Structure Dataset (Beck et al., 2000), and authors' calculations.

Figure 5. Stock Market Development, Growth Volatility and its Correlation with Terms of Trade Shocks in LICs, 1978-2012



Sources. Financial Development and Structure Dataset (Beck et al., 2000), and authors' calculations.

Table 1 reports the results from the fixed effects estimator. They provide support to the hypothesis that banking sector development acts as a shock absorber in LICs. Banking sector development captured by the private credit ratio is negatively associated with growth volatility consistently across specifications, not only as a standalone variable but also as an interaction with terms of trade volatility. The economic significance is meaningful as moving from the first decile of the distribution of private credit ratio (4.2 percent of GDP) to the first quartile (6 percent of GDP) reduces the elasticity of growth volatility to terms of trade shocks by about 40 percent (from 0.39 to 0.24).[5]

The results also suggest that growth volatility tends to decline as income per capita rises. The coefficient on income per capita is negative and significant in four out of six specifications. As expected, political stability appears to be associated with lower growth volatility, while credit growth volatility seems to be positively related to it. However, we do not find any evidence that higher inflation volatility be related to higher growth volatility, nor that an agriculture driven economy would be subject to larger output volatility.

[5] Estimate obtained using the specification of column 6 in Table 1.

Table 1. Financial Development, Terms of Trade Shocks and Growth Volatility: Fixed-Effect Estimates

Fixed effects	(1)	(2)	(3)	(4)	(5)	(6)
	LICs	LICs	LICs	LICs	LICs	LICs
GDP per capita (log)	-0.423	-0.328	-0.375	-0.520	-0.379	-0.439
	[0.183]**	[0.189]*	[0.202]*	[0.197]**	[0.278]	[0.329]
Trade openness	-0.003	-0.004	-0.003	-0.004	0.001	-0.004
	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.007]
Terms of trade volatility (log)	0.893	0.838	0.803	0.926	0.740	0.599
	[0.160]***	[0.166]***	[0.132]***	[0.166]***	[0.152]***	[0.173]***
Private credit ratio (log)	-0.896	-0.860	-0.858	-0.918	-0.827	-0.725
	[0.207]***	[0.206]***	[0.195]***	[0.214]***	[0.224]***	[0.236]***
Private credit ratio (log) * Terms	-0.323	-0.311	-0.295	-0.335	-0.269	-0.255
of trade volatility (log)	[0.069]***	[0.068]***	[0.056]***	[0.068]***	[0.058]***	[0.062]***
Credit growth volatility (log)		0.239				0.208
		[0.080]***				[0.147]
Inflation volatility (log)			0.078			0.011
			[0.094]			[0.123]
Political stability					-0.505	-0.645
					[0.205]**	[0.218]***
Agricultural value-added share				-0.349		-0.534
				[0.352]		[0.559]
Constant	1.333	1.145	1.100	3.268	0.081	2.424
	[0.946]	[0.969]	[0.953]	[2.169]	[1.533]	[3.420]
Observations	180	177	171	175	129	118
Number of countries	38	38	38	37	38	37
R-squared	0.16	0.20	0.17	0.17	0.20	0.27

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively.

Looking at the shock variables, it is worth noting that across specifications the elasticity of growth volatility to terms of trade shocks is the largest, three times the elasticity to credit growth volatility. Consistent with Easterly and Kraay (2000) and World Bank (2018), this suggests that terms of trade shocks are one of the main sources of growth volatility in LICs. This observation is not quite surprising considering the narrow export base for many LICs and the high reliance of government budget on commodity revenues. The results from the one-step system GMM estimator[6] with robust standard errors are presented in Tables 2.[7] They largely confirm the findings from the fixed-effect estimations (column 1 to 5, Table 2).[8]

Table 2. Financial Development, Terms of Trade Shocks and Growth Volatility: System-GMM Estimates

System GMM	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	LICs	LICs	LICs	LICs	LICs	LICs+LMICs	Developing countries
GDP per capita (log)	-0.517	-0.413	-0.401	-0.393	-0.442	-0.200	-0.211
	[0.304]*	[0.296]	[0.268]	[0.408]	[0.348]	[0.151]	[0.168]
Trade openness	-0.006	-0.006	-0.008	-0.006	-0.007	-0.009	-0.013
	[0.004]	[0.004]	[0.005]	[0.005]	[0.006]	[0.005]**	[0.004]***
Terms of trade volatility (log)	1.154	0.933	1.409	0.983	0.796	0.773	0.455
	[0.422]***	[0.386]**	[0.487]***	[0.421]**	[0.381]**	[0.342]**	[0.244]*
Private credit ratio (log)	-0.889	-0.698	-1.244	-0.982	-0.776	-0.409	-0.213
	[0.411]**	[0.373]*	[0.531]**	[0.465]**	[0.395]**	[0.395]	[0.279]
Private credit ratio (log) * Terms of trade volatility (log)	-0.331	-0.270	-0.434	-0.327	-0.274	-0.248	-0.169
	[0.151]**	[0.137]**	[0.167]***	[0.166]**	[0.139]**	[0.122]**	[0.083]**
Credit growth volatility (log)		0.203			0.482	-0.116	0.125
		[0.151]			[0.174]***	[0.218]	[0.161]
Inflation volatility (log)			-0.101		-0.102	0.320	0.176
			[0.152]		[0.140]	[0.161]**	[0.111]
Agricultural value-added share				0.168	-0.606	-0.145	-0.513
				[0.740]	[0.495]	[0.275]	[0.251]**
Constant	2.751	1.839	2.698	1.193	4.207	0.800	1.488
	[2.151]	[1.877]	[2.121]	[5.171]	[3.941]	[1.819]	[1.709]
Observations	180	177	171	175	163	373	542
Number of countries	38	38	38	37	37	83	121
Hansen test p-values	0.40	0.45	0.35	0.43	0.49	0.52	0.14
AR(2) test (p-values)	0.51	0.44	0.42	0.55	0.43	0.36	0.69

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively. AR(2): Arellano and Bond test of second order autocorrelation.

[6] All covariates are assumed endogenous and instrumented by the second to the fifth lags. Because too many instruments can overfit instrumented variables—failing to remove their endogenous components and biasing the coefficient estimates (Roodman, 2009)—, the instrument set is "collapsed" to limit instrument proliferation, and therefore an upward bias in the Hansen test statistic.

