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New Proxy of Financial Development and Economic Growth in Medium-Income Countries: A Bootstrap Panel Granger Causality Analysis

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Abstract This paper examines the causal relationship between financial development and economic growth for 27 medium-income countries in the period 1970 to 2012. We develop a new proxy for financial development that refers to the input of real resources into the financial system and apply the panel bootstrapped approach to Granger causality. The results show, for three countries the findings support strong evidence on supply-leading hypothesis which implies that financial development induces economic growth and for six countries the findings support strong evidence on demand-following. Our results confirm for twenty one countries suggesting that their financial development does not depend on economic growth.

Keywords: *causality, financial development, economic growth, bootstrapping, panel data*

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1. Introduction

Economists hold opinions of the role of finance in economic growth and the developed theoretical literature mirrors the divisions. The question of whether or not financial development affects economic activity has attracted a lot of attention in previous and current research (Kirkpatrick, 2000; Ang, 2008; Murinde, 2012). Bagehot (1873) and Hicks (1969) argued that financial system played a critical role in igniting industrialization in England by facilitating the mobilization of capital for "immense works." Schumpeter (1934) emphasized the importance of the banking system in economic growth and highlighted circumstances when banks can actively spur innovation and future growth by identifying and funding productive investments. With the contributions of McKinnon (1973) and Shaw (1973), the relationship between financial development and economic growth has been an important issue of debate, and during the last thirty years these studies have fostered a fresh research interest in this relationship. Recent empirical studies, however, offer contradictory evidence (Kaminsky and Reinhart, 1999; Deidda and Fattouh, 2002; Wachtel, 2003; Favara, 2003; Rousseau and Wachtel, 2011and Arcand et al., 2012).

In addition, the direction of causality still remains divisive. In summary, three schools of thought are identifiable in the extant literature: supply-leading response school of thought which argues that financial development leads to economic growth pioneered by Schumpeter (1911) and confirmed by notable studies such as Rajan and Zingales (1998), Levine et al., (2000) and Bittencourt (2012); demand-leading school of thought supported by studies such as Odhiambo (2004), Liang and Teng (2006) and Zang and Kim (2007) and Odhiambo (2008) which argues that growth leads to financial development; and bidirectional school of thought grounded by the studies such as Wood (1993), Demetriades and Hussein (1996), Akinboade (1998), Luintel and Khan (1999), Rousseau and Vuthipadadorn (2005) and Apergis et al., (2007) which submits that there is a bidirectional causality between financial development and economic growth. This shows that a consensus on the role of financial development in the process of economic growth does not so far exist.

Unfortunately, there is no simple procedure to determine which view is empirically adequate – not even one that would rule out some views as obviously false. First, the factors that govern economic growth admittedly include many others besides financial development, and interactions among them are likely to prevail. Second, mutual causation, which in economic growth may be the rule rather than the exception, makes it difficult, if not impossible, to rule out a specific hypothesis. Third, the existing data on financial development are plagued by poor reliability and dubious validity. Thus, the existing econometric studies do not really rule out any of the main hypotheses; significant results can be cited for any of them.

Consequently, the current verdict on the relationship between financial development and economic growth and their causality has remained inconclusive. However, the discussion focuses on measures of financial development, which must move literature because most authors only analyze an approach that from the outputs and the same database published by the International Monetary Fund (IMF) and the World Bank. Accordingly, it is logical to find almost the same results. In addition, what might be an adequate financial system at one time or in one social, institutional and economic environment may be outright detrimental at another time or in other environments. In other words: there may be various structural shifts or breaks which further complicate identification of causal relationships.

The economic historians are able to give convincing examples for all possibilities of causality outlined above. There is, obviously, need for further research. This paper contributes to the existing literature in several aspects. First, a new, resource-based (rather than monetary) proxy variable for financial development will be introduced. This new proxy will be used to investigate the possibility of Granger causality between financial development and economic growth. Second, The sample adopted for the dataset is wider than other contributions based on the panel approach and includes 27 medium-income countries[1] from 1970–2012. Third, this study is one of the few researches use the bootstrap panel Granger causality testing approach of Kónya (2006) that allows testing for causality on each individual country separably by accounting for dependence across countries.

