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Determinants of Growth Volatility in Low- and Middle-income Countries

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I. Introduction

There is a negative correlation between economic growth and volatility that has been accepted by a burgeoning body of literature centered on growth decoding. Among the first researchers who raised concerns about the correlation, Ramey and Ramey (1995) estimate that one standard-deviation increase in growth variability translates into a reduction of 0.21 percentage points in per capita GDP growth using a cross-national analysis. The strong and negative association was again confirmed and further examined in subsequent studies like Aghion et al. (2005) and Hnatkovska and Loayza (2005) with different empirical methods.

The volatility of economic progress, not just the speed thereof, has caught the attention of economists due to the adverse effects it might have on investment and output through producing mixed signals about the future of an economy. That said, in the context of developing countries, the negative consequences of economic fluctuations can extend even beyond investment and output falls. While it is true that the developing world is more prone to volatility compared to its industrialized counterpart, a tendency that has been documented in a number of studies[1], what is more important is that, given the prevalence of poverty in low and middle-income countries, their populations are extremely vulnerable to economic uncertainty. As pointed out by Aizenman and Pinto (2005), poor people usually do not have much access to financial markets and therefore are presented with limited options, if at all, to diversify their sources of income. On top of that, they rely to a great extent on public services for the most essential needs, such as education and health care. The provision of these resources, however, is profoundly procyclical in less developed economies, resulting in significant welfare damages to be endured by the poor, some of which cannot be reversed, during times of economic fluctuations. Therefore, in terms of welfare, obtaining positive growth rates is not enough. The growth itself has to be sustained, so

[1] See Easterly, Islam, and Stiglitz (2000), Koren and Terenyo (2007), and Loayza et al. (2007)

that certainty is established and investment in human capital can take place without interruptions. With this in mind, I set out to explore the causes of economic fluctuations happening along the growth paths of developing economies. Assessing data from 86 countries pertaining to low and middle-income categories for the period 1997-2019, I find that the most important determinants of growth variations in the poorest countries in the dataset are access to credit in financial markets, the size of government spending, fluctuations in agricultural productivity growth, and the strength of governing institutions, particularly with respect to rule of law. For the developing economies at higher income levels, volatility is strongly correlated with productivity fluctuations in the industrial and service sectors, in addition to its positive correlation with the size of the agricultural sector. Noteworthily, the results of this study imply that much of the empirical ambiguity presented by the current literature on economic volatility can be resolved by taking into account the discrepancies between different stages of development, even within the group of developing countries alone.

The rest of the paper is structured as follows. Section II discusses the theoretical framework of economic volatility. Section III reviews the related literature that informs the choice of explanatory variables examined in this study. In section IV, I am going to provide a description of the sample and introduce the methodological approach employed to investigate the research question. Empirical findings are summarized in section V. Finally, before the concluding remarks, I am going to discuss some policy implications as well as the limitations faced by this study, which are also the avenues future research can explore.

II. Theoretical framework

For the most part of the twentieth century, economic volatility was examined through the lenses of the Keynesian and the classical views of business cycles. Output and employment volatility, according to Keynes, is brought about by fluctuations in aggregate demand whose

three main components are household consumption, government spending, and business investment. Keynes placed a special interest in the last component. He argued that investment decisions are driven by one's perceptions about future profits, which in turn are determined by speculations about an unknown future. As a result, investment decisions sometimes "have no foundation in circumstances," and investors facing uncertainty have no choice but to "take their cues from the beliefs of others […] and [are] continually buffeted by 'the news'" (Coddington, 1976). When there is a discrepancy between expected and real profits with the expected being higher, investors would quickly withdraw from further investment commitments. Meanwhile, when real returns exceed their expectation, investors often display overoptimism and, as a result, invest more than they should. Swings in investment, on a large scale, are what Keynes believed to result in fluctuations that have crippling effects on various aspects of an economy.

Real Business Cycle (RBC) theory, which was developed out of the classical school of economics, offers a very different explanation of economic fluctuations. Rejecting the role of aggregate demand in directing business cycles, RBC theorists put forth models in which volatility is explained by exogenous shocks leading to productivity disturbances. A positive shock, such as the adoption of labor-augmenting equipment, enhances the marginal productivity of workers, making them more desirable to firms. As a result, more workers are hired, and the economy expands with higher levels of employment and output. In contrast, negative shocks like the spikes in oil prices in the 1970s would hurt labor and capital productivity. What follows are lower levels of employment and output. Different from the Keynesian belief, RBC theory holds that government interventions are largely ineffective (Eichenbaum, 1991). Efforts to stimulate a troubled economy through expansionary fiscal policy, for example, only lead businesses and households to form an expectation that taxes will rise in the future, to which they might respond by cutting today's investment and spending. Total output, therefore, remains unchanged even if

the government has intervened. With regard to empirical evidence, Kydland and Prescott (1982) examine total factor productivity in the U.S during the postwar period and detect a significant correlation between technological disturbances and output growth volatility, a finding that enhances the support for real business cycle theory. Galí (1999), in contrast, finds a significant portion of business cycle fluctuations in the U.S between 1948 and 1994 to be accounted for by demand shocks, substantiating the Keynesian theory.

To this day, there is no end to the debate over whether it is the Keynesian view or RBC theory that explains the reality of economic variance better. Both theoretical perspectives, therefore, jointly serve as the foundation for conversations about volatility. However, from the perspective of policymakers, it would not be enough to narrow down the primary source of economic volatility to either investment uncertainty or productivity shocks. This is because investment uncertainty has been known to stem from a variety of sources, such as changes in a country's political climate, terms-of-trade fluctuations in global markets, or whether access to funding sources is available during difficulty times. Similarly, labor productivity can be promoted through various channels, including encouraging tertiary education enrollment, building a robust healthcare system, or adopting labor-augmenting technologies. Given the limited resources a developing country has to invest, it would be more useful to know that specific aspects of the economy that would be most likely to generate the desired stability if looked after. This quandary further motivates the research question put forth in this study.

In the following section, I am going to review existing evidence on factors that have been found to importantly explain growth variability.

III. Existing Literature

This paper is related to three strands of literature on economic volatility. The first one considers the effect of trade liberalization on economic fluctuations in the domestic market. The

second looks into financial policy. The last strand of literature is concerned with the role of political institutions in managing variance in economic performance.

3.1 Trade liberalization

With regard to economic stability, there are three reasons why engaging in international trade can be desirable for a developing country. First, trade offers access to markets that are larger and often more stable than the domestic markets. Down (2007) estimates the levels of domestic volatility in OECD countries between 1952 and 2000 and finds that, in all the countries studied, the magnitude of domestic volatility exceeded that of fluctuations in global markets. The explanation provided by Down (2007) is that global markets are made up of many business cycles not operating in synchronization at all times. As a result, even when part of the world is going through a recession, the downside effect of that recession can be offset by consumption expansion in another corner of the globe.

The second reason why countries can achieve greater stability with trade is that trade allows for the opportunity to diversify production baskets and, thus, dilute risks specific to a trade partner or product. For developing countries, diversification could mean transitioning from relying primarily on commodities that are subject to high price volatility to producing manufactured goods that are more stable in prices. McIntyre et al. (2018), in examining the correlation between economic diversification and output volatility in small states, find the magnitude of volatility to be smaller in countries that have well-diversified export baskets.

Finally, exposure to global markets offers an opportunity for developing countries to become beneficiaries of technology and knowledge transferred from abroad. According to Hoppe (2005), two channels are involved in this process. First, by opening up its domestic economy to the world, a country can import machinery that directly and immediately improves production capacity. The second channel operates in accordance with the observation that market integration

has been accompanied by a geographical shift of production from developed to developing countries, allowing less developed economies to participate in global value chains and become more attractive in the eyes of foreign investors (Hoppe, 2005). The newly-formed business relationships represent sources of knowledge that a labor force can absorb to enhance its knowledge and skill base. Choudhri and Hakura (2000), using a multi-sectoral framework applied to 10 sectors and 44 economies, empirically show that in medium- and fast-growing manufacturing sectors, more import competition is correlated with higher productivity growth. Given productivity fluctuations have been treated by RBC theorists as the central explanation for business cycles, the constant improvement thereof, propelled by international trade, can be reasonably expected to reduce macroeconomic volatility.

Despite arguments and evidence that suggest trade openness can be conducive to stable growth, numerous studies have reported a positive correlation between trade liberalization and fluctuations in output and consumption (Di Giovanni and Levchenko, 2009; Easterly, Islam, and Stiglitz, 2000; Easterly and Kraay, 2000; Razin, Sadka, and Coury, 2003). The problem with trade lies along several lines.

First, as a larger portion of an economy depends on global demand, the economy itself becomes more vulnerable to external shocks that it can do nothing to control. Fluctuations in terms of trade are among the external shocks that worry policymakers the most when it comes to the impact of trade on economic stability. Prices in global markets are set without regard to the domestic costs of production. Therefore, when prices are low and so are profits, domestic firms have no choice but to cut back on investment, which exacerbates the state of an economy. Conversely, when exporting is lucrative, wages and prices will rise in exported sectors. If this rise is followed by orresponding price surges in non-tradable sectors, the result would be higher inflation economy-wide (Cameron, 1978). Trade openness, therefore, can inject volatility into a

country's growth trajectory by exposing the domestic market to terms-of-trade swings. This argument is empirically supported by Mallick (2013) who, studying a sample of 79 countries between 1980 and 2004, discovers that fluctuations in terms of trade worsen both business cycle volatility and long-run growth volatility. Meanwhile, Mendoza (1995), applying cross-sectional analysis to a mixed group of 30 developed and developing countries, estimates that 45 to 60 percent of output variability in the studied countries can be attributable to terms-of-trade shocks.

The second problem with trade is that buying and selling goods and services on the global scale, as suggested by the Ricardian model of comparative advantage, would give rise to a more specialized production structure, which in turn is suggestive of risks being concentrated among a small basket of goods and thus more volatility (Brainaird and Cooper, 1968; Ruffin, 1974). This is exactly what was found in Di Giovanni and Levchenko (2008). Documenting trade and production patterns in 61 countries for over 30 years, the researchers report a positive link between trade liberalization and production specialization in which a one standard-deviation increase in trade openness raises the concentration index by 0.54 standard deviations. The study further finds that though trade can reduce volatility by shielding the traded sectors from the impact of domestic fluctuations, the aggregate effect is still a positive correlation with higher volatility as a result of greater specialization and exposure to global shocks in sectors that are open to trade. However, not all evidence points towards the same direction. Caselli et al. (2019) find that reducing barriers to trade, though leading to more sectoral specialization, gives rise to a higher degree of economy-wide diversification. Taken together, the net impact is a lower level of output volatility.

