ISSN 1518-3548

BANCO CENTRAL DO BRASIL

Economic Growth, Volatility and Their Interaction: What's the role of finance?

Sergio Henrique Rodrigues da Silva, Benjamin Miranda Tabak, Daniel Oliveira Cajueiro and Dimas Mateus Fazio

March 2018

Working Papers

474

ISSN 1518-3548
CGC 00.038.166/0001-05

Working Paper Series	Brasília	no. 474	March	2018	p. 1-28

Working Paper Series

Edited by the Research Department (Depep) – E-mail: workingpaper@bcb.gov.br

Editor: Francisco Marcos Rodrigues Figueiredo – E-mail: francisco-marcos.figueiredo@bcb.gov.br

Co-editor: José Valentim Machado Vicente – E-mail: jose.valentim@bcb.gov.br

Editorial Assistant: Jane Sofia Moita – E-mail: jane.sofia@bcb.gov.br

Head of the Research Department: André Minella – E-mail: andre.minella@bcb.gov.br

The Banco Central do Brasil Working Papers are all evaluated in double-blind refereeing process.

Reproduction is permitted only if source is stated as follows: Working Paper no. 474.

Authorized by Carlos Viana de Carvalho, Deputy Governor for Economic Policy.

General Control of Publications

Banco Central do Brasil
Comun/Divip
SBS – Quadra 3 – Bloco B – Edifício-Sede – 2º subsolo
Caixa Postal 8.670
70074-900 Brasília – DF – Brazil
Phones: +55 (61) 3414-3710 and 3414-3565
Fax: +55 (61) 3414-1898
E-mail: identidadevisual.comun@bcb.gov.br

Citizen Service Division

Banco Central do Brasil
Deati/Diate
SBS – Quadra 3 – Bloco B – Edifício-Sede – 2º subsolo
70074-900 Brasília – DF – Brazil
Toll Free: 0800 9792345
Fax: +55 (61) 3414-2553
Internet: http//www.bcb.gov.br/?CONTACTUS

Non-technical Summary

In the early 2000s, there was a growing consensus that finance had a substantial role in fostering economic growth. Basically, financial institutions allocate private and public savings across firms and individuals. Better financial development would lead to more efficient allocations, and thus to economic growth. Despite that, the idea that this relationship is not quite so straightforward started to gain support, especially after the dawn of the global financial crisis. What is the influence of financial development on economic growth? Does finance smooth the economic system's engine, helping to reduce business cycle fluctuations, or does it increase the variation of economic growth around its trend?

This paper examines the relation between financial development (FD) and economic growth and its volatility. We use a traditional measure of FD: the ratio of the amount of credit provided by banks to the private sector to GDP. It means that, all other things equal, the higher the amount of credit available in a country, the more financially developed that country is. Our main finding is that the mentioned relation is nonlinear and "inverted-U" shaped. That way, at moderate levels of financial development, further deepening increases the ratio of average growth to volatility, a clearly positive result, since the country would obtain a higher and more stable growth rate. However, as financial development increases, this relation reverts, so that the rise in volatility overcomes that of economic growth. From this point on, the potential increment in growth would be followed by greater instability. Therefore, there would be an optimal level for financial development, in which it would be possible to attain high growth with low volatility.

Sumário Não Técnico

No início dos anos 2000, havia um crescente consenso de que o sistema financeiro tinha um papel substancial em promover o crescimento econômico. Basicamente, instituições financeiras alocam a poupança privada e pública entre firmas e indivíduos. Um melhor desenvolvimento financeiro levaria a alocações mais eficientes, e assim induziria o crescimento econômico. Apesar disso, a ideia de que esta relação não é tão simples e direta começou a ganhar força, especialmente após o início da crise financeira global. Qual é a influência do desenvolvimento financeiro no crescimento econômico? Será que as finanças lubrificam o motor do sistema econômico, ajudando a reduzir as flutuações do ciclo de negócios, ou elas elevam a variação do crescimento econômico ao redor de sua tendência?

Este trabalho examina a relação entre o desenvolvimento financeiro (DF) e o crescimento econômico e sua volatilidade. Nós utilizamos uma medida tradicional de desenvolvimento financeiro: a razão entre a quantidade de crédito provida pelos bancos ao setor privado e o PIB. Isso significa que, tudo o mais constante, quanto maior a quantidade de crédito disponível em um país, mais esse país é desenvolvido financeiramente. O principal resultado obtido é que a referida relação é não linear, com formato de "U invertido". Assim, em níveis moderados de desenvolvimento financeiro, seu incremento aumenta a razão entre o crescimento médio e a volatilidade, um resultado claramente positivo, uma vez que o país teria um crescimento maior e mais estável. Porém, à medida que o desenvolvimento financeiro se eleva, esta relação se reverte, e o aumento da volatilidade ultrapassa o do crescimento econômico. A partir deste ponto, a elevação potencial do crescimento seria acompanhada de mais instabilidade. Dessa forma, haveria um nível ótimo para o desenvolvimento financeiro, no qual seria possível atingir um alto crescimento com baixa volatilidade.

Economic Growth, Volatility and Their Interaction: What's the role of finance?

Sergio Henrique Rodrigues da Silva[*]

Benjamin Miranda Tabak[**]

Daniel Oliveira Cajueiro[***]

Dimas Mateus Fazio[****]

Abstract

This paper examines the relation between financial depth and the interaction of economic growth and its volatility. We use a sample of 52 countries for the period 1980–2011, and our main finding is that, at moderate levels of financial depth, further deepening increases the ratio of average economic growth to volatility; however, as financial depth gets higher, this relation reverts, and the rise in volatility overcomes that of economic growth. This result is obtained both in the medium and long run; however, the peak of the relation seems to be lower in the medium run (domestic credit-to-GDP ratio around 40% to 55%) than in the long run (around 75% to 99%). This suggests that increasing the domestic credit-to-GDP ratio may intensify relative volatility in the medium term, but still may raise relative long-term growth before the long-run threshold is achieved.

Keywords: Financial development, Growth, Volatility, Non-linearity
JEL Classification: O11, O40, E44, G10

[*] Research Department, Banco Central do Brasil, e-mail: sergio.silva@bcb.gov.br
[**] Department of Economics and Law, Universidade Católica de Brasilia, e-mail: benjaminm.tabak@gmail.com
[***] Department of Economics, Universidade de Brasília, e-mail: danielcajueiro@gmail.com
[****] London Business School, e-mail: dimasfazio@gmail.com

1. Introduction

In the early 2000s, there was a growing consensus that finance had a substantial role in fostering economic growth. Basically, financial institutions allocate private and public savings across firms and individuals. Better financial development would lead to more efficient allocations, and thus to economic growth. Despite that, the idea that this relationship is not quite so straightforward started to gain support, especially after the dawn of the global financial crisis. What is the influence of financial development on economic growth? Does finance smooth the economic system's engine, helping to reduce business cycle fluctuations, or does it increase the variation of economic growth around its trend?

This paper examines the relation between financial depth and the interaction of economic growth and its volatility. Our main finding is that, at moderate levels of financial depth, further deepening increases the ratio of average growth to volatility; however, as financial depth increases, this relation reverts, so that the rise in volatility overcomes that of economic growth.

Our work builds upon four connected bodies of literature. The preliminary literature proposed that well-developed financial systems are associated with faster economic growth, but did not yet have the tools to properly evaluate that proposition.[1] Levine (2005) summarizes this argument in the five main functions of financial systems: producing information about investment opportunities; monitoring the enterprises that receive financial resources; helping risk management; pooling savings, thus allowing the capitalization of large-scale investment projects; and facilitating the exchange of goods and services.

The first empirical study trying to evaluate the causal relation of financial development with economic growth was King and Levine (1993).[2] They employed three main measures of development of financial intermediaries and, besides GDP per capita growth, used capital per capita growth and productivity growth as dependent variables to assess the channels through which finance influences economic growth. Their results indicated that there was a positive relation between the financial development indicators

[1] In fact, this idea exists since the late nineteenth century, for example in the works of Bagehot (1873), Schumpeter (1934) and Gurley and Shaw (1955).