[7] To test the validity of the lagged variables as instruments, we use the standard Hansen test of over-identifying restrictions, where the null hypothesis is that the instrumental variables are not correlated with the residual, and the serial correlation test, where the null hypothesis is that the errors exhibit no second-order serial correlation. The results from both tests support the validity of the instruments.

[8] Political stability is dropped from the regressions because it reduces considerably the sample size due to missing data.

(continued…)

Extending the sample to lower middle-income countries (LMICs, see column 6, Table 2) and then to all developing countries (column 7, Table 2) leads to several observations.[9] First, consistent with the U-shape results found by Dabla-Norris and Srivisal (2013), the association between banking sector development and growth volatility fades away when richer countries are added to the sample. Second, banking sector development dampens the transmission of terms of trade shocks to growth volatility, although it plays a much more important role in reducing output instability in LICs (the elasticity of private credit ratio is not significant for the sample of developing countries in contrast to LICs). This dampening effect has itself a U-shape. Finally, the elasticity of growth volatility with respect to terms of trade shocks is smaller for the sample of developing countries, underscoring the high vulnerability of LICs to terms of trade shocks.

When using the liquidity ratio as an alternative indicator of banking sector development, the results confirm the previous findings (Table 3) with the difference that the liquidity ratio is significant also in the sample of developing countries, in contrast with the private credit ratio. In fact, while both indicators are often used interchangeably, they capture different, although closely intertwined, dimensions of banking sector development. This result suggests that the ability of banks to provide savings opportunities (which the liquidity ratio measures) matters for growth volatility in both LICs and other developing countries, but the credit channel is much more important for LICs, perhaps reflecting tighter credit constraints.

Stock markets have emerged in some LICs as early as in the 1980s and have continued to grow over time, although they are still relatively small, and trading is limited to a few large firms. Are these markets associated differently to volatility? The results presented in Table 4 suggest that there is no robust evidence that stock markets in LICs are associated with lower growth volatility. The coefficient on the stock market indicator is only significant in one out of four specifications (columns 1 to 4, Table 4). Surprisingly, the coefficient on the stock market indicator turns positive and significant in the larger sample of developing countries. Further investigation reveals that this result is not robust as it is driven by outliers, representing a mere 2.5 percent of the total number of observations (see Figure A1).[10] The regressions with the LIC sample are also subject to a robustness test by excluding from the sample the observations with growth volatility that deviates from the sample average by more than two standard deviations. Rerunning the regressions in columns 1 to 4 (Table 4) yields similar findings. Therefore, one can consider that as

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[9] See Table A3 for the mean-comparison tests between LICs and Non LICs.

[10] In Figure A1, we rank countries by increasing level of GDP per capita and run the specification in Table 4 (column 5 and 6) consecutively by only including for each iteration the sample of countries with GDP per capita below a threshold ranging from the first quartile of the sample distribution to the maximum value of GDP per capita. The idea is to see how the coefficients on stock market development and its interaction term with terms of trade volatility converge to the full sample estimates. It appears that the two coefficients only turn positive and significant toward the end of the sample distribution, driven by outliers accounting for 2.5 percent of the sample. In other words, for 97.5 percent of the sample, the two coefficients are not statistically significantly different from zero at conventional levels.

(continued…)

for LICs, stock market development is neither a shock-absorber nor a shock-amplifier as far as growth volatility and the transmission of terms of trade shocks are concerned.[11]

Table 3. Using the Liquid Liability Ratio to Gauge Financial Development: System GMM Estimates

System GMM	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	LICs	LICs	LICs	LICs	LICs	LICs+LMICs	Developing countries
GDP per capita (log)	-0.453	0.026	-0.074	-0.455	0.003	0.347	-0.121
	[0.311]	[0.302]	[0.273]	[0.414]	[0.534]	[0.385]	[0.290]
Trade openness	-0.007	-0.006	-0.008	-0.008	-0.004	-0.008	-0.008
	[0.005]	[0.007]	[0.006]	[0.006]	[0.007]	[0.005]*	[0.004]**
Terms of trade volatility (log)	1.711	2.956	2.634	1.884	3.065	2.536	1.296
	[0.639]***	[1.191]**	[0.967]***	[0.752]**	[1.422]**	[0.928]***	[0.547]**
Liquid liability ratio (log)	-1.305	-3.092	-2.815	-1.584	-3.512	-2.275	-0.969
	[0.608]**	[1.349]**	[1.071]***	[0.735]**	[1.341]***	[1.097]**	[0.564]*
Liquid liability ratio (log) * Terms of trade volatility (log)	-0.470	-0.887	-0.772	-0.545	-0.931	-0.761	-0.366
	[0.193]**	[0.380]**	[0.294]***	[0.240]**	[0.452]**	[0.307]**	[0.159]**
Volatility of the liquid liability ratio (log)		0.272			0.177	0.389	0.444
		[0.287]			[0.284]	[0.284]	[0.195]**
Inflation volatility (log)			-0.115		-0.082	0.151	0.155
			[0.174]		[0.160]	[0.183]	[0.129]
Agricultural value-added share				-0.066	-0.034	0.390	-0.781
				[0.616]	[1.031]	[0.707]	[0.577]
Constant	4.052	7.188	6.065	5.010	8.035	2.276	5.106
	[1.960]**	[3.828]*	[3.376]*	[4.360]	[7.658]	[4.049]	[3.954]
Observations	183	167	173	178	161	368	534
Number of countries	38	38	38	37	37	83	120
Hansen test p-values	0.42	0.52	0.27	0.42	0.45	0.60	0.19
AR(2) test (p-values)	0.38	0.34	0.41	0.37	0.43	1.00	0.69

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively. AR(2): Arellano and Bond test of second order autocorrelation.