Overall, there is little consensus among the existing literature as to what the effect of trade liberalization on economic volatility is. More importantly, the conundrum does not appear

to only exist within the scope of the relationship between trade and volatility but extends to the effect that trade has on production patterns.

3.2 Financial institutions

There are two aspects of a financial system that studies on macroeconomic volatility have been particularly interested in: how developed it is and how connected it is to international capital markets.

According to Aghion, Banerjee and Piketty (1999), economic fluctuations are a result of the separation between investors and savers, which tends to be wider in underdeveloped financial systems. An important source of the separation, as argued by the researchers, is originated in the problem of asymmetric information, which is considered among the oldest and the most important riddles in the financial world. Asymmetric information arises in the first place because borrowers usually have more information than lenders about the feasibility and profitability of the projects they invest in. Consequently, there exists a cost of screening associated with the process of issuing a loan, and a cost of monitoring incurred after the loan is issued to ensure that borrowers are committed to their repayment duty. If the informational gap is sufficiently wide, which would result in hefty costs of borrowing, no one from either side would engage in lending-borrowing activities. A well-functioning financial system with an extensive network of financial intermediaries overcomes this problem by evaluating risks with economies of scale and diversifying risks over a large pool of investment projects. Moreover, financial intermediaries like banks possess extensive knowledge of some borrowers with their access to the borrowers' history of transactions - the type of information that is extremely valuable in mitigating informational gaps but not widely shared with the public (Davis, 1994). Antzoulatos, Tsoumas, and Kyriazis (2008) show that, for a sample of 22 developed and developing economies between 1990 and 2004, there is a negative correlation between the level of financial development and the

degree of market uncertainty as revealed by movements of the FTSE and MSCI indices. With regard to volatility, models developed by Greenwald and Stiglitz (1993) and Kiyotaki and Moore (1997) all predict that output fluctuations would be greater when high levels of asymmetric information hinder a financial system from allocating its resources effectively. Denizer, Ayigun, and Owen (2000) also confirm the negative relationship between financial development and variability in consumption, investment, and most relevant to this paper, per capita GDP growth.

However, not all studies concerning the role of financial institutions agree on the aforementioned relationship between financial development and economic volatility. Assessing evidence from 72 countries with data aggregated from 1960 to 1997, Easterly, Islam, and Stiglitz (2000) observe that the depth of a financial system, as measured by the ratio of private credit to GDP, affects per capita GDP growth in a nonlinear way. For emerging markets, the study suggests that a deeper financial system would enhance stability. In contrast, the financial sector in a developed country where the pool of credit is too large compared to the size of the economy would magnify shocks. Berkes, Panizza, and Arcand (2012) call this phenomenon "too much finance." The explanation provided by Rajan (2005) is that the abundance of credit supply observed in developed financial systems is often a result of the intense competition between banks and non-bank firms as credit providers, which takes place on top of the existence of an incentive system where salaries of financial workers are directly tied to the profits they can generate. Each financial worker, therefore, is highly motivated to engage in risky investments, especially those with tail risks, not only because of the expected high returns but also because this type of risks can be easily hidden in most times. However, when the risks can no longer be contained, the results, of which the financial crisis in 2008 is an epitome, can be catastrophic.

What is significant about the theory of "too much finance" is that it may very well apply to countries with immature financial systems by a similar mechanism. The main constraint,

regardless whether it concerns developing or industrialized economies, lies in how much risk an economy can tolerate before going bust. With the limited capacity of regulatory agencies in developing economies to keep potential risks in check, especially in the face of a strong credit expansion, the answer is not much. Sahay et al. (2015), examining a sample of 128 countries over the 1980-2010 period, empirically show that the pace of financial deepening and GDP growth volatility are positively correlated. Wynne (2002) explains that during a lending boom, banks have to come into contact with newly established projects and borrowers of whom they have neither working history nor knowledge. The problem of asymmetric information is thus more serious in the mid-stage of development when credit provision is undergoing rapid expansion. Related to this line of thought, Dell'Ariccia and Marquez (2004) propose a model in which it is shown that when more "unknown borrowers" enter credit markets to seek funding, the profit-maximizing response for each bank would be to relax its lending standards, which helps bring about a larger market share for the bank but at the same time deteriorates the quality of its investment portfolio.

Besides the level of financial development, financial integration, or how open a domestic market is to capital flows from abroad, has also been widely studied by the literature on finance. For the past few decades, foreign capital has become increasingly important to developing economies as it fuels economic growth and plays a vital role in poverty eradication in these places. According to Prasad et al. (2005), there are three components of international capital flows: bank borrowing, portfolio investment, and foreign direct investment (FDI), with the first two usually being more volatile than the last. Theoretically, capital inflows from abroad can help reduce macroeconomic volatility by providing additional funding to domestic projects, making demand and supply for credit less cyclical. On top of that, better access to global financial markets allows the burden of risks to be shared between domestic and foreign investors, which

attenuates the magnitude of shocks. Finally, capital inflows, especially in the form of FDI, often carry along technological and knowledge transfers (Prasad et al., 2005). This helps improve a country's production capacity and supports the transition away from volatility-prone industries. Empirical evidence, however, provides a more complicated picture regarding the impact of financial integration. Studies like Easterly, Islam, and Stiglitz (2000) and Razin and Rose (1992) find no significant link between financial openness and output volatility. Differently, it is emphasized in Gavin and Hausmann (1996) that a surge in foreign capital flows may give rise to a lending boom, which puts a strain on supervisory institutions and banks' screening capacity. Thus, the expected result is a more unstable economy. In contrast, Bekaert, Harvey and Lundblad (2006), Calderon et al. (2005), and Haddad et al. (2012) find evidence pointing towards a negative correlation between financial openness and the volatility of output.

Briefly speaking, the correlation between economic volatility and finance, whether in terms of the stage of development or the level of integration, cannot be easily determined without considering the role of regulations. The challenge for regulatory institutions with regard to financial policy is to keep a financial system's exposure to risk at the right amount, not too little that would curtail growth, but not too much that would threaten the sustainability of credit supply.

3.3. Political Institutions

Aside from the regulatory decisions that have been argued to importantly determine the ways in which financial liberalization affects economic variability, there are two other dimensions of a governing body that have caught the attention of economists when it comes to understanding the causes of macroeconomic volatility: the size of government spending and the strength of the institutions in place.

The linkage between government size and economic fluctuations lies at the core of the compensation hypothesis, which suggests that an extensive welfare state exists to compensate for the greater degree of shocks a country encounters after opening to global markets (Berg, 2019). One of the earliest discussions on the role of the welfare state was provided by Lindbeck (1975). The researcher argues that a generous welfare system contributes to macroeconomic stability in the short term by enacting tax schemes and social insurance programs that help smooth out aggregate demand. However, Lindbeck also acknowledged that the impact can go the other way around when too much government spending spurs the need for public sector borrowing, which implies that interest rates will be higher in the future, adding uncertainty to a struggling economy. This phenomenon is often called the crowding-out effect. Existing evidence seems to favor the latter correlation between the government sector and economic stability. For instance, Ramey and Ramey (1995), examining a subgroup containing only OECD countries in their sample, find that government spending volatility and output volatility are positively correlated. Bekaert, Harvey and Lundblad (2006), studying a group of countries undergoing financial liberalization, find a large government sector to be one of the contributors to variations in consumption growth.

However, the impact of institutional arrangements extends beyond government spending. In his 1999 paper, Rodrik proposes a model in which the growth differential is a function of external shocks, latent social conflicts, and institutional strength, defined as the ability of political institutions to keep conflicts under control. By "latent social conflict," Rodrik (1999) refers to the wealth gap, ethnic disparities, and geographical divisions. Meanwhile, the institutional strength encompasses multiple aspects of a government, including how democratic it is, whether there is prevalent corruption among bureaucrats, the independence and effectiveness of judiciary processes, and finally, the social insurance system in effect. Empirically testing his

model on a group of countries for the periods 1960-1975 and 1975-1989, Rodrik (1999) finds that deep social cleavages resulting in income inequality, racial tensions and crimes exacerbate the effects of large shocks on growth. Conversely, having strong institutions mitigates the growth differential before and after a shock. What is worth noticing about the results of Rodrik (1999) is that after controlling for governing factors and social conflicts, the parameters of variables like trade openness, government spending, and public debt become statistically insignificant. This finding resonates with what was found in Acemoglu et al. (2003). Documenting the relationship between economic development and the institutional structures that developing countries inherited from past European colonists, Acemoglu et al. (2003) show that macroeconomic volatility and slow growth are more severe in countries with weak institutions, bereft of means to constrain abuses of power. The researchers went further to argue that institutional weaknesses constitute the root cause of volatile economic performance while policy distortions and their associated outcomes only represent the symptoms. So far, the strand of literature on the institutional impact has two important implications. First, it fills in the "black box" of volatility accounting that standard economic indicators alone cannot explain. Second, the literature has been fairly consistent in saying that countries with institutions that promote social equity, political rights, and law enforcement are better at coping with shocks.

To sum up this section, it is clear that there has not been a conclusive answer to the question of what makes some countries experience more frequent and serious economic volatility than others. The impacts of standard economic variables like trade openness, production patterns, financial development and liberalization are highly inconsistent and oftentimes appear to go in either direction depending on the specific countries and time periods being sampled. This represents a challenge for policymakers who attempt to draw from economic evidence but at the same time an opportunity for researchers who wish to contribute to the existing volatility

literature with evidence from novel perspectives. Given what has been said, the contributions of this research are threefold. First, by extending the sampling period to 2019, this study takes into consideration recent economic progress and global trends that might importantly explain a country's susceptibility to growth fluctuations. Second, compared to studies done in the past, I adopt a more holistic approach to the dissection of growth volatility by providing a discussion not only on traditional economic variables, such as finance and trade, but also on human development, political institutions, and especially, fluctuations in productivity - a factor that has rarely been examined outside the context of its one-to-one correlation with business cycle fluctuations. Finally, instead of comparing low- and middle-income countries against more developed nations, this study targets the differences among countries in the two lower income categories which have received little attention from previous research.

