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## RESUMO/ABSTRACT

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**Keywords:** Financial Development, Economic Growth.

**JEL Classification:** O16, O40, G28.

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## ABSTRACT

In a seminal paper, Levine et al. (2000) provide cross-sectional evidence on the causal positive impact of financial development on the mean of the conditional long-run growth distribution, in a sample of 71 countries. Using the same data-set, we argue that the impact of financial development on the median of the conditional growth distribution is doubtful. In addition, we find that the mean-based results due to Levine et al. (2000) are not robust to the presence of three outliers: Korea (Republic of), Malta and Taiwan.

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## **Introduction**

The effect of financial development on real long-run GDP growth is a long-memory controversial issue in economics. As noted by Levine (2003), the issue seems to divide economists in two groups: on the one side, there are those who argue, following Schumpeter (1912), that financial development accelerates growth; on the other side, there are those who maintain, following Robinson (1952), that financial development simply follows growth. The same type of disagreement seems to divide the opinions of two recent Nobel laureates. Indeed, while Miller (1998) considers that “financial markets contribute to economic growth in a proportion that is almost too obvious for serious discussion”, Lucas (1988) points out that “the importance of financial matters is very badly overstressed”.

This brief introductory discussion helps to show that the topic of the link between finance and growth is mainly an empirical issue which basically has to do with the estimation of the causal impact of financial development on real growth. This estimation, however, is complicated by the existence of a number of problems that can be basically divided in two main categories. The first one is concerning with the way in which the financial development of a country is measured, while the second one has to do with the fact that every indicator of financial development can be, in principle, considered to be endogenous with respect to real growth, which basically implies the need of using instrumental variables to perform consistent estimation.

The empirical research dealing with the link between economic growth and finance begins with the inspiring works by Goldsmith (1969) and McKinnon (1973) who document the existence of a positive correlation between measures of real economic activity and measures of financial development, using cross-sectional data at country-level. However,

the first papers that try to explore the causal nexus between finance and growth are due to King and Levine (1993a, 1993b). Particularly, the empirical strategy of these authors is based on two types of regression analyses. The first type explores the contemporaneous dependence of growth indicators from financial variables, mainly related to the size of the financial intermediary sector. In short, the authors first perform standard ordinary-least-squares estimation and then check the robustness of their results by using initial sample (1960) values of financial variables as instruments. The second type considers finance as a leading indicator of growth. That is, the authors directly use initial sample values of financial variables as predictors of averaged growth rates over the next 10 to 30 years.

A similar treatment of the finance-endogeneity issue characterizes the empirical analysis that is presented in a paper by Levine and Zervos (1998) who mainly contribute to the research advance by extending and improving the way in which the financial development of a country is measured. Specifically, the authors keep both the equity market and the banking system into account by using measures of bank credit and stock-market turnover, among others.

As well known, the use of initial sample values of financial indicators as instrumental variables or exogenous regressors is not entirely satisfactory because they are likely to incorporate expectations on future growth rates, thus being somehow endogenous with respect to future growth rates. It is also known, indeed, that a more elegant and innovative way of explicitly dealing with the endogeneity of finance only appears, in the literature, at the beginning of the new millennium with the publication of two almost-contemporaneous papers by Levine et al. (2000) and Beck et al. (2000). The first paper focuses on the estimation of the mean causal impact of financial development on growth using both cross-sectional and panel data at country-level. The second one concentrates on the mean

impact of financial development on the so-called “sources of growth”, such as the growth rate of the total factor productivity or the growth rate of the real per-capita stock of capital. Both papers explore an updated and extended version of the data-set used by King and Levine (1993a, 1993b) and by Levine and Zervos (1998). Let us focus on the cross-sectional evidence provided by Levine et al. (2000).

As instruments for financial development, Levine et al. (2000) use indicator-variables on the legal origin of the countries in their sample (English, French, German, Scandinavian), as reported by La Porta et al. (1998), and measure the causal impact of financial development on the mean of the conditional growth distribution, finding evidence of a positive impact. Although the authors perform an outliers’ sensitivity analysis and argue in favour of the robustness of their results, Levine et al. (2000) always use mean-related estimators, which are known to be more sensitive to outliers than median-related estimators.

