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Private investment and financial development in a globalized world

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Abstract Using recently developed panel data techniques on data for 43 developing countries over the period 1970–1998, this article provides an exhaustive analysis of causality between aggregate private investment and financial development. A common factor approach on annual data, allowing for global interdependence and heterogeneity across countries, suggests positive causal effects going in both directions. The finding has rich implications for the development of financial markets and the conduct of macroeconomic policies in developing countries in an integrated global economy.

Keywords Private investment · Financial development · Global interdependence · Common factor analysis

JEL Classification O16 · E22 · F3

1 Introduction

In recent decades there has been a large body of literature studying the substantial roles investment and financial development play in long-run economic growth (Levine and Renelt 1992; King and Levine 1993 among others). This article aims to provide an exhaustive analysis of the existence and directions of causality between these two important aspects of economic activities, namely aggregate private investment and financial development. By exploiting the time series variation in both private investment and financial development, and allowing for global interdependence and

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heterogeneity across countries, this article suggests positive causal effects going in both directions.

As is well-known, in the absence of asymmetric information, financial markets can function efficiently in the sense that, for any investment project, the financial contract provides the borrowers and investors with expected payments determined by the prevailing economy-wide interest rate. However, entrepreneurs in reality are always much better informed than investors as to the outcome of investment projects and their actions, calling for costly state verification conducted by financial intermediaries (Townsend 1979),[1] and the corresponding contracting problem between financial intermediaries and entrepreneurs (Diamond 1984; Gale and Hellwig 1985; Williamson 1986, 1987; Bernanke and Gertler 1989). Does entrepreneurs' investment behaviour exert any effect on the expansion of financial system or the reduction of agency costs? Does the increase in private investment as a whole contribute to financial development? On the other hand, another natural question could be whether more efficient financial markets encourage entrepreneurs' investment behaviour, or whether financial development brings about a surge of private investment.

Economic theory in general predicts that private investment and financial intermediary development contribute in a significant way to each other. On the one hand, an increase in private investment constitutes rising demand for external finance, enlarging the extent of financial intermediation by directly encouraging financial intermediaries to persuade savers to switch their holdings of unproductive tangible assets to bank deposits. Levine and Renelt (1992) suggest that more investment raises the rate of economic growth, which could stimulate financial development (Greenwood and Smith 1997). On the other hand, the endogenous finance-growth models (e.g. Diamond 1984; Diamond and Dybvig 1983; Greenwood and Jovanovic 1990; Bencivenga and Smith 1991; Greenwood and Smith 1997) suggest that financial markets have an important role in channelling investment capital to its highest valued use. Financial intermediaries tend to induce a portfolio allocation in favour of productive investment by offering liquidity to savers, easing liquidity risks, reducing resource mobilization costs and exerting corporate control. It seems natural to wonder if what is possible in theory is consistent with what has happened in reality.

This background has motivated research into the interactions between aggregate private investment and financial development in this article. The econometric analysis is based on a dataset for 43 developing countries over the period 1970–1998. The significance of this research has become more evident as the importance of Small and Medium Enterprises (SMEs) for economic growth has been widely recognized by policy makers, accordingly pro-SMEs policies like improving SMEs' access to finance have been advocated in recent decades. Many developing countries have sought to stimulate private sector-led growth by choosing to encourage private investment, while abandoning import-substitution policies led by the public sector, since the 1970s.

[1] Financial intermediaries emerge endogenously under certain conditions, as widely addressed by Diamond (1984) and Williamson (1986), to avoid the duplication of monitoring costs (to minimize the monitoring costs by pooling projects), to channel savings from households to firms for use in the production process and to pool risk.

It is worth noting that this analysis focuses on the period when, after the collapse of the Bretton Woods system, the world economy has experienced "a new and deeper version of globalization" following "a gradual liberalization of trade and capital flows" (Crafts 2000). The increase in global trade and financial integration[2] has been found to induce closer interdependence in the global economy through its implications for the properties of business cycle fluctuations. Imbs (2003) finds, using data for a group of developed and developing countries over 1983–1998, that the intensity of financial linkages and the volume of intra-industry trade have a positive impact on cross-country business cycle comovement. Frankel and Rose (1998) show that trade partners have a higher degree of business cycle comovement. Kim et al. (2003) observe a high degree of business cycle comovement for a set of Asian emerging market countries over 1960–1996.

