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Stock Markets, Banks and Long Run Economic Growth: A Panel Cointegration-Based Analysis

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The aim of this paper is to investigate the long run relationship between the development of banks and stock markets and economic growth. We make use of the Groen and Kleibergen (2003) panel cointegration methodology to test the number of cointegrating vectors among these three variables for 5 developing countries. In addition, we test the direction of potential causality between financial and economic development. Our results conclude to the existence of a single cointegrating vector between financial development and growth and of causality going from financial development to economic growth. We find little evidence of reverse causation as well as bi-directional causality.

JEL Classification: E44, G20, O43

Keywords: Banks, Stock Markets, Economic Growth, Panel Cointegration, Causality

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1 Introduction

Almost one hundred years ago, Schumpeter (1912) already addressed the relation between financial development and economic growth. He asserted that a well-functioning financial system should promote economic growth through the selection of the productive investments which are the most likely to be successful and the efficient allocation of resources (via bank credits) to these innovative technologies. Since then, the financial system has significantly evolved. Access of private companies to funding through financial markets has been improved and stock markets have been established in almost any part of the world. New financial products have also been created which allow better risk diversification and allocation. Although all these improvements may have had a positive impact on economic development in many countries through better resource allocation and risk diversification, recent events have also shown that misused financial innovations can have adverse effects on short run economic stability. Moreover, measures taken to reestablish systemic stability in the wake of the recent subprime crisis have important implications for economic development policies. If financial development facilitates long run economic development, expanding the banking system and stock markets in developing countries might help promote their long run economic growth. One central question is then to investigate whether financial development has had a positive impact on economic growth in the long run. In addition, it is also of prime importance to determine whether the structure of the financial system is relevant. In other words, we want to know whether banks and stock markets can both promote long run economic development.

The goal of this paper is to analyze the potential link between financial development and economic growth in the long run using data from 5 developing countries (Malaysia, Mexico, Nigeria, Philippines and Thailand) between 1977 and 2007. While this question has already been quite extensively investigated in the literature, the contribution of this paper with respect to existing studies is fourfold. First, this paper does not only focus on the development of the banking system or financial markets alone but integrates both aspects of financial development hence allowing to highlight potentially different roles and implications on the growth of financial intermediaries such as banks and financial markets. Second, the use of a panel-based cointegration analysis allows us to investigate the potential existence of a long run equilibrium and causality between both aspects of financial development and economic growth while reducing the well-known size and power distortions which arise in time series analyses with short time dimension. Third, while a few papers have already used cointegration analysis in panel data in the same context (for instance Christopoulos and Tsionas (2004) or Apergis et al. (2007)), our study is the first to apply these techniques to both banking system and financial markets simultaneously. Fourth, our paper is also innovative in the sense that we use a Johansen system approach (in contrast with residual-based analysis used in the existing literature) which allows us to take into account and test for more than a single (assumed) cointegrating relation among all the variables. Besides, the Groen and Kleibergen (2003) procedure that we implement in the next sections of this paper accommodates contemporaneous cross-country correlation, which also represents an extension with respect to the existing literature.

The rest of this paper is structured as follows: in the first section, we propose a review of the literature which summarizes current theoretical and empirical research on the link between finance and growth. We then present our data and methodology as well as the results from our empirical investigation.

2 Literature review

2.1 Review of the theoretical literature

In contrast with Schumpeter (1912), several authors argue that if a relationship exists between financial development and economic growth, it is of the reverse direction i.e. financial intermediation occurs in response to economic growth (see for instance Robinson (1952)). Patrick (1966) formalizes both approaches to the direction of causality between finance and economic growth. He suggests a demand-following process in which financial institutions develop in response to the increasing demand of the real side of the economy for these kind of institutions (which might be a consequence of economic growth). On the other hand, the supply-leading hypothesis supposes that the banking system develops in advance of the demand for banking services, provides efficient resource allocation and hence stimulates entrepreneurship and economic growth.[1] During the early 1970's, several authors among whom Goldsmith (1969) and McKinnon (1973) revived the debate surrounding the link between financial development and economic growth. Goldsmith (1969) and McKinnon (1973) support the idea of a positive impact of finance on economic growth and provide early empirical correlations between indicators of both variables.

However, as stated by Pagano (1993), these observed significant correlations between financial services and growth lacked analytical foundations. Indeed, early models of economic growth such as the Solow (1956) model explain long term economic growth per capita by exogenous technological progress.[2] However, the development of endogenous growth models[3] in the 1980's provided a theoretical explanation of the impact of financial development on economic growth in the long run. Within endogenous growth mod-

[1] We can define four hypotheses regarding the relationship between finance and growth. The supply-leading hypothesis argues that financial development causes economic growth. The demand-following hypothesis assumes the reverse causality. We might also consider a bi-directional causation where finance leads to growth and in turn growth supports the development of financial institutions. Possibly, there might be no causal relation between both variables.