[2] Previous studies, such as Goldsmith (1969), found a positive correlation between finance and growth, but didn't establish a causal relation.

and the growth indicators, and the initial financial development was a good predictor for subsequent long-run growth. Related works, such as Levine and Zervos (1998), expanded the scope of financial development measures, including stock market development indicators, and found similar results.

The second strand of literature states a positive causal relation from financial development to economic growth. The most influential works were Levine et al. (2000) and Beck et al. (2000), who used instrumental variables cross-section regressions and dynamic panel GMM methods to reevaluate the work of King and Levine (1993). The instrumental variable used for financial development was the country's legal origin, following LaPorta et al. (1998). The authors found that the exogenous component of financial development has a positive impact on GDP and productivity growth, but not on capital accumulation and the savings rate.

Aghion et al. (2005) took a different approach to analyze the finance-growth nexus. Most studies (at least implicitly) assume that financial development may affect the steady-state growth rate; nonetheless, Aghion et al. (2005) suggested that financial development might speed up convergence to steady-state without altering steady-state growth itself. To check that, they used a cross-country regression similar to Levine et al. (2000), adding an interaction term between the initial level of relative per capita GDP and the financial development indicators. The results support their hypothesis.

Meanwhile, some studies started to propose that the impact of finance on growth might vary according to the level of financial development. Rioja and Valev (2004) reproduced the work of Levine et al. (2000), but split the sample into three regions with low, medium and high financial development. That way, they noticed that the impact of increasing financial development was small in the region with low financial development, but strong in the medium region. Seven and Yetkiner (2016) also split the country sample, but according to the country's income level. They analyzed the separate impact of bank and stock market development, and found that banking development is beneficial to growth in low- and middle-income countries, but harmful in high-income ones. Conversely, stock markets favor growth in middle- and high-income countries. Loayza and Ranciere (2006) tried to link the financial development literature to the financial crisis literature[3], which affirms that indicators of credit can be used as predictors of crises, and

[3] Such as Kaminsky and Reinhart (1999).

therefore have a negative influence on economic growth. They used a Pooled Mean Group method and panel data to detach the long- and short-run responses of economic growth to *private credit*, and confirmed that this relation is positive in the long run. Despite this, the opposite occurs in the short run, so that financial development may be associated with financial volatility and crises.

After that, several works started exploring a possible non-monotonic relation between finance and growth, originating the third main related line of work. Cecchetti and Kharroubi (2012) employed a pooled OLS method and quadratic financial development variables, and found that the growth of GDP per worker can be expressed as an inverted U function of financial development, with a peak at around 100% of GDP for private credit and 90% for bank credit. Law and Singh (2014) applied a dynamic panel threshold regression to test the existence of a threshold of financial development with different effects on economic growth below and above it. For private credit, they observed a threshold at about 88% of GDP and an inverted V relation, so financial development beyond that level would hinder economic growth. Arcand et al. (2015) utilized semi-parametric estimations and dynamic panel GMM with squared *private credit*, and obtained similar results, also with a peak near 100% of GDP. Sahay et al. (2015) created a financial development index comprising both financial institutions and markets and three dimensions of financial development: depth, access, and efficiency. Using dynamic panel GMM and the index quadratic term, they reached analogous outcomes, showing that a high financial development index harms economic growth.

Finally, the fourth strand of literature studied the impact of financial development on economic growth volatility, measured by the standard deviation of GDP per capita growth. Easterly et al. (2001) found weak evidence of a U-shaped effect of private credit on growth volatility. However, the subsequent literature mainly proposed a linear relation of financial development and volatility, and found this relation to be negative. Beck et al. (2006) tried to evaluate how financial development influences the impact of real and monetary volatility on growth volatility. They found that higher private credit may reduce and increase the impacts of real and monetary volatility, respectively, especially if stock markets are underdeveloped. Furthermore, Beck et al. (2014) used a new measure of financial development to separate the effects of the financial systems' intermediation and non-intermediation activities (such as market making, advisory services and insurance, among others) on economic growth and growth volatility. Their main result is that

financial intermediation increases growth while reducing volatility in the long run, but these effects become weaker when considering a shorter and more recent time horizon. Nevertheless, non-intermediation activities don't affect growth or volatility in the long run and may increase volatility in the medium run. Mallick (2014) decomposes growth volatility into business-cycle and long-run components, and finds that the development of financial intermediaries reduces business-cycle volatility, but has no effect in the long run.

We extend the previous literature by taking into account a non-linear relation of financial development on growth volatility, and find robust evidence that there is likewise "too much finance" in this case. Besides that, we also employ a new measure to evaluate the interaction of economic growth and its volatility, and find a non-linear relation between financial development and this variable. This means that, as finance gets deeper, growth volatility will increase faster than the average growth itself.

The remainder of this paper is organized as follows: Section 2 discusses the data and methods employed in our model, Section 3 presents the empirical results, and Section 4 concludes the paper.

2. Data and methodology

In this paper we employ two dependent variables that are traditionally used to measure the increase of a country's welfare and its volatility, and propose a new indicator to assess this last dimension. The first two variables are average real GDP per capita growth (ΔGDP_{pc} or Δ) and its standard deviation ($\sigma(\Delta\text{GDP}_{pc})$ or σ). For country i,

$$\Delta_i = \frac{\sum_{t=1}^{T_i} growth_{it}}{T_i} \tag{1}$$

and

$$\sigma_i = \sqrt{\frac{\sum_{t=1}^{T_i}(growth_{it} - \Delta_i)^2}{T_i - 1}} \tag{2}$$

However, the standard deviation is a measure of absolute dispersion, and thus it is not appropriate to compare the variability within countries with different average growth. To deal with that, we introduce the indicator $Z(\Delta\text{GDP}_{pc})$, or simply Z, defined

as the inverse hyperbolic sine transformation[4] of the interaction of Δ and $1/\sigma$, for a given time period.[5] That way, higher values of Z imply that the country is attaining higher levels of growth with lower growth volatility.[6]

To illustrate the relevance of variable Z, Figure 1 presents the evolution over time of annual Δ in four countries with similar σ: South Africa, Portugal, Slovakia and China. These four countries have, in the period considered, an σ around 2.6%. Despite that, their average growth is considerably different, ranging from 0.5% in South Africa to 9.0% in China, with resulting Z values of 0.21 and 3.31, respectively. Note that a high Z implies that the country is less prone to recessions; for instance, China always had positive growth in this period.

<Insert Figure 1 here>

As the main independent variable of interest, we use a standard measure of financial intermediaries development (FD), domestic credit by banks (*Dom. Credit*).[7] This variable refers to the log of the ratio of outstanding credit provided by banks to the private sector by GDP.[8] We follow the finance-growth nexus literature, using the country's legal origin as an instrumental variable for the FD indicator.[9]

The control variables are also chosen according to this literature, and are divided into two groups: the narrow one includes the log of GDP per capita of the first year of the period (Initial $\text{GDP}_{pc,0}$), and the log of one plus the average years of secondary schooling of the adult population (*Years of Schl.*); the wide group includes both variables from the first group, and additionally the log of government final consumption expenditure relative to GDP (*Govrmnt. Consumption*), the log of the sum of imports and exports of goods and services over GDP (*Ecnmy. Openness*), and consumer inflation (*Cons. Price Index*).

[4] The inverse hyperbolic sine transformation of variable x is defined as $\ln\left(x + (x^2 + 1)^{1/2}\right)$. We use this transformation instead of the logarithmic one because it allows negative or zero values of the transformed variable, maintaining approximately the same marginal effect of the log transformation.

[5] The most usual measure of relative dispersion, the Coefficient of Variation, CV (σ/Δ), would not be appropriate in this case since real GDP growth can take positive and negative values, so its average may be zero, leading to an undetermined CV.

[6] When average growth is negative, low volatility (and thus low values of Z) implies that the chance of the country attaining positive growth was low.

[7] We do not employ measures of stock market development due to lower data availability.

[8] It may include credit to public enterprises.

[9] We use dummy variables that represent the country's legal origin: English, French, German, or Scandinavian.