Since the System-GMM estimator is designed to handle appropriately model specifications with the presence of the lagged dependent variable, it is worthwhile to introduce the lagged growth volatility in the regressions to account for any persistence in growth volatility. The results in table A4 suggest that, although the coefficient on the lagged growth volatility is positive in most specifications, it is not significant at the standard levels. In other words, a country that has experienced high growth volatility in the past would not necessarily experience the same level of

[11] Some countries do not have stock markets but dropping them will considerably reduce the sample. To ensure that our results are not driven by the large variations of stock market development across the sample, the indicator of stock market development is replaced with a dummy variable capturing the presence of stock markets (it takes 1 when there is a stock market, and 0 otherwise). The results (not shown) confirm the finding that stock markets in LICs, and other developing countries, seem not to help them buffer shocks.

volatility in the future. More importantly, our previous conclusions are robust to the inclusion of the lagged dependent variable.

Table 4. Accounting for Stock Market Development: System-GMM Estimates

System GMM	(1)	(2)	(3)	(4)	(5)	(6)
	LICs	LICs	LICs	LICs	Developing countries	Developing countries
GDP per capita (log)	-0.336	-0.400	-0.282	-0.357	-0.188	-0.179
	[0.353]	[0.340]	[0.355]	[0.324]	[0.202]	[0.182]
Trade openness	-0.006	-0.004	-0.006	-0.004	-0.009	-0.007
	[0.006]	[0.005]	[0.005]	[0.005]	[0.003]***	[0.003]**
Terms of trade volatility (log)	0.703	0.762	0.905	0.825	0.381	0.403
	[0.299]**	[0.327]**	[0.370]**	[0.398]**	[0.254]	[0.243]*
Private credit ratio (log)	-0.621	-0.759	-0.834	-0.875	-0.255	-0.272
	[0.330]*	[0.340]**	[0.431]*	[0.455]*	[0.275]	[0.256]
Private credit ratio (log) * Terms of trade volatility (log)	-0.250	-0.247	-0.293	-0.275	-0.178	-0.173
	[0.107]**	[0.113]**	[0.154]*	[0.160]*	[0.090]**	[0.082]**
Stock market capitalization ratio (log)	-0.238		-0.311		0.265	
	[0.114]**		[0.274]		[0.208]	
Stock market total value traded ratio (log)		-0.078		0.156		0.515
		[0.163]		[0.344]		[0.307]*
Stock market capitalization (log) * Terms of trade volatility (log)			-0.034		0.139	
			[0.101]		[0.069]**	
Stock market total value traded (log) * Terms of trade volatility (log)				0.069		0.233
				[0.127]		[0.096]**
Credit growth volatility (log)	0.401	0.443	0.307	0.468	0.239	0.251
	[0.171]**	[0.169]***	[0.111]***	[0.162]***	[0.124]*	[0.145]*
Inflation volatility (log)	-0.045	-0.126	-0.047	-0.179	0.130	0.118
	[0.148]	[0.143]	[0.101]	[0.146]	[0.099]	[0.091]
Agricultural value-added share	-0.449	-0.384	-0.420	-0.397	-0.626	-0.523
	[0.473]	[0.493]	[0.656]	[0.434]	[0.287]**	[0.248]**
Constant	2.658	2.912	2.766	2.798	1.505	1.051
	[3.663]	[3.844]	[4.316]	[3.540]	[2.143]	[1.862]
Observations	163	163	163	163	542	542
Number of countries	37	37	37	37	121	121
Hansen test p-values	0.91	0.71	0.68	0.85	0.39	0.27
AR(2) test (p-values)	0.47	0.50	0.51	0.54	0.72	0.59

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively. AR(2): Arellano and Bond test of second order autocorrelation.

In the section on model specification, we show how our measure of volatility improves on the standard deviation of growth. Nevertheless, it is important to show that our findings are not driven by the choice of this measure, but rather our preferred indicator of growth volatility is only meant to disentangle better the cycle from the long-term trend. We, therefore, rerun the regressions using the standard deviation of growth as the dependent variable. For consistency purposes, the standard deviation is also used to measure the volatility of the right-hand side variables, notably terms of trade volatility, credit growth volatility and inflation volatility. The results shown in table A5, A6, and A7 suggest that our previous finding hold across specifications with both the fixed-effect and System-GMM estimators.

V. THE ROLE OF FINANCE IN THE DYNAMIC EFFECT OF TERMS OF TRADE SHOCKS ON GROWTH VOLATILITY: A LOCAL PROJECTION APPROACH

The objective of this section is to use a different econometric methodology to see how banking sector and stock market development affect growth volatility and the transmission of terms of trade shocks, while paying attention to the dynamic response of growth volatility which can be far more complex than what the fixed effect and the System GMM estimators can capture. Specifically, the aim is to address the following questions: how fast is the transmission of the shock? What is the magnitude of the peak pass-through? How persistent is the shock (temporary effect vs permanent effect)? How banking sector and stock market development alter this dynamic?

To answer such questions, a standard approach in the literature is to estimate Vector Autoregressive models (VAR), inverting its estimates and then imposing sufficient identifying restrictions to obtain the impulse responses (see for instance Broda, 2004). However, if it turns out that the VAR model does not coincide with the data generation process, this would lead to a misspecification, with potentially serious bias in the coefficient estimates. Jordà (2005) underlines that misspecification errors are compounded with the forecast horizon as an impulse response is a function of forecasts at increasingly distant horizons.

To avoid this drawback, we adopted the local projection approach developed by Jordà (2005). It consists in generating multi-step predictions using direct forecasting models that are re-estimated for each forecast horizon. The approach has the advantage of being robust to misspecification and is relatively straightforward to implement as it can be estimated using OLS. There has been a growing interest in the literature in estimating impulse responses using local projections techniques (see for instance Auerbach and Gorodnichenko, 2013; Ramey and Zubairy, 2014; Caselli and Roitman, 2015; Kpodar and Abdallah, 2017). Nevertheless, Teulings and Zubanov (2014) underscores that the local projection approach may be subject to a bias if innovations in the regressors between periods t and t+h are not controlled for when estimating the impulse response at horizon h. The model specification, incorporating the correction suggested by Teulings and Zubanov (2014), is as follows:

$$Vgrowth_{i,t+h} = \alpha_0 + \beta_k \sum_{k=0}^{n} Vtot_{i,t-k} + \gamma_j \sum_{j=1}^{h} Vtot_{i,t+h} + \delta_h Vtot_{i,t} * DFin_{i,t} + A_h X_{i,t} + u_i + \varepsilon_{i,t+h} \quad (5)$$

where $Vgrowth$ represents the volatility of real GDP growth; $Vtot$ is the volatility of terms of trade; $DFin$ is a dummy variable taking 1 beyond a given level of banking sector or stock market development and 0 otherwise; X is the same set of control variables used for fixed-effect/System-GMM model, which includes trade openness, financial volatility, inflation volatility, and the share of agricultural value added in GDP; u is the country-specific effect and ε is the error term.