[2] Even if we acknowledged the fact that the development of the financial markets might have any positive or negative (see among others Pagano (1993) for a discussion) impact on the savings rate of an economy, this would only impact the steady state income per capita level rather than its long run growth rate.

[3] See among others the models of Romer (1986), Lucas (1988), Aghion and Howitt (1992), Rebelo (1991) and Romer (1990)

els, there are mainly two channels through which financial development may influence long run economic growth i.e. by fostering capital accumulation and/or promoting technological innovation. Consequently, the theoretical literature on finance and economic growth describes different ways through which financial development may affect capital accumulation (or savings) and innovation.[4]

From the increased savings perspective, the results are somewhat ambiguous. While the development of the financial system might positively influence the amount of savings through more efficient fund mobilization, the impact of the resulting increase in return and decrease in idiosyncratic and liquidity risk might have either a positive or negative impact on the overall level of savings, depending on the intensity of the income and substitution effects (Levine (1997)). In an international context, Devereux and Smith (1994) show that risk mitigation through diversification may lead to a decrease in savings and hence economic growth. On the other hand, Pagano (1993) argues that financial development could influence the proportion of savings which are effectively invested. He notably cites fees, commissions and taxes as potential sources of a gap between savings and actual investments. As a consequence, if financial development decreases the proportion of savings lost in the intermediation process through for instance increased competition, it can in turn result in higher long run economic growth.

Several models focus on the potential impact of financial intermediation on technological innovation and productivity improvement instead of capital accumulation to derive a role for banks and stock markets in promoting long run economic growth. Financial intermediaries allow the investors to decrease the idiosyncratic and liquidity risk that they would have to bear in the absence of financial institutions. The pooling of funds by financial intermediaries enables them to diversify specific risk and to direct a part of

[4]For a deeper analysis of the financial system functions which might have an impact on capital accumulation and technological changes, see Levine (1997).

the funds at their disposal to less liquid but more productive investments. These two features allow a larger part of savings to be headed to high return investments. In Greenwood and Jovanovic (1990), savers can decide to invest in a risk-free asset which yields a low return and a risky project which offers a higher expected return. By diversifying away the idiosyncratic risk of risky projects and more efficiently acquiring information about the prospects of the economy, financial intermediaries can alter saving allocation toward more productive investments and hence induce economic growth. Building on Diamond and Dybvig (1983), Bencivenga and Smith (1991) underline the role of banks in reducing liquidity risk in an overlapping generation model. Without banking system in the presence of liquidity risk, agents' investment decisions would favor the liquid investment. Banks appear as a provider of liquidity for agents in need thereof. Banks can determine the expected overall need for liquid assets and invest a higher proportion of savings in the illiquid and productive asset than under "decentralized" agents' investment decisions.[5]

Using a slight variation of the same model, Greenwood and Smith (1997) come to the same conclusion and extend it to the case of stock markets. Levine (1991) shows that stock markets can also be used to diversify idiosyncratic (technology) risk and liquidity risk through the exchange of illiquid and liquid assets on financial markets. As a consequence, stock markets may solve the problem of premature withdrawal of funds from companies in a similar way as banks and support productivity growth. Saint-Paul (1992) argues that financial markets ease technological and labor specialization. Without stock markets, agents prefer flexible hence less risky technologies rather than specialized and more productive investments as well as a low division of labor. Financial markets through risk diversification allow for greater technological and labor specialization which in turn raises productivity and economic

[5]Banks also decrease the resort to self financed investment projects which might need to be liquidated in case of liquidity shock.

growth rate.

In addition to risk diversification, several studies highlight the ability of financial intermediaries to gather at a lower average cost and to efficiently use information about potential investments and their ensuing capacity to select the most profitable projects (Greenwood and Jovanovic (1990), King and Levine (1993b) and Berthelemy and Varoudakis (1996)).

Whereas this literature emphasizes the potential causal relation from financial development and economic growth, several studies have put forward a bi-directional causal relationship. While financial development may support economic growth, economic growth is a prerequisite for the formation of a financial system. Using models in which both growth rates and financial development are endogenously determined, Greenwood and Jovanovic (1990) and Greenwood and Smith (1997) define a process which goes from an early stage of low economic growth and inefficient financial system to well-developed financial intermediaries and higher growth rates. Berthelemy and Varoudakis (1996) find the same reciprocal relation between economic growth and banking system development. Greenwood and Smith (1997) propose a model in which the structure of the financial system (i.e. the relative development of banks and equity markets in the economy) is endogenously determined. They describe conditions under which the development of stock markets is hampered by the existence of a banking system (even if equity markets may be growth enhancing[6]) as well as the required assumptions for the coexistence of both banks and equity markets.