Our sample is composed of 52 countries with data for the period 1980 to 2011. Two datasets are built based on this sample: a cross-sectional one with data averaged and volatility calculated by country over the whole sample period, and a panel dataset with data averaged and volatility calculated by country over 5-year non-overlapping intervals. Tables 1 and 2 present the summary statistics of the main variables for the cross-section and panel datasets, respectively.

<Insert Tables 1 and 2 here>

For the cross-sectional database, the econometric methods employed are standard OLS and instrumental variables OLS (IV), and for the panel dataset, we employ pooled OLS (POLS), a fixed effects specification (FE), and the dynamic panel Arellano-Bond estimator (AB), where the instruments are the lags of the explanatory variables (in levels and differences).[10] The main motivation for the use of AB is the presence of independent variables that may not be strictly exogenous, such as the financial development variables[11], and to present a dynamic specification avoiding "dynamic panel bias".[12] For all specifications, we include a squared term of the financial depth variable to allow for non-monotonic effects. Time fixed effects are included in all panel specifications. Equations 3 and 4 present the cross-sectional and panel AB specifications, respectively:

$$DepVar_i = \beta_0 + \beta_1 FD_i + \beta_2 FD_i^2 + \beta_3{}' X_i + \varepsilon_i \tag{3}$$

$$\begin{aligned} DepVar_{it} = \beta_0 + \beta_1 FD_{it} + \beta_2 FD_{it}^2 + \beta_3{}' X_{it} \\ + \beta_4 DepVar_{it-1} + \mu_i + \eta_t + \varepsilon_{it} \end{aligned} \tag{4}$$

where DepVar may be either Δ, σ or Z; FD is a measure of financial development; X is the set of control variables; μ is the country fixed effect; η is the time fixed effect; and ε is the error term.

[10]In this last case, we also include excluded instruments that reflect the country's legal origin (English, French, German, or Scandinavian).
[11]See the discussion in Section 1 on the causal relation between financial development and growth.
[12]Caused by correlation between the lagged dependent variable and the fixed effects in the error term.

3. Empirical results

3.1 Cross-sectional data

Tables 3 to 5 present the results of the cross-section regressions for Z, Δ and σ as dependent variables, respectively. In all tables, columns 1 to 4 and 5 to 8 present the results using *Dom. Credit* and *Priv. Credit* as the main independent variable, respectively; moreover, columns 1, 3, 5 and 7 present the results employing the narrow group of control variables, while columns 2, 4, 6 and 8 employ the wide group. Finally, columns 1, 2, 5 and 6 present the results of the standard OLS specification, while columns 3, 4, 7, 8 present the results of the IV specification.

Regarding Z, the FD variable linear and squared terms are statistically significant in all specifications, as shown in Table 3. Linear terms always have a positive coefficient, whereas the squared terms' coefficients are negative. That way, the relation of FD and volatility is hump-shaped, with a *ceteris paribus* positive marginal effect on Z for low values of FD, but this effect becomes negative as FD increases. All other things being equal, for a country with the lowest level of average *Dom. Credit* in the sample (2.8), a 1% increase in *Dom. Credit* would lead to around a 1% increase in Z; however, for the highest level of *Dom. Credit* (5.0), the same increase in this variable would lead to a decrease between 0.2% and 0.5% in Z. Moreover, the estimated maximum point after which *Dom. Credit* starts exerting a negative impact on Z is around the original variable value of 75% (with respect to the OLS wide control group specification).[13] The 90% confidence interval (CI) for this critical point ranges from 48% to 117%. 21 of the 52 observations have *Dom. Credit* below the lower bound of this interval, and are thus in the region with a significant positive marginal effect, while 3 are above the upper bound and have a significant negative marginal effect. Note that the estimated critical points are smaller when the wide control group is employed than those estimated using the narrow group.

<Insert Table 3 here>

[13] The critical points analysis always considers the variable values before transformation.

It's also noteworthy that the coefficients for the exogenous component of FD are considerably higher than the standard OLS ones. The results also indicate that education has a positive impact on Z, whereas the effect of initial GDP is negative, indicating that high-income countries may have lower long-run growth rates and/or higher growth volatility (the next tables will try to untie these effects). The impacts of government size and inflation are not significant, and the OLS specifications point to a negative effect of trade openness on volatility.

We do not find a significant long-run relation of the linear and squared terms of FD to growth (Table 4). However, in an unreported specification without the squared term[14], we find that the linear term's coefficient is positive and significant at around 0.01 for the OLS estimators and 0.03 for the IV ones. This means that, considering the OLS results, a 1% increase in *Dom. Credit* would lead to around a 0.01 p.p. increase in Δ. Education has a positive impact on growth, while the effect of initial GDP is negative, as expected by the convergence hypothesis. Government consumption seems to have a small positive influence on long-run growth, but generally the other control variables do not have a significant effect.

<Insert Table 4 here>

Finally, when we use the wide control group, σ is significantly affected by both the linear and squared terms of the FD variable, whose coefficients are negative and positive, respectively (Table 5), implying a valley-shaped relation, with the minima very close to the maxima achieved in the Z regressions. Along with the results of last paragraph, this suggests that FD affects Z both through its effect on growth and through its standard deviation. It's also noticeable that government size always has a positive and significant coefficient. Openness exhibits a positive and significant impact on the OLS specifications, and inflation also presents this characteristic in the IV specifications.

<Insert Table 5 here>

[14] The regression results are available upon request

3.2 Panel data

Tables 6 to 8 present the results of the panel data regressions for Z, Δ and σ as dependent variables, respectively. In all tables, columns 1 to 6 and 7 to 12 present the results using *Dom. Credit* and *Priv. Credit* as the main independent variable, respectively; moreover, columns 1, 3, 5, 7, 9 and 11 present the results employing the narrow group of control variables, while columns 2, 4, 6, 8, 10 and 12 employ the wide group. Finally, columns 1, 2, 7 and 8 present the results of the pooled OLS specification, columns 3, 4, 9 and 10 present the results of the fixed effects specification, and columns 5, 6, 11 and 12 present the results of the dynamic panel Arellano-Bond estimator.

In Table 6 we can see that, for variable Z, the linear and squared terms of the FD variables are significant and have positive and negative coefficients, respectively, in all panel data specifications, as in the cross-section specifications. Additionally, the absolute values of the coefficients of the FD variable in the POLS specification are greater than those of the OLS specification, suggesting that the impact of financial depth on volatility is greater in the medium than in the long run. Furthermore, when we add country fixed effects, the estimated coefficients are larger (in absolute value) than those of the POLS, and the same also happens when we employ the dynamic panel estimator. In the POLS specifications, the estimated maximum value of Z is achieved for values of *Dom. Credit* around 53%; when using FE and AB, these values are lower at about 41% and 43%, respectively. The 90% CIs for the critical points, using the wide control group and the POLS, FE and AB estimators, are 45%–59%, 30%–54% and 29%–58%, respectively. For the same groups, the number of observations below the CI lower bound are 142, 87 and 80, and above the CI upper bound they are 150, 163 and 152, respectively.

The data also support a negative and significant effect of inflation on medium-term volatility. The POLS specifications endorse a positive impact of education and a negative impact of government spending. Initial GDP and openness have positive and negative coefficients, respectively, but both are mostly not significant. The lagged Z term does not have a significant impact on the AB specifications.

<Insert Table 6 here>

The panel specifications indicate a hump-shaped effect of FD on medium-run growth (except in the AB specifications), in contrast with the results obtained in the cross-

country specifications, where the coefficients are not statistically significant (Table 7). The estimated peak of the relation is around 59% and 44% in POLS and FE, respectively. These values are close to the ones obtained in the Z regressions. Government spending, inflation and openness have negative and significant effects, whereas initial GDP has a positive coefficient. Education only has a significant impact in the AB specifications, which also reveal a positive influence from lagged GDP growth.

<Insert Table 7 here>

The data in Table 8 also support a valley-shaped medium-term relation between FD and the growth standard deviation (again, except in the AB specifications). Compared to the growth regressions considered in the last paragraph, the σ regressions have an estimated valley at somewhat higher values of the FD variable at around 65% and 54% in the POLS and FE specifications, respectively. Initial GDP and government consumption seem to increase volatility, while education reduces it in the POLS specification. All the other control variables do not present significant effects.