Even though the equation for the local projection approach relies on the same set of variables as the fixed-effect/System-GMM model and the specification is quite similar, the equation for the local projection differs slightly from several standpoints:

- The dependent variable $Vgrowth_{i,t+h}$ is the real GDP growth volatility at horizon h=0,1,2,3,4 and 5; allowing to estimate the impact of a terms of trade shocks on growth volatility up to five years after the shock.
- The second term of the equation includes lagged value of terms of trade shocks (n=4),[12] while the third term represents the Teulings and Zubanov (2014)'s adjustment factor to account for shocks occurring within the forecast horizon.
- For the sake of simplicity and to facilitate the graphical representation of the impulse response functions (IRFs), the financial depth variable is replaced by a dummy variable. For banking sector development, the dummy variable takes 1 for values above the sample median for LICs, and zero otherwise. For stock market development, the dummy variable takes 1 if stock market capitalization is strictly positive, and zero otherwise (implying the country does not have stock markets).[13]
- The local projection is estimated with annual data as opposed to the 5 year-average data used for the fixed-effect/System GMM model. This increases the number of observations by three to 4 times, thereby allowing to estimate more precisely the coefficient estimates. Moreover, if our findings are confirmed, this would provide evidence that they are quite robust as they do not depend on data periodicity or averaging.

While the local projection approach brings some advantages, it also raises two main challenges. First, with annual data it is no longer possible to measure the volatility as the standard deviation of the residual relative to the estimated long-term trend over a given period. Instead, the measure of volatility in year *t* is calculated as the absolute value of the difference between the residual at year *t* and the average of the last 5 years (including the year *t*).[14] The second challenge, which is related to the first one, arises from the overlapping nature of the volatility variables. Since the volatility is defined relative to the average of the past 5 years, the error term has, by construction, a moving average form and is potentially autocorrelated, therefore coefficient estimates from standard statistical inference may be biased. To address this issue, we adopt a fixed effect estimator with Driscoll-Kraay standard errors[15] to estimate the IRFs instead of the standard fixed effect estimator. The Driscoll-Kraay fixed-effect estimator has the added advantage of proposing a nonparametric covariance matrix estimator that generates not only heteroskedasticity and autocorrelation-consistent standard errors, but also standard errors that are robust to cross-sectional dependence.

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[12] The number of lags is informed by the construction of the volatility variable for terms of trade.

[13] Due to the very skewed distribution of stock market capitalization in the sample, taking the median value, similar to banking sector development, is not appropriate.

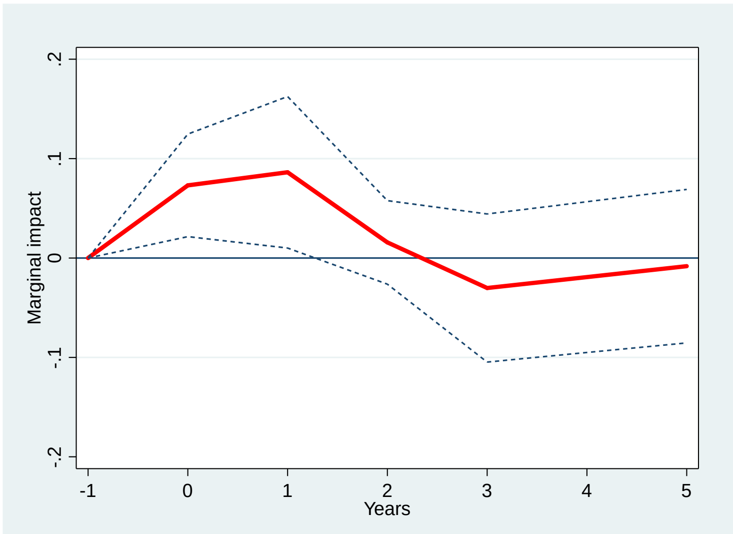
[14] As noted earlier, the residual is derived from an AR(1) process with a trend. For each country and for the entire period (1978-2012), the variable is regressed on its lagged value and a time trend.

[15] Driscoll and Kraay (1998).

(continued…)

Figure 6, showing the unconditional impulse response,[16] indicates that growth volatility reacts quite rapidly to terms of trade shocks with the peak pass-through reached within a year after the shock. This confirms the previous findings that terms of trade shocks lead to growth volatility. The effect dies out thereafter and remains statistically insignificant in the outer years, implying that the effect is of a temporary nature rather than permanent.