The phenomenon of business cycle comovement has often been explained by using a common factor analysis in which macroeconomic variables such as aggregate output, consumption and investment are decomposed into common observed global shocks (like sharp fluctuations of oil prices), common unobserved global shocks (like technological shocks), specific regional shocks and country shocks (Gregory et al. 1997; Kose et al. 2003b; Bai and Ng 2004). It is these shocks that lead to a closer real and financial interdependence across countries. The 1990s witnessed growing research on the stochastic properties of panel datasets where the time dimension and cross-sectional dimension are relatively large, and especially, the issue of cross-sectional error dependence has received a great deal of attention in recent years. This research attempts to explore this issue by fully taking into account the effects of global shocks causing cross-sectional dependence across countries.

The analysis in this article uses methods on pooled annual data assuming a common factor structure in the error term. The models are then estimated by the Pesaran (2006) Common Correlated Effect approach. The annual data study suggests that two-way positive long-run causal effects exist between private investment and financial development. The findings of this article support the view that a private investment boom is typically followed by further financial development, while the demand for external finance is reflected in the subsequent level of financial development. As the financial system in a country becomes more sophisticated, more funds are channelled for productive investment so that firms, especially SMEs, find it easier to get access to funds. It has significant policy implications for the development of financial markets and the conduct of macroeconomic policies in developing countries in a global economy.

The remainder of the article proceeds in Section 2 to describe the data. After the outline of methods in Section 3, Section 4 employs the common correlated effects (CCE) approach to examine this link with annual data. Section 5 concludes.

[2] Kose et al. (2003a) show that the overall volume of international trade and gross private capital flows has increased dramatically over the past three decades, in particular, "the growth of world trade has been larger than that of world income in almost all years since 1970."

2 The data

This section describes the measures and data for private investment and financial development.

The measure of private investment, denoted by PI, is the ratio of nominal private investment to nominal GDP. The data are taken from the World Bank Global Development Network Database (World Bank 2002).[3]

The measure of financial development is denoted by FD. Since commercial banks dominate the financial sector and stock markets play very minor roles in most developing countries, this research focuses on the level of financial intermediary development, for which a new index is constructed by using principal component analysis[4] based on three banking development indicators widely used in the literature.

The principal component analysis is based on the following three popular banking development indicators[5]:

The first measure, Liquid Liabilities (LLY), is one of the major indicators used to measure the size, relative to the economy, of financial intermediaries including three types of financial institutions: the central bank, deposit money banks and other financial institutions. It is calculated by the ratio of liquid liabilities of banks and non-bank financial intermediaries (currency plus demand and interest-bearing liabilities) over GDP.

The second indicator, Private Credit (PRIVO), is defined as credit issued to the private sector by banks and other financial intermediaries divided by GDP. This excludes the credit issued to government, government agencies and public enterprises, as well as the credit issued by the monetary authority and development banks. It is a general indicator of financial intermediary activities provided to the private sector.

The third one, Commercial-Central Bank (BTOT), is the ratio of commercial bank assets to the sum of commercial bank and central bank assets. It reflects the advantage of financial intermediaries in dealing with lending, monitoring and mobilizing saving and facilitating risk management relative to the central bank.

Data on these financial development indicators are obtained from the World Bank's Financial Structure and Financial Development Database (World Bank 2008). FD is the first principal component of these three indicators above and accounts for 74% of their variation. The weights resulting from principal component analysis over the period 1990–1998 are 0.60 for Liquid Liabilities, 0.63 for Private Credit and 0.49 for

[3] This source could be the most reliable one for private investment ratio, while we can calculate it by deducting the net inflows of FDI and public investment from the gross fixed capital formation. Although data for private investment are only up to 1998, they are sufficient (or long enough) to conduct this analysis.

