Financial Development and Long-Run Growth: Is the Cross-Sectional Evidence Robust?

Corrado Andini
Universidade da Madeira, CEEAplA & IZA

ABSTRACT

In a seminal paper, Levine et al. (2000) provide cross-sectional evidence showing that financial development has positive average impact on long-run growth, using a sample of 71 countries. We argue that the evidence is sensitive to the presence of outliers.

Keywords: Financial Development, Economic Growth.
JEL Classification: O16, O40.

Please send correspondence to: Corrado Andini, Universidade da Madeira, Campus da Penteada, 9000-390 Funchal, Portugal. Email: andini@uma.pt, Website: http://www.uma.pt/andini. Financial support from the Fundação para a Ciência e a Tecnologia (FCT) is gratefully acknowledged. For useful comments and discussions, the author would like to thank Monica Andini, Santiago Budría, Ricardo Cabral, Günther Lang, Marco Pagano and Pedro Telhado Pereira. The usual disclaimer applies.

Introduction

The effect of financial development on 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 over-stressed".

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

The empirical research dealing with the link between finance and growth 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 articles that try to explore the causal nexus between finance and growth are due to King and Levine (1993a, 1993b) who explore cross-sectional data at country level, which are generally obtained as averages of observations collected over the 1960-1989 period.

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. Summarizing, 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 financial development as a leading indicator of growth. That is, the authors directly use initial-sample values of financial variables as exogenous predictors of sample-average growth (1960-1989).

A similar treatment of the finance-endogeneity issue characterizes the empirical analysis presented 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 known, the use of initial-sample values of financial indicators as either instrumental variables or exogenous regressors is not entirely satisfactory because financial indicators are likely to incorporate expectations on future growth rates, thus being somehow endogenous with respect to future growth rates. Indeed, a more elegant way for dealing with the finance-endogeneity issue, originally proposed by Levine et al. (2000) as well as Beck et al. (2000), consists of exploiting the idea that the degree of financial development of a country is correlated with the fundamental nature of its legal system[1] (English, French, German, Scandinavian), the latter being mainly exogenous if interpreted as inheritance of colonization in most of the world's countries.

The quoted article by Levine et al. (2000) focuses on real per-capita GDP growth. The one by Beck et al. (2000) concentrates on the so-called "sources of growth", such as the

[1] For instance, the level of the creditors' protection rights within a country is likely to be associated with its degree of financial development.

growth rate of the total factor productivity or the growth rate of the real per-capita stock of capital. Both the two articles explore an updated and extended version of the data-set used by King and Levine (1993a, 1993b) and by Levine and Zervos (1998). In this manuscript, we focus on the cross-sectional evidence provided by Levine et al. (2000).

Using indicator-variables on the legal origin of the countries in their sample as reported by La Porta et al. (1998), Levine et al. (2000) measure the causal impact of financial development on the mean of the conditional growth distribution, finding evidence of positive impact. Although the authors perform an outliers' sensitivity analysis and argue in favour of the robustness of their results, Levine et al. (2000) do not use a median-regression technique to identify potential outliers. We do exactly the latter and find that the mean-based results provided by Levine et al. (2000) are not entirely robust to the presence of outliers.

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>. The sample descriptive statistics are reported by Levine et al. (2000, p. 68)[2]. 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; COMMERCIAL-CENTRAL BANK, i.e. assets of deposit money banks divided by assets of deposit money banks plus central bank assets; and finally LIQUID LIABILITIES, i.e. liquid liabilities of the financial system (currency plus

[2] We perfectly replicate the sample descriptive statistics.

demand and interest-bearing liabilities of banks and non-banks financial intermediaries) divided by GDP.

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 (GMM), LLB estimate an empirical model of the following type:

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

where G represents the average growth rate of real GDP per-capita in country $i = 1,...,71$ 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 β_1 is the main parameter of interest.

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

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

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. Afterwards, we look for potential outliers by using a

median-regression technique. Specifically, we keep the issue of the endogeneity of F into account by implementing the procedure suggested by Arias et al. (2001), which is an instrumental-variable technique for quantile regression (IVQR) and consists of two stages. 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 estimation procedure by Arias et al. (2001) is as follows:

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

where:

$$E\left(u_i \middle| Z_i, X_{hi}\right) = 0$$

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

(Second stage) $$G_i = \beta_{\theta 0} + \beta_{\theta 1} \hat{F}_{ji} + \beta_{\theta 2} X_{hi} + e_{\theta i}$$

where:

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

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

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

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

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

Note that θ 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). As we will see in the next section, this feature turns out to be useful for the identification of potential outliers. 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 β_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 of LLB on p. 43, related to model (2)[3].