In the next section, I am going to provide a description of the countries included in the dataset and a discussion on the methodology employed.

IV. Data and Methodology

4.1 Sample Selection

The sample constructed for this study comprises 86 developing countries that were classified as either low- or middle-income by the World Bank in 1997. For the purpose of explaining growth volatility using a combination of structural and institutional variables, I do not consider oil-dependent economies[2] that would otherwise meet the income criterion. This is because a large part of their economic fluctuations is caused by movements in oil prices rather than by the aforementioned factors.

[2] Here I define oil-reliant economies as those having the average share of oil rents in GDP between 1997 and 2017 exceeding 20 percent.

Table 1A in the Appendix reports the list of countries used in this study together with their income status and geographic locations. Overall, it can be inferred from the data that economic achievements were not evenly distributed across regions and income groups. Out of the 43 countries classified as low-income in 1997, nearly half of them, with the majority being in Sub-Saharan Africa, were still in the very same income category more than two decades later. Meanwhile, more than two-thirds of countries starting as lower-middle income in 1997 have successfully acquired upper-middle income status as of 2019. For the group of 16 countries initially classified as upper-middle income, however, only 9 became high-income as of 2019 while the rest never progressed further from the initial income rank. Noteworthily, the majority of countries that were able to graduate to the high-income category are located in Eastern Europe, such as Poland, Estonia, and Czech Republic whose economies became intertwined with the more developed Western Europe after their accession to the European Union in the early 2000s.

Since the 86 countries in the dataset vary greatly with respect to their income levels, they differ markedly from each other in the institutional strength and financial resources available to combat economic volatility. Therefore, in order to eliminate any cross-country difference that might skew the analysis, I divided the sample into two sub-groups. One group includes countries with per capita GDP in 1997 of at least 8000 in the international dollar (PPP$), called the higher-income developing countries (HIDCs). Countries failing to meet this criterion constitute the other group called lower-income developing countries (LIDCs). The average income of the HIDCs was 13,909 PPP$ at the start of the sampling period. Meanwhile, 59 countries in the LIDC group had per capita GDP averaging at only 3,077 PPP$ in the same year.

4.2 Measuring growth volatility

Consistent with previous work on the topic of economic volatility, I measure growth volatility by computing rolling standard deviations of per capita GDP growth rates over overlapping three-year periods. To be specific, the observation given by the standard deviation of per capita GDP growth rates between years t and $t + 2$ is followed by the observation obtained by applying the same computational technique to the years between $t + 1$ and $t + 3$. Since my dataset already contains a large number of missing values, if the time periods were completely non-overlapping as in the approaches chosen by Giovanni and Levchenko (2008) and Haddad et al. (2012), the sample size would shrink significantly, which might lead to sampling biases. As for terminology, in this study, I am going to use the terms "growth volatility", "economic volatility" and "volatility" interchangeably.

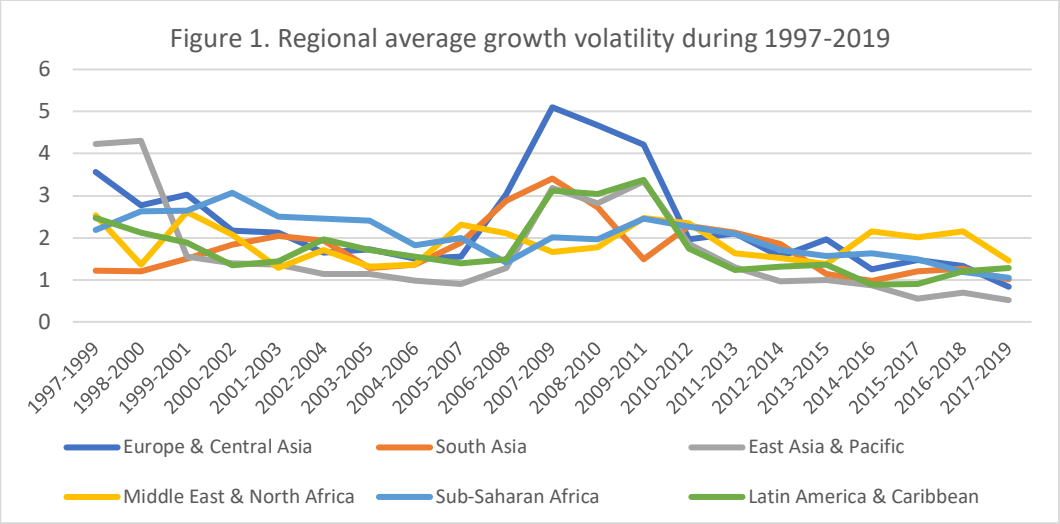
4.3 Some stylized facts about growth volatility

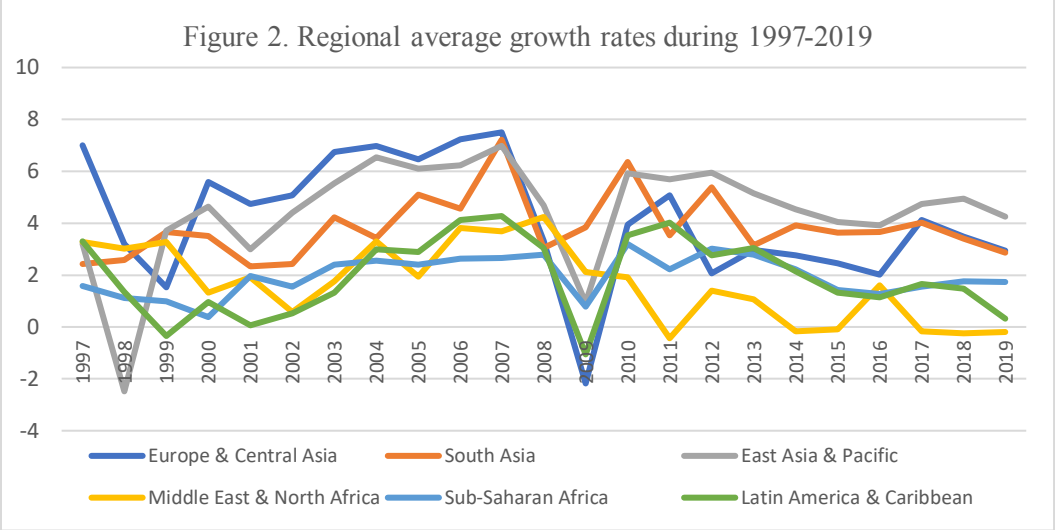
Figure 1 illustrates the average levels of per capita GDP growth volatility in each region between 1997 and 2019. As expected, the largest spikes in growth volatility coincide with major economic shocks whose impacts were felt globally, such as the Asian Financial Crisis taking place during 1997-1999 and the Great Recession between 2007 and 2009. Figure 2 exhibits each region's per capita GDP growth rates over time and thus can explain the movements of economic volatility. For countries in East Asia and the Pacific, the most fluctuating economic performance was experienced in the late 1990s, induced by the Asian Financial Crisis. The repercussions of this crisis caused the regional growth rate to dive deeply to a negative 2.5 percent in 1998 before bouncing back to nearly 4 percent in 1999. Aside from this period, growth was robust in this region with a high average of 4.46 percent and growth volatility remained the lowest among all regions for the most part of the 23-year period.

The picture, however, is very different for other regions. Europe and Central Asia together achieved sustained high growth from 2000 until the onset of the Great Recession. This region and Latin America were hit the hardest by the 2007 global crisis, which is evident in the sudden falls of their growth rates during this time (Figure 2). However, between 2007 and 2011, growth volatility in Europe and Central Asia is notably higher than that in other regions, even Latin America. This can be explained by the fact that Europe and Central Asia were growing very fast before the crisis and later recovered to a high speed while Latin America was growing at a slower pace both before and after the crisis.

Among all the regions, Middle East and North Africa seem to display the most peculiar growth path. This region was not much affected by either the Asian Financial Crisis or the Great Recession. However, while other economies started to regain speed after 2009, Middle Eastern and North African countries have since plummeted in growth and spiked in growth volatility. This period of economic instability has been linked to political and social uprisings associated with the Arab Spring that shook Egypt and Tunisia (Arayssi, Fakih, and Haimoun, 2019). Meanwhile, Iraq was a war zone during 2014-2017 and Jordan for the past few years has struggled with the refugee influx from Syria[3].

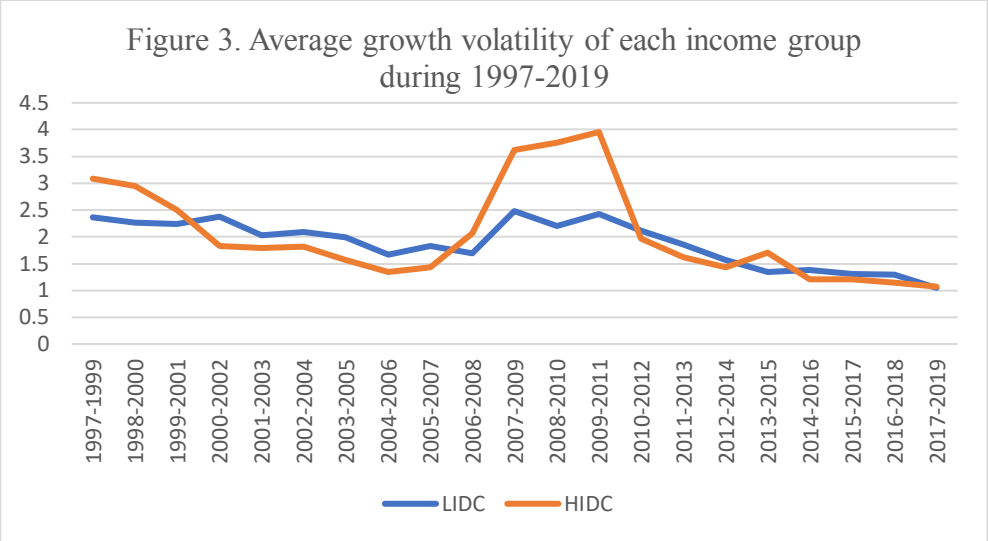
[3] See https://www.dni.gov/index.php/the-next-five-years/middle-east-and-north-africa for details.