2.2 Review of the empirical literature

From the empirical point of view, many studies have investigated the potential link and causality direction between financial development and economic growth by using varied econometric techniques. While the first analyses of

[6]And even if the combination of banks and equity markets might lead to a higher growth rate than with banks only.

correlation between financial development and economic growth (Goldsmith (1969) or McKinnon (1973)) suffer from several statistical biases as well as regarding the choice of variables (i.e. indicators based on money stocks), the empirical literature on finance and economic development has mainly developed (from the early 1990's) around four econometric approaches: from cross-sectional regressions to panel cointegration through panel and time series estimations.

Building mainly on the cross-country regressions used in the economic growth literature (see for instance Barro (1991) and Mankiw et al. (1992)), early empirical papers on financial development and economic growth try to eliminate (or at least attenuate) the bias in Goldsmith (1969) or McKinnon (1973) coming from potential omitted variables. These studies typically use the value of different variables related to financial development as well as control variables averaged over a relatively long period.

A large part of the cross-sectional literature focuses on the relation between the banking system and economic growth. Early indicators of banking and financial depth were primarily based on measures of liquid liabilities such as M1, M2 or M3 divided by GDP. While the link between these monetary aggregates and the development and quality of the banking system may be weak and ambiguous (see for instance Gregorio and Guidotti (1995) for a discussion), King and Levine (1993a) propose new indicators which measure financial development more precisely. Besides the traditional liquid liability variables, they use a measure of the relative importance of private banks and the central bank and two measures of credit allocation. These latter two reflect the nature of credit recipients. They argue that a banking system whose role is confined to providing funds to the government or state-owned enterprises may not as efficiently exert its role of investment evaluation and risk management as a financial system mainly dealing with the private sector. In this seminal paper, they first study the contemporaneous correlation between financial development and economic growth. They find a significant and robust positive contemporaneous relationship between economic growth and all of their four financial development indicators on a sample of 80 countries over the period 1960-1989. While these results support the idea of the existence of a link between finance and growth, they give no indication on the direction of the causality. To test whether finance is a good predictor of long term economic performance, they also perform similar regressions using initial (beginning of period) values of financial development indicators and subsequent economic growth. Their results support the idea of a leading role of financial development on economic growth. King and Levine (1993b) confirm these findings by using a similar approach. In addition, King and Levine (1993a) also test the link between financial development and two channels proposed in the theoretical literature which may lead to economic growth i.e. stimulating capital accumulation and improving productivity. They find that financial development affects growth by both increasing the rate of capital accumulation and improving the efficiency of capital use. This paper and its results have given rise to a large empirical literature on finance and growth. Several papers have investigated the potential coexistence of different relations between banking development and economic growth based on country characteristics such as the level of income. Gregorio and Guidotti (1995) find a significantly positive relation between banking system development and growth on a sample of 98 countries. However, they also highlight some differences across time and groups of countries. They find that the effect of financial development on economic growth is weaker in high income countries than in medium and low income countries. They even find a significantly negative effect of finance on growth in Latin American countries. By contrast, using a threshold model and the same data set as King and Levine (1993a), Deidda and Fattouh (2002) confirm the overall positive relation between finance and growth although they show that it holds only for high per capita income countries and that it is not significant for low income countries. However, the results from the cross-sectional studies may suffer from simultaneity bias as financial development has an impact on economic growth but may at the same time be influenced by economic growth. As a result, several papers make use of instrumental variables for financial development. Following La Porta et al. (1997) and La Porta et al. (1998), Levine (1999) and Levine et al. (2000) use indicators of the regulatory and legal environment to extract the exogenous components of banking system development. They argue that favorable regulatory and legal environment can foster the creation of well functioning institutions (in this case financial institutions) while being exogenous in the model. Their results confirm a significant positive relationship between financial development and economic growth. Levine (1998) and Beck et al. (2000) extend the same approach to the influence of financial development on the determinants of economic growth. Levine (1998) suggests that the effect of banking system development on economic growth comes from its impact on total factor productivity and capital accumulation while Beck et al. (2000) note that the impact on capital accumulation is less robust. McCaig and Stengos (2005) enlarge the set of instrumental variables and reach the same conclusion with respect to the positive link between financial development and economic growth.