Table 1 presents our main estimation results, related to model (1). The first four columns compare the GMM estimates provided by LLB, and reported in Column 1, with our GMM (replication exercise), 2SLS and IVQR5 estimates. The last four columns focus on the outliers' sensitivity analysis, performed using the GMM estimator.

Column 2 vs. Column 1

Unlike model (2), we are not able to perfectly replicate the GMM results[4] reported by LLB on p. 46. However, the only relevant difference concerns with the coefficient of the variable COMMERCIAL-CENTRAL BANK (say CCB), in the group of results that are

[3] All the estimation results presented in this paper as well as additional regression statistics can download from the author's website at <http://www3.uma.pt/andini/Documentos/Data6095.log>.

[4] As already mentioned, we use a two-step efficient GMM estimator, selected (among the existing types of GMM estimators) for being the one that, after repeated replication attempts, provides the closest estimates to those presented by LLB. It is worth stressing that LLB do not clearly report which type of GMM estimator is used in the cross-sectional analysis.

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). Nevertheless, as one can see by comparing Column 1 and Column 2, our replication exercise confirms the results presented by LLB.

Column 3 vs. Column 1

Interestingly, we find that the 2SLS estimates, focusing on the impact of F on the conditional mean of G (likewise the GMM estimator), are consistent with the GMM findings obtained by LLB, even for the above-referred case of the CCB coefficient.

Column 4 vs. Column 1

In contrast to the GMM and 2SLS findings, the IVQR5 estimation provides a different picture of the causal nexus between financial development and growth. Particularly, six out of the nine estimated coefficients are not statistically significant at 5% level[5], thus suggesting that the median impact of financial development on growth is doubtful.

In addition, the results on the median impact seem to be at odds with the evidence on the mean impact provided by LLB (and confirmed by our replication analysis). Particularly, 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 growth.

Column 5 vs. Column 1

We test the extreme-values' hypothesis by running a two-step efficient GMM estimation of model (1) and using a sample that excludes those countries whose growth rates are

[5] The standard errors are bootstrapped.

higher than 6%, as suggested by the box-plot in Figure 1. These countries are Korea, Malta and Taiwan (the box-plot seems to indicate that there are only two very high-growth countries, but they are actually three because two points are overlapping; see Appendix). Specifically, the fifth column in Table 1 reports that none out 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. Therefore, the cross-sectional evidence on the average positive impact of financial development on real GDP growth disappears if three very high-growth countries are removed from the LLB sample.

Column 6 vs. Column 1

Since Figure 1 also indicates the existence of two (overlapping) extremely-low values of growth (see Appendix), we perform a further GMM estimation by excluding those countries whose growth rates are lower than -2%, i.e. Zaire and Niger. In this case, however, the estimation results, presented in the sixth column of Table 1, are roughly consistent with those proposed by LLB.

Column 7 vs. Column 1

As an additional robustness check, to deeper inspect the results presented in Column 5, we run a GMM estimation using a sample that excludes the country with the highest growth rate, i.e. Korea. The seventh column in Table 1 shows that the cross-sectional evidence on the causality between finance and growth becomes mixed. On the one hand, the results based on the simple conditioning set are in line with those provided by LLB. On the other hand, if the conditioning set is extended (see policy and full conditioning), the results point against a causal positive average impact of financial development on growth because only one out of six coefficients is significant at 5% level.

Column 8 vs. Column 1

As a final check, we perform a further GMM estimation using a sample that excludes the two countries with the highest growth rates, i.e. Korea and Malta. Again, the results point against the LLB findings because only three out of nine coefficients are found to be significant at 5% level. The results are very similar to those obtained when just Korea is removed from the sample (Column 7).

Conclusions

This paper provides four main results. First, the cross-sectional evidence due to LLB is replicable. Second, there is preliminary evidence that financial development does not affect the median of the conditional long-run growth distribution. Third, if three very high-growth countries are removed from the LLB sample (Korea, Malta and Taiwan), the evidence that financial development has average positive causal effect on growth disappears. Fourth, if the country with the highest growth rate is removed from the sample (Korea), the evidence becomes mixed. Summing up, the cross-sectional results provided by LLB are sensitive to the presence of outliers (with Korea playing a fundamental role).