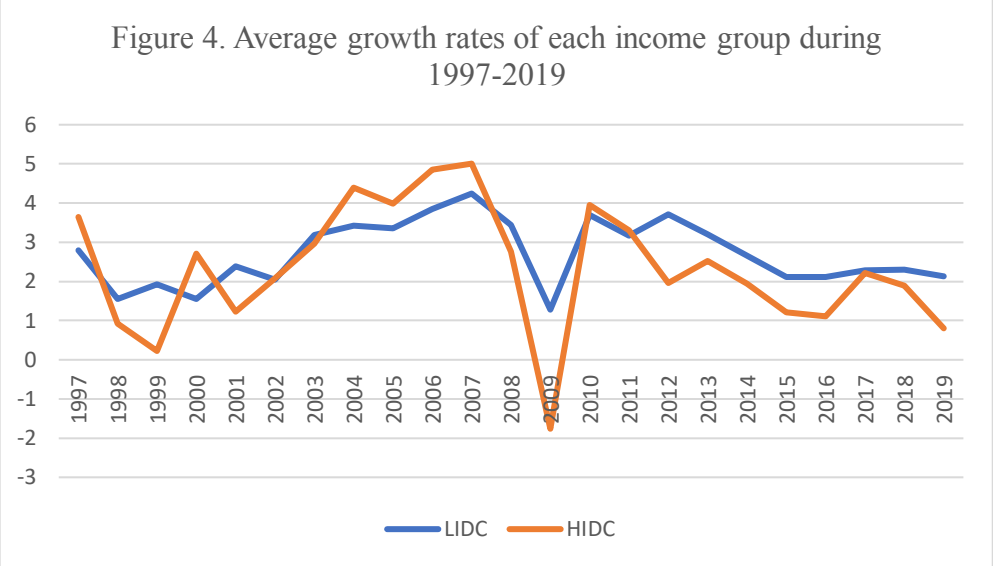




Data source: World Development Indicators

Across the income spectrum, so far it is not always obvious that low-income economies are more prone to volatility than the more developed as suggested by the literature. Figure 3 presents the average standard deviations of per capita GDP growth for both the LIDCs and HIDCs during 1997-2019. It can be inferred from the graph that growth volatility in the higher-income group is only slightly higher than that in the lower-income group during normal times. However, when global shocks hit, such as in 1997 and 2008, the more advanced economies tend to be adversely affected to a greater extent than the less developed.





Data source: World Development Indicators

4.4 Empirical model specification

There are four empirical models that I am going to investigate in this study. They are specified as follows.

$$Growth\ vol_{it} = Constant + \beta X_{it} + \varepsilon_{it} \quad (1)$$

$$Growth\ vol_{it} = Constant + \alpha Growth\ vol_{it-1} + \beta X_{it} + \varepsilon_{it} \quad (2)$$

$$Growth\ vol_{it} = Constant + \alpha Growth\ vol_{it-1} + \beta X_{it} + \gamma Institutions_{it} + \varepsilon_{it} \quad (3)$$

$$Growth\ vol_{it} = Constant + \alpha Growth\ vol_{it-1} + \beta X_{it} + \gamma Institutions_{it} + \tau + \varepsilon_{it} \quad (4)$$

Model (1) is the baseline regression model where X_{it} is a set of explanatory variables and ε_{it} denotes an error term. To systematically summarize the final outcome of this study, I divide the independent variables in (1) into four main categories: economic structure, population, trade, finance, and productivity. Model (2) adds to model (1) the effect of growth volatility in the preceding period. Models (3) and (4) are the most comprehensive in the sense that they take into account the impact of political institutions. Model (4) differs from (3) in the inclusion of a set of year dummies (τ). All models are run with unbalanced panel data. Before running the regression models, I standardized all the variables using the scale function in R except for the ones already expressed in rolling standard deviations. The goal of this step is to obtain comparable regressors.

With regard to the regression method, since one of the explanatory variables is a lagged term of the dependent variable, it would have been ideal to apply the Generalized Method of Moments procedure to generate the estimators. However, due to time constraints, I made use of more familiar regression methods for panel data, which are the fixed-effects and random-effects. To determine between the two types of regressions, I performed Hausman tests, which indicated that for most empirical models examined in this study, the random-effects method offered more consistent estimators. The final results reported in the next section, therefore, are those derived from random-effects regressions. Additionally, the standard errors have been adjusted for heteroskedasticity and serial correlation.

In what follows, I am going to provide a brief description of each variable included in this study. Further details of variable descriptions and transformations can be found in Table 2A.

4.4.1 Economic structure

Although it has been shown in Section 4.3 that higher-income countries, on average, do not always exhibit less volatility, it does not entail that there is no statistical correlation whatsoever between initial per capita GDP levels and growth volatility in the following three

years. Figure A1 plots growth volatility against per capita output for all countries in the dataset. It can be inferred from the plot that as income rises, growth volatility initially declines, then increases slightly before eventually dwindling towards the upper end of the middle-income range. To capture this relationship in the best way possible, I am going to examine the impact of the initial income level in both level and quadratic terms.

In addition to a country's level of economic development, I am also interested in exploring the relationship between growth volatility and the relative size of government expenditure and the agricultural sector. Here the size of the government sector is given by the share of government expenditure in a country's GDP, while that of the agricultural sector is measured by the percentage contribution of agricultural output to GDP. The potential effect of government spending on growth volatility, as discussed in Section 3.3, cannot be easily determined with economic theory or existing evidence from previous studies.

With regard to the effect of the agricultural sector, it can be reasonably expected that countries having large portions of their output coming from agriculture experience more growth fluctuations than others. This is because prices of agricultural commodities are highly unstable, and production can be easily disrupted by bad weather conditions. On average, the economies of the LIDCs are much more reliant on agriculture for output (21.6% of GDP) compared to the HIDCs (5.2% of GDP).

4.4.2 Population

There are two aspects of a country's population that I investigate in this study: the size of the population and the level of human capital accumulation.

The size of a country's population reveals information about the size of the domestic market. It has been widely recognized by literature on economic volatility that larger markets

offer better risk diversification and, therefore, more stability. As a result, a larger population base can be predicted to mitigate per capita GDP fluctuations.

Human development matters because the skill level of a labor force reflects the level of technology involved in the production it undertakes. Generally speaking, goods that are more sophisticated are often less volatile in prices and thus promise a more even growth path. Here I proxy human capital by the average years of schooling completed by adults aged 25 and above. Data for this variable was extracted from the United Nations Development Programs.

4.4.3 Trade

The first aspect of trade inspected in this study is the combined share of import and export values in a country's GDP, which I use to substitute for the level of trade openness. The summary statistics reveal that the developing countries considered in this study are highly open to global markets, with some emerging markets like Malaysia and Vietnam having trade shares exceeding 200 percent of GDP in several years. On average, higher-income countries are more open to trade compared to the less developed with the trade-to-GDP ratios registered at 88.5 and 71.8 percent, respectively. Notably, these numbers are substantially large when compared to the average of roughly 26 percent[4] reported for the U.S during 1997-2017. The expected correlation between trade liberalization and growth volatility, however, is indeterminate due to contradictory empirical evidence.

The second trade-related indicator I examine is volatility in commodity terms of trade (ToT). Extracted from the International Monetary Fund, commodity ToT denotes the difference between export and import prices as a percentage of GDP for a set of commodities that encompass the following categories: energy (including coal, crude oil, and gas), metals, food and

[4] Based on author's calculations with data obtained from the World Bank's World Development Indicators.

beverages, and finally, agricultural raw materials (such as cotton, logs, rubbers, sunflower seed oil, etc.).

The last trade element included in this study is the export concentration index, a normalized Herfindahl-Hirschman index that reveals how diversified a country's export basket is. The index is measured for commodities at the three-digit level of SITC and obtained from the United Nations Conference on Trade and Development (UNCTD). The index runs from 0 to 1 with a higher value indicating more concentration. As discussed in the previous section, economies whose export baskets are not diversified tend to be more susceptible to external shocks. Interestingly, a simple plot of the correlation between diversification and volatility as shown in Figure A2 suggests that higher concentration does not necessarily exacerbate economic fluctuations until after the index surpasses 0.6. In general, countries in the dataset seem to favor diversified as opposed to concentrated trade patterns with the index averaging at only 0.3 for LDICs and 0.2 for HIDCs.

4.4.4 Finance

For financial variables, I follow the standard route to define the stage of financial development using the size of domestic credit provided to the private sector as a percentage of GDP. Between the two groups, there is big gap with regard to the relative size of credit supplied. Specifically, the average credit-to-GDP ratio in the HIDCs is 57.5 percent while that for the LDICs is only 27.8 percent.

As previously discussed, the relationship between a more developed financial system and economic volatility has been presented with contradictory evidence. The relationship, however, is fairly straightforward in Figure A3. The plot suggests that a higher level of financial development lessens rather than magnifies economic fluctuations along the growth path. However, as the size of credit supply increases, the impact of financial development flattens out,

which contradicts the argument put forth by the "too much finance" hypothesis in which there should be upward pressure on volatility when credit supply gets too large.

With regard to financial openness, I employ the ratio of FDI net inflows to GDP as the sole indicator due to the lack of data on bank borrowing and portfolio investment. Noteworthily, for a few low-income countries in the dataset, FDI net inflows for some years were reported with negative values, signifying more disinvestment being made by foreign investors than investment. Overall, the contribution of capital inflows from abroad is very small compared to the sizes of the economies, averaging at only 4.1 percent for the LIDCs and 3.9 percent for the HIDCs. There is, however, not enough consistent evidence to form a conjecture about the effect of financial liberalization on economic volatility.

Finally, I am going to look into the impact on growth variance of price changes in the domestic market. The level of price fluctuations is measured by the rolling standard deviations of inflation rates over three consecutive years. In the absence of price stability, investors would find it hard to correctly estimate returns on investment, causing investment disruptions which are linked to economic volatility by the Keynesian theory.

4.4.5 Productivity

To investigate the relationship between productivity and growth fluctuations, for every three-year period in the dataset, I compute a rolling standard deviation of productivity growth rates, which in turn are given by the year-to-year percentage change of value added per worker. The three sectors of which volatility in productivity I am going examine are agriculture, industry and services.

As summarized in Table A3, production efficiency grows the fastest in agriculture and this holds true for both higher-income and lower-income groups. Contrary to the widely held perception that higher-income countries often pay more attention to modern sectors as opposed

to the agricultural sector, the HIDCs in the dataset outperform the other lower-income group in terms of agricultural productivity growth while the latter group have more success in improving labor efficiency in industrial and service production. With regard to volatility, agriculture witnessed the most fluctuations out of the three sectors and the service sector experienced the least.