While most of the cross-sectional literature focuses on the relationship between banking system development and economic growth, some authors also investigate the potential role of financial markets in promoting economic growth by using a cross-sectional approach. Atje and Jovanovic (1993) study both the effect of financial intermediaries (through the ratio of credit from private and government banks to GDP) and financial markets (through the ratio of annual stock market trades to GDP) on economic growth. They test in turn the significance of initial values of banking system and market indicators in a growth regression while controlling for the investment rate. They conclude to a significantly positive effect of stock market development on economic growth while their results regarding the banking system are not conclusive. However, Harris (1997) invalidates the results of Atje and

Jovanovic (1993) regarding stock markets and finds at best a weak relation between stock market development and economic growth. Using two stage least square, he shows that the stock market effect highlighted by Atje and Jovanovic (1993) almost completely vanishes. While the previous two studies assess the role of stock markets in economic development, they do not consider the inclusion of both banking system and financial markets in their model. On the other hand, Levine and Zervos (1998) allow both variables to enter their regression. As indicators of financial markets, they use one indicator of market size (market capitalization of domestic shares divided by GDP), two indicators of market liquidity (turnover ratio and value traded ratio)[7], two measures of international financial markets integration[8] and a measure of stock market volatility (i.e. the standard deviation of market returns). They find that both banking system development and stock market liquidity are significantly correlated with contemporaneous and future economic growth, capital accumulation and productivity enhancement, suggesting that financial intermediaries and equity markets may provide different and complementary services which eventually help to spur economic development.

Following the cross-sectional literature on finance and economic growth, panel-based analyses have attempted to solve another potential bias present in cross-sectional regressions. As noted by Levine et al. (2000), the use of panel data allows them to account for the time series dimension of the data in addition to the cross-sectional one. The panel data approach also enables them to solve the potential bias of cross-sectional regression arising from

[7]The turnover ratio is measured as the value of the trades of domestic assets over the value of listed domestic shares. The value traded ratio is equal to the value of trades of domestic shares divided by GDP. See Levine and Zervos (1998) for a thorough discussion of these two measures.

[8]These two measures are based on the intercept of the Capital Asset Pricing Model and the Arbitrage Pricing Theory to domestic stocks. They consider significant intercepts as being evidence against international market integration. See Levine and Zervos (1998) for further discussion.

unobservable country specific effects. In this context, Levine et al. (2000) use the dynamic panel estimator proposed by Arellano and Bond (1991) applied to variables averaged over 5 years[9] (in order to create a panel). They also use the GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) which improves on the potential weaknesses of Arellano and Bond (1991)'s instruments by combining the regression in difference (as in Arellano and Bond (1991)) and the regression in level. Using both techniques, Levine et al. (2000) find a positive correlation between financial intermediaries development and economic growth. Broadening the same analysis to the determinants of growth, Beck et al. (2000) report a relationship between financial and economic growth through total factor productivity improvements.[10] Beck and Levine (2004) investigate the effect of stock market development in combination with financial intermediaries by using the same econometric procedure. They conclude that both stock markets and banks have a positive impact on growth. Rioja and Valev (2004a) replicate the analysis of Levine et al. (2000) but group the countries according to the level of development of their financial system. They find that banking system development has a positive impact on economic growth only once it has reached a certain threshold. Rioja and Valev (2004b) also notice that the determinants of growth through which financial development affects economic development might differ according to income levels. Whereas the relation arises through capital accumulation for low income countries, it mainly materializes through productivity increase for middle and high income countries. Rousseau and Wachtel (2000) also apply the Arellano and Bond (1991)'s methodology to study the link between banks, stock markets and economic growth in a vector autoregressive (VAR) setting. The VAR model allows them to test Granger causality in addition to correlations in a tri-variate model where the three variables of interest are economic growth and a mea-

[9]Averaging over 5 years instead of using annual data permits to decrease the influence of business cycles on the results.

[10]These results are confirmed by Benhabib and Spiegel (2000) using a similar technique.

sure of stock market and banking system development. They conclude to a Granger causal relationship going from stock market development and financial intermediaries to economic growth. They do not find indications of the reverse causality from economic growth to financial development, hence supporting the supply-leading hypothesis. Focusing exclusively on financial intermediaries, Calderon and Liu (2003) use pooled data for 94 countries and the Geweke (1982) methodology[11] to test the direction of the causality between finance and growth. They find that financial development generally leads to economic growth but that the contribution of financial intermediaries is stronger in developing countries. They also notice evidence of a bi-directional relationship when the sample is split between developed and developing countries. Unlike most of panel-based studies, Dawson (2003) finds no relationship between financial development and economic growth, when using a panel of 13 countries from Central and Eastern Europe between 1994 and 1999, in a fixed and random effect panel estimator framework.