[4] Essentially the principal component analysis takes N specific indicators and produces new indices (the principal components) $X_1, X_2, \ldots, X_N$ that are mutually uncorrelated. Each principal component, a linear combination of the N indicators, captures a different dimension of the data. Typically the variances of several of the principal components are low enough to be negligible, and hence the majority of the variation in the data will then be captured by a small number of indices.

[5] The summary below is heavily drawn from Demirgüç-Kunt and Levine (1996, 1999).

Commercial-Central Bank.[6] Since these indicators are used to measure the size of financial intermediary development,[7] the composite index, FD, mainly captures the depth of bank-based intermediation.

The panel dataset contains 43 developing countries over the period 1970–1998. The transition economies are omitted. We also exclude countries with less than 20 observations over 1970–1998.

3 Methodology: CCE approach

This section outlines the methods used to explore the link between private investment and financial development by using pooled annual data. By explicitly looking at the yearly time series variation, one can explore the existence of heterogeneity across countries adequately and estimate the parameters of interest more precisely.

Assume the interactions between financial development (FD) and private investment over GDP (PI) are represented by the unrestricted autoregressive distributed lag ARDL(p, q) systems:

$$\mathrm{FD}_{it} = \sum_{j=1}^{p}\alpha_{1ij}\mathrm{FD}_{i,t-j} + \sum_{j=0}^{q}\beta_{1ij}\mathrm{PI}_{i,t-j} + \theta_{1i}t + \lambda_i^{'} f_t + v_{1it} \quad (1)$$

$$\mathrm{PI}_{it} = \sum_{j=1}^{p}\alpha_{2ij}\mathrm{PI}_{i,t-j} + \sum_{j=0}^{q}\beta_{2ij}\mathrm{FD}_{i,t-j} + \theta_{2i}t + \lambda_i^{'} f_t + v_{2it}$$

$$i = 1, 2, \ldots, 43 \text{ and } t = P + 1, \ldots, 29 \quad (2)$$

where f_t is a $(r \times 1)$ vector of unobserved common factors, and λ_i is a factor loading vector, such that $\lambda_i' f_t = \lambda_{i1} f_{t1} + \lambda_{i2} f_{t2} + \cdots + \lambda_{ir} f_{tr}$ (here r is the number of common factors). The common factors could be a global trend component, a global cyclical component, common technological shocks or macroeconomic shocks that cause cross-sectional dependence. v_{it} are errors assumed to be serially uncorrelated and independently distributed across countries. We allow for richer dynamics in the representations to control for business cycle influences.

The above representations with a factor structure are believed to be very general. Bai (2009) points out that the interactive effects model including the interaction between factors, f_t, and factor loadings, λ_i, is more general than an additive effects model, the traditional one-way or two-way fixed effects model.[8]

[6] The precision of the principal component analysis used to derive this new index depends on having a relatively large number of variables. Given that there are only three indices on which the principal component analysis is based, the new index of financial development is almost the mean of the three individual indices.

[7] Two measures for the efficiency of financial intermediation widely used are Overhead Costs, the ratio of overhead costs to total bank assets, and Net Interest Margin, the difference between bank interest income and interest expenses, divided by total assets. Due to the incompleteness of the available data, they are not included in this analysis.

[8] For the case of $r = 2$, when $f_t = (1 \eta_t)'$ and $\lambda_i' = (\alpha_i 1)$, we have $\lambda_i' f_t = \alpha_i + \eta_t$, where α_i and η_t are the individual effect and time effect, respectively.

Since the common factors are unobservable, standard regression methods are not applicable for the equations like 1 and 2. Study of the estimation of large cross section and time series panel datasets with a common factor structure has received considerable attention. Pesaran (2006) proposes the CCE approach to estimate this type of model directly by proxying the common factors with weighted cross-sectional averages. This section below sets out the estimation methods associated with either the cross-sectional error independence or the cross-sectional error dependence.