Figures A4, A5, and A6 in the Appendix provide a preliminary description of the link between the productivity indicators and per capita GDP growth volatility. It can be inferred from the plots that fluctuations in productivity growth in all three sectors are positively correlated with growth volatility in the rest of the economy. However, since the correlations are not strictly linear, the degree to which productivity fluctuations affect growth volatility must be evaluated by more sophisticated statistical analysis.

4.4.6 Political Institutions

For the purpose of this research, I obtained variables containing information about the characteristics of political arrangements from the Worldwide Governance Indicators (WGI). To assess the quality of a country's governing body, the WGI compiles data provided by a wide range of household and firm surveys, business intelligence agencies, non-governmental and governmental organizations. Preliminary data are evaluated, rescaled, then reconstructed using a statistical technique called Unobserved Components Model (UCM). The final indices stretch from negative 2.5 to 2.5, with higher values denoting better governing quality.

There are six indices reported by the WGI, each concerned with a unique governing aspect. However, since the indices are highly correlated, I only check the significance of the two most relevant aspects suggested by the literature on political institutions. One of them is called Voice and Accountability, capturing the perceptions of the extent to which citizens of a country can participate in selecting their government, the degree of transparency practiced by the state

when it comes to economic policy and financial statistics, and the degrees to which freedom of expression, freedom of association, and a free media are protected. The aspects covered by the Voice and Accountability index, denoted as VA, are similar to those constituting the Civil Liberties Index, an institutional indicator employed by Coríc and Pugh (2013) and Haddad et al. (2012) in their research on the determinants of economic disturbances. The second index is Rule of Law (or RL), revealing the degree of confidence that agents can have in the abidance of laws, contract enforcement, and the protection of property rights, in addition to their perceptions about the likelihood of crime and violence. Figures A7 and A8 suggest that better governing quality, as reflected through higher VA and RL index scores, helps reduce growth volatility though the impact appears to be minute.

V. Results

The main regression outcomes of this study are summarized in Table 1 for the lower-income countries and Table 2 for the higher-income group. In each table, columns (1), (2), (3), and (4) summarize the regression outcomes of the corresponding models specified in Section IV. The regression models generating the results captured under columns (5) and (6) are exactly the same to those in (3) and (4) except for the Voice and Accountability index being replaced by the Rule of Law index. In what follows, I am going to discuss the regression outcomes in depth.

5.1 Lower-income developing countries

For the group of lower-income countries, at the first glance, the most important determinant of variations in per capita GDP growth is the magnitude of growth volatility in the preceding period. Between models (1) and (2), the value of adjusted R-squared, a measure of the goodness-of-fit of the regression models, jumps from 20 to more than 40 percent just by adding the lagged dependent variable. Structural variables, including the initial per capita GDP level and the size of the government sector, are also found to play critical roles.

Table 1. Random-effects regression results for lower-income developing countries

Dependent variable: per capita GDP growth volatility						
Independent variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Lagged dependent variable		**0.450*****	**0.423*****	**0.428*****	**0.428*****	**0.433*****
		(0.07)	(0.08)	(0.07)	(0.07)	(0.07)
GDP/capita	**1.004*****	**0.514****	**0.591****	**0.690*****	**0.580****	**0.685*****
	(0.28)	(0.22)	(0.26)	(0.24)	(0.25)	(0.23)
(GDP/capita) squared	-0.448*	-0.289	-0.422	-0.223	-0.375	-0.158
	(0.27)	(0.24)	(0.26)	(0.25)	(0.26)	(0.24)
Government spending	**0.181*****	**0.111****	**0.142*****	**0.159*****	**0.147*****	**0.168*****
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Agriculture's share	0.410***	0.168	0.171	0.154	0.16	0.145
	(0.12)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Population	0.099**	0.039	0.047	0.023	0.05	0.024
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Education	-0.181**	-0.118*	-0.114	-0.075	-0.119	-0.077
	(0.08)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)
Trade openness	0.017	-0.073	-0.071	-0.083	-0.077	-0.092
	(0.07)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
ToT volatility	0.02	-0.008	-0.014	-0.0002	-0.012	0.003
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)
Ex. Concentration Index	0.08	0.069	0.055	0.085	0.063	0.094
	(0.11)	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)
Private credit share	**-0.493*****	**-0.227*****	**-0.273*****	**-0.229*****	**-0.266*****	**-0.220*****
	(0.10)	(0.08)	(0.08)	(0.07)	(0.08)	(0.07)
FDI share	0.012	0.045	0.045	0.056	0.043	0.053
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)
Inflation volatility	0.075***	0.041**	0.045*	0.014	0.041*	0.008
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Productivity volatility (AGR)	**0.056*****	**0.037****	**0.044****	**0.040****	**0.044****	**0.040****
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Productivity volatility (IND)	0.059**	0.021	0.016	0.015	0.016	0.015
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Productivity volatility (SERV)	-0.01	0.002	0.012	0.005	0.011	0.004
	(0.04)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Voice and Accountability			**-0.114***	**-0.111***		
			(0.07)	(0.06)		
Rule of Law					**-0.219*****	**-0.227*****
					(0.07)	(0.06)
Constant	1.450***	0.762***	0.827***	1.500***	0.745***	1.387***
	(0.23)	(0.17)	(0.20)	(0.36)	(0.19)	(0.36)
Observations	857	857	726	726	726	726
Adjusted R^2	0.193	0.404	0.391	0.411	0.398	0.423
F-Statistic	220.086***	595.252***	482.327***	542.572***	497.087***	569.585***
Hausman Test (p-value)	0.071	0.339	0.377	0.19	0.2166	0.00232

Note: Hausman tests suggest that fixed-effects method is preferrable for Model (6)
**p<0.1; **p<0.05; ***p<0.01*

Despite the perplexing correlation between initial income levels and economic fluctuations described in Figure 5, the regression results suggest a more direct relationship in which a one standard-deviation increase in per capita GDP is expected to raise volatility in the

following three-year period by 0.685 to 0.69 percentage points depending on the institutional variable being considered. The effect is significant at the 1 percent level when time effects are taken into account and the 5 percent level without time effects.

With regard to the impact of the government sector, the coefficient is found to be significant at the 1 percent level across all the models investigated. The magnitude of the impact, however, is smaller when compared to that of income. To be specific, with the inclusion of time dummies, a one standard-deviation rise in the share of public spending in GDP only induces volatility to go up by 0.22 percentage points. This finding supports the theory of a crowding-out effect, which holds that an extensive government sector would prevent resources from being effectively allocated to the private sector, and thus contributes to the destabilization of an economy (Bekaert, Harvey and Lundblad, 2006).

The last structural indicator, the share of agricultural output in GDP, posts a positive and significant correlation with per capita GDP growth volatility in the simplest version of the empirical models. However, the estimator quickly becomes insignificant when the variable is analyzed alongside institutional factors.

Between the two variables denoting the size and the average level of education of a population, none plays a significant role in regulating volatility. However, this regression outcome does not imply that there is no desirable return whatsoever to investment in education. It is worth remembering that this study only observes changes to growth rates within the three years after an improvement in the average level of educational attainment has been recorded. Meanwhile, human capital can have a more enduring impact on growth variations through the enhancement of productivity, a component of long-term growth.

None of the trade-related factors is found to have a significant influence on growth volatility although it might be important to note that, for the variable denoting the share of trade

in GDP, the signs of the coefficients are negative in all regression models except for the last one. This is indicative of the risk-sharing benefit of international trade. However, given there is a significant amount of ambiguity and conflicting evidence surrounding the theory of trade liberalization, it is not surprising to see the magnitude of trade's influence on volatility clustering around small numbers and carrying no statistical significance. Also related to trade, the positive, though not significant, coefficients associated with the export concentration index seem to confirm the widely held belief that economic instability is greater when a country risks putting all of its "eggs" in a few baskets.

To understand how the magnitude of growth volatility changes with terms-of-trade shocks when an export basket is less diversified, I re-ran models (5) and (6) for only the lower-income group with an interaction term between terms-of-trade fluctuations and the concentration index. Detailed results are reported in the Appendix (Table A5) with a significant parameter of the interaction term at the 5 percent level. To be specific, if terms-of-trade volatility goes up by one percentage point and the concentration index is increased by one standard deviation, growth volatility is expected to be 0.062 standard-deviation higher than if that were not the case. This finding implies that while the descriptive analysis would suggest an export basket must be highly concentrated for its impact on growth volatility to be observed clearly, the potential negative impact of a specialized trade pattern cannot be neglected if the country mostly exports raw materials and agricultural goods that are susceptible to large degrees of price fluctuations.

In terms of financial development, a larger pool of credit provided to domestic businesses is found to reduce economic disturbances at the 1 percent significance level. This finding echoes the conclusions established in Bekaert, Harvey and Lundblad (2006), Haddad et al. (2012) and Denizer, Ayigun, and Owen (2000). Moreover, it is consistent with the "too much finance" theory, in which it is claimed that strong credit expansions generally benefit economies at the

early stage of financial development, which happens to be the case for the majority of countries in the lower-income group. Regarding the magnitude of the impact, when the relative size of credit supply is expanded by one standard deviation, growth variations would shrink by around 0.22 percentage points after controlling for time dummies. Related to financial and monetary policies, inflation is suggested by models (3) and (5) to represent a challenge for lower-income countries in terms of economic stability. The significance of the correlation between volatility and price changes, however, dies out when time effects are considered.

With regard to productivity fluctuations, only those in agriculture contribute significantly to the overall growth variability. This is not surprising because agriculture, on average, accounts for more than one-fifth of the total output in the lower-income countries. The impact, however, falls behind other explanatory factors in terms of its magnitude. It is estimated that a one percentage-point increase in the volatility of agricultural productivity only raises per capita GDP growth variations by 0.04 percentage points.