The remainder of this paper is organized as follows. Section 2 gives a description of sample, the new proxy for financial activity and economic growth. Section 3 outlines the econometric methodology employed. Section 4 discusses the empirical findings. Finally, Section 5 concludes.

2. Sample and Data

The annual data used in this study cover the period from 1970-2012 for 27 medium-income countries. Consistent with theoretical specifications and previous studies (Demetriades and Hussein, 1996; Arestis et al., 2001; Beck and Levine, 2004, Odhiambo, 2010), we define economic development as the logarithm of real GDP per capita. The sample excluding countries that are very small (less than one million), countries with centrally planned economies [2] during the period 1970-2012, countries where oil exports constituted over 20% of GDP in 1995, and countries with civil wars claiming a death toll exceeding 2.5% of total population during 1970-2012. The exclusion of these countries in the sample is justified by the fact that it is unreasonable to run regressions across countries that are fundamentally different from the usual conditions (Harberger, 1998).

2.1. A New Proxy for Financial Development

One of the most important issues in assessing the relationship between financial development and economic growth is how to obtain a satisfactory empirical measure of financial development. An increase in financial instruments and the foundation of these instruments more commonly available in a country is defined as financial development. Various measures have been used in the literature to proxy for the “level of financial development”. For instance, the proportion of the financial sector to GDP is defined as financial depth (Depth). However, due to instability and differences in definition, the choice of an appropriate monetary aggregate raises a serious problem (Khan and Senhadji, 2000). Private shows the effectiveness of the financial system towards the private sector. Bank shows the importance of assets of deposit banks, compared to those of the central bank. Nowadays, credit to the private sector is seen as an inefficient allocation and detrimental to the sustainable growth achievement. To solve problems related to these measures that reflect the monetization and the allocation of credit, an innovative approach has a specific branch within the empirical literature (La Porta et al., 1998, 2008). This approach refers to variables concerning the origin of a country's legal system and, more bureaucratic and political characteristics as the instrumental variables to the the traditional measure of financial development. The problems of bias and convergence of the estimators are therefore corrected. However, these instruments are usually very rough qualitative variables. A classification by legal origin, which refers to the socio-economic and political constitution of a country, makes the possibility of evaluating the financial sector's contribution to growth during recent decades very limited.

Finally, some researchers attempt to identify the structural features of the financial system. These contributions (Goldsmith, 1969 and 1987; Bhattarcharyay, 1988; Clague et al., 1997 and Ergungor, 2008) refer to different ratios of currency or credit aggregates (eg, M_2/M_1 or credit of the central bank in the private credit), while researchers such as Beck, Demirguç-Kunt and Levine [3] have constructed a large database of national characteristics and institutional performance indicators, referring to the various financial institutions. These features may eventually help classify financial systems from the fundamental theory but empirically unclear. While this distinction of countries according to a financial system based on banks versus market-based or oriented versus the rights of creditors facing the debtor's rights, is encouraging as regards the possibility to specify the nature of link between finance and growth. This research is still at the consolidation of data and resulting classifications.

We leave the boundaries of those measures in the empirical literature and the work of Graff (2001, 2002 and 2005) on the growth-finance relationship, proposing a new proxy measure for financial development based on the inputs of the financial system. The construction of the new variable for financial development is motivated by the interest in obtaining a reasonably reliable and comparable quantification of the proportion of societal resources devoted to the financial system. Even if the intention has a certain resemblance to the basic argument of transaction costs and institutional economics (Williamson, 1985; North, 1990), namely, that the overall transaction costs are far from negligible and that financial institutions are a major response to this problem. Instead, we consider that the amount of resources devoted to the functioning of these institutions as a reliable indicator of the effort to control transaction costs (and, frictions and market failures

[1] These countries have been distributed on the basis of per capita GDP in 1995 : The medium-income (between 1000 and 10000 $US in 1995).

[2] Centrally planned economies were characterized by the dominance of large enterprises, while SMEs hardly existed.