<Insert Table 8 here>

3.3 Robustness tests

We performed robustness tests to assess the responsiveness of the results to using a different measure of financial depth and alternative time samples. The first test was to replace *Dom. Credit* by private credit by banks and other financial institutions (*Priv. Credit*). These variables represent different concepts of credit, and one is not a subset of the other: as mentioned before, *Dom. Credit* refers to credit provided by banks to the private sector, including credit to public enterprises, and *Priv. Credit* refers to credit provided by banks and other financial institutions to the private sector. All results obtained using *Priv. Credit* are very similar to our main results. For example, the estimated critical points for the cross-section OLS *Priv. Credit* specifications with the dependent variable Z are around 71% and 98%, and the panel data peaks for POLS, FE and AB are achieved at around 50%, 34% and 35%, respectively. We also employed Liquid Liabilities (the ratio of M3 to GDP) as a measure of financial depth with similar

results.

The second set of robustness tests consisted of using alternative time samples. For the cross-sectional data, we used the alternative period of 1990-2011, again reaching similar results. For the panel data, we changed the starting year from 1981 to 1984, so the 5-year intervals in each time sample were different. We also divided the time sample into four 8-year non-overlapping intervals. The outcomes were also consistent with our main results.

We conducted tests using interaction terms between the financial development variables (both linear and squared) and the control variables, but the estimated coefficients obtained were never individually significant. Finally, for the panel data specifications, we tested whether the estimated coefficient of the lagged dependent variable using the AB estimator lies between the ones estimated by the dynamic POLS (upward biased) and FE (downward biased) specifications, as described by Roodman (2009).[15] The only specification that did not match this criterion was the PD specification with real GDP per capita growth as dependent variable and the wide control group, for which the estimated AB coefficient for the lagged term (0.391) was slightly smaller than the POLS one (0.382).

4. Conclusion

In this paper, we evaluated the impact of financial development on the interaction of economic growth and its volatility. We introduced a new variable, Z, which measures the ratio of average economic growth to its volatility. Our results are compatible with the "too much finance" literature. Financial development increases Z up to a point, and then starts reducing it, both in the medium and long run. This means that, even if financial development boosts economic growth, for high levels of financial development, it will simultaneously and more than proportionally raise growth volatility.

The main difference between the results in the long and medium term is that we do not find a quadratic relation of financial development on economic growth in the long run, but the data support this relation in the medium run. This means that, in the medium run, finance starts to both reduce growth and increase volatility after a certain threshold is passed. The estimated thresholds in the panel data specifications are also somewhat

[15] Conditional on the true parameter being positive.

lower than those obtained in the cross-sectional specifications: for Z, for example, the estimated thresholds are around 40% to 55% in the panel data specification, and around 75% to 99% in the cross-sectional specification. This suggests that increasing the level of domestic credit may intensify the relative volatility in the medium term, but still raise relative long-term growth before the long-run threshold is achieved.

Figure 1. GDP pc growth, selected countries

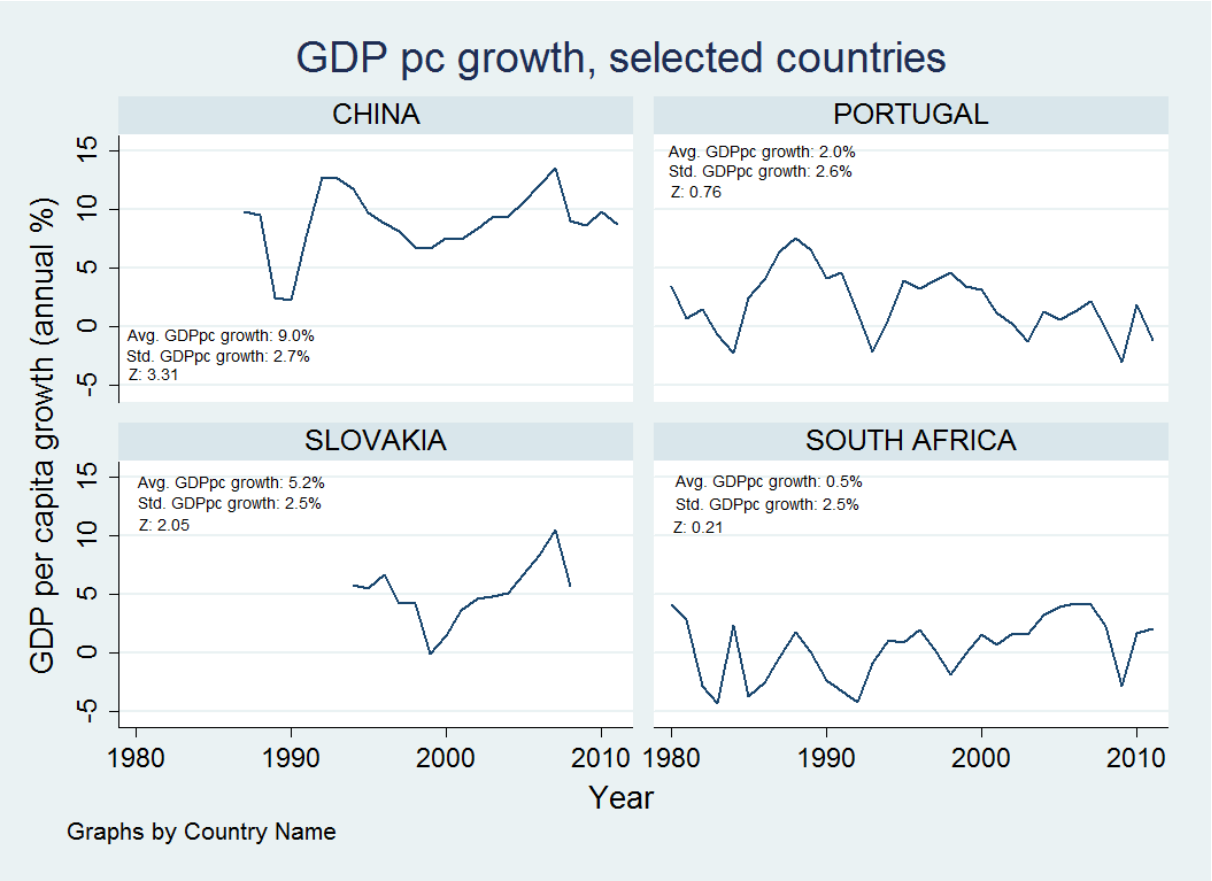

Table 1. Summary statistics – Cross-sectional data

Variable	Mean	Std. Dev.	Min.	Max.
$\Delta\text{GDP}_{pc,i}$	2.379	1.646	-0.542	8.970
$\sigma_i(\Delta\text{GDP}_{pc,i})$	2.945	1.323	1.061	6.503
$Z(\Delta\text{GDP}_{pc})$	0.964	0.879	-0.095	5.070
Dom. Credit_i	64.149	35.233	16.110	149.928
Priv. Credit_i	67.413	38.595	15.992	177.607
Ecnmy Openness_i	72.750	41.966	20.473	235.020
$\text{Cons. Price Index}_i$	32.088	94.210	1.058	437.460
Years of Schl_i	2.729	1.198	0.875	5.291
$\text{Govrmnt Consumption}_i$	16.770	4.988	5.047	26.949
$\text{Initial GDP}_{pc,i0}$	12866.97	11742.90	291.46	41095.95
N		52		

Table 2. Summary statistics – Panel data

Variable	Mean	Std. Dev.	Min.	Max.
$\Delta\text{GDP}_{pc,i}$	2.254	2.499	-12.461	10.805
$\sigma_i(\Delta\text{GDP}_{pc,i})$	2.264	1.714	0.120	10.609
$Z(\Delta\text{GDP}_{pc})$	2.215	4.163	-18.260	43.598
Dom. Credit_i	66.793	46.179	8.427	213.807
Priv. Credit_i	70.522	48.691	6.838	218.636
Ecnmy Openness_i	71.928	44.963	13.044	318.539
$\text{Cons. Price Index}_i$	32.152	191.275	-1.174	2414.346
Years of Schl_i	2.750	1.357	0.390	6.900
$\text{Govrmnt Consumption}_i$	16.761	5.211	4.543	33.264
$\text{Initial GDP}_{pc,i0}$	17250.57	16509.98	291.46	80925.22
N		335		