At the same time that the panel based approach developed, another part of the empirical literature started to make an extensive use of time series methodologies. This approach not only permits to test causality but it also allows to investigate the long run relationship between finance and economic growth by testing potential cointegration between these variables. In addition, it relaxes the hypothesis of a single and homogenous (across countries) relationship between financial development and economic development. Indeed, the time series approach allows to test the significance of the correlation between finance and growth in the long run as well as the direction of the causality (if any) which might differ from one country to another. Moreover, performing the analysis on a country by country basis obviously implicitly solves the country-specific effect which may have biased cross-sectional results. On the other hand, the time series approach requires a sufficient num-

[11]The Geweke (1982) methodology decomposes the linear dependence between X and Y as the sum of a linear feedback from X to Y plus a linear feedback from Y to X and a linear instantaneous feedback between X and Y.

ber of observations to provide meaningful results on long run relation between financial development and economic growth, which may not be available for many countries. Demetriades and Hussein (1996) first test for potential cointegration between banking and economic development indicators that they report to be integrated of order one. Using more sophisticated measures of financial intermediaries growth than liquid liabilities (similar to those used in the cross-sectional and panel literature), they find little support of the supply-leading hypothesis in 16 countries. They indicate bi-directional links between finance and economic growth in most cases and even going from economic growth to finance in some cases. In addition, they support the idea that the results are very country specific. Using a similar methodology but measuring financial depth by the GDP of the banking sector, Neusser and Kugler (1998) confirm the ambiguity of the causality between finance and growth and the great variability of the results from one country to another. Luintel and Khan (1999) support the bi-directional hypothesis using a multivariate VAR where they add real interest rate and per capita stock to the bi-variate VAR commonly used in previous studies. On the other hand, Xu (2000) shows strong evidence that financial intermediaries development induces economic growth in a sample of 41 countries. Rousseau and Wachtel (1998) cast doubt on the results of previous studies focusing exclusively on bank development. Indeed, they provide evidence on the increasing importance of financial markets in today's economies, which might bias previous conclusions based on financial intermediaries only. They use data from 5 industrializing countries between 1870 and 1929 when -they argue- financial intermediaries were dominant. They conclude to a causal relation from financial development to economic growth while they find no evidence of the reverse causation. Arestis et al. (2001) study potential cointegration between economic growth, stock market and banking development. They show that both banks and stock markets have a positive impact on long run economic growth while the effect of the former is stronger. Arestis and Demetriades

(1997) investigate the same relationship for Germany and the USA. They find a causal link from banking development to GDP growth for Germany. Their results are not conclusive, neither for banks nor for stock markets in the case of the USA. In the latter case, the causality seems to be the reverse one, i.e. from economic growth to financial development. More recently, the results of Caporale et al. (2004) in a sample of 7 countries support the hypothesis that financial development fosters economic growth mainly through stock markets.

Recently, a few studies have investigated the relation between finance and growth using panel cointegration techniques. These techniques can notably solve the problem of the small size of samples that time series methodology faces while retaining the attractive features of the time series approach in testing potential long run relations between financial and economic variables. Indeed, as argued by Christopoulos and Tsionas (2004), small samples might have an impact on the power of the tests in a time series framework. Using measures of banking and economic development, Christopoulos and Tsionas (2004) test for cointegrating vectors in a panel of 10 countries. They find a single cointegrating vector and conclude to a long run impact of financial development on economic growth. More recently, Apergis et al. (2007) enlarges the sample of countries and the set of banking development indicators used by Christopoulos and Tsionas (2004). In addition, they allow for coefficient heterogeneity across countries. However, unlike Christopoulos and Tsionas (2004), who allow for several cointegrating vectors by using a Johansen-like approach, they restrict their panel cointegration analysis to a single hypothesized vector. They conclude to a bi-directional causality between financial intermediaries development and economic growth.

3 Data and methodology

To test the potential link between financial development and economic growth, we use 2 different indicators of the banking system and 3 variables for financial markets. Following the existing empirical literature, we focus on the two main variables which are used for the development of financial intermediaries, that are liquid liabilities (LL) over GDP and private credit by deposit money banks over GDP (PRIV). While the relevance of liquid liabilities as a measure of the development of the banking system is questioned (see for instance Gregorio and Guidotti (1995) or Levine (1997) for a discussion of these financial indicators), we nevertheless choose to integrate it in our analysis because of its frequent use in the literature. For financial markets, we use 3 indicators which are the stock market capitalization over GDP (MKTCAP), the stock market turnover ratio (TURN) and the stock market value traded over GDP (VALTRAD). While MKTCAP is a measure of the size of the financial markets relative to the GDP, the other two indicators are measures of the liquidity of the markets. The turnover ratio is measured as the ratio of the value of the trades of domestic shares divided by the value of listed domestic shares. VALTRAD is computed as the ratio of the value of the trades of domestic shares over GDP. In contrast with TURN which measures liquidity with respect to the size of the financial markets, VALTRAD captures liquidity on an economywide basis. Economic growth is measured as the logarithm of real GDP per capita in local currency (GDP). All financial development indicators are retrieved from Beck et al. (2009) database. Real GDP per capita comes from the World Development Indicator database of the World Bank. Countries are selected on the basis of data availability for all the 6 variables between 1977 and 2007 (31 yearly observations). Based on this selection criterion, our database is composed of five countries: Malaysia, Mexico, Nigeria, Philippines and Thailand. These countries share the additional characteristic of all being developing countries for which the question of the development of the financial system as a source of economic development is of crucial importance.