[3] See Demirgüç-Kunt and Levine (1999) and Beck et al., (2000).

due to asymmetric information that is tempered by the financial system).

This measurement is the first principal component of a set of different indicators (For more details on the database, refer to Appendix.) for financial activity. While monetary indicators, such as Depth, are very difficult to compare over time and space because of the diversity and institutional change. Our proxy is likely to be less sensitive to changes in the institutional regulations and national and international shocks, but to capture rather stable characteristics of a given economy's structure. In addition, it is well known that monetary indicators are leading indicators of business cycles. Therefore, these variables are less endogenous inputs to current economic activity that traditional variables of financial development.

In terms of their approximate validity in quantitative conception of financial activity, the financial system's share in GDP, that is to say, the factor incomes generated in the financial sector, is probably the best indicator. More specifically, the share of the financial system in GDP consists of wages and the labor markets are characterized by the optimality of wages fixed by the market. This is based on equality between wages and marginal productivity of labor. The sector's share is valued at conditions that are very close to what most economists consider appropriate. Following this line of reasoning, the only flaw is to point to the observation that in the real world factor markets are frequently far from resulting in market clearing prices, so that some reservation is called for.

The second indicator is the number of banks and branches per capita, which gives an idea about the degree to which a country's population has access to financial services. Obviously, the validity of this indicator is weakened by differences in the dispersion of a country's population over its territory. In addition to this, technical progress and financial innovations, such as, telephone and Internet banking have made the accessibility of a bank office obsolete for many financial interactions and services. Thus, although this measure indicates a decline in financial development in most developed countries in recent years is the result of innovations in the banking sector and thus a sign of progress rather than a decline. Indeed, Table 1 shows the first signs of stabilization or even a fall in the number of banks and branches by one of the active population, which could indicate a structural break, but only after 1990. Considering these arguments, the use of this indicator for recent years in highly developed countries may cause a problem. However, since our analysis refers to the period 1970-2012 and covers a wide sample of countries.

Table 1. Banks and branches per 100,000 labor forces, by level of development

	1970	1975	1980	1985	1990	1995	2000	2005	2009	2012
All 71 countries	14,6	15,9	16,5	19,3	21,6	21,7	21,9	21,9	22	22,2
21 countries low-income *	1,7	1,7	2,1	2,0	2,2	2,2	2,3	2,3	2,4	2,4
27 countries medium-income *	9,8	10,1	10,9	11,8	12,9	13,8	14,1	14,2	14,2	14.3
23 countries high-income *	32,5	35,8	36,5	44,4	49,7	49,0	49,2	49,1	49,2	49,2

*Split by real gross domestic product per worker in 1995.

Finally, we refer to the share of manpower employed in the financial system. This measure is questionable because it ignores the productivity levels of those working in the financial system. To address this problem, we suggest a weighting of raw numbers of employees with an internationally comparable labour productivity proxy, mean years of schooling of the population aged 25–65 years (Barro and Lee, 1996), which results in an indicator for 'effective' rather than 'raw' labour. For a first picture, this correction, albeit imperfect, should, at least to some degree, improve the validity of our manpower indicator.

For a study on the relationship finance-growth in a cross-sample of countries covering thirty or forty years, despite all the adjustments and reservations, due to data quality indicators are considered far from satisfactory. Thus, these variables can be transformed in a way to make these measures reasonably reliable, valid and complete, to reflect the concept of 'resources for finance'. The procedure is currently chosen to determine the common variance of the three indicators, using principal component analysis (PCA). If the operating costs of the financial system are reasonably well represented by the first principal component this component can serve as a valid proxy variable for financial development. The PCA is based on the variance of specific variables and can extract a minimum of factors that explain the largest number of specific variance. To approach this goal, a technical requirement must be satisfied: the dummy variables must be measured independently. This condition is satisfied, because our three variables for the size of the financial system are derived from different databases. The PCA is a technique that aims to identify groups of quantitative variables strongly linked. This group is called 'component'. Variables (in our case, the three new inputs of financial activity) belonging to the same component are strongly linked represent a single concept 'financial development'. Instead, variables not linked they do not measure the same concept and are not part of the same component.