This paper re-evaluates the cross-sectional empirical evidence provided by Levine et al. (2000) by estimating the median causal impact of financial development on growth rather than the mean impact. Particularly, we find that the evidence on the median impact is weaker than the evidence on the average impact, suggesting that the mean-based results provided by Levine et al. (2000) are not entirely robust to the presence of outliers. We test and do not reject the latter hypothesis.

### **Empirical strategy**

The data-set explored in this paper can be downloaded from the website of Ross Levine, at: [http://www.econ.brown.edu/fac/Ross\\_Levine/IndexLevine.htm](http://www.econ.brown.edu/fac/Ross_Levine/IndexLevine.htm). The sample descriptive

statistics are reported by Levine et al. (2000, p. 68)<sup>i</sup>. The sample has a cross-sectional dimension and contains detailed information on 71 countries over the 1960-1995 period.

Levine et al. (2000, henceforth LLB) use three indicators of financial development: PRIVATE CREDIT, i.e. credit by deposit money banks and other financial institutions to private sector divided by GDP, times 100; COMMERCIAL-CENTRAL BANK, i.e. assets of deposit money banks divided by assets of deposit money banks plus central bank assets, times 100; and finally LIQUID LIABILITIES, i.e. liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and non-banks financial intermediaries) divided by GDP, times 100.

LLB distinguish among three types of conditioning sets: the simple conditioning set, including the average number of schooling years in 1960 and the level of GDP in 1960; the policy conditioning set, which extends the simple conditioning set by considering measures of government size, inflation, black market premium, openness of trade; and the full conditioning set which, in turn, extends the policy conditioning set by adding indicators of revolutions and coups, political assassinations, and ethnic diversity.

Using the generalized method of moments, LLB estimate an empirical model of the following type:

$$(1) \quad G_i = \beta_0 + \beta_1 F_{ji} + \beta_2 X_{hi} + e_i$$

where  $G$  represents the average growth rate of real GDP in country  $i = 1, \dots, 71$  from 1960 to 1995,  $F$  is an indicator of financial development of type  $j$  (one of the three previously described indicators),  $X$  is a conditioning set of type  $h$  (one of the three previously described conditioning sets), and  $\beta_1$  is the main parameter of interest.

The first-stage regression results are based on a regression model of the following type:

$$(2) \quad F_{ji} = \alpha_0 + \alpha_1 Z_i + \alpha_2 X_{hi} + u_i$$

where  $Z$  is a set of legal-origin dummies playing the role of instrumental variables for financial development (the Scandinavian origin is the excluded category).

To re-evaluate the empirical findings by LLB, we first try to replicate their results using a two-step efficient GMM estimator<sup>ii</sup>. Afterwards, we estimate model (1) by looking at the impact of  $F$  on the conditional median of  $G$  rather than on the conditional mean.

We keep the issue of the endogeneity of  $F$  into account by implementing the procedure suggested by Arias et al. (2001). The latter approach is an instrumental-variable technique for quantile regression (IVQR) and consists of two steps. In the first stage, we run an ordinary-least-squares estimation of model (2) and obtain predicted values of  $F$  which are used for replacing actual values of  $F$  in model (1). In the second stage, we run a quantile-regression estimation of model (1), using the quantile-regression estimator of Koenker and Bassett (1978). The latter regression provides a consistent estimation of the impact of  $F$  on  $G$  along the conditional growth distribution.

Formally, the IVQR estimation procedure is as follows:

$$\text{(First stage)} \quad F_{ji} = \alpha_0 + \alpha_1 Z_i + \alpha_2 X_{hi} + u_i$$

where:

$$E(u_i | Z_i, X_{hi}) = 0$$

$$\hat{\alpha} = \arg \min \sum_i u_i^2$$

$$\text{(Second stage)} \quad G_i = \beta_{00} + \beta_{01}\hat{F}_{ji} + \beta_{02}X_{hi} + e_{0i}$$

where:

$$\hat{F}_{ji} = E(F_{ji}|Z_i, X_{hi})$$

$$Q_\theta(e_{0i}|\hat{F}_{ji}, X_{hi}) = 0$$

$$\hat{\beta}_\theta = \arg \min \sum_i \rho_\theta(e_{0i})e_{0i}$$

$$\rho_\theta(e_{0i}) = \begin{cases} \theta e_{0i} & \text{if } e_{0i} \geq 0 \\ (\theta - 1)e_{0i} & \text{if } e_{0i} < 0 \end{cases}$$

$$\theta \in (0,1)$$

Note that  $\theta$  is a given quantile of the conditional distribution of the second-stage dependent variable  $G$ . Since we focus of the median, we just consider the case of  $\theta = 0.5$  (IVQR5). Further, note that the quantile-regression estimator of Koenker and Bassett (1978) is highly robust to the presence of extreme values of the dependent variable (Buchinsky, 1994, p. 411). Finally, note that, by running (in the second stage) a simple ordinary-least-squares estimation of model (1) rather than a quantile regression, one obtains a standard two-stage-least-squares estimate of  $\beta_1$ , measuring the mean impact of  $F$  on  $G$ . We present both IVQR5 and 2SLS estimates.

### Estimation results

First of all, it is worth stressing that we are able to perfectly replicate the findings published by LLB on p. 43, related to model (2), apart from an absolute difference of 0.023 for one coefficient (a constant term), which may be due to a printing mistake<sup>iii</sup>.

Table 1 compares the GMM estimates of model (1) provided by LLB with our GMM estimates as well as with our 2SLS and IVQR5 estimates. In this case, we are not able to perfectly replicate the GMM results reported by LLB on p. 46. However, the only relevant difference has to do with the coefficient of the variable COMMERCIAL-CENTRAL BANK (say CCB), in the group of results that are related to the policy conditioning set. Specifically, LLB claim that the coefficient of CCB is statistically significant at 5% level while we find that this coefficient is not statistically significant (p-value 0.160).

Interestingly, we find that the 2SLS estimates, focusing on the impact of F on the conditional mean of G, confirm the GMM findings obtained by LLB (even for the above-referred case of the CCB coefficient). In contrast, the IVQR5 estimation provides a different picture. Particularly, six of the nine estimated coefficients are not statistically significant at 5% level, clearly suggesting that the median impact of financial development on growth is doubtful.

In addition, the results on the median impact are clearly at odds with the results on the mean impact provided by LLB (and confirmed by our replication analysis), which are therefore more likely to be driven by the presence of outliers than previously thought.

Since our median-based estimator is not sensitive to the presence of extreme values of the dependent variable, the natural step onwards consists of checking whether the mean-based results by LLB are driven by the existence of countries with extreme values of real growth. We test the latter hypothesis by running another two-step efficient GMM estimation of all the regression models estimated by LLB, excluding those countries whose growth rates are higher than 6%, as suggested by the box-plot in Figure 1. These countries are Korea (Republic of), Malta and Taiwan.

Specifically, the fifth column in Table 1 reports that none of the nine estimated coefficients is statistically significant at 5% level, with only one being significant at 10% level. All the coefficients have the expected positive sign but their magnitude is lower than suggested by LLB (see the first column in Table 1). Note that this sensitivity check is not included in the analysis of LLB.

Finally, since Figure 1 also indicates the existence of extreme left-hand-side values of growth, we perform a further GMM estimation, excluding those countries whose growth rates are lower than  $-2\%$ , i.e. Zaire and Niger. In this case, however, our estimation results, presented in the last column of Table 1, are roughly consistent with those proposed by LLB.

## **Conclusions**

This paper provides two main results. First, based on the cross-sectional data provided by LLB, financial development is unlikely to affect the median of the long-run growth distribution. Second, if three very high-growth countries are removed from the LLB sample, the evidence that financial development has a positive causal effect on the mean of the growth distribution no longer exists.

LLB also provide empirical evidence on the mean impact of financial development on growth by estimating a dynamic panel-data model with unobserved heterogeneity, i.e. implementing the GMM techniques due to Arellano and Bond (1991), Arellano and Bover (1995) as well as Blundell and Bond (1998). Again, it would be interesting to check whether a median-related estimation of a dynamic panel-data model controlling for unobserved heterogeneity would provide the same type of answers as the mean-related estimation performed by LLB. Unfortunately, the quantile-regression techniques that are

currently available only cover static panel-data models (Koenker, 2004) but nevertheless the issue remains an interesting topic for future investigation. In addition, it would be worth to check whether the mean-based panel-data results by LLB are robust to the presence of Korea (Republic of), Malta and Taiwan in the sample: another topic in our research agenda.