Table 3. Financial Growth Nexus – Cross-sectional specifications – $Z_i(\Delta \text{GDP}_{pc})$

This table shows a cross-sectional model similar to the ones of the Financial Growth Nexus literature (Beck et al., 2000) employing data from the World Bank's World Development Indicators (WDI) and Barro-Lee from 1980 to 2011. We average all variables by country and run cross-sectional estimations. The dependent variable $Z_i(\Delta \text{GDP}_{pc})$ equals the inverse hyperbolic sine transformation of the ratio between average per capita real GDP growth and its standard deviation. The main independent variables – i.e., Dom. Credit_i and Priv. Credit_i – denote the level of financial development of a country and are defined as the log of domestic credit provided by the financial sector as % of GDP, and the log of domestic credit provided to the private sector as % of GDP, respectively. $\text{Years of Schooling}_i$, taken from Barro-Lee, is the log of 1 plus the average years of schooling of adults. $\text{Initial GDP}_{pc,i0}$ is the log of GDP per capita (in USD) in 1980. $\text{Economy Openness}_i$ equals the log of imports plus exports over GDP. $\text{Cons. Price Index}_i$ is the log of one (1) consumer price index (inflation). Govrmnt Size_i equals the log of general government consumption as % of GDP. Columns 1, 2, 5 and 6 present the results of an OLS specification, while columns 3, 4, 7 and 8 present the results of an IV specification where the instruments are dummies equal to one if the country's legal origin is English, French, German, or Scandinavian. Robust standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	[1] $Z_i(\Delta \text{GDP}_{pc})$	[2] $Z_i(\Delta \text{GDP}_{pc})$	[3] $Z_i(\Delta \text{GDP}_{pc})$	[4] $Z_i(\Delta \text{GDP}_{pc})$	[5] $Z_i(\Delta \text{GDP}_{pc})$	[6] $Z_i(\Delta \text{GDP}_{pc})$	[7] $Z_i(\Delta \text{GDP}_{pc})$	[8] $Z_i(\Delta \text{GDP}_{pc})$
Dom. Credit_i	2.473**	2.856**	7.882**	6.532**				
	(0.986)	(1.198)	(3.155)	(2.904)				
Dom. Credit_i^2	-0.269**	-0.331**	-0.917**	-0.765*				
	(0.124)	(0.154)	(0.415)	(0.399)				
Priv. Credit_i					2.154**	2.659**	5.908*	6.338*
					(0.898)	(1.194)	(3.088)	(3.471)
Priv. Credit_i^2					-0.235**	-0.312**	-0.703*	-0.773*
					(0.111)	(0.150)	(0.398)	(0.463)
Years of Schl_i	0.557**	0.515**	0.367	0.394*	0.647**	0.624***	0.672**	0.678***
	(0.240)	(0.203)	(0.294)	(0.226)	(0.264)	(0.220)	(0.320)	(0.259)
$\text{Initial GDP}_{pc,i0}$	-0.266***	-0.185**	-0.289***	-0.173	-0.278***	-0.184**	-0.284***	-0.136
	(0.074)	(0.081)	(0.085)	(0.132)	(0.080)	(0.083)	(0.085)	(0.116)
Govrmnt Cons._i		0.027		-0.034		0.001		-0.112
		(0.092)		(0.099)		(0.089)		(0.127)
$\text{Cons. Price Index}_i$		-0.453		-0.619		-0.507		-0.775*
		(0.285)		(0.387)		(0.308)		(0.417)
Ecnmy Openness_i		-0.363***		-0.225		-0.352**		-0.286
		(0.129)		(0.254)		(0.140)		(0.206)
Constant	-3.114	-3.090	-13.721**	-9.960*	-2.409	-2.491	-9.727*	-8.945
	(1.904)	(2.228)	(6.030)	(5.153)	(1.720)	(2.051)	(5.890)	(5.813)
Countries	52	52	52	52	52	52	52	52
R-squared	0.395	0.518	0.055	0.368	0.353	0.478	0.207	0.387
Estimator	OLS	OLS	IV	IV	OLS	OLS	IV	IV

Table 4. Financial Growth Nexus – Cross-sectional specifications – ΔGDP_{pc}

This table shows a cross-sectional model similar to the ones of the Financial Growth Nexus literature (Beck et al., 2000) employing data from the World Bank's World Development Indicators (WDI) and Barro-Lee from 1980 to 2011. We average all variables by country and run cross-sectional estimations. The dependent variable ΔGDP_{pc} equals the average per capita real GDP growth. The main independent variables – i.e., Dom. Credit_i and Priv. Credit_i – denote the level of financial development of a country and are defined as the log of domestic credit provided by the financial sector as % of GDP, and the log of domestic credit provided to the private sector as % of GDP, respectively. Years of Schooling_i, taken from Barro-Lee, is the log of 1 plus the average years of schooling of adults. $\text{Initial GDP}_{pc,i0}$ is the log of GDP per capita (in USD) in 1980. $\text{Economy Openness}_i$ equals the log of imports plus exports over GDP. $\text{Cons. Price Index}_i$ is the log of one (1) consumer price index (inflation). Govrmnt Size_i equals the log of general government consumption as % of GDP. Columns 1, 2, 5 and 6 present the results of an OLS specification, while columns 3, 4, 7 and 8 present the results of an IV specification where the instruments are dummies equal to one if the country's legal origin is English, French, German, or Scandinavian. Robust standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
VARIABLES	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}
Dom. Credit_i	0.052	0.031	0.124	0.049				
	(0.031)	(0.042)	(0.097)	(0.120)				
Dom. Credit_i^2	-0.005	-0.003	-0.013	-0.003				
	(0.004)	(0.006)	(0.012)	(0.016)				
Priv. Credit_i					0.054*	0.010	0.062	-0.008
					(0.029)	(0.040)	(0.084)	(0.099)
Priv. Credit_i^2					-0.006	-0.001	-0.007	0.002
					(0.004)	(0.005)	(0.011)	(0.013)
Years of Schl_i	0.021***	0.020***	0.016	0.016	0.024***	0.021***	0.024***	0.020**
	(0.007)	(0.007)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)
$\text{Initial GDP}_{pc,i0}$	-0.011***	-0.010***	-0.012***	-0.014***	-0.011***	-0.010**	-0.010***	-0.011***
	(0.002)	(0.004)	(0.003)	(0.005)	(0.003)	(0.004)	(0.002)	(0.004)
Govrmnt Cons._i		0.006*		0.003		0.007**		0.007*
		(0.003)		(0.004)		(0.003)		(0.004)
$\text{Cons. Price Index}_i$		-0.001		0.003		-0.001		0.001
		(0.010)		(0.014)		(0.010)		(0.013)
Ecnmy Openness_i		-0.007		0.000		-0.007		-0.007
		(0.006)		(0.010)		(0.007)		(0.007)
Constant	-0.034	-0.007	-0.178	-0.049	-0.036	0.032	-0.050	0.062
	(0.063)	(0.085)	(0.188)	(0.217)	(0.057)	(0.076)	(0.159)	(0.166)
Countries	52	52	52	52	52	52	52	52
R-squared	0.439	0.503	0.269	0.190	0.389	0.462	0.383	0.456
Estimator	OLS	OLS	IV	IV	OLS	OLS	IV	IV

Table 5. Financial Growth Nexus – Cross-sectional specifications – $\sigma_i(\Delta \text{GDP}_{pc})$