Table 2. A financial development proxy from principal component analysis

FD indication	Description	
Bank	Number of banks and branches / 100,000 labor force	
Fin/PIB	Financial system's share (factor income) in GDP	
Fin per	Share of labor employed in the financial system (adjusted by educational attainment)	
Principal component analysis, 3 FD indicators, n = 42 x 71		
Principal component	Explained variance	Cumulated explained variance
1	74,7%	74,7%
2	17,9%	92,6%
3	7,4%	100%
FD indicator	Loading principal component No. 1	Variance commune
Bank	0,87	0,75
Fin/PIB	0,93	0,87
Finper	0,81	0,68

Practically, to prepare raw series, the three variables (number of banks and branches per capita, weighted share of manpower employed in the financial system, share of the financial system in GDP) were carefully screened for obvious errors and incompatibilities. Subsequently, PCA

(We conducted a PCA using SPSS (Statistical Package for the Social Sciences).) was applied to a set of observations arising from a matrix of 1134 × 3. The PCA results are shown in Table 2.

Table 2 reveals that the principal component extraction is quite well done. It reduces the data and gives us a first principal component representing 75% of the overall variance (a total of 70% of variance explained is generally considered acceptable). In addition, the variance is explained for the second and third principal component accounts for only 17.9% and 7.4% respectively. All loadings are high (0.87 for banks per capita, 0.93 for the share of finance in GDP and 0.81 for the share of manpower in financial sector), indicating that the expected three-dimensional structure of the three variables is in fact well represented only by the first principal component. Therefore, in what follows, the individual scores for this component are taken as proxy of financial development (FD) for future analysis. We can therefore proceed to a new variable defined, which assigns a specific value for financial development. This indicator is defined for the 27 countries in our sample, across 42 time points (n = 1134, $\mu = 0$ and $\sigma = 1$).

3. Econometric Methodology

The choice of a suitable method allowing for the analysis of causality for panel data requires the assessment of cross-sectional dependence. If cross-sectional dependence exists, the seemingly unrelated regressions (SUR) are more efficient then the ordinary least-squares (OLS) (Zellner, 1962). Kónya (2006) proposed a method to account for both the cross-sectional dependence and the heterogeneity. It is based on SUR systems and Wald tests with country specific bootstrap critical values and eanbles to test for Granger-causality on each individual panel member separately, by taking into account the possible contemporaneous correlation across countries. Given its generality, we will implement this last approach in this paper.

Our empirical methodology is carried out in two steps. First, we devote our attention to preliminary analysis to investigate cross-section dependence. In the second step, based on the results from preliminary analysis we apply an appropriate panel causality method, which is able to represent cross-section features our panel data set to do the test. In what follows, we briefly outline the econometric methods.

3.1. Tests of Cross-Sectional Dependence

The first step in analyzing panel data Granger causality is testing for cross-sectional dependence. Kónya (2006) and Kar et al., (2010), to investigate the existence of cross- sectional dependence we employ four different cross-sectional dependence test statistics: Lagrange multiplier test statistic (LM) of Breusch and Pagan (1980), two tests statistic of Pesaran (2004), one based on Lagrange multiplier (CD_{LM}) and the other based on the pair-wise correlation coefficients (CD) and test of Pesaran et al., (2008) (L_{Madj}). Pesaran et al., (2008) concluded that the CD test has an important drawback, namely it will lack power in certain situations where the population average pair-wise correlations are zero, although the underlying individual population pair-wise correlations are non-zero. Pesaran et al., (2008) proposed a bias-adjusted test, which is a modified version of the LM test, by using the exact mean and variance of the LM statistic.