Figure 6. Terms of Trade Shocks and Growth Volatility in LICs: Unconditional IRF

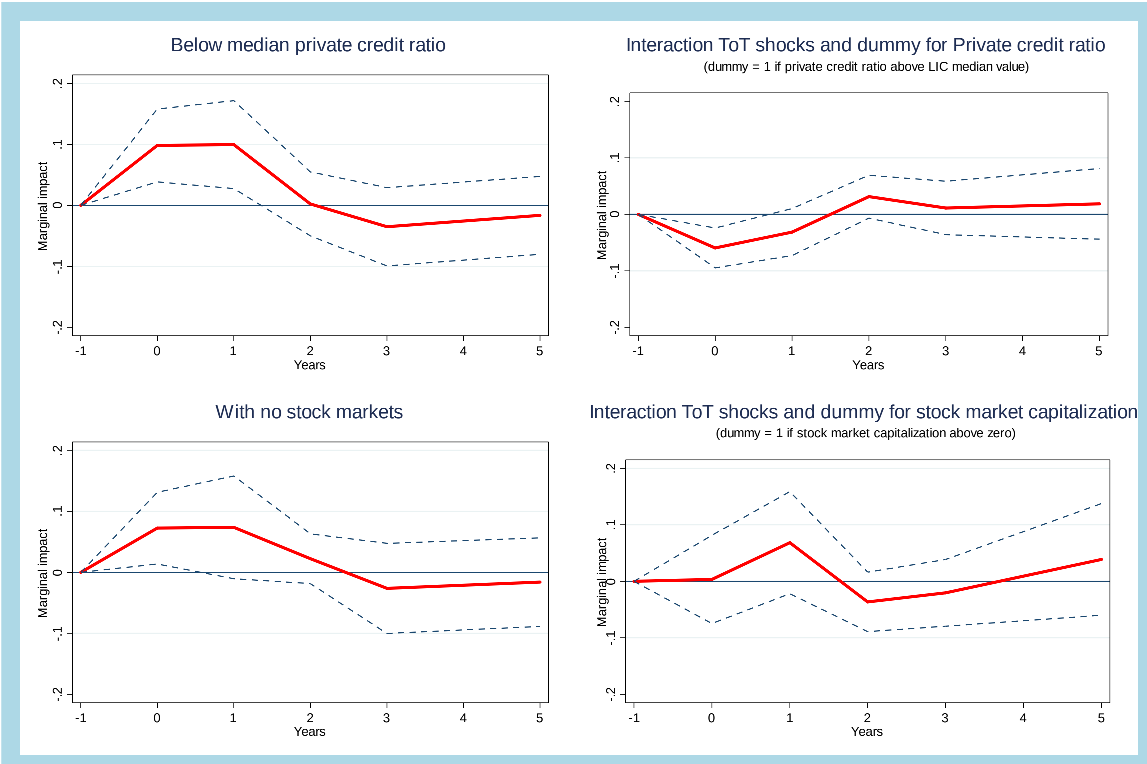


Notes: The solid line depicts the impulse response of growth volatility to a terms of trade shock occurring at year 0. Dotted lines are the 90 percent confidence interval.
Source: authors' calculations.

Turning to the conditional IRFs, Figure 7 shows that for countries below the median private sector credit ratio, terms of trade shocks are positively associated with growth volatility, but the effect is smaller for countries above the median private sector credit ratio as evidenced by the negative and significant coefficient observed for the interaction term between terms of trade shocks and the financial depth dummy variable (top right chart in the panel). Nevertheless, when looking at countries with no stock markets, we observe also that terms of trade shocks magnify growth volatility, but the effect is not statistically different in countries with stock markets (as the interaction terms between terms of trade shocks and the stock market development dummy is not statistically significant). These results lend support to the previous findings that banking sector development may help cushion the effect of terms of trade shocks on growth volatility, whereas stock market development seems not to dampen (or amplify) it.

[16] Equation (5) is estimated without the interaction term between the terms of trade shocks and the dummy variable for financial development.

Figure 7. Terms of Trade Shocks and Growth Volatility in LICs: IRFs Conditional to Financial Depth



Notes: The solid line depicts the impulse response functions, whereas the dotted lines are the 90 percent confidence interval.
Source: authors' calculations.

VI. Conclusions

At the time when increased attention in policy is being paid at improving the global resilience of economies, it is appropriate to ask what role institutions play, especially finance. Yet, limited research has been carried out on this topic and results have been mixed. The wide heterogeneity of the samples used, covering both advanced and developing countries, may have played a role in this ambiguity. Our paper attempts to contribute to this debate by focusing first on LICs, hoping to reach more definite answers, and second on one of the most important sources of growth volatility in LICs – terms of trade shocks –, examining to what extent financial deepening could absorb or on the contrary amplify these shocks. Our paper also investigates whether bank-based financial development could be more resilient than a market-based one, a topic that have not been addressed in most studies.

Focusing on a sample of 38 LICs over the period 1978-2012, this paper provides support to the hypothesis that banking sector development acts as a shock absorber in LICs, including by reducing the effects terms of trade shocks have on growth volatility. Expanding the sample to 121 developing countries, however, the results suggest this role of shock-absorber fades away as economies grow richer. Stock market development, by contrast, appears neither to be a shock absorber nor a shock amplifier for most economies. The findings hold regardless of the three econometric approaches used: (i) the fixed-effect estimator to control for country's unobservable time-invariant characteristics; (ii) the system GMM estimator to deal with potential endogeneity issues and; (iii) the local projection approach to uncover the dynamic response of growth volatility to terms of trade shocks.

Financial deepening achieved through the expansion of banks and improvement in the issuance of credits (through the establishment of credit bureaus for example) would thus be associated not only with the usual arguments of better access to finance, but also be more resilient in the face of external shocks, especially at early stages of economic development. At that stage of development, one would expect informational problems to be more acute and the role of banks in dealing with such problems more important. The banking system may also play an important role in LICs as terms of trade shocks are more prevalent and severe. Against this backdrop, the policies needed to achieve the development of a stable and sound banking system such as a stable macro-economic environment, and appropriate banking regulations and supervision, would also contribute in making the economy as a whole, more resilient. The development of financial mobile services, provided that associated risks are controlled, could also represents a promising tool for the macroeconomic stability of developing countries.

For LICs integrating into the world economy, this result is even more important. Greater openness offers them greater economic opportunities, but will also expose them more to terms of trade shocks. This is all the more a concern as financial sectors remain shallow in many LICs. Making these countries more resilient will require developing their banking sector to allow it to shelter the economy from external shocks.

Our empirical analysis should, however, be seen as exploratory. While the development of bank-based financial systems seems to be associated with more resilient economies, nothing was said about the characteristics of these banks. The ownership structure of the banking system, for example, might be important, especially the presence of foreign banks. The integration of domestic with international capital markets might have an important impact on growth volatility. Foreign banks may have more limited networks and local knowledge that would prevent them from being as effective as local banks in dealing with information problems. Furthermore, the regulatory and supervisory framework and the degree of competition might have an impact on the extent to which financial intermediaries serve as absorbers or as propagators of exogenous shocks. What would be the incentive of a bank to incur the costs of screening potential borrowers, if once identified the better ones are tempted to bank elsewhere? These questions are left for future research.