To locate our paper within the context of the existing literature, it is worth stressing that our findings question not only the cross-sectional evidence provided by Levine et al. (2000) but also the earlier evidence provided by King and Levine (1993a, 1993b)[6]. In addition, they are consistent with the results of Zhu et al. (2004) who argue that the cross-sectional evidence presented by Levine and Zervos (1998) is driven by the presence of outliers (Taiwan and Korea).

[6] This is mainly because, as stressed before, the cross-sectional evidence provided by Kind and Levine (1993a, 1993b) is based on a smaller version of the data-set used by Levine et al. (2000) and does not fully take into account the endogeneity of financial variables.

As a final note, we would like to point out that 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). However, a recent paper by Roodman (2007) argues that the evidence on a causal link from financial development to GDP growth disappears if:

- the standard errors are correctly computed using the correction method proposed by Windmeijer (2005);
- the estimation is performed through the new XTABOND2 module for Stata rather than the old DPD96 package for Gauss used by LLB (there are subtle differences in how time dummies are entered and in what weighting matrix is used in the first step);
- the number of instruments is appropriately reduced (since the number of instruments used by LLB is too large relative to the number of observations, their instrumental-variable estimates are likely to be biased towards exogeneity-based estimates and therefore fail to capture the causal impact of financial development on growth).

Moreover, a sceptical view on the growth implications of financial development is supported by a recent article due to Zang and Kim (2007) who use the panel data-set provided by LLB and do not find evidence of a positive causal link from financial development to economic growth, using Sims-Geweke causality tests. On the contrary, a substantial indication that economic growth precedes subsequent financial development is found.

In summary, we believe that the controversial issue of the finance-growth nexus is still open.

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Table 1

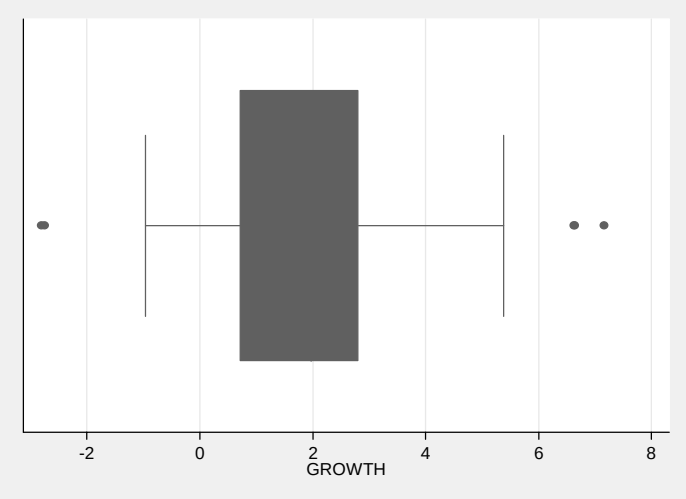
The impact of financial development on growth