The remaining regressors concern the indices representing the quality of a governing body. Between the two indices chosen for this study, better Rule of Law significantly reduces volatility at the 1 percent level while Voice and Accountability only has a marginally significant impact. Regardless, the two indicators bear alike correlations with growth volatility and the correlations are as expected: a more transparent government, a stronger law enforcement system, and a less violent society are all shown to result in a more stable economy. This result is supported by a large body of literature. Sahay et al. (2015) point out that better governing quality, as measured by the same Rule of Law index obtained from the Worldwide Governance Indicators, is conducive to the development of the financial sector, which has been shown by this study to have a significant stabilizing effect on growth volatility. Meanwhile, in Aghion, Banerjee and Piketty (1999), when explaining why developing nations tend to experience more

economic volatility than more developed ones, the researchers lay an emphasis on the role of the regulatory system in addition to the problem of asymmetric information, arguing that it is not only the poorly functioning financial sector but also the loose protection of property rights, poor infrastructure, and high inequality that widen the separation between savers and borrowers, leading to disruptions in credit supply as discussed in Section 3.2.

To sum up, the reduction of growth volatility in lower-income countries would require a combination of a smaller government role, better access to liquidity provided by financial intermediaries, and last but not least, strong political institutions that effectively regulate economic activity.

5.2 Higher-income developing countries

Unlike for the lower-income group, the regression results for higher-income countries do not observe significant influence from government spending, access to finance, or any of the institutional indicators. The signs of the coefficients associated with the four aforementioned variables, however, stay the same regardless of what income group is being considered, suggesting that the directions of their impacts do not change as a country moves up the income rank.

In order to conclude with more confidence the nonexistence of a turnaround effect, I reconstructed regression models (5) and (6) with the inclusion of a quadratic term of the variable capturing the size of credit supply. The regression, of which results can be seen in the Appendix (Table A6), detects no significant impact of financial development on the fluctuations of per capita GDP growth, whether in level or quadratic terms. This confirms the observation I made with the descriptive analysis that large expansions of credit supply have not constituted a challenge for the developing countries considered in this study, at least in terms of growth volatility. It is worth mentioning that credit provision exceeding 100 percent of GDP, the point at

which Easterly, Islam, and Stiglitz (2000) predict that the turnaround effect would emerge, happened very rarely in higher-income countries during the period 1997-2019 with the exception of Thailand, Chile, Malaysia and South Africa. What is confounding about the latter three economies is that, on average, their per capita GDP growth volatility stayed very close to the mean value reported for the higher-income countries even during periods of strong credit booms. Meanwhile, in terms of institutional quality, only Chile scored relatively high on the scale of the WGI, especially with respect to Rule and Laws and Regulatory Quality, while the scores of the others were not noticeably better than the average. This suggests that the quality of supervision cannot be the reason why Malaysia and South Africa managed to maintain slow but relatively stable growth with their very large financial sectors. Therefore, I believe it will help further our knowledge of the correlation between financial development and economic volatility if future studies examine each country-specific case in depth.

Moving on to other explanatory variables, volatility in the preceding period continues to have its significant and strong impact prolonged to the next period. The quadratic form of initial per capita GDP level is reported to be significant at the 10 percent level in the models with time effects included. This suggests that, while the evidence is not strong, there is a non-linear relationship between the stage of economic development and the level of volatility to which a higher-income country is subject. To be specific, volatility initially becomes larger as the country makes more economic progress but eventually declines after income has surpassed a certain point.

Table 2. Random-effects regression results for higher-income developing countries

Dependent variable: per capita GDP growth volatility						
Independent variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Lagged dependent variable		**0.486*****	**0.566*****	**0.547*****	**0.567*****	**0.550*****
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
GDP/capita	**0.847****	**0.454***	**0.426**	**0.496****	**0.423**	**0.487****
	(-0.348)	(0.24)	(0.28)	(0.22)	(0.28)	(0.22)
(GDP/capita) squared	**-0.131***	**-0.069**	**-0.065**	**-0.083***	**-0.065**	**-0.082***
	(-0.07)	(0.05)	(0.06)	(0.05)	(0.06)	(0.05)
Government spending	0.249*	0.1	0.129	0.053	0.128	0.053
	(-0.137)	(0.11)	(0.12)	(0.10)	(0.12)	(0.10)
Agriculture's share	**1.504*****	**0.602**	**0.919****	**0.824****	**0.919****	**0.813****
	(0.49)	(0.38)	(0.44)	(0.34)	(0.44)	(0.34)
Population	0.668	0.397	0.364	0.352	0.363	0.351
	(0.44)	(0.36)	(0.35)	(0.32)	(0.35)	(0.32)
Education	-0.438*	-0.272	-0.246	-0.094	-0.241	-0.088
	(0.23)	(0.18)	(0.19)	(0.19)	(0.18)	(0.18)
Trade openness	0.065	0.011	-0.018	-0.064	-0.02	-0.067
	(0.09)	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)
ToT volatility	0.023	0.075	0.112*	0.048	0.114*	0.056
	(0.07)	(0.06)	(0.06)	(0.05)	(0.06)	(0.05)
Ex. Concentration Index	0.14	0.047	-0.077	-0.002	-0.077	-0.005
	(0.12)	(0.09)	(0.10)	(0.08)	(0.10)	(0.08)
Private credit share	-0.067	-0.06	-0.092	-0.048	-0.092	-0.048
	(0.08)	(0.06)	(0.07)	(0.05)	(0.07)	(0.05)
FDI share	0.245	0.116	0.127	0.098	0.126	0.096
	(0.18)	(0.15)	(0.11)	(0.12)	(0.11)	(0.12)
Inflation volatility	0.138***	0.102**	0.070*	0.023	0.070*	0.023
	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)
Productivity volatility (AGR)	0.017	0.012	0.012	0.013	0.012	0.013
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Productivity volatility (IND)	**0.285*****	**0.127***	**0.145***	**0.121****	**0.144***	**0.119****
	(0.07)	(0.07)	(0.08)	(0.06)	(0.08)	(0.06)
Productivity volatility (SERV)	**0.063****	**0.049*****	**0.041*****	**0.036*****	**0.041*****	**0.036*****
	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Voice and Accountability			-0.025	-0.065		
			(0.08)	(0.06)		
Rule of Law					0.011	-0.018
					(0.12)	(0.08)
Constant	1.976***	0.709**	0.808**	1.272***	0.817**	1.266***
	(0.38)	(0.35)	(0.37)	(0.38)	(0.36)	(0.38)
Observations	429	429	357	357	357	357
Adjusted R^2	0.252	0.469	0.556	0.641	0.556	0.64
F-Statistic	159.290***	394.713***	463.283***	673.575***	463.037***	670.697***
Hausman Test (p-value)	0.017	0.009	0.067	0.507	0.159	0.639

Notes: Hausman tests suggest that fixed-effects method is preferrable for Models (1) and (2)
**p<0.1; **p<0.05; ***p<0.01*

In terms of the magnitude of the impact, the share of agricultural output in GDP is the most important determinant of growth volatility for the group of HIDCs. A one standard-deviation increase in the relative size of the agricultural sector is estimated to raise per capita GDP fluctuations in the following three years by 0.8 percentage points with the consideration of time dummies. What is worrying about this finding is that since the 1980s, there has been a trend where Latin American economies, which make up one-third of higher-income countries in the dataset, revert to specializing in agricultural and resource-heavy sectors after failed attempts to build up industries that would be productive enough to compete in international markets (Paus, 2017). Given the positive correlation between volatility and the size of the agricultural sector and the negative link between volatility and economic growth, it can be expected that if this trend is continued into the future, not only will these economies be unlikely to escape from the state of economic stagnation in which most of them currently find themselves, but their living standards could even retrogress.

The last group of variables found to have a significant impact on growth volatility entails productivity fluctuations in the industrial and service sectors. While the coefficients associated with service productivity growth have more statistical significance, their magnitude lags behind those of industrial productivity. With time effects taken into account, a one standard-deviation increase in fluctuations of industrial productivity growth causes per capita GDP growth volatility to go up by 0.12 percentage points. Meanwhile, the effect resulted from the same rise in service productivity fluctuations is only 0.036 percentage points, which is about the size of the estimated coefficients reported for volatility in agricultural productivity in the analysis of lower-income countries.

In summary, for higher-income countries, the key to economic stability lies in a smaller agricultural sector and the ability of governing institutions and business owners to maintain persistent productivity growth.

VI. Policy implications and limitations

The empirical findings for both groups of income are suggestive of an inevitable trade-off between economic development and volatility, meaning a higher level of income may not be achieved without greater uncertainty and abrupt changes. As a result, alongside policies that are focused on supporting growth, governments of developing countries must also prepare to deal with a greater degree of economic shocks, especially the consequences they might have on people who are already economically vulnerable. A common approach to preserving welfare is to increase public funding in areas such as unemployment insurance, public transportation, healthcare, and education, etc. However, the results of this study suggest that governments of lower-income countries should be cautious about this approach as too much public spending can exacerbate volatility. A better solution would be to maintain the supply of liquidity so that domestic firms can stay in operation during times of high uncertainty and thus maintain employment and salary payment for their workers. For more developed economies in the middle-income range, strengthening the welfare system might help, but enhancing productivity and boosting production in high-skilled sectors were empirically found to be more effective solutions in terms of economic stabilization.

As with many studies, this study is not the one without its limitations. Indeed, there are two limitations that can narrow the applicability of its findings. First, the study only considers growth volatility over three-year spans. This means that it cannot fully account for the influence of long-term variables, such as investments in human capital and physical capital that determine economic performance in the long run. Indeed, findings obtained by Mallick (2013) suggest that

the same external shocks can impact an economy on different levels depending on whether the impact is evaluated in the short term or long term. Therefore, a meaningful extension of this paper would be to examine volatility over a longer time span to see how the magnitude and significance levels of the estimators will change from the ones previously discussed.

Second, this study was conducted with relatively narrow definitions of economic indicators. For instance, economic volatility is restricted to per capita GDP growth fluctuations. Meanwhile, there could be interesting insights from examining consumption and investment volatility separately from GDP. Similarly, in terms of human capital, Mincer (1984) argues that assessing the "transmission and embodiment" of people with "available knowledge" alone does not provide the complete picture. According to the author, a comprehensive approach must also take into account the creation of new knowledge and of technological advances that foster growth, the factors that were not investigated in this study due to data limitations.

The two aforementioned limitations, together with the puzzling relationship between financial development and growth volatility in some countries, constitute the avenues along which this research can be extended.