This table shows a cross-sectional model similar to the ones of the Financial Growth Nexus literature (Beck et al., 2000) employing data from the World Bank's World Development Indicators (WDI) and Barro-Lee from 1980 to 2011. We average all variables by country and run cross-sectional estimations. The dependent variable $\sigma_i(\Delta \text{GDP}_{pc})$ equals the standard deviation of per capita real GDP growth. The main independent variables – i.e., Dom. Credit_i and Priv. Credit_i – denote the level of financial development of a country and are defined as the log of domestic credit provided by the financial sector as % of GDP, and the log of domestic credit provided to the private sector as % of GDP, respectively. $\text{Years of Schooling}_i$, taken from Barro-Lee, is the log of 1 plus the average years of schooling of adults. $\text{Initial GDP}_{pc,i0}$ is the log of GDP per capita (in USD) in 1980. $\text{Economy Openness}_i$ equals the log of imports plus exports over GDP. $\text{Cons. Price Index}_i$ is the log of one (1) consumer price index (inflation). Govrmnt Size_i equals the log of general government consumption as % of GDP. Columns 1, 2, 5 and 6 present the results of an OLS specification, while columns 3, 4, 7 and 8 present the results of an IV specification where the instruments are dummies equal to one if the country's legal origin is English, French, German, or Scandinavian. Robust standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
VARIABLES	$\sigma_i(\Delta \text{GDP}_{pc})$	$\sigma_i(\Delta \text{GDP}_{pc})$	$\sigma_i(\Delta \text{GDP}_{pc})$	$\sigma_i(\Delta \text{GDP}_{pc})$	$\sigma_i(\Delta \text{GDP}_{pc})$	$\sigma_i(\Delta \text{GDP}_{pc})$	$\sigma_i(\Delta \text{GDP}_{pc})$	$\sigma_i(\Delta \text{GDP}_{pc})$
Dom. Credit_i	-2.089*	-2.957**	-7.181**	-8.073**				
	(1.110)	(1.352)	(3.410)	(3.612)				
Dom. Credit_i^2	0.230	0.344**	0.851*	1.002**				
	(0.138)	(0.170)	(0.440)	(0.472)				
Priv. Credit_i					-1.435	-3.372**	-6.155*	-10.347**
					(1.077)	(1.318)	(3.462)	(4.033)
Priv. Credit_i^2					0.145	0.395**	0.718	1.268**
					(0.133)	(0.165)	(0.443)	(0.529)
Years of Schl_i	-0.106	-0.127	0.050	-0.043	-0.163	-0.237	-0.161	-0.339
	(0.364)	(0.315)	(0.355)	(0.301)	(0.374)	(0.318)	(0.417)	(0.357)
$\text{Initial GDP}_{pc,i0}$	0.042	-0.023	0.050	-0.118	0.064	-0.021	0.096	-0.110
	(0.082)	(0.082)	(0.103)	(0.127)	(0.085)	(0.080)	(0.108)	(0.130)
Govrmnt Cons._i		0.235**		0.264***		0.282***		0.496***
		(0.103)		(0.102)		(0.101)		(0.152)
$\text{Cons. Price Index}_i$		0.363		0.695*		0.455		0.962**
		(0.319)		(0.376)		(0.317)		(0.421)
Ecnmy Openness_i		0.292**		0.254		0.242**		0.113
		(0.122)		(0.180)		(0.119)		(0.176)
Constant	5.353**	5.529**	15.316**	14.926**	4.017*	6.026**	13.224**	18.262***
	(2.161)	(2.411)	(6.612)	(6.713)	(2.135)	(2.252)	(6.651)	(7.034)
Countries	52	52	52	52	52	52	52	52
R-squared	0.162	0.309	-0.137	0.080	0.157	0.313	-0.142	-0.062
Estimator	OLS	OLS	IV	IV	OLS	OLS	IV	IV

Table 6. Financial Growth Nexus – Panel specifications – $Z_{it}(\Delta \text{GDP}_{pc})$

This table shows a Panel model similar to the ones of the Financial Growth Nexus literature (Beck et al., 2000) employing data from the World Bank's World Development Indicators (WDI) and Barro-Lee from 1980 to 2011. We average all variables by country for each group of 5 years between 1980 and 2011 and run panel estimations. The dependent variable $Z_{it}(\Delta \text{GDP}_{pc})$ equals the inverse hyperbolic sine transformation of the ratio between average per capita real GDP growth and its standard deviation. The main independent variables – i.e., Dom. Credit_i and Priv. Credit_i – denote the level of financial development of a country and are defined as the log of domestic credit provided by the financial sector as % of GDP, and the log of domestic credit provided to the private sector as % of GDP, respectively. $\text{Years of Schooling}_{it}$, taken from Barro-Lee, is the log of 1 plus the average years of schooling of adults. $\text{Initial GDP}_{pc,i0}$ is the log of GDP per capita (in USD) of the first year of the period. $\text{Economy Openness}_{it}$ equals the log of imports plus exports over GDP. $\text{Cons. Price Index}_{it}$ is the log of one (1) consumer price index (inflation). Govrmnt Size_{it} equals the log of general government consumption as % of GDP. Columns 1, 2, 7 and 8 present the results of a Pooled OLS specification; columns 3, 4, 9 and 10 present the results of a fixed effects specification; and columns 5, 6, 11 and 12 show a dynamic panel using the Arellano-Bond estimator, where the instruments are the lags of the explanatory variables (in levels and differences). In this last case, we also include excluded instruments that reflect a country's legal origin: English, French, German, or Scandinavian. Time fixed effects are included in all specifications. Robust standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	[1] $Z_{it}(\Delta \text{GDP}_{pc})$	[2] $Z_{it}(\Delta \text{GDP}_{pc})$	[3] $Z_{it}(\Delta \text{GDP}_{pc})$	[4] $Z_{it}(\Delta \text{GDP}_{pc})$	[5] $Z_{it}(\Delta \text{GDP}_{pc})$	[6] $Z_{it}(a\text{GDP}_{pc})$	[7] $Z_{it}(\Delta \text{GDP}_{pc})$	[8] $Z_{it}(\Delta \text{GDP}_{pc})$	[9] $Z_{it}(\Delta \text{GDP}_{pc})$	[10] $Z_{it}(\Delta \text{GDP}_{pc})$	[11] $Z_{it}(\Delta \text{GDP}_{pc})$	[12] $Z_{it}(\Delta \text{GDP}_{pc})$
$Z_{it-1}(\Delta \text{GDP}_{pc})$					0.064	0.055					0.128	0.110
					(0.104)	(0.109)					(0.106)	(0.109)
Dom. Credit_i	4.483***	4.371***	5.324***	4.775***	6.507**	5.992**						
	(0.582)	(0.664)	(0.906)	(1.035)	(2.640)	(2.782)						
Dom. Credit_i^2	-0.559***	-0.555***	-0.716***	-0.645***	-0.848***	-0.808**						
	(0.075)	(0.086)	(0.117)	(0.134)	(0.317)	(0.334)						
Priv. Credit_i							3.860***	3.831***	5.117***	4.877***	3.421*	3.176
							(0.594)	(0.718)	(0.877)	(0.980)	(2.033)	(2.478)
Priv. Credit_i^2							-0.490***	-0.493***	-0.724***	-0.689***	-0.477*	-0.450
							(0.076)	(0.090)	(0.114)	(0.125)	(0.248)	(0.296)
Years of Schl_i	0.539**	0.524**	0.075	0.165	1.346	0.679	0.698***	0.683***	-0.072	0.005	1.986**	1.311**
	(0.243)	(0.234)	(0.578)	(0.604)	(0.909)	(0.619)	(0.245)	(0.235)	(0.642)	(0.660)	(0.891)	(0.622)
$\text{Initial GDP}_{pc,i0}$		0.158*		0.531		0.393		0.067		0.472		0.063
		(0.088)		(0.408)		(0.240)		(0.089)		(0.406)		(0.246)
Govrmnt Cons._i		-0.404***		-0.215		-0.297		-0.371***		-0.107		-0.456
		(0.139)		(0.188)		(0.378)		(0.129)		(0.155)		(0.423)
$\text{Cons. PriceIndex}_i$		-0.721***		-0.826*		-1.093***		-0.779***		-0.910**		-0.918*
		(0.183)		(0.443)		(0.408)		(0.197)		(0.406)		(0.483)
Ecnmy Openness_i	-0.196***	-0.098	-0.326	-0.578	-0.170	0.126	-0.201***	-0.088	-0.548	-0.790	-0.259	-0.014
	(0.066)	(0.067)	(0.450)	(0.504)	(0.209)	(0.172)	(0.068)	(0.069)	(0.489)	(0.536)	(0.196)	(0.165)
Constant	-6.809***	-5.881***	-6.078	-2.764	-11.031**	-10.057*	-5.617***	-4.504***	-3.141	-0.095	-4.671	-3.065
	(1.210)	(1.326)	(4.544)	(5.852)	(5.296)	(5.405)	(1.235)	(1.335)	(4.582)	(5.357)	(4.173)	(4.545)
OBS	327	327	327	327	274	274	327	327	327	327	274	274
R-squared	0.222	0.276	0.257	0.275			0.205	0.258	0.284	0.301		
Estimator	POLS	POLS	FE	FE	AB	AB	POLS	POLS	FE	FE	AB	AB
Countries			52	52	52	52			52	52	52	52
AR(2) (P-value)					0.744	0.750					0.400	0.572
Hansen (P-value					0.295	0.545					0.189	0.548