	(1) GMM LLB	(2) GMM Replication	(3) 2SLS	(4) IVQR5	(5) GMM without Korea, Malta and Taiwan	(6) GMM without Zaire and Niger	(7) GMM without Korea	(8) GMM without Korea and Malta
Simple conditioning set								
PRIVATE CREDIT	2.515	2.515	2.472	2.576	1.023	2.478	2.088	2.070
	[0.814]	[0.834]	[0.884]	[0.752]	[0.646]	[0.812]	[0.925]	[0.955]
	(0.003)	(0.004)	(0.007)	(0.001)	(0.118)	(0.003)	(0.027)	(0.034)
COMMERCIAL-CENTRAL BANK	10.861	9.954	8.446	7.986	4.785	9.818	7.552	7.436
	[3.086]	[3.173]	[3.227]	[3.366]	[2.842]	[3.284]	[2.983]	[3.113]
	(0.001)	(0.003)	(0.011)	(0.021)	(0.097)	(0.004)	(0.014)	(0.020)
LIQUID LIABILITIES	1.723	1.844	2.507	1.973	1.046	1.394	1.633	1.608
	[0.844]	[0.885]	[0.989]	[1.187]	[0.676]	[0.861]	[0.801]	[0.863]
	(0.045)	(0.041)	(0.014)	(0.101)	(0.127)	(0.110)	(0.046)	(0.067)
Policy conditioning set								
PRIVATE CREDIT	3.222	3.364	3.400	2.871	1.168	3.274	3.011	2.943
	[1.245]	[1.572]	[1.619]	[1.576]	[1.498]	[1.448]	[2.007]	[2.085]
	(0.012)	(0.037)	(0.040)	(0.074)	(0.439)	(0.028)	(0.139)	(0.164)
COMMERCIAL-CENTRAL BANK	9.641	10.627	12.906	11.180	3.542	12.792	5.135	4.397
	[4.039]	[7.465]	[6.125]	[13.218]	[5.008]	[6.503]	[5.826]	[5.920]
	(0.021)	(0.160)	(0.040)	(0.401)	(0.483)	(0.054)	(0.382)	(0.461)
LIQUID LIABILITIES	2.173	1.934	2.869	2.290	1.120	1.718	1.817	1.820
	[0.908]	[1.018]	[1.282]	[2.529]	[0.964]	[1.029]	[0.982]	[1.047]
	(0.020)	(0.063)	(0.029)	(0.369)	(0.251)	(0.101)	(0.070)	(0.088)
Full conditioning set								
PRIVATE CREDIT	3.356	3.462	3.386	1.934	1.492	3.140	3.390	3.329
	[1.150]	[1.438]	[1.318]	[1.285]	[1.323]	[1.346]	[1.870]	[1.947]
	(0.005)	(0.020)	(0.013)	(0.139)	(0.265)	(0.024)	(0.076)	(0.094)
COMMERCIAL-CENTRAL BANK	11.289	12.971	14.878	8.673	8.581	11.132	12.964	12.427
	[3.258]	[6.651]	[5.453]	[8.640]	[9.343]	[4.847]	[9.273]	[9.387]
	(0.001)	(0.057)	(0.009)	(0.320)	(0.363)	(0.026)	(0.168)	(0.192)
LIQUID LIABILITIES	2.788	2.648	3.232	2.812	1.404	2.155	2.319	2.337
	[0.903]	[0.990]	[1.138]	[1.209]	[0.896]	[0.984]	[0.933]	[1.024]
	(0.003)	(0.010)	(0.006)	(0.024)	(0.124)	(0.033)	(0.016)	(0.027)

Robust standard errors in square brackets; P-values of t-statistics in parentheses.

Figure 1

Box-plot of the growth distribution



Appendix

Average growth rate of real GDP per capita, 1960-1995

Korea (Republic of)	7.16	Mexico	1.97
Malta	6.65	Kenya	1.96
Taiwan (China)	6.62	United Kingdom	1.96
Cyprus	5.38	India	1.92
Thailand	4.88	Sweden	1.89
Japan	4.30	Fiji	1.85
Malaysia	4.11	United States	1.71
Portugal	3.65	Costa Rica	1.61
Ireland	3.25	Chile	1.45
Greece	3.22	Switzerland	1.42
Norway	3.18	Philippines	1.16
Mauritius	3.02	New Zealand	1.12
Iceland	3.01	Trinidad and Tobago	1.12
Italy	2.93	Papua New Guinea	1.12
Brazil	2.93	Uruguay	1.03
Austria	2.89	Guatemala	0.93
Spain	2.88	Zimbabwe	0.84
Israel	2.81	Nepal	0.77
Finland	2.80	Bangladesh	0.71
Sri Lanka	2.70	Argentina	0.62
Pakistan	2.70	Honduras	0.60
Barbados	2.65	Togo	0.46
Belgium	2.65	Jamaica	0.42
Syrian Arab Republic	2.51	South Africa	0.39
Dominican Republic	2.50	Bolivia	0.36
Germany	2.45	Peru	0.06
France	2.43	Guyana	–0.28
Ecuador	2.39	Sierra Leone	–0.34
Canada	2.39	Senegal	–0.44
Paraguay	2.38	Liberia	–0.47
Colombia	2.23	El Salvador	–0.61
Netherlands	2.20	Haiti	–0.66
Denmark	2.18	Venezuela	–0.88
Panama	2.03	Ghana	–0.96
Australia	1.98	Niger	–2.75
		Zaire	–2.81