VI. Concluding remarks

Studying a group of 86 developing economies for the period between 1997 and 2019, I found that the determinants of growth volatility vary depending on where a country is along the process of development. For countries starting at low-income levels, to mitigate volatility, it is essential to control excessive government spending, improve access to credit, and reduce fluctuations in agricultural productivity. On top of that, better property rights protection and contract enforcement are also found to generate downward pressure on volatility. For countries of higher-income ranks, the key to stable growth lies in an economic structure that is less dependent on agricultural production as well as mechanisms to modulate productivity

fluctuations in the industrial and service sectors. It is also important to note that, for both income groups investigated in this study, there is a significant and robust correlation between volatility in the current and the preceding periods, meaning any effort to control volatility today is likely to benefit the economy for many more years into the future. However, it also means that for any failure to contain volatility, we cannot expect its consequences to be quickly dissolved.

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APPENDIX

Table A1. List of countries along with their income status and geographical areas

Country name	1997 Income Status	2019 Income Status	Regional Area
Tajikistan	L	L	Europe & Central Asia
Haiti	L	L	Latin America & Caribbean
Afghanistan	L	L	South Asia
Burkina Faso	L	L	Sub-Saharan Africa
Burundi	L	L	Sub-Saharan Africa
Chad	L	L	Sub-Saharan Africa
Ethiopia	L	L	Sub-Saharan Africa
Gambia, The	L	L	Sub-Saharan Africa
Guinea	L	L	Sub-Saharan Africa
Guinea-Bissau	L	L	Sub-Saharan Africa
Liberia	L	L	Sub-Saharan Africa
Madagascar	L	L	Sub-Saharan Africa
Malawi	L	L	Sub-Saharan Africa
Mali	L	L	Sub-Saharan Africa
Mozambique	L	L	Sub-Saharan Africa
Niger	L	L	Sub-Saharan Africa
Rwanda	L	L	Sub-Saharan Africa
Sierra Leone	L	L	Sub-Saharan Africa
Togo	L	L	Sub-Saharan Africa
Uganda	L	L	Sub-Saharan Africa
Cambodia	L	LM	East Asia & Pacific
Mongolia	L	LM	East Asia & Pacific
Vietnam	L	LM	East Asia & Pacific
Kyrgyz Republic	L	LM	Europe & Central Asia
Honduras	L	LM	Latin America & Caribbean
Nicaragua	L	LM	Latin America & Caribbean
Bangladesh	L	LM	South Asia
Bhutan	L	LM	South Asia
India	L	LM	South Asia
Nepal	L	LM	South Asia
Pakistan	L	LM	South Asia
Benin	L	LM	Sub-Saharan Africa
Cameroon	L	LM	Sub-Saharan Africa
Comoros	L	LM	Sub-Saharan Africa
Côte d'Ivoire	L	LM	Sub-Saharan Africa
Ghana	L	LM	Sub-Saharan Africa
Kenya	L	LM	Sub-Saharan Africa
Lesotho	L	LM	Sub-Saharan Africa
Mauritania	L	LM	Sub-Saharan Africa
Nigeria	L	LM	Sub-Saharan Africa
Senegal	L	LM	Sub-Saharan Africa
Tanzania	L	LM	Sub-Saharan Africa
Zambia	L	LM	Sub-Saharan Africa
Panama *	LM	H	Latin America & Caribbean

Table A1. List of countries along with their income status and geographical areas (continued)

Philippines	LM	LM	East Asia & Pacific
Bolivia	LM	LM	Latin America & Caribbean
El Salvador	LM	LM	Latin America & Caribbean
Egypt, Arab Rep.	LM	LM	Middle East & North Africa
Morocco	LM	LM	Middle East & North Africa
Tunisia	LM	LM	Middle East & North Africa
Sri Lanka	LM	LM	South Asia
China	LM	UM	East Asia & Pacific
Indonesia	LM	UM	East Asia & Pacific
Thailand *	LM	UM	East Asia & Pacific
Belarus	LM	UM	Europe & Central Asia
Georgia	LM	UM	Europe & Central Asia
Kazakhstan *	LM	UM	Europe & Central Asia
Colombia *	LM	UM	Latin America & Caribbean
Costa Rica *	LM	UM	Latin America & Caribbean
Dominican Republic *	LM	UM	Latin America & Caribbean
Ecuador	LM	UM	Latin America & Caribbean
Guatemala	LM	UM	Latin America & Caribbean
Guyana	LM	UM	Latin America & Caribbean
Jamaica *	LM	UM	Latin America & Caribbean
Paraguay *	LM	UM	Latin America & Caribbean
Peru	LM	UM	Latin America & Caribbean
Suriname *	LM	UM	Latin America & Caribbean
Iraq	LM	UM	Middle East & North Africa
Jordan *	LM	UM	Middle East & North Africa
Namibia	LM	UM	Sub-Saharan Africa
Croatia *	UM	H	Europe & Central Asia
Czech Republic *	UM	H	Europe & Central Asia
Estonia *	UM	H	Europe & Central Asia
Poland *	UM	H	Europe & Central Asia
Slovak Republic *	UM	H	Europe & Central Asia
Chile *	UM	H	Latin America & Caribbean
Uruguay *	UM	H	Latin America & Caribbean
Bahrain *	UM	H	Middle East & North Africa
Mauritius *	UM	H	Sub-Saharan Africa
Malaysia *	UM	UM	East Asia & Pacific
Turkey *	UM	UM	Europe & Central Asia
Brazil *	UM	UM	Latin America & Caribbean
Mexico *	UM	UM	Latin America & Caribbean
Lebanon *	UM	UM	Middle East & North Africa
Botswana *	UM	UM	Sub-Saharan Africa
South Africa *	UM	UM	Sub-Saharan Africa

Note: Countries marked with (*) are the classified by the author of this study as Higher-income Developing Countries (HIDCs). The rest are Lower-income Developing Countries (LIDCs).

Table A2. Variable description

Explanatory variables	Description	Source
Initial GDP/capita	Per capita values for gross domestic product (GDP) that is expressed in current international dollars and converted by purchasing power parity (PPP) conversion	World Development Indicators
GDP/capita growth	Annual percentage growth rate of GDP per capita based on constant local currency.	World Development Indicators
Government expenditure (% GDP)	All government current expenditures for purchases of goods and services, including compensation of employees and most expenditures on national defense.	World Development Indicators
Agriculture, value added (% GDP)	The net output of the agriculture sector, including forestry, hunting and fishing, and cultivation of crops and livestock production.	World Development Indicators
Population, total	The number of all residents regardless of legal status or citizenship. The values shown are midyear estimates.	World Development Indicators
Mean years of schooling	The average number of years of education received by people ages 25 and older, converted from educational attainment levels using official durations of each level.	UN Development Program
Trade openness	The sum of exports and imports of goods and services measured as a share of gross domestic product.	World Development Indicators
Commodity Terms-of-trade Volatility	Rolling standard deviations of net export price index, which is measured by weighted by ratio of net exports to GDP for individual commodities.	International Monetary Fund
Export concentration index	A normalized Herfindahl-Hirschmann index of the product concentration of merchandise exports at the country level. This index ranges from zero to one. A higher value denotes higher concentration.	UNCTAD
Private credit share (% GDP)	Financial resources provided to the private sector by financial corporations. For some countries these claims include credit to public enterprises. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available.	World Development Indicators
FDI share (% GDP)	The net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.	World Development Indicators
Inflation volatility	Rolling standard deviation of inflation rates calculated by the consumer price index.	World Development Indicators
Productivity growth volatility (AGR)	Rolling standard deviation of annual growth rates of value added per worker. Agriculture includes forestry, hunting, and fishing as well as cultivation of crops and	World Development Indicators

Table A2. Variable description (continued)

Productivity growth volatility (IND)	Rolling standard deviation of annual growth rates of value added per worker. Industry comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas.	World Development Indicators
Productivity growth volatility (SERV)	Rolling standard deviation of annual growth rates of value added per worker. Services include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services.	World Development Indicators
Voice and Accountability	Perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. The index ranges from -2.5 to 2.5.	Worldwide Governance Indicators
Rule of Law	Perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. The index ranges from -2.5 to 2.5.	Worldwide Governance Indicators

Table A3. Summary Statistics

Explanatory variables	**Lower-income Developing Countries**				**Higher-income Developing Countries**			
	Mean	**Max**	**Min**	**SD**	**Mean**	**Max**	**Min**	**SD**
GDP/capita growth	2.78	17.03	-10.86	3.16	2.39	10.80	-9.67	3.14
GDP/capita volatility (t to t+2)	1.70	9.20	0.03	1.55	1.90	8.78	0.03	1.62
GDP/capita volatility (t+1 to t+3)	1.86	19.06	0.03	1.85	2.01	11.58	0.03	1.72
Population (100,000,000 people)	0.90	13.90	0.01	2.66	0.30	2.08	0.01	0.46
GDP/capita (1000 PPP$)	4.46	19.07	0.73	3.39	18.15	48.30	8.14	7.97
Trade (% GDP)	71.82	311.35	20.72	37.22	88.51	220.41	16.44	42.18
Commodity ToT volatility (t to t+2)	1.38	12.53	0.01	1.44	1.16	7.88	0.01	1.22
Export concentration index	0.35	0.98	0.07	0.19	0.24	0.90	0.06	0.17
FDI (% GDP)	4.06	103.34	-37.15	7.67	3.93	23.21	-8.40	3.29
Private credit (% GDP)	28.94	156.23	2.34	25.10	57.55	160.12	11.67	36.10
Inflation rate	6.32	59.22	-3.10	5.80	4.82	22.03	-3.75	3.61
Inflation volatility (t to t+2)	2.64	28.15	0.03	2.83	1.72	8.99	0.07	1.48
Government expenditure (% GDP)	13.30	41.89	3.46	5.30	15.38	24.90	7.20	3.75
Agriculture, value added (% GDP)	21.61	66.03	3.76	11.50	5.23	14.80	0.26	3.02
Mean years of schooling	5.40	12.80	1.00	2.60	9.00	12.90	5.20	1.70
Agricultural productivity growth	2.69	86.19	-38.16	8.02	3.53	65.60	-35.37	10.54
Industrial productivity growth	1.92	115.13	-37.77	9.85	1.30	20.59	-25.78	5.25
Service productivity growth	1.47	87.54	-15.95	5.74	1.28	13.24	-9.84	3.25
Agriculture productivity growth volatility (t to t+2)	5.30	48.72	0.07	5.47	8.40	50.93	0.13	7.47
Industrial productivity growth volatility (t to t+2)	3.06	39.67	0.04	4.05	2.16	15.48	0.02	1.84
Service productivity growth volatility (t to t+2)	3.03	50.82	0.04	3.95	2.29	9.32	0.01	1.68
Voice and Accountability	-0.50	0.60	-1.75	0.56	0.33	1.29	-1.32	0.63
Rule of Law	-0.65	0.52	-1.90	0.44	0.16	1.43	-1.25	0.64