Table 7. Financial Growth Nexus – Panel specifications – $\Delta\text{GDP}_{pc,it}$

This table shows a Panel model similar to the ones of the Financial Growth Nexus literature (Beck et al., 2000) employing data from the World Bank's World Development Indicators (WDI) and Barro-Lee from 1980 to 2011. We average all variables by country for each group of 5 years between 1980 and 2011 and run panel estimations. The dependent variable $\Delta\text{GDP}_{pc,it}$ equals the average per capita real GDP growth of country i in period t. The main independent variables – i.e., Dom. Credit_i and Priv. Credit_i – denote the level of financial development of a country and are defined as the log of domestic credit provided by the financial sector as % of GDP, and the log of domestic credit provided to the private sector as % of GDP, respectively. $\text{Years of Schooling}_{it}$, taken from Barro-Lee, is the log of 1 plus the average years of schooling of adults. $\text{Initial GDP}_{pc,i0}$ is the log of GDP per capita (in USD) of the first year of the period. $\text{Economy Openness}_{it}$ equals the log of imports plus exports over GDP. $\text{Cons. Price Index}_{it}$ is the log of one (1) consumer price index (inflation). Govrmnt Size_{it} equals the log of general government consumption as % of GDP. Columns 1, 2, 7 and 8 present the results of a Pooled OLS specification; columns 3, 4, 9 and 10 present the results of a fixed effects specification; and columns 5, 6, 11 and 12 show a dynamic panel using the Arellano-Bond estimator, where the instruments are the lags of the explanatory variables (in levels and differences). In this last case, we also include excluded instruments that reflect a country's legal origin: English, French, German, or Scandinavian. Time fixed effects are included in all specifications. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
VARIABLES	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$elta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$	$\Delta\text{GDP}_{pc,it}$
$\Delta\text{GDP}_{pc,it-1}$					0.313***	0.391***					0.312***	0.345***
					(0.112)	(0.103)					(0.088)	(0.106)
Dom. Credit_i	0.121***	0.113***	0.148***	0.125***	0.026	-0.023						
	(0.022)	(0.022)	(0.027)	(0.027)	(0.063)	(0.049)						
Dom. Credit_i^2	-0.015***	-0.014***	-0.020***	-0.017***	-0.005	0.001						
	(0.003)	(0.003)	(0.003)	(0.003)	(0.007)	(0.006)						
Priv. Credit_i							0.110***	0.100***	0.143***	0.128***	0.018	-0.016
							(0.026)	(0.028)	(0.031)	(0.035)	(0.044)	(0.047)
Priv. Credit_i^2							-0.014***	-0.013***	-0.020***	-0.018***	-0.004	0.000
							(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.006)
Years of Schl_i	0.004	0.005	-0.001	0.002	0.051***	0.028**	0.010	0.009	-0.004	-0.001	0.059***	0.036***
	(0.008)	(0.007)	(0.012)	(0.011)	(0.019)	(0.013)	(0.007)	(0.007)	(0.012)	(0.011)	(0.021)	(0.013)
$\text{Initial GDP}_{pc,i0}$		0.007***		0.024***		0.005		0.005***		0.023***		0.002
		(0.002)		(0.008)		(0.006)		(0.002)		(0.008)		(0.006)
Govrmnt Cons._i		-0.012**		-0.010*		-0.009		-0.010**		-0.006		-0.012*
		(0.005)		(0.006)		(0.008)		(0.004)		(0.004)		(0.007)
$\text{Cons. Price Index}_i$		-0.016***		-0.028**		-0.014*		-0.018***		-0.030**		-0.013
		(0.005)		(0.012)		(0.008)		(0.005)		(0.012)		(0.008)
Ecnmy Openness_i	-0.006***	-0.004*	-0.019*	-0.029**	-0.008*	-0.001	-0.006***	-0.003*	-0.025*	-0.034**	-0.009**	-0.003
	(0.002)	(0.002)	(0.010)	(0.012)	(0.004)	(0.003)	(0.002)	(0.002)	(0.013)	(0.014)	(0.004)	(0.003)
Constant	-0.182***	-0.161***	-0.095	0.012	-0.010	0.084	-0.162***	-0.129**	-0.017	0.079	0.024	0.099
	(0.047)	(0.042)	(0.101)	(0.122)	(0.122)	(0.091)	(0.054)	(0.051)	(0.121)	(0.137)	(0.091)	(0.083)
OBS	335	335	335	335	283	283	335	335	335	335	283	283
R-squared	0.234	0.304	0.317	0.373			0.225	0.285	0.358	0.406		
Estimator	POLS	POLS	FE	FE	AB	AB	POLS	POLS	FE	FE	AB	AB
Countries			52	52	52	52			52	52	52	52
AR(2) (P-value)					0.863	0.986					0.831	0.861
Hansen (P-value)					0.802	0.390					0.737	0.498

Table 8. Financial Growth Nexus – Panel specifications – $\sigma_{it}(\Delta \text{GDP}_{pc})$