Following Schich and Pelgrin (2002), Ndikumana (2000, 2005) and Aslan (2008),[9] among others, we assume that a long-run relationship exists in this context. As shown by Engle and Granger (1987), the error correction equations governing the comovements of the series of financial development and private investment over time are as follows:

$$\begin{aligned} \Delta \mathrm{FD}_{it} &= \alpha_{1i}\left(\mathrm{FD}_{i,t-1} - \frac{\beta_{1i}}{\alpha_{1i}}\mathrm{PI}_{it}\right) - \sum_{j=1}^{p-1}\left[\left(\sum_{m=j+1}^{p}\alpha_{1im}\right)\Delta \mathrm{FD}_{i,t-j}\right] \\ &\quad -\sum_{j=0}^{q-1}\left[\left(\sum_{m=j+1}^{q}\beta_{1im}\right)\Delta \mathrm{PI}_{i,t-j}\right] + \theta_{1i}t + \lambda_i' f_t + v_{1it} \end{aligned} \tag{3}$$

$$\begin{aligned} \Delta \mathrm{PI}_{it} &= \alpha_{2i}\left(\mathrm{PI}_{i,t-1} - \frac{\beta_{2i}}{\alpha_{2i}}\mathrm{FD}_{it}\right) - \sum_{j=1}^{p-1}\left[\left(\sum_{m=j+1}^{p}\alpha_{2im}\right)\Delta \mathrm{PI}_{i,t-j}\right] \\ &\quad -\sum_{j=0}^{q-1}\left[\left(\sum_{m=j+1}^{q}\beta_{2im}\right)\Delta \mathrm{FD}_{i,t-j}\right] + \theta_{2i}t + \lambda_i' f_t + v_{2it} \\ i &= 1, 2, \ldots, 43 \text{ and } t = p+1, \ldots, 29 \end{aligned} \tag{4}$$

where

$$\alpha_{1i} = \sum_{j=1}^{p}\alpha_{1ij} - 1$$

$$\alpha_{2i} = \sum_{j=1}^{p}\alpha_{2ij} - 1$$

$$\beta_{1i} = \sum_{j=0}^{q}\beta_{1ij}$$

$$\beta_{2i} = \sum_{j=0}^{q}\beta_{2ij}$$

[9] Schich and Pelgrin (2002) indicate a positive effect going from financial development to private investment in 19 OECD countries over 1970 to 1997. Ndikumana (2000, 2005) finds that the development of banks and stock markets tends to stimulate domestic investment. Aslan (2008) studies panel cointegration of the finance-growth nexus.

In Eqs. 3 and 4, α_{1i} and α_{2i} are the coefficients for the speeds of adjustment. $-\frac{\beta_{1i}}{\alpha_{1i}}$ and $-\frac{\beta_{2i}}{\alpha_{2i}}$ are the long-run coefficients for PI_{it} and FD_{it}, respectively. $\sum_{m=j+1}^{p} \alpha_{1im}$ and $\sum_{m=j+1}^{q} \beta_{1im}$ are the short-run coefficients for $\Delta\mathrm{FD}_{i,t-j}$ and $\Delta\mathrm{PI}_{i,t-j}$ in Eq. 3, respectively, whereas $\sum_{m=j+1}^{p} \alpha_{1im}$ and $\sum_{m=j+1}^{q} \beta_{1im}$ are the short-run coefficients for $\Delta\mathrm{PI}_{i,t-j}$ and $\Delta\mathrm{FD}_{i,t-j}$ in Eq. 4, respectively.

For identification, the following equation should hold:

$$\frac{\beta_{1i}}{\alpha_{1i}} = 1/\left(\frac{\beta_{2i}}{\alpha_{2i}}\right) \tag{5}$$

In the absence of common factors, the within groups (WG) approach, mean group (MG) approach of Pesaran and Smith (1995) and pooled mean group (PMG) approach of Pesaran et al. (1999) are especially suited to the analysis of panels with large time and large cross-sectional dimensions. The consistency of the WG estimator for the dynamic homogeneous model is approximately justified when T is large, as $N \to \infty$ (Nickel 1981). In comparison to the WG method, which only allows the intercept to vary across countries but imposes homogeneity on all slope coefficients, the MG and PMG approaches allow for considerable heterogeneity across countries. The MG approach applies an OLS regression for each country to obtain individual slope coefficients, and then averages the country-specific coefficients to derive a long-run parameter for the panel.[10] For small samples, the MG estimator is likely to be inefficient although it is still consistent.