In the coming sections, we proceed as follow. First, we test the order of integration of our 6 variables. We use the Pesaran (2007) approach to panel unit root testing. This method allows heterogeneity in autoregressive coefficients across individuals and cross-section dependence through a single common factor which can be appropriately proxied by the cross-sectional mean of the endogenous variables y_{it}[12] and its lagged values. Individual test statistics $t_{\phi_i=0}$ can be computed on the basis of the following cross-sectionally augmented Dickey Fuller (CADF) regression for an AR(p) error structure (Δ denotes first differences):

$$\Delta y_{it} = \alpha_i + \phi_i y_{it-1} + c_i \bar{y}_{t-1} + \sum_{j=0}^{p} d_{ij} \Delta \bar{y}_{t-j} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{it-j} + e_{it}.$$

Panel unit root tests can then be implemented on the basis of the individual CADF test statistics. The cross-sectionally augmented version of the Im et al. (2003) test (CIPS) can simply be computed as:

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} t_{\phi_i=0}$$

where t_{ϕ_i} are the individual CADF statistics.

To avoid too strong an influence of extreme values, Pesaran (2007) proposes to use a truncated version of the CIPS statistics ($CIPS^*$) where $t_{\phi_i=0}$ is

[12] He defines $\bar{y}_t = \frac{1}{N} \sum_{j=1}^{N} y_{jt}$.

replaced by $t^*_{\phi_i=0}$[13]:

$$\begin{cases} t^*_{\phi_i=0} = t_{\phi_i=0} & if \ -K_1 < t_{\phi_i=0} < K_2 \\ t^*_{\phi_i=0} = -K_1 & if \ \ t_{\phi_i=0} \leq -K_1 \\ t^*_{\phi_i=0} = K_2 & if \ \ t_{\phi_i=0} \geq K_2 \end{cases}$$

Pesaran (2007) reports tables with simulated critical values for CIPS and $CIPS^*$.

The small sample properties of several common factor unit root tests have been studied by Gengenbach et al. (2010) who show that the power and size of the Pesaran (2007) test are satisfactory but might be distorted if more than one factor generates the cross-country dependence. We nevertheless keep this method as a sufficient approximation to guide our decision regarding degree of integration of the variables used in our analysis. Evidence of non-zero orders of integration would lead us to apply a cointegration analysis to our variables. We then perform the Groen and Kleibergen (2003) cointegration test and estimation using all potential combinations of banking, stock markets and economic development indicators.[14] This allows us to test for the potential number of long run relationships between them in contrast to the residual-based tests which assume a single cointegration vector. In addition, the Groen and Kleibergen (2003) methodology is the only panel Johansen-based approach which also takes into account potential cross-country contemporaneous correlation. Groen and Kleibergen (2003) define a full-system

[13]The values of K_1 and K_2 are chosen such that the probability that individual test statistics lie within the interval $[-K_1, K_2]$ is high (Pesaran (2007) uses 99.99%)

[14]We decide to work in tri-variate systems instead of including all variables in the analysis for mainly two reasons. First, some financial variables show high levels of correlations which may result in collinearity problems. In addition, we see respectively the two banking and the three stock market series as different indicators of a same variable. We use several indicators for each variable as a robustness check of our results.

VECM model with unrestricted constant and higher order dynamics as:

$$\Delta Y_t = \lambda + \begin{pmatrix} \Pi_{11} & \dots & \Pi_{1N} \\ \vdots & \ddots & \vdots \\ \Pi_{N1} & \dots & \Pi_{NN} \end{pmatrix} Y_{t-1} + \Gamma W_t + \epsilon_t = \lambda + \Pi Y_{t-1} + \Gamma W_t + \epsilon_t$$

where $Y_{t-1} = (y'_{1t-1} \dots y_{Nt-1})'$, Π_{ur} is $Nk \times Nk$ (k is the number of variables), λ is a vector of constants and W_t contains lagged differences.

Their test is based on the restricted version of the model with Π being restricted to be a block-diagonal matrix denoted by Π_A and in which cross-unit cointegration is ruled out.

$$\Delta Y_t = \lambda + \begin{pmatrix} \Pi_1 & 0 & \dots & 0 & 0 \\ 0 & & \ddots & & 0 \\ 0 & 0 & \dots & 0 & \Pi_N \end{pmatrix} Y_{t-1} + \Gamma W_t + \epsilon_t = \lambda + \Pi_A Y_{t-1} + \Gamma W_t + \epsilon_t,$$

where in our context, Y_t is composed of GDP and one indicator of both banking and financial market development (in this order).