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Table A1. Summary Statistics and Correlation Matrix (LIC Sample)

Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min.	Max.
GDP growth volatility	320	0.04	0.04	0.00	0.43
GDP per capita (USD)	344	343.6	233.8	42.5	1,426.7
Trade openness (percent of GDP)	347	56.8	28.7	0.3	168.3
Terms of trade volatility	239	0.09	0.07	0.00	0.43
Private credit ratio (percent of GDP)	243	12.0	10.0	0.3	99.5
Liquid liability ratio (percent of GDP)	246	23.1	12.2	0.4	104.2
Stock market capitalization ratio (percent of GDP)	440	1.6	10.6	0.0	193.1
Stock market total value traded (percent of GDP)	440	0.5	8.3	0.0	173.6
Volatility of private credit ratio	292	0.19	0.12	0.00	0.77
Inflation volatility	252	0.09	0.18	0.00	1.88
Political stability	173	-0.85	0.86	-3.14	0.96
Agricultural value-added share (percent of GDP)	331	37.6	13.9	8.9	77.7

Correlation Matrix

Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
GDP growth volatility	(1)	1.00											
GDP per capita	(2)	-0.18*	1.00										
Trade openness	(3)	-0.01	0.37*	1.00									
Terms of trade volatility	(4)	0.11*	-0.15*	-0.25*	1.00								
Private credit ratio	(5)	-0.19*	0.41*	0.42*	-0.27*	1.00							
Liquid liability ratio	(6)	-0.19*	0.46*	0.26*	-0.30*	0.78*	1.00						
Stock market capitalization ratio	(7)	-0.03	0.15*	0.09*	-0.10	0.16*	0.17*	1.00					
Stock market total value traded	(8)	0.02	0.06	0.06	-0.04	0.08	0.07	0.89*	1.00				
Volatility of private credit ratio	(9)	0.32*	-0.11*	0.00	0.16*	-0.27*	-0.27*	0.21*	0.22*	1.00			
Inflation volatility	(10)	0.06	-0.14*	0.01	0.21*	-0.19*	-0.22*	0.16*	0.21*	0.36*	1.00		
Political stability	(11)	-0.29*	0.23*	0.11	-0.01	0.18*	0.15*	0.00	-0.02	-0.08	-0.33*	1.00	
Agricultural value-added share	(12)	0.24*	-0.54*	-0.40*	0.28*	-0.43*	-0.38*	-0.16*	-0.09*	0.15*	0.11	-0.24*	1.00

Notes. * significant at 1, 5 or 10 percent.

Table A2. Variable Definitions and Sources

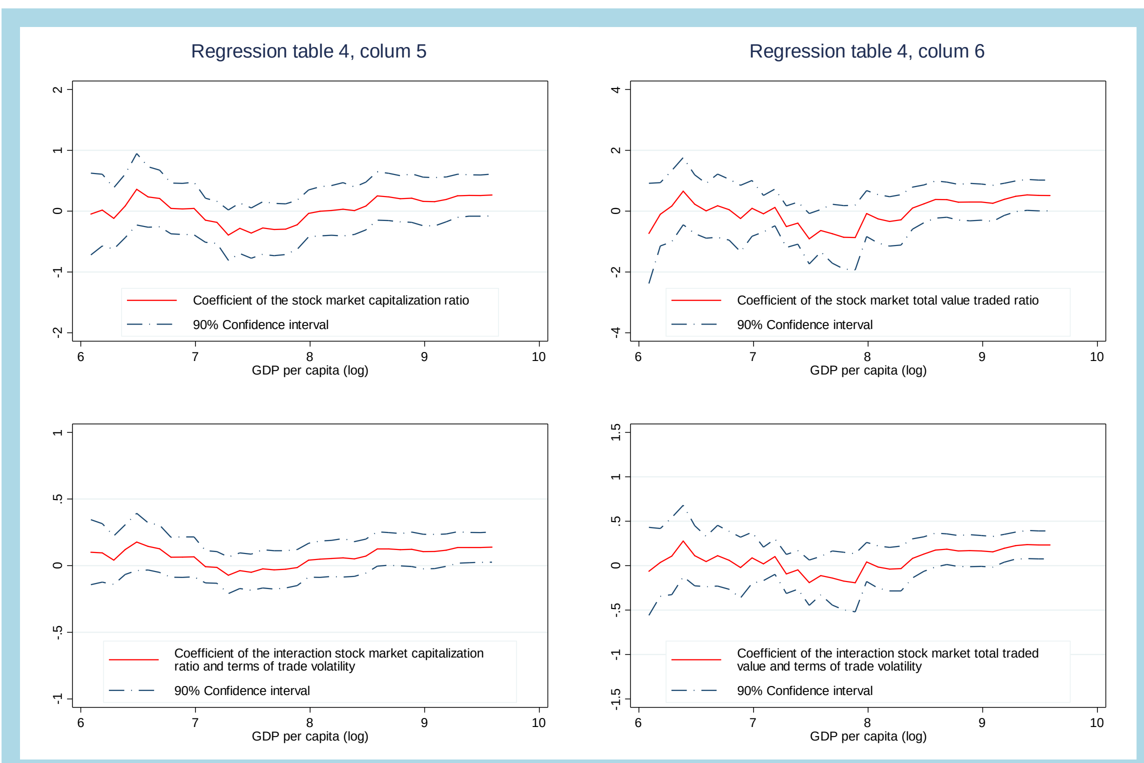
Variables	Definition	Sources
GDP growth volatility	The standard deviation of the residual of the log of real GDP regressed on its lags value and a time trend (assuming an AR(1) process with a trend), calculated over a 5-year period	World Development Indicators and author's calculations
GDP per capita (USD)	The ratio of nominal GDP divided by the size of the population	International Monetary Fund
Trade openness (percent of GDP)	Sum of exports and imports of goods and services measured as a share of GDP	World Development Indicators
Terms of trade volatility	The standard deviation of the residual of the log of terms of trade index regressed on its lags value and a time trend, calculated over a 5-year period. The terms of trade index is calculated as the percentage ratio of the export unit value indexes to the import unit value indexes, measured relative to the base year 2000	World Development Indicators and author's calculations
Private credit ratio (percent of GDP)	The private credit ratio is the total amount of credit by deposit money banks to the private sector divided by GDP	Financial Development and Structure Dataset
Liquid liability ratio (percent of GDP)	Total currency plus demand and interest-bearing liabilities of banks and other financial intermediaries divided by GDP	Financial Development and Structure Dataset
Stock market capitalization ratio (percent of GDP)	Total value of listed shares divided by GDP	Financial Development and Structure Dataset
Stock market total value traded (percent of GDP)	Total shares traded on the stock market exchange divided by GDP	Financial Development and Structure Dataset
Volatility of private credit ratio	The standard deviation of the residual of the log of private credit ratio regressed on its lags value and a time trend, calculated over a 5-year period.	Financial Development and Structure Dataset and authors' calculations
Inflation volatility	The standard deviation of the residual of the log of Consumer Price Index regressed on its lags value and a time trend, calculated over a 5-year period	World Development Indicators and author's calculations
Political stability	Political Stability and Absence of Violence/Terrorism (Estimate)	World Bank Governance Database
Agricultural value-added share (percent of GDP)	Ratio of agricultural value added over GDP	World Development Indicators