Unlike the MG approach, which imposes no restriction on slope coefficients, the PMG approach imposes cross-sectional homogeneity restrictions only on the long-run coefficient, but allows short-run coefficients, the speeds of adjustment and the error variances to vary across countries. The restriction of long-run homogeneity can be tested via a Hausman test. Under the null hypothesis of long-run homogeneity, the PMG estimators are consistent and more efficient than the MG estimators. Moreover, Pesaran et al. (1999) show that the PMG estimators are consistent and asymptotically normal irrespective of whether the underlying regressors are $I(1)$ or $I(0)$.

The PMG approach requires that the coefficients for long-run effects are common across countries, that is,

$$\alpha_{1i} = \sum_{j=1}^{p} \alpha_{1j} - 1$$

$$\alpha_{2i} = \sum_{j=1}^{p} \alpha_{2j} - 1$$

$$\beta_{1i} = \sum_{j=0}^{q} \beta_{1j}$$

[10] More specifically, the MG estimator and its standard errors are calculated as $\widehat{\theta}_{\mathrm{MG}} = \bar{\theta} = \frac{\sum_{i=1}^{N} \widehat{\theta}_i}{N}$ and $se(\widehat{\theta}_{\mathrm{MG}}) = \frac{\sigma(\widehat{\theta}_i)}{\sqrt{N}} = \frac{\sqrt{\sum_{i-1}^{N} \frac{(\widehat{\theta}_i - \bar{\theta})^2}{N-1}}}{\sqrt{N}}$, respectively.

$$\beta_{2i} = \sum_{j=0}^{q} \beta_{2j}$$

When common factors are allowed, Pesaran (2006) suggests the use of the (weighted) cross-sectional averages of the dependent variable and individual specific regressors to proxy the common factors. More specifically, he proposes to augment the observed regressors with the (weighted) cross-sectional averages of the dependent variable and the individual specific regressors such that as the number of cross-sectional units goes to infinity, the effects of unobserved common factors can be eliminated.

Pesaran (2006) proposes two CCE approaches for large heterogeneous panels whose errors contain unobserved common factors. One is the common correlated effect pooled (CCEP) estimator, a generalization of the WG estimator that allows for the possibility of cross-sectional correlation, and the other is the common correlated effects mean group (CCEMG) estimator, a generalization of the MG estimator of Pesaran and Smith (1995) that is adapted for the possibility of cross-sectional correlation. The CCEP estimator is the WG estimator with the (weighted) cross-sectional averages of the dependent variable and the individual specific regressors included in the model. The CCEMG approach uses OLS to estimate an auxiliary regression for each country in which the (weighted) cross-sectional averages of the dependent variable and the individual specific regressors are added, the coefficients and standard errors are then computed as usual.

The Pesaran (2006) approach exhibits considerable advantages. It does not involve estimation of unobserved common factors and factor loadings. It allows unobserved common factors to be possibly correlated with exogenous regressors and exert differential impacts on individual units. It permits unit root processes amongst the observed and unobserved common effects. The proposed estimator is still consistent, although it is no longer efficient, when the idiosyncratic components are not serially uncorrelated.

In this context, the cross-sectional means of $\Delta\mathrm{FD}_{it}$, $\mathrm{FD}_{i,t-1}$, $\Delta\mathrm{PI}_{it}$, $\mathrm{PI}_{i,t-1}$ are considered.[11] The models are augmented with the interactions between regional dummies and cross-sectional means of these variables, and time dummies. The CCEP and CCEMG estimators have been shown to be asymptotically unbiased and consistent as $N \to \infty$ and $N \to \infty$, and to have generally satisfactory finite sample properties. More importantly, the CCEP and CCEMG estimators hold for any number of unobserved common factors as long as the number is fixed, which is especially attractive.

A common correlated effects pooled mean group (CCEPMG) estimator is introduced in this study, which is a generalization of the pooled MG estimator of Pesaran et al. (1999) that also allows for the possibility of cross-sectional correlation. The restriction of long-run homogeneity can also be tested via a Hausman test. Under the null hypothesis of long-run homogeneity, the CCEPMG estimators are expected to be consistent and more efficient than the CCEMG estimators.