The Lagrange multiplier test statistic for cross-sectional dependence of Breusch and Pagan (1980) is given by:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2} \quad (1)$$

Where $\hat{\rho}_{ij}^{2}$ is the estimated correlation coefficient among the residuals obtained from individual OLS estimations. Under the null hypothesis of no cross-sectional dependency with a fixed N (number of cross-sections) and time period $T \to \infty$, the statistic has chi-square asymptotic distribution with $N(N-1)/2$ degrees of freedom. It is important to note that the LM test is applicable with N relatively small and T sufficiently large. This drawback was attempted to be solved by Pesaran (2004) by the following scaled version of the LM test:

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\hat{\rho}_{ij}^{2}-1) \quad (2)$$

Under the null hypothesis of no cross-sectional dependence with $T \to \infty$ and $N \to \infty$, this test statistic has the standard normal distribution. Though CD_{LM} is applicable even for N and T large, it is likely to exhibit substantial size distortions when N is large relative to T. The shortcomings of the LM and the CD_{LM} tests clearly show a need for a cross-sectional dependency test that can be applicable with large N and small T. In that respect, Pesaran (2004) proposed the following test for cross-sectional dependence CD:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij} \quad (3)$$

However, in some cases that the population average pair-wise correlations are zero, the CD test is lacking power, although the underlying individual population pair-wise correlations are non-zero (Pesaran et al., 2008). Furthermore, when the mean of the factor loadings is zero in the cross-sectional dimension, the CD test can not reject the null hypothesis in stationary dynamic (Sarafidis and Robertson, 2009). In order to solve this problem, Pesaran et al. (2008) raises a modified version of the LM test based on the exact mean and variance of the LM statistic. This bias-adjusted LM test is:

$$LM_{adj} = \sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\frac{(T-k)\hat{\rho}_{ij}^{2}-\mu_{Tij}}{\sqrt{v_{Tij}^{2}}} \quad (4)$$

Where μ_{Tij} and v^{2}_{Tij} are respectively the exact mean and variance of $(T-k)\rho^{2}_{ij}$ provided in Pesaran et al., (2008 p. 108). Pesaran et al., (2008) showed that under the null hypothesis of no cross-sectional dependence with $T \to \infty$ first followed by $N \to \infty$, the statistics LM_{adj} follow an asymptotic standard normal distribution.

3.2. Panel Causality Test

The panel causality approach by Kónya (2006) that examine the relation-ship between *Y* and *FD* can be formulated as follows:

$$\begin{cases} y_{i,t} = \alpha_{1,i} + \sum_{s=1}^{ly_1} \beta_{1,i,s} y_{i,t-s} + \sum_{s=1}^{lFD_1} \gamma_{1,i,s} FD_{i,t-s} + \varepsilon_{1,i,t} \\ FD_{i,t} = \alpha_{2,i} + \sum_{s=1}^{ly_2} \beta_{2,i,s} y_{i,t-s} + \sum_{s=1}^{lFD_2} \gamma_{2,i,s} FD_{i,t-s} + \varepsilon_{2,i,t} \end{cases} \quad (5)$$

In these formulas, index *i* refers to the country *(i = 1, ..., N)*, *t* to the time period *(t = 1, ..., T)* the period, *s* the lag, and ly_1, lFD_1, ly_2 and lFD_2 indicate the lag lengths. The error terms, $\varepsilon_{1,i,t}$ and $\varepsilon_{2,i,t}$ are supposed to be white-noises (i.e. they have zero means, constant variances and are individually serially uncorrelated) that may be correlated with each other for a given country, but not across countries ($\varepsilon_{1,i,t}$ and $\varepsilon_{2,i,t}$ are correlated when there is feedback between FD and Y, i.e. in the non-reduced form of (1), called structural VAR, y_t depends on FD_t and/or FD_t depends on y_t. For a proof see Enders (2004, p. 266).).

In this study, we consider bivariate systems, and we apply it in our context to economic growth and financial development. With respect to system *(5)* for instance, in country *i* there is one-way Granger-causality running from *FD* to *Y* if in the first equation not all $\beta_{2,i}$'s are zero but in the second all $\gamma_{1,i}$'s are zero; there is one-way Granger-causality from *Y* to *FD* if in the first equation all $\gamma_{1,i}$'s are zero but in the second not all $\beta_{2,i}$'s are zero; there is two-way Granger-causality between *Y* and *FD* if neither all $\beta_{2,i}$'s nor all $\gamma_{1,i}$'s are zero; and there is no Granger-causality between *Y* and *FD* if all $\beta_{2,i}$'s and $\gamma_{1,i}$'s are zero (Chang et al., 2013).