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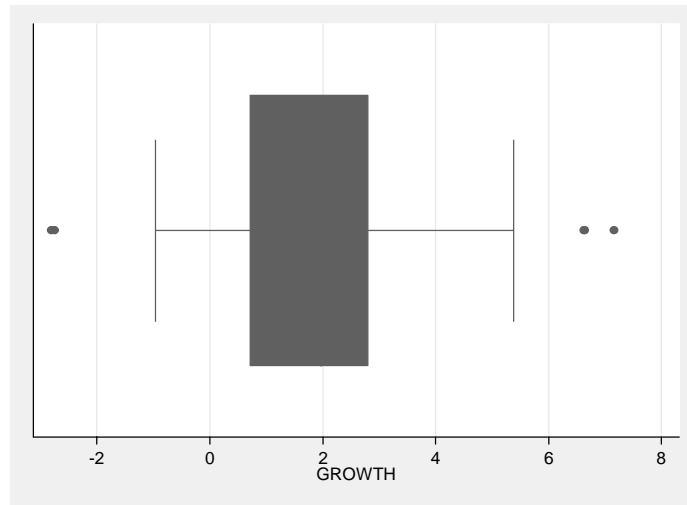
**Table 1****Mean and median impacts of financial development on growth**

	(1)	(2)	(3)	(4)	(5)	(6)
	GMM LLB	GMM	2SLS	IVQR5	GMM < 6%	GMM > -2%
<u>Simple conditioning set</u>						
PRIVATE CREDIT	2.515 (0.003)	2.515 (0.004)	2.472 (0.007)	2.576 (0.001)	1.023 (0.118)	2.478 (0.003)
COMMERCIAL-CENTRAL BANK	10.861 (0.001)	9.954 (0.003)	8.446 (0.011)	7.986 (0.021)	4.785 (0.097)	9.818 (0.004)
LIQUID LIABILITIES	1.723 (0.045)	1.844 (0.041)	2.507 (0.014)	1.973 (0.101)	1.046 (0.127)	1.394 (0.110)
<u>Policy conditioning set</u>						
PRIVATE CREDIT	3.222 (0.012)	3.364 (0.037)	3.400 (0.040)	2.871 (0.074)	1.168 (0.439)	3.274 (0.028)
COMMERCIAL-CENTRAL BANK	9.641 (0.021)	10.627 (0.160)	12.906 (0.040)	11.180 (0.401)	3.542 (0.483)	12.792 (0.054)
LIQUID LIABILITIES	2.173 (0.020)	1.934 (0.063)	2.869 (0.029)	2.290 (0.369)	1.120 (0.251)	1.718 (0.101)
<u>Full conditioning set</u>						
PRIVATE CREDIT	3.356 (0.005)	3.462 (0.020)	3.386 (0.013)	1.934 (0.139)	1.492 (0.265)	3.140 (0.024)
COMMERCIAL-CENTRAL BANK	11.289 (0.001)	12.971 (0.057)	14.878 (0.009)	8.673 (0.320)	8.581 (0.363)	11.132 (0.026)
LIQUID LIABILITIES	2.788 (0.003)	2.648 (0.010)	3.232 (0.006)	2.812 (0.024)	1.404 (0.124)	2.155 (0.033)

P-values of t-statistics in parentheses.

**Figure 1**

**Box-plot of the growth distribution**



## Endnotes

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<sup>i</sup> We perfectly replicate the sample descriptive statistics.

<sup>ii</sup> Unfortunately, our analysis is complicated by the fact that LLB do not clearly report which type of GMM estimator is used for the cross-sectional analysis.

<sup>iii</sup> Note that the logarithm of the GDP level in 1960 is the only covariate that is included in the set  $X$  of model (2). It appears, as control variable, in three of the six regressions reported on p. 43.