[11] To overcome the problem of missing data, imputation within each region is conducted since countries in a region tend to have similar income levels, closer economic relations and be more dependent on each other. There are 49 observations imputed for FD and 64 observations for PI, corresponding to 4 and 5% of complete observations in the resulting balanced panels, respectively.

Table 1 Unit root tests in heterogeneous panels

	Maddala and Wu (1999) Fisher test			
	Without trend		With trend	
FD	65.143[0.95]		71.679[0.87]	
PI	97.754[0.18]		94.101[0.26]	
	Bai and Ng (2004) Test			
	FD		PI	
	Without trend	With trend	Without trend	With trend
Common components (ADF)	−2.713[0.07]*	−3.099[0.11]	−1.981[0.29]	−2.202[0.49]
Idiosyncratic components (P-test)	214.555[0.00]***	199.876[0.00]***	79.206[0.68]	55.067[1.00]
Unit root	No	Yes	Yes	Yes

Note: The upper panel presents the results of Maddala and Wu (1999) Fisher test on the observed data under the null hypothesis of a unit root. The lower panel reports the Bai and Ng (2004) test, which decomposes the errors and conducts the unit root tests for the common components (ADF test) and idiosyncratic components (Maddala and Wu 1999 Fisher test) separately. P-values are in brackets.

4 Estimation results

This section presents the empirical results. Before proceeding to estimation, the panel unite tests are conducted to examine the time series properties of the variables FD and PI.

Table 1 contrasts the panel unit root tests proposed by Maddala and Wu (1999) and Bai and Ng (2004). The former is related to the assumption of cross-sectional independence, whereas the latter is defined under the assumption of cross-sectional dependence. The Maddala and Wu (1999) Fisher test, which does not require a balanced panel, indicates the series of FD and PI may be $I(1)$ processes no matter whether a trend is allowed. Controlling for the common factor, the Bai and Ng (2004) approach suggests that the series for FD and PI are $I(1)$ variables when we allow for a trend. These results suggest that two $I(1)$ co-integrating equations exist in this context. Given the low power of these tests, this article still reports two estimates of the long-run relationship between FD and PI. One should soon realize that the long-run coefficients in Tables 2 and 3 are very much similar after normalizing the coefficients.

Table 2 examines whether private investment causes financial development for 43 developing countries over 1970–1998, whereas Table 3 studies causality in the reverse direction. Tables 2 and 3 contrast the CCEP, CCEMG and CCEPMG estimates with their counterparts, the WG, MG and PMG estimates.[12] The first group of estimates is associated with the assumption of errors being cross sectionally dependent, whereas

[12] The short-run coefficients reported in Tables 2 and 3 are in general less informative. The CCEP and WG assume the short-run coefficients to be identical across countries, ignoring the heterogeneity widely recognized. The CCEPMG and CCEMG (as well as PMG and MG) allow the short-run coefficients to vary across countries, which is a more realistic assumption to make. However, the short-run coefficients reported are the cross-country averages, and therefore they are highly influenced by the outliers.

Table 2 Causality from private investment to financial development, 1970–1998

Dependent variable: FD_{it}	Cross-sectional dependence				Cross-sectional independence			
	CCEP	CCEPMG	CCEMG	Hausman	WG	PMG	MG	Hausman
Speed of adjustment	−0.073	−0.090	−0.335		−0.070	−0.077	−0.142	
	[0.02]***	[0.02]***	[0.06]***		[0.02]***	[0.01]***	[0.02]**	
Long-run coefficient								
$PI_{i,t-1}$	12.398	23.055	25.220	0.91	12.256	10.098	12.085	0.79
	[3.51]***	[2.15]***	[19.18]		[3.96]***	[1.33]***	[7.71]	
Short-run coefficient								
$\Delta PI_{i,t-1}$	−0.250	−1.154	−0.764		−0.244	−0.206	−0.152	
	[0.18]	[0.31]***	[0.38]**		[0.18]	[0.18]	[0.26]	
$\Delta PI_{i,t-2}$	−0.275	−0.513	−0.229		−0.269	0.001	0.028	
	[0.22]	[0.24]***	[0.25]		[0.22]	[0.16]	[0.19]	
Observations	987	987	987		987	987	987	
No. of countries	43	43	43		43	43	43	