Table A3. Mean-Comparison Tests

	LICs average (1)	Non LICs average (2)	Difference (1)-(2)	
GDP growth volatility	0.04	0.04	0.00	
GDP per capita (USD)	343.64	2143.49	-1799.85	***
Trade openness (percent of GDP)	56.82	78.40	-21.58	***
Terms of trade volatility	0.09	0.08	0.01	**
Private credit ratio (percent of GDP)	12.00	27.46	-15.46	***
Liquid liability ratio (percent of GDP)	23.15	40.11	-16.96	***
Stock market capitalization ratio (percent of GDP)	1.58	6.86	-5.27	***
Stock market total value traded (percent of GDP)	0.54	2.32	-1.78	***
Volatility of private credit ratio	0.19	0.15	0.04	***
Inflation volatility	0.09	0.07	0.01	
Political stability	-0.85	-0.22	-0.64	***
Agricultural value-added share (percent of GDP)	37.62	17.37	20.25	***

Notes: *,**,***Denote significance at 10%, 5% and 1%, respectively

Figure A1. Robustness of the Estimated Effect of Stock Market Development on Growth Volatility in Developing Countries



Source. Authors' calculations.

Notes. A data point on the red line represents the coefficient on the stock market development (or its interaction term with terms of trade volatility) estimated on a sample of countries with a GDP per capital level below the corresponding x-axis value. As GDP per capita increases, the coefficients converge toward the full sample estimates shown in table 4, column 5 and 6.

Table A4. Testing a Dynamic Specification: System-GMM Estimates

System GMM	(1)	(2)	(3)	(4)	(5)	(6)
	LICs	LICs	LICs	LICs	Developing countries	Developing countries
Lagged growth volatility	0.071	0.199	0.056	0.209	-0.006	0.100
	[0.309]	[0.305]	[0.353]	[0.305]	[0.162]	[0.148]
GDP per capita (log)	-0.378	-0.352	-0.339	-0.291	-0.151	-0.084
	[0.310]	[0.341]	[0.291]	[0.349]	[0.195]	[0.178]
Trade openness	-0.006	-0.003	-0.007	-0.003	-0.009	-0.008
	[0.005]	[0.004]	[0.005]	[0.004]	[0.003]***	[0.003]**
Terms of trade volatility (log)	0.714	0.700	1.009	0.753	0.378	0.441
	[0.324]**	[0.334]**	[0.410]**	[0.394]*	[0.260]	[0.240]*
Private credit ratio (log)	-0.635	-0.696	-0.956	-0.801	-0.256	-0.295
	[0.444]	[0.449]	[0.599]	[0.543]	[0.270]	[0.247]
Private credit ratio * Terms of trade volatility	-0.250	-0.224	-0.343	-0.254	-0.172	-0.178
	[0.117]**	[0.121]*	[0.176]*	[0.165]	[0.089]*	[0.079]**
Stock market capitalization ratio (log)	-0.228		-0.228		0.211	
	[0.120]*		[0.253]		[0.209]	
Stock market total value traded ratio (log)		-0.053		0.233		0.400
		[0.145]		[0.364]		[0.299]
Stock market capitalization (log) * Terms of trade volatility (log)			-0.005		0.123	
			[0.091]		[0.067]*	
Stock market total value traded (log) * Terms of trade volatility (log)				0.089		0.194
				[0.127]		[0.094]**
Credit growth volatility (log)	0.462	0.492	0.337	0.508	0.271	0.311
	[0.171]***	[0.177]***	[0.119]***	[0.166]***	[0.128]**	[0.145]**
Inflation volatility (log)	-0.096	-0.183	-0.046	-0.219	0.115	0.092
	[0.139]	[0.143]	[0.107]	[0.145]	[0.100]	[0.089]
Agricultural value-added share	-0.596	-0.489	-0.737	-0.498	-0.611	-0.437
	[0.452]	[0.454]	[0.647]	[0.385]	[0.279]**	[0.245]*
Constant	3.668	3.414	4.823	3.211	1.264	0.705
	[3.228]	[3.431]	[3.965]	[3.218]	[2.059]	[1.757]
Observations	161	161	161	161	537	537
Number of countries	37	37	37	37	120	120
Hansen test p-values	0.92	0.92	0.80	0.95	0.43	0.26
AR(2) test (p-values)	0.44	0.36	0.51	0.36	0.84	0.57

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively. AR(2): Arellano and Bond test of second order autocorrelation.

Table A5. Measuring Volatility with the Standard Deviation: Financial Development, Terms of Trade Shocks and Growth Volatility - Fixed-Effect Estimates