This table shows a Panel model similar to the ones of the Financial Growth Nexus literature (Beck et al., 2000) employing data from the World Bank's World Development Indicators (WDI) and Barro-Lee from 1980 to 2011. We average all variables by country for each group of 5 years between 1980 and 2011 and run panel estimations. The dependent variable $\sigma_{it}(\Delta \text{GDP}_{pc})$ is the log of the standard deviation of GDP per capita growth. The main independent variables – i.e., Dom. Credit_i and Priv. Credit_i – denote the level of financial development of a country and are defined as the log of domestic credit provided by the financial sector as % of GDP, and the log of domestic credit provided to the private sector as % of GDP, respectively. $\text{Years of Schooling}_{it}$, taken from Barro-Lee, is the log of 1 plus the average years of schooling of adults. $\text{Initial GDP}_{pc,i0}$ is the log of GDP per capita (in USD) of the first year of the period. $\text{Economy Openness}_{it}$ equals the log of imports plus exports over GDP. $\text{Cons. Price Index}_{it}$ is the log of one (1) consumer price index (inflation). Govrmnt Size_{it} equals the log of general government consumption as % of GDP. Columns 1, 2, 7 and 8 present the results of a Pooled OLS specification; columns 3, 4, 9 and 10 present the results of a fixed effects specification; and columns 5, 6, 11 and 12 show a dynamic panel using the Arellano-Bond estimator, where the instruments are the lags of the explanatory variables (in levels and differences). In this last case, we also include excluded instruments that reflect a country's legal origin: English, French, German, or Scandinavian. Time fixed effects are included in all specifications. Robust standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	[1] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[2] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[3] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[4] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[5] $\sigma_{it}(\Delta \text{GDP}_{pc}ht)$	[6] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[7] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[8] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[9] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[10] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[11] $\sigma_{it}(\Delta \text{GDP}_{pc})$	[12] $\sigma_{it}(\Delta \text{GDP}_{pc})$
$\sigma_{it-1}(\Delta \text{GDP}_{pc})$					-0.085	-0.074					-0.038	-0.027
					(0.103)	(0.096)					(0.106)	(0.100)
Dom. Credit_i	-2.612***	-2.322***	-2.145***	-1.733***	-0.763	0.100						
	(0.492)	(0.541)	(0.567)	(0.638)	(2.491)	(2.716)						
Dom. Credit_i^2	0.312***	0.278***	0.268***	0.218***	0.115	0.020						
	(0.064)	(0.070)	(0.070)	(0.079)	(0.288)	(0.320)						
Priv. Credit_i							-1.927***	-1.894***	-1.975***	-1.719**	-1.007	0.313
							(0.491)	(0.606)	(0.540)	(0.694)	(2.338)	(2.855)
Priv. Credit_i^2							0.226***	0.226***	0.260***	0.228***	0.136	-0.012
							(0.063)	(0.077)	(0.067)	(0.085)	(0.278)	(0.336)
Years of Schl_i	-0.352*	-0.361*	-0.037	-0.193	0.417	0.290	-0.430**	-0.430**	-0.007	-0.154	0.223	0.033
	(0.201)	(0.199)	(0.443)	(0.474)	(0.589)	(0.502)	(0.207)	(0.204)	(0.472)	(0.497)	(0.570)	(0.514)
$\text{Initial GDP}_{pc,i0}$		0.142*		0.282		-0.054		0.170**		0.307		-0.034
		(0.079)		(0.356)		(0.277)		(0.081)		(0.356)		(0.267)
Govrmnt Cons._i		0.308***		0.182**		0.514		0.271**		0.133		0.425
		(0.094)		(0.069)		(0.464)		(0.109)		(0.083)		(0.511)
$\text{Cons. Price Index}_i$		0.204		0.510		0.070		0.248		0.563*		-0.156
		(0.171)		(0.329)		(0.551)		(0.179)		(0.332)		(0.497)
Ecnmy Openness_i	0.059	0.025	0.365	0.382	-0.172	-0.206	0.074	0.022	0.442	0.450	-0.084	-0.077
	(0.051)	(0.053)	(0.368)	(0.382)	(0.182)	(0.183)	(0.053)	(0.054)	(0.368)	(0.381)	(0.168)	(0.152)
Constant	5.803***	4.351***	1.721	-1.625	2.978	1.432	4.443***	3.380***	0.518	-2.679	2.032	-0.058
	(0.953)	(1.027)	(3.555)	(4.029)	(4.750)	(5.497)	(0.958)	(1.073)	(3.349)	(3.693)	(4.885)	(5.829)
OBS	327	327	327	327	274	274	327	327	327	327	274	274
R-squared	0.234	0.258	0.263	0.276			0.215	0.241	0.264	0.278		
Estimator	POLS	POLS	FE	FE	AB	AB	POLS	POLS	FE	FE	AB	AB
Countries			52	52	52	52			52	52	52	52
AR(2) (P-value)					0.120	0.0859					0.191	0.186
Hansen (P-value)					0.476	0.428					0.451	0.388

Appendix A. Data Sources

Variable	Variable definition	Source
$\Delta \mathrm{GDP}_{pc}$	GDP per capita growth	World Bank WDI
$\sigma_i(\Delta \mathrm{GDP}_{pc})$	Log of the standard deviation of GDP per capita growth	Own calculation
$Z(\Delta \mathrm{GDP}_{pc})$	The inverse hyperbolic sine transformation of the average GDP per capita growth divided by the standard deviation of GDP per capita growth	Own calculation
Dom. Credit	The log of domestic credit to the private sector by banks (% of GDP)	World Bank WDI
Priv. Credit	The log of private credit by deposit money banks and other financial institutions to GDP (% of GDP)	World Bank GFDD
Ecnmy. Openness	Log of the sum of imports and exports of goods and services (% of GDP)	World Bank WDI
Cons. Price Index	Log of 1 plus consumer price index inflation	World Bank WDI
Years of Schl	Log of 1 plus the average years of secondary schooling in the total population (25 years and over)	Barro-Lee
Govrmnt. Consumption	Log of general government final consumption expenditure (% of GDP)	World Bank WDI
Initial $\mathrm{GDP}_{pc,0}$	Log of GDP per capita from the first year of the period (2005 prices)	World Bank WDI

References

Aghion, Philippe, Peter Howitt, and David Mayer-Foulkes (2005), "The effect of financial development on convergence: Theory and evidence." *The Quarterly Journal of Economics*, 120, 173–222.

Arcand, Jean Louis, Enrico Berkes, and Ugo Panizza (2015), "Too much finance?" *Journal of Economic Growth*, 20, 105–148.

Bagehot, Walter (1873), *Lombard Street: A description of the money market*, 3 edition. Henry S. King & Co., London.

Beck, Thorsten, Hans Degryse, and Christiane Kneer (2014), "Is more finance better? Disentangling intermediation and size effects of financial systems." *Journal of Financial Stability*, 10, 50 – 64.

Beck, Thorsten, Ross Levine, and Norman Loayza (2000), "Finance and the sources of growth." *Journal of Financial Economics*, 58, 261 – 300.

Beck, Thorsten, Mattias Lundberg, and Giovanni Majnoni (2006), "Financial intermediary development and growth volatility: Do intermediaries dampen or magnify shocks?" *Journal of International Money and Finance*, 25, 1146 – 1167.

Cecchetti, Stephen G and Enisse Kharroubi (2012), "Reassessing the impact of finance on growth." BIS Working Papers, 381.

Easterly, William, Roumeen Islam, and Joseph E. Stiglitz (2001), *Annual World Bank Conference on Development Economics 2000*, chapter Shaken and Stirred: Explaining Growth Volatility, 191–211. The World Bank.

Goldsmith, Raymond (1969), *Financial structure and economic development*. Yale University Press, New Haven.

Gurley, John G. and E. S. Shaw (1955), "Financial aspects of economic development." *The American Economic Review*, 45, 515–538.

Kaminsky, Graciela L. and Carmen M. Reinhart (1999), "The twin crises: The causes of banking and balance-of-payments problems." *American Economic Review*, 89, 473–500.

King, Robert G. and Ross Levine (1993), "Finance and growth: Schumpeter might be right." *The Quarterly Journal of Economics*, 108, 717–737.

LaPorta, Rafael, Florencio Lopez de Silanes, Andrei Shleifer, and Robert W. Vishny (1998), "Law and finance." *Journal of Political Economy*, 106, 1113–1155.

Law, Siong Hook and Nirvikar Singh (2014), "Does too much finance harm economic growth?" *Journal of Banking & Finance*, 41, 36 – 44.

Levine, Ross (2005), "Finance and growth: Theory and evidence." In Philippe Aghion and Steven N. Durlauf, (Eds.), Part A of *Handbook of Economic Growth* volume 1, Elsevier, 865 – 934.

Levine, Ross, Norman Loayza, and Thorsten Beck (2000), "Financial intermediation and growth: Causality and causes." *Journal of Monetary Economics*, 46, 31 – 77.

Levine, Ross and Sara Zervos (1998), "Stock markets, banks, and economic growth." *The American Economic Review*, 88, pp. 537–558.

Loayza, Norman V and Romain Rancire (2006), "Financial development, financial fragility, and growth." *Journal of Money, Credit, and Banking*, 38, 1051–1076.

Mallick, Debdulal (2014), "Financial development, shocks, and growth volatility." *Macroeconomic Dynamics*, 18, 651–688.

Rioja, Felix and Neven Valev (2004), "Does one size fit all?: a reexamination of the finance and growth relationship." *Journal of Development Economics*, 74, 429 – 447.

Roodman, D. (2009), "How to do xtabond2: An introduction to difference and system gmm in stata." *Stata Journal*, 9, 86–136(51).

Sahay, Ratna, Martin Cihak, Papa N'Diaye, Adolfo Barajas, Ran Bi, Diana Ayala, Yuan Gao, Annette Kyobe, Lam Nguyen, Christian Saborowski, Katsiaryna Svirydzenka, and Seyed Reza Yousefi (2015), "Rethinking financial deepening: Stability and growth in emerging markets." IMF Staff Discussion Note, 15/08, Washington.

Schumpeter, Joseph Alois (1934), *The theory of economic development*. Harvard University Press, Cambridge, MA.

Seven, Unal and Hakan Yetkiner (2016), "Financial intermediation and economic growth: Does income matter?" *Economic Systems*, 40, 39 – 58.