Since for a given country the two equations in *(5)* contain the same pre-determined, i.e. lagged exogenous and endogenous variables, the OLS estimators of the parameters are consistent and asymptotically efficient. This suggests that the *2N* equations in the system can be estimated one-by-one, in any preferred order. Then, instead of *N VAR* systems in *(5)*, we can consider the following two sets of equations:

$$\begin{cases} y_{1,t} = \alpha_{1,1} + \sum_{s=1}^{ly_1} \beta_{1,1,s} y_{1,t-s} + \sum_{s=1}^{lFD_1} \gamma_{1,1,s} FD_{1,t-s} + \varepsilon_{1,1,t} \\ y_{2,t} = \alpha_{1,2} + \sum_{s=1}^{ly_1} \beta_{1,2,s} y_{2,t-s} + \sum_{s=1}^{lFD_1} \gamma_{1,2,s} FD_{2,t-s} + \varepsilon_{1,2,t} \\ \vdots \\ y_{N,t} = \alpha_{1,N} + \sum_{s=1}^{ly_1} \beta_{1,N,s} y_{N,t-s} + \sum_{s=1}^{lFD_1} \gamma_{1,N,s} FD_{N,t-s} + \varepsilon_{1,N,t} \end{cases} \quad (6)$$

and

$$\begin{cases} FD_{1,t} = \alpha_{2,1} + \sum_{s=1}^{ly_2} \beta_{2,1,s} y_{1,t-s} + \sum_{s=1}^{lFD_2} \gamma_{2,1,s} FD_{1,t-s} + \varepsilon_{2,1,t} \\ FD_{2,t} = \alpha_{2,2} + \sum_{s=1}^{ly_2} \beta_{2,2,s} y_{2,t-s} + \sum_{s=1}^{lFD_2} \gamma_{2,2,s} FD_{2,t-s} + \varepsilon_{2,2,t} \\ \vdots \\ FD_{N,t} = \alpha_{2,N} + \sum_{s=1}^{ly_2} \beta_{2,N,s} y_{N,t-s} + \sum_{s=1}^{lFD_2} \gamma_{2,N,s} FD_{N,t-s} + \varepsilon_{2,N,t} \end{cases} \quad (7)$$

Compared to *(5)*, each equation in *(6)*, and also in *(7)*, has different predetermined variables. The only possible link among individual regressions is contemporaneous correlation within the systems. Therefore, system *6* and *7* must be estimated by (SUR) procedure to take into account contemporaneous correlation within the systems (in presence of contemporaneous correlation the SUR estimator is more efficient than the OLS estimator). Following Kónya (2006), we use country specific bootstrap Wald critical values to implement Granger causality. This procedure (For the details and exposition of the estimation and testing procedures, see Konya (2006), Kar et al. (2011), and Tekin (2012).) has several advantages. Firstly, it does not assume that the panel is homogeneous, so it is possible to test for Granger-causality on each individual panel member separately. However, since contemporaneous correlation is allowed across countries, it makes possible to exploit the extra information provided by the panel data setting. Therefore, country specific bootstrap critical values are generated. Secondly, this approach does not require pretesting for unit roots and cointegration, though it still requires the specification of the lag structure. This is an important feature since the unit-root and cointegration tests in general suffer from low power, and different tests often lead to contradictory outcomes. Thirdly, this panel Granger causality approach allows the researcher to detect for how many and for which members of the panel there exists one-way Granger-causality, two-way Granger-causality or no Granger-causality.