Table A4. Correlation between government indicators

	Government Effectiveness	Control of Corruption	Rule of Law	Regulatory Quality	Voice and Accountability	Political Stability
Government Effectiveness	1	0.834952	0.885488	0.874842	0.574597	0.550797
Control of Corruption	0.834952	1	0.892508	0.751337	0.603083	0.637065
Rule of Law	0.885488	0.892508	1	0.833079	0.641534	0.648509
Regulatory Quality	0.874842	0.751337	0.833079	1	0.637075	0.52036
Voice and Accountability	0.574597	0.603083	0.641534	0.637075	1	0.509088
Political Stability	0.550797	0.637065	0.648509	0.52036	0.509088	1

Table A5. Random-effects for LIDCs with an interaction term between ToT volatility and the concentration index

Dependent variable: ***per capita GDP growth volatility***		
Independent variables	Model (5)	Model (6)
Lagged dependent variable	0.428***	0.435***
	(0.07)	(0.07)
GDP/capita	0.496*	0.589***
	(0.26)	(0.23)
(GDP/capita) squared	-0.407	-0.213
	(0.26)	(0.24)
Government spending	0.159***	0.179***
	(0.05)	(0.05)
Agriculture's share	0.176	0.167
	(0.11)	(0.11)
Population	0.031	0.005
	(0.04)	(0.04)
Education	-0.1	-0.055
	(0.08)	(0.07)
Trade share	-0.074	-0.089
	(0.09)	(0.09)
ToT volatility	-0.083*	-0.089*
	(0.04)	(0.05)
Ex. Concentration Index	-0.055	-0.021
	(0.11)	(0.11)
Private credit share	-0.259***	-0.211***
	(0.08)	(0.07)
FDI share	0.051	0.065
	(0.06)	(0.06)
Inflation volatility	0.045*	0.012
	(0.02)	(0.02)
Productivity volatility (AGR)	0.043**	0.040**
	(0.02)	(0.02)
Productivity volatility (IND)	0.014	0.012
	(0.03)	(0.03)
Productivity volatility (SERV)	0.01	0.002
	(0.03)	(0.03)
Rule of Law	-0.201***	-0.208***
	(0.06)	(0.06)
ToT volatility*Concentration index	**0.059****	**0.062****
	(0.03)	**(0.03)**
Constant	0.807***	1.446***
	(0.19)	(0.35)
Observations	726	726
Adjusted R^2	0.405	0.427
F Statistic	511.339***	579.007***
Note:		*p<0.1; **p<0.05; ***p<0.01

Table A6. Random-effects for HIDCs with the quadratic form of the credit supply variable

Dependent variable: ***per capita GDP growth volatility***		
Independent variables	Model (5)	Model (6)
Lagged dependent variable	0.536***	0.538***
	(0.06)	(0.06)
GDP/capita	0.444*	0.451**
	(0.24)	(0.20)
(GDP/capita) squared	-0.06	-0.075
	(0.05)	(0.05)
Government spending	0.167	0.105
	(0.10)	(0.09)
Agriculture's share	0.759**	0.673**
	(0.38)	(0.33)
Population	0.188	0.174
	(0.37)	(0.33)
Education	-0.329**	-0.171
	(0.16)	(0.18)
Trade share	-0.073	-0.1
	(0.09)	(0.07)
ToT volatility	0.128**	0.056
	(0.06)	(0.05)
Ex. Concentration Index	-0.087	-0.029
	(0.10)	(0.09)
Private credit share	**-0.162**	**-0.017**
	(0.16)	**(0.14)**
Private credit share squared	**0.025**	**-0.015**
	(0.06)	**(0.05)**
FDI share	0.089	0.035
	(0.12)	(0.13)
Inflation volatility	0.076**	0.028
	(0.04)	(0.03)
Productivity volatility (AGR)	0.013	0.014
	(0.01)	(0.01)
Productivity volatility (IND)	0.147**	0.110*
	(0.07)	(0.06)
Productivity volatility (SERV)	0.039***	0.036***
	(0.01)	(0.01)
Rule of Law	0.074	0.032
	(0.12)	(0.08)
Constant	0.691*	1.167***
	(0.38)	(0.40)
Observations	357	357
Adjusted R^2	0.639	0.639
F Statistic	669.358***	669.358***
Note:		*p<0.1; **p<0.05; ***p<0.01

Figure A1. Correlation between growth volatility and log of initial per capita GDP level

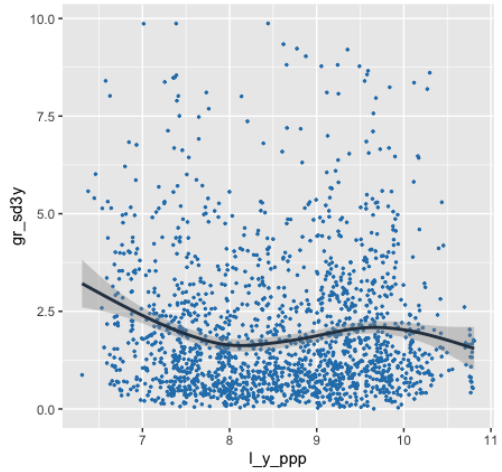


Figure A2. Correlation between growth volatility and export concentration index

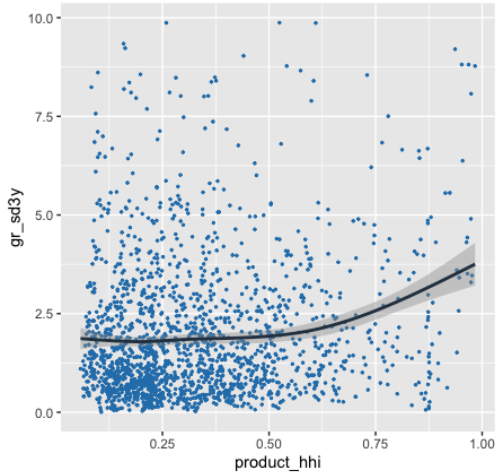
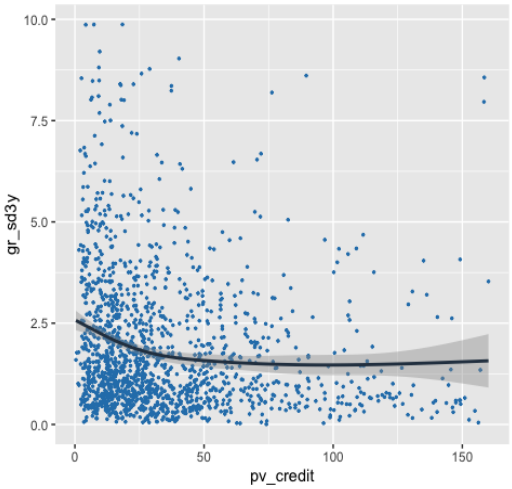
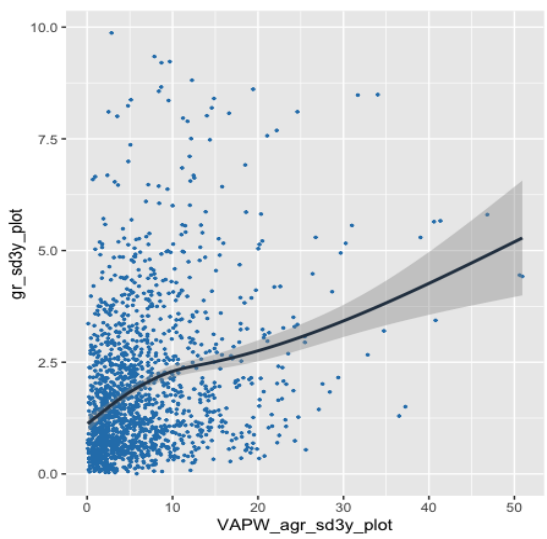
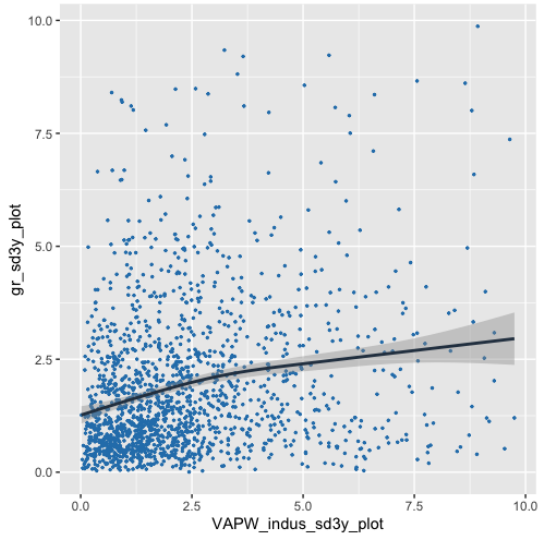


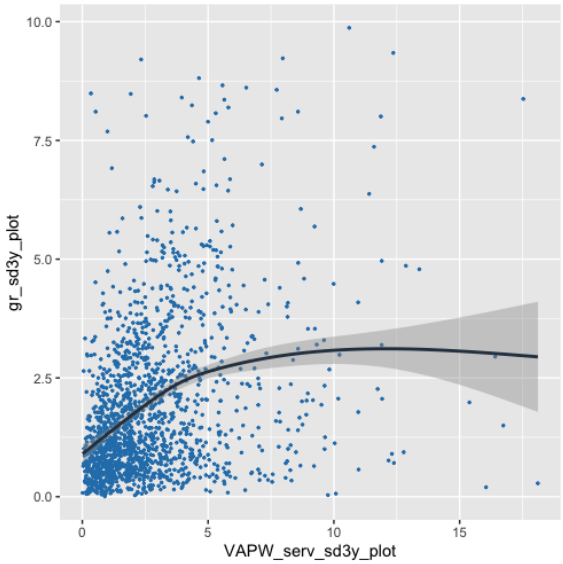
Figure A3. Correlation between growth volatility and the size of private credit



Figures A4 (upper left), A5 (upper right), and A6 (lower center).
The correlation between agricultural, industrial, and service productivity fluctuations and growth volatility







Figures A7 (left) and A8 (right). The correlation between governing indices and growth volatility