Note: This table presents the Pesaran (2006) CCEP and CCEMG estimates, and CCEPMG estimates defined in the text under the assumption of cross-sectional error dependence, and their counterparts associated with the assumption of cross-sectional error independence including the WG estimates, Pesaran and Smith (1995) MG and Pesaran et al. (1999) PMG estimates. The PMG and CCEPMG approaches use the long-run coefficients of MG and CCEMG estimates, respectively, as initial values, and the Newton-Raphson algorithm. The Hausman test (P-values reported) is used to examine the null hypothesis of no difference between the MG and PMG estimators, and between CCEMG and CCEPMG estimators. The asymptotic standard errors are reported in the brackets. For WG and CCEP estimates the standard errors are corrected for possible heteroscedasticity in cross-sectional error variances. *, **, *** significant at 10%, 5% and 1%, respectively.

the latter group assumes cross-sectional error independence. An autoregressive distributed lag ARDL(3, 3) system has been adopted for this analysis.[13]

We look first at the case of cross-sectional error dependence. The coefficients corresponding to the speeds of adjustment in the two tables are significantly different from zero, suggesting that two-way Granger causalities exist between them.

Imposing homogeneity on all slope coefficients except for the intercept, the CCEP estimates in two tables suggest that there are positive long-run effects going in two directions. When heterogeneity is sought, the CCEMG and CCEPMG are called for. The CCEMG estimates find that the long-run effects are less precisely estimated for both directions. This is of no surprise—the long-run effects become much harder to capture when full heterogeneity is allowed. Nevertheless, it does imply that heterogeneity is especially prominent in this context. Moving from the CCEMG (no restriction, but potentially inefficient) to CCEPMG (a common long-run effect required) changes the results significantly, in particular, imposing long-run homogeneity reduces the standard errors and the speeds of adjustment. The restriction cannot be rejected at a conventional level by a Hausman test. The CCEPMG estimates provide evidence in support of significant long-run effects in both directions.

[13] The number of lags is constrained by the number of observations. As shown by Pesaran et al. (1999), the PMG estimator seems quite robust to outliers and the choice of ARDL order.

Table 3 Causality from financial development to private investment, 1970–1998

Dependent variable: PI_{it}	Cross-sectional dependence				Cross-sectional independence			
	CCEP	CCEPMG	CCEMG	Hausman	WG	PMG	MG	Hausman
Speed of adjustment	−0.422 [0.04]***	−0.921 [0.08]***	−1.000 [0.10]***		−0.418 [0.04]***	−0.479 [0.04]***	−0.582 [0.05]**	
Long-run coefficient								
$FD_{i,t-1}$	0.008 [0.00]**	0.008 [0.00]***	0.028 [0.05]	0.65	0.008 [0.00]**	−0.005 [0.00]	0.068 [0.07]	0.29
Short-run coefficient								
$\Delta FD_{i,t-1}$	0.000 [0.01]	−0.013 [0.01]	−0.016 [0.02]		0.000 [0.01]	0.003 [0.01]	−0.007 [0.01]	
$\Delta FD_{i,t-2}$	0.001 [0.01]	−0.009 [0.01]	−0.021 [0.01]		0.001 [0.01]	0.004 [0.01]	−0.003 [0.01]	
Observations	968	968	968		968	968	968	
No. of countries	43	43	43		43	43	43	

Note: See Table 2 for notes

The long-run coefficients in Tables 2 and 3 are actually quite similar. For example, the CCPMG and CCEMP estimates of the long-run coefficients for FD in Table 3 are 0.008 and 0.028, respectively, whereas their counterparts in Table 2 are 0.043 (1/23.055) and 0.040 (1/25.220). This result suggests that it is very likely for a single long-run relationship to exist in this context.