Because the results of the causality test may be sensitive to the lag structure, determining the optimal lag length is crucial for robustness of findings (Chang and Hsieh, 2012). As indicated by Kónya (2006), the selection of optimal lag structure is important because the causality test results may depend critically on the lag structure. In general, both too few and too many lags may cause problems. Too few lags mean that some important variables are omitted from the model and this specification error will usually cause bias in the retained regression coefficients, leading to incorrect conclusions. On the other hand, too many lags waste observations and this specification error will usually increase the standard errors of the estimated coefficients, making the results less precise. For a relatively large panel, equation and variable with varying lag structure would lead to an increase in the computational burden substantially. Following Kónya (2006), we decided to allow for different lags in each system but did not allow for different lags across countries. Assuming that the number of lags ranges from 1 to 4, we estimated all equations and used the Akaike Information Criterion (AIC) and Schwartz Criterion (SC) to determine the optimal (The combinations which minimize the AIC and SC.) solution defined as:

$$AIC_k = \ln\ln|W| + \frac{2N^2 q}{T}, SC_k = \ln\ln|W| + \frac{N^2 q}{T}\ln(T)$$

Where *W* stands for estimated residual covariance matrix, *N* is the number of equations, *q* is the number of coefficients per equation, *T* is the sample size, all in system *k = 1, 2*. Occasionally, these two criteria select different lag lengths.

4. Results and Discussions

Table 3. Cross-sectional dependence tests

Study Study Study	Test Stat	
Breush and Pangan (1980)	LM	165.814***
Pesaran (2004)	CD_{LM}	21.855***
	CD	15.031***
Pesaran et al (2008)	LM_{adj}	7.424***

*** denote statistical significance at 1%

As outlined earlier, testing for cross-sectional dependency in a panel causality study is crucial for selecting the appropriate estimator. To investigate the existence of cross-section dependence, we carried out four different test (*LM*, CD_{LM}, *CD*, LM_{adj}) and illustrate results in Table 4. The results show that all the four tests reject the null of no cross-sectional dependence across the members of the panel at 1% level of significance; this implies that the SUR method is more appropriate than the country-by-country OLS estimation. This finding implies that a strong economic links exist between sample countries. These findings show that a shock which occurred in one country of the sample will be transmitted to other countries.

The existence of cross-sectional dependence in these countries means that it is justified to use the Bootstrap Panel Granger Causality method in Kónya (2006). For each system of equations the number of lags was chosen according to the AIC and SC criterion (We used the AIC criterion to compare the specifications with and without a linear trend. Finally, we constructed SUR with one lag and without a linear trend.). Additionally, specifications incorporating deterministic trend were taken into account. The results from the bootstrap (Following the original paper of Kónya (2006) and several others, e.g. Nazlioglu et. al., (2011), we used 10000 replications in the procedure. Andrews and Buchinsky (2001) provide an exact method of evaluating the adequacy of the chosen number of replications.) panel Granger causality (The TSP routine written by László Kónya was used to obtain the results for the panel Granger causality test. We are grateful to László Kónya for sharing his codes.) analysis are reported in Table 4.

Our empirical results show that the Granger causality from FD to economic growth exists in Argentina, Brazil and South Africa, but not in the other twenty four countries and the feedback hypothesis for Guatemala, Iran, Jamaica, Morocco, Panama and Thailand, but not in the other twenty one countries.

Some points are worth noting based on the results given above. Firstly, compared to the number of countries considered, Granger non causality in either direction can be rejected relatively rarely. Secondly, for three counties the findings support strong evidence on supply-leading hypothesis which implies that financial development induces economic growth. On the other hand, for six countries the findings support strong evidence on demand-following.

Table 4. Results for panel causality: Wald tests with bootstrapping, mlY = mlFD = 1