Fixed effects	(1)	(2)	(3)	(4)	(5)	(6)
	LICs	LICs	LICs	LICs	LICs	LICs
GDP per capita (log)	-0.492	-0.388	-0.410	-0.586	-0.425	-0.416
	[0.219]**	[0.229]*	[0.243]*	[0.241]**	[0.343]	[0.414]
Trade openness	-0.001	-0.003	-0.002	-0.003	0.002	-0.006
	[0.004]	[0.005]	[0.004]	[0.004]	[0.006]	[0.007]
Terms of trade volatility (log)	0.678	0.646	0.569	0.706	0.472	0.389
	[0.187]***	[0.186]***	[0.171]***	[0.189]***	[0.204]**	[0.205]*
Private credit ratio (log)	-0.730	-0.736	-0.699	-0.747	-0.574	-0.566
	[0.226]***	[0.217]***	[0.212]***	[0.229]***	[0.251]**	[0.240]**
Private credit ratio (log) * Terms	-0.255	-0.262	-0.224	-0.266	-0.161	-0.174
of trade volatility (log)	[0.083]***	[0.080]***	[0.075]***	[0.082]***	[0.075]**	[0.076]**
Credit growth volatility (log)		0.292				0.269
		[0.089]***				[0.166]
Inflation volatility (log)			0.085			0.008
			[0.092]			[0.121]
Political stability					-0.533	-0.621
					[0.229]**	[0.234]**
Agricultural value-added share				-0.340		-0.544
				[0.394]		[0.573]
Constant	1.144	1.027	0.781	3.015	-0.286	2.190
	[1.128]	[1.212]	[1.227]	[2.484]	[1.888]	[3.867]
Observations	178	175	169	173	128	117
Number of countries	38	38	38	37	38	37
R-squared	0.13	0.19	0.14	0.13	0.17	0.26

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively.

Table A6. Measuring Volatility with the Standard Deviation: Financial Development, Terms of Trade Shocks and Growth Volatility - System-GMM Estimates

System GMM	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	LICs	LICs	LICs	LICs	LICs	LICs+LMICs	Developing countries
GDP per capita (log)	-0.581	-0.655	-0.655	-0.202	-0.810	-0.138	-0.133
	[0.339]*	[0.355]*	[0.285]**	[0.462]	[0.397]**	[0.161]	[0.165]
Trade openness	-0.006	-0.006	-0.008	-0.006	-0.007	-0.009	-0.013
	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]	[0.004]**	[0.004]***
Terms of trade volatility (log)	0.632	0.728	0.960	0.507	0.765	0.641	0.328
	[0.459]	[0.386]*	[0.436]**	[0.471]	[0.277]***	[0.427]	[0.277]
Private credit ratio (log)	-0.373	-0.346	-0.471	-0.682	-0.542	-0.177	-0.039
	[0.352]	[0.364]	[0.350]	[0.561]	[0.345]	[0.413]	[0.311]
Private credit ratio (log) * Terms	-0.165	-0.202	-0.255	-0.209	-0.277	-0.185	-0.122
of trade volatility (log)	[0.161]	[0.148]	[0.149]*	[0.201]	[0.115]**	[0.144]	[0.104]
Credit growth volatility (log)		0.246			0.527	0.031	0.275
		[0.160]			[0.210]**	[0.188]	[0.159]*
Inflation volatility (log)			0.038		-0.081	0.302	0.210
			[0.129]		[0.146]	[0.154]*	[0.097]**
Agricultural value-added share				0.737	-0.678	-0.029	-0.455
				[0.692]	[0.468]	[0.281]	[0.257]*
Constant	1.602	2.433	2.751	-3.180	6.152	-0.370	0.683
	[2.287]	[2.177]	[2.005]	[4.915]	[3.514]*	[1.801]	[1.756]
Observations	178	175	169	173	161	362	532
Number of countries	38	38	38	37	37	83	122
Hansen test p-values	0.39	0.38	0.48	0.47	0.63	0.28	0.06
AR(2) test (p-values)	0.32	0.34	0.27	0.52	0.37	0.23	0.45

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively. AR(2): Arellano and Bond test of second order autocorrelation.

Table A7. Measuring Volatility with the Standard Deviation: Accounting for the Impact of Stock Market Development on Growth Volatility - System-GMM Estimates

System GMM	(1)	(2)	(3)	(4)	(5)	(6)
	LICs	LICs	LICs	LICs	Developing countries	Developing countries
GDP per capita (log)	-0.729	-0.776	-0.240	-0.660	-0.173	-0.208
	[0.395]*	[0.393]**	[0.394]	[0.395]*	[0.220]	[0.190]
Trade openness	-0.008	-0.005	-0.007	-0.004	-0.013	-0.009
	[0.006]	[0.005]	[0.005]	[0.005]	[0.004]***	[0.004]**
Terms of trade volatility (log)	0.705	0.684	0.471	0.582	0.634	0.495
	[0.271]***	[0.274]**	[0.430]	[0.313]*	[0.306]**	[0.280]*
Private credit ratio (log)	-0.410	-0.458	-0.515	-0.465	-0.599	-0.326
	[0.302]	[0.283]	[0.490]	[0.358]	[0.356]*	[0.307]
Private credit ratio (log) * Terms of trade volatility (log)	-0.265	-0.224	-0.191	-0.187	-0.348	-0.234
	[0.104]**	[0.105]**	[0.194]	[0.148]	[0.120]***	[0.104]**
Stock market capitalization ratio (log)	-0.243		-0.371		0.482	
	[0.105]**		[0.264]		[0.234]**	
Stock market total value traded ratio (log)		-0.100		-0.022		0.595
		[0.150]		[0.352]		[0.326]*
Stock market capitalization (log) * Terms of trade volatility (log)			-0.058		0.242	
			[0.102]		[0.087]***	
Stock market total value traded (log) * Terms of trade volatility (log)				0.015		0.286
				[0.146]		[0.115]**
Credit growth volatility (log)	0.447	0.490	0.358	0.526	0.332	0.349
	[0.196]**	[0.187]***	[0.132]***	[0.168]***	[0.168]**	[0.168]**
Inflation volatility (log)	-0.002	-0.100	-0.001	-0.178	0.147	0.161
	[0.149]	[0.143]	[0.102]	[0.140]	[0.125]	[0.112]
Agricultural value-added share	-0.692	-0.413	-0.140	-0.377	-0.701	-0.640
	[0.380]*	[0.483]	[0.493]	[0.476]	[0.318]**	[0.275]**
Constant	5.564	4.699	0.582	3.649	2.527	2.016
	[3.060]*	[3.725]	[3.542]	[3.725]	[2.290]	[1.980]
Observations	161	161	161	161	532	532
Number of countries	37	37	37	37	122	122
Hansen test p-values	0.93	0.87	0.84	0.92	0.75	0.21
AR(2) test (p-values)	0.37	0.43	0.38	0.46	0.57	0.40

Notes. Robust standard errors in brackets. *,**,***Denote significance at 10%, 5% and 1%, respectively. AR(2): Arellano and Bond test of second order autocorrelation.