Comparing the above case with the case of cross-sectional error independence is worthwhile. As its counterpart associated with cross-sectional error dependence, the WG estimates (restrictions on all slope coefficients except for the intercept) show positive long-run effects in both directions. Allowing for heterogeneity across countries but no error dependence across countries, the MG approach finds no evidence in support of significant long-run effects in both directions. Supported by the Hausman tests in Tables 2 and 3, the PMG estimates indicate a significant long-run effect going from private investment to financial development, but not vice versa. This tends to underscore the importance of allowing for heterogeneity across countries in the sense that, compared to the PMG approach, the WG approach ignoring the divergent performance across countries is likely to produce misleading results. Moving from PMG to CCEPMG clearly highlights the importance of controlling for error dependence across countries.

After controlling for error dependence and heterogeneity across countries, the CCEPMG estimates clearly suggest positive long-run effects going in both directions between private investment and financial development. A note of caution may therefore be appropriate here: taking careful consideration over the integrated properties of the data, the error structure and the extent of heterogeneity is always worth keeping in mind in the econometric analysis of panel data.

In the following a set of experiments are conducted to test whether the above findings are robust to various model specifications. This research considers including trade openness and GDP per capita separately as additional regressors.[14] Various estimates suggest that either trade openness or GDP per capita is significantly positively associated with not only FD but also PI. With the inclusion of trade openness, CCEPMG estimates confirm the positive effects going in both directions between FD and PI. With GDP per capita entering the models, CCEPMG estimate indicates that PI is still found to positively related to FD while CCEMG, which is preferred to CCEPMG, confirms the positive impact of FD on PI. In general, results clearly indicate that the inclusion of either trade openness or GDP per capita does not alter the pattern of the findings.

In sum, after allowing for global interdependence and heterogeneity across countries, this analysis on annual data clearly shows positive long-run effects going in both directions between private investment and financial development. It is very likely that a single long-run relationship exists in this context. The findings in general suggest that surges of private investment stimulate the deepening of financial markets, and on the other hand, financial development facilitates resource mobilization, and increases the quantity of funds available for investment.

5 Conclusion

This article aims to investigate the causality between aggregate private investment and financial development in a globalized world. Using a panel data set with 43 developing countries over 1970–1998, the analysis is conducted with a common factor approach on annual data allowing for global interdependence and heterogeneity across countries. The analysis demonstrates that two-way positive causal effects exist between them implying that, in a globalized world, private investment is both an engine and a follower of financial development, and vice versa.

This analysis has produced significant insights into the interactions between two important aspects of economic activities, aggregate private investment and financial development, in developing countries. The implications of the findings can be summarized in the following:

First, the finding in terms of a positive effect of private investment on financial development has rich implications for the development of financial markets. This finding may shed light on a possible channel through which other variables drive financial development. For example, both trade openness and financial openness appear to promote financial development (Baltagi et al. 2009), and institutional improvement has been found to bring about financial development (Huang 2010).

Second, the finding on better financial development leading to a private investment boom has clear implications for the conduct of macroeconomic policies in developing countries. This finding is in support of the financial development framework proposed by McKinnon (1973) and Shaw (1973), who emphasize that financial liberalization and financial development can foster economic growth by boosting investment and its

[14] Trade openness (OPENC) is the sum of exports and imports over GDP (at current prices). The regression uses $\log(1 + \mathrm{OPENC}/100)$. GDP per capita is the real GDP per capita (Chain), taken in logs. Data on trade openness and real GDP per capita are taken from Penn World Table (6.1) due to Heston et al. (2002).

productivity, substantially influencing macroeconomic policies in developing countries since the 1970s. This research contributes to the existing body of research on the links between financial development and economic growth, by suggesting that financial development may enhance economic growth through a private investment boom.

Third, this research stresses the importance of taking careful account of error structure and heterogeneity in the econometric analysis of panel data since the interactions and comovements of economic factors, and the trends of globalization, have been the central features of world economy in recent decades. By considering the effects of common trends in a global economy and allowing for heterogeneity across countries, this analysis represents a significant improvement in comparison to existing research, which in general assumes error independence across countries.

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