Countries	H_0: FD does not cause Y				H_0: Y does not cause FD			
	Wald stat	Bootstrap Critical Values 1%	5%	10%	Wald stat	Bootstrap Critical Values 1%	5%	10%
Algeria	2.172	35.030	17.284	11.049	12.141	41.211	22.012	14.261
Argentina	16.804**	20.911	11.714	8.077	0.019	22.845	12.601	8.626
Botswana	0.307	15.673	8.345	5.994	0.645	31. 831	18.297	12.884
Brazil	22.105***	19.227	10.374	7.116	0.035	25.148	14.231	10.008
Cameroon	6.324	20.683	11.614	7.955	0.003	28.517	16.534	11.547
Colombia	3.790	42.134	25.311	18.109	3.432	36.621	20.001	13.871
Costa Rica	2.971	25.831	13.651	9. 178	0.608	37.003	21.133	14.123
Dominican Rep	2.784	24.322	13.336	9.106	0.197	38.512	20.852	14.029
Ecuador	0.426	42.191	22.128	15.088	0.785	37.016	20.117	14.230
Egypt	1.723	12.590	6.796	12.590	2.910	34.534	17.488	11.334
El Salvador	4.141	40.017	22.122	15.017	0.570	24.276	12.370	8.971
Guatemala	2.232	41.018	20.342	13.172	21.050**	31.116	17.225	11.793
Iran	1.558	37.654	18.786	11.661	11.451***	40.557	26.498	13.992
Jamaica	2.389	18.504	11.217	8.967	32.216***	15.234	8.640	9.127
Jordan	1.971	27.541	14.455	10.003	12.123	36.718	20.165	14.656
Malaysia	1.876	16.932	8.874	6.932	0.015	20.761	11.551	8.018
Mexico	3.326	21.894	11.769	8.206	8.172	36.052	19.348	13.674
Morocco	2.512	41.518	20.765	13.876	21.132**	31.324	17.411	11.920
Panama	3.456	30.136	15.688	10.799	15.330**	26.812	14.579	10.307
Paraguay	0.894	38.099	20.779	14.635	0.219	41.145	23.507	16.480
Peru	1.837	41.122	20.920	13.180	7.506	27.011	14.878	9.880
Philippines	3.276	16.034	8.754	5.931	0.012	20.196	11.461	7.597
South Africa	23.127***	19.434	10.703	7.609	0.041	25.780	14.690	10.203
Sri Lanka	0.007	16.987	9.778	6.853	5.689	32.934	18.050	12.714
Thailand	2.676	24.111	13.098	9.034	0.109	38.311	20.603	14.006
Tunisia	0.723	58.259	12.122	8.378	15.009**	23.174	14.348	10.873
Venezuela	3.512	28.104	14.456	9.595	0.942	51.979	30.022	22.127

*, ** and *** denote statistical significance at 10, 5 and 1%, respectively. Critical values are based on 10,000 bootstrap replications.

5. Conclusion

In this paper we have studied the possibility of Granger causality between financial development and economic growth in twenty seven medium-income countries from 1970 to 2012. It is the fact that there is a vast diverse figure in terms of financial development in these countries. Some of them have a relatively developed financial sector but others are not.

We developed a new proxy for financial development from three financial development indicators using principal component analysis and applied to a panel causality analysis which accounts for cross-country dependency. This approach has two advantages. On the one hand, it does not assume that the panel is homogeneous, so it is possible to perform Granger causality tests on each individual panel member separately. However, since contemporaneous correlation is allowed across countries, it makes possible to exploit the extra information provided by the panel data setting. On the other hand, this approach does not require pretesting for unit roots and cointegration, though it still requires the specification of the lag structure. This is an important feature since the unit-root and cointegration tests in general suffer from low power. Different tests often lead to contradictory outcomes, so the conclusions drawn from them are usually conditional on some more or less arbitrary decisions made by the researcher. The empirical results indicate that out of the twenty seven countries studied we find support for the 'demand following' hypothesis in only in six countries and for the 'supply leading' hypothesis in three countries. Finally, the financial development does not depend on economic growth, but is enhanced by other factors in twenty one countries.

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Appendix: Data and Sources

BANK: The number of Banks and branches are counted from the corresponding editions of the BANKERS' ALMANAC AND YEARBOOK, London: Thomas Skinner; labor force data (for normalization) are from ILO and included in the PENN WORLD TABLES.

FIN/PIB: The financial system's share of GDP is computed from various issues of the UN NATIONAL ACCOUNT STATISTICS, New York, referring to 'finance, insurance and business services'.

FINPER: The share of labor employed in the financial system is taken from various issues the ILO YEARBOOK OF LABOUR STATISTICS, Geneva. The corresponding ISIC-2 ('international standard industrial classification of all economic activities', 1968) classification is 'majordivision 8' (financial institutions, insurance, real estate and business services)