In the presence of within country cointegration, the blocks on the main diagonal of Π_A have reduced rank r ($< k$) and can be expressed as $\Pi_i = \alpha_i \beta_i'$, with α_i and β_i being $k \times r$ matrices. The matrix with $\alpha_i \beta_i'$ on the main diagonal has rank $N \times r$ and will be denoted by Π_B. In addition, the homogeneous condition $\beta_i = \beta, \forall i$ can also be considered. With this additional restriction imposed, the matrix Π_B will be denoted by Π_C. Groen and Kleibergen (2003) show that the restriction $\beta_i = \beta$ for $i = 1 \dots N$ can be tested by using the following likelihood ratio test:

$$LR(\Pi_C|\Pi_B) = 2[l_{max}(\Pi_B, \Omega) - l_{max}(\Pi_C, \Omega)] \Rightarrow \chi^2((N-1)r(k-r))$$

where Ω is the covariance matrix of ϵ_t.

In order to test the potential number of cointegrating vectors among the N variables by using a likelihood-ratio test as in Johansen's framework, we need estimates of the matrices Π_A, Π_B (and Π_C if we are interested in the hypothesis of common cointegrating vectors) as well as estimates of Ω under the rank restriction from 0 to k-1 . Groen and Kleibergen (2003) propose a GMM-based procedure to obtain such consistent maximum-likelihood estimates. This procedure consists in applying a stepwise maximization of the log-likelihood given in turn a consistent estimate of the matrix Π (for the imposed restriction on its rank) and Ω. Once maximum-likelihood estimates are obtained from the iterative procedure described by Groen and Kleibergen (2003), the (common-to-all-units) number of cointegrating vectors can be tested using the likelihood ratio statistics:

$$LR(\Pi_B|\Pi_A) = T\left[ln|\hat{\Omega}(\hat{\Pi}_B)| - ln|\hat{\Omega}(\hat{\Pi}_A)|\right]$$

Groen and Kleibergen (2003) prove that this test statistics is asymptotically distributed as (for T $\rightarrow \infty$):

$$LR(\Pi_B|\Pi_A) \Rightarrow \sum_{i=1}^{N} tr\left(\int dB_{k-r,i}S_i'\left[\int S_iS_i'\right]^{-1}\int S_i dB_{k-r,i}'\right),$$

where $B_{k-r,i}$ is a (k-r)-dimensional Brownian motion for individual (country) i with identity covariance matrix and S_i is (k-r)-dimensional for each individual i ($S_i(t) = (B_{k-r,i}(t) - \int_0^1 B_{k-r,i}(t)dt, t - \int_0^1 tdt)$.

Critical values are obtained following the Monte Carlo simulation procedure proposed by Johansen (1995) as suggested by Groen and Kleibergen (2003). For each individual i, $tr\left(\int dB_{k-r,i}S_i'\left[\int S_iS_i'\right]^{-1}\int S_i dB_{k-r,i}'\right)$ is approximated by $tr\left(\sum_{t=1}^{T}\epsilon_t Z_t'\left[\sum_{t=1}^{T} Z_t Z_t'\right]^{-1}\sum_{t=1}^{T} Z_t\epsilon_t'\right)$ where ϵ_t are independent $N_{k-r}(0, I)$. Z_t is defined as $(X_{t-1}' - \bar{X}', t - \frac{1}{2}(T+1))'$ where X_t is a $(k-r-1)$ dimensional random walk $(X_t = X_{t-1} + \epsilon_t)$. Simulated random walks are independent "within" each individual but are correlated "between" individuals according to the covariance matrix Ω obtained in the test and estimation procedure. We use T=400 and repeat the procedure 5000 times to obtain critical values.

Once the number of cointegrating vectors is determined, we test (long-run) causality using the framework proposed by Toda and Phillips (1993, 1994) to determine whether financial development has an impact on economic growth in the long run and to discriminate between potentially different impacts of financial intermediaries and financial markets. The reverse causality from economic growth to financial development is also tested. If the variables are not stationary, Sims et al. (1990) and Toda and Phillips (1993) show that Wald test statistics for causality from level a VAR have nonstandard asymptotic distributions which are functions of nuisance parameters. It is shown that test statistics are chi-square distributed under a set of assumptions in terms of the number of cointegrating vectors and rank of submatrices, which renders causality tests almost unpracticable in VAR in level with integrated variables. In an ECM framework, Mosconi and Giannini (1992) and Toda and Phillips (1993, 1994) show that, under a set of hypotheses, causality likelihood ratio and Wald tests in a cointegrated system are chi-square distributed and more tractable than under a VAR in level setting. Toda and Phillips (1994) propose a test procedure for causality in this context. They start with the following ECM representation where $J(L)$ denotes a p-th order matrix lag polynomial:

$$\Delta Y_t = J(L)\Delta Y_{t-1} + \alpha\beta' Y_{t-1} + u_t.$$

If for instance the purpose is to test the causality from the last n_3 variables on the first n_1 variables, they partition Y_t into three subvectors Y_{1t}, Y_{2t} and Y_{3t} of respective sizes n_1, n_2 and n_3. The null hypothesis of no causality from the last n_3 variables on the first n_1 variables given the n_2 variables Y_{2t} can be written as:

$$H_0 : J_{1,13} = \cdots = J_{p,13} = 0 \;\; and \;\; \alpha_1 \beta_3' = 0,$$

where $J_{i,13}$ corresponds to the coefficients on the i times lagged differences of Y_3 in the first n_1 equations, α_1 are the first n_1 rows of α and β_3 are the last n_3 rows of β.

The first half of the hypothesis refers to short-run causality while the second half is related to long-run causality. Toda and Phillips (1993, 1994) prove that the test statistics related to both sides of the null hypothesis are chi-square distributed provided $rank(\alpha_1) = n_1$ and $rank(\beta_3) = n_3$. Under these conditions (which are easily tested if $n_1 = n_3 = 1$), Toda and Phillips (1994) propose a sequential procedure to test for causality. This procedure is based on the decomposition of the null hypothesis in three different hypotheses on short run dynamic parameters, α_1 and β_3 which can be sequentially tested. In this paper, we focus on the long run causality part of this test procedure.

4 Results

4.1 Panel unit root tests

For each of the 6 variables of interest, we test the order of integration. We apply the Pesaran (2007) individual CADF tests and panel CIPS tests. More particularly, we first test the presence of a unit root in twice differenced series. If this hypothesis is rejected, we then conclude that second differences are stationary. In a second step, we perform the same test on differenced series.

If the null hypothesis of a unit root is rejected[15], we eventually test level series which are I(1) if the null hypothesis is not rejected and I(0) otherwise. We allow for a linear trend and intercept in level series, for an intercept in first differences and for no deterministic component for second differences. Lag selection is based on the BIC information criteria. The results of these sequential tests are reported in Table 1. Starting with second differences, panel unit root tests reject the null of a unit root for almost all variables and countries in our panel as well as for the panel. Regarding first differences, the panel statistics reject the null hypothesis of a unit root at the 5% level for all the variables. The results related to the individual countries are less clear-cut but might be affected by the relatively low test power which characterizes unit root tests in small samples.[16]

Eventually, level series are shown to have a unit root since none of the panel statistics (and few of the individual ones) is rejected even a the 10% level. Consequently, the results from our panel unit root tests conclude to the presence of a unit root in all level series but not in their difference so that they are shown to be I(1). As a result, we apply in the next section a cointegration analysis which enables us to determine whether there exists one or more long run relationships among the different variables in our panel.

4.2 Panel cointegration tests and estimation

Since all the series in our data set have been shown to be I(1), we test within-country cointegration for all possible combinations of the economic development indicator plus an indicator of bank and stock market development (6 combinations). We follow the Groen and Kleibergen (2003) methodology which allows us to test the number of cointegrating relationships among each triplet (Johansen-like approach) while taking into account potential

[15]Otherwise, the series is shown to be I(2).

[16]Which is one of the main reasons why we use panel statistics instead of individual unit root tests.

Table 1: Individual CADF and CIPS unit root tests

2nd Difference						
D=0						
	GDP	LL	PRIV	MKTCAP	TURN	VALTRAD
Malaysia	-2.81**	-4.62***	-1.76	-2.42*	-6.19***	-7.41***
Mexico	-3.76***	-3.90***	-4.53***	-4.52***	-4.78***	-7.06***
Nigeria	-6.37***	-7.11***	-4.15***	-2.70**	-3.32**	2.98
Philippines	-4.79***	-2.39*	-3.16**	-3.58***	-7.41***	-7.40***
Thailand	-3.21**	-3.51***	-3.98***	-5.14***	-3.88***	-2.89**
Panel	-4.19***	-4.31***	-3.51***	-3.67***	-5.12***	-4.36***
Panel (trunc.)	-4.13***	-4.11***	-3.51***	-3.67***	-4.84***	-3.65***
1st Difference						
D=1						
	GDP	LL	PRIV	MKTCAP	TURN	VALTRAD
Malaysia	-2.57	-2.44	-2.29	-2.09	-5.10***	-4.68***
Mexico	-3.08*	-2.08	-2.64	-1.46	-4.27***	-5.04***
Nigeria	-3.66**	-4.29***	-2.90	-0.80	-0.28	3.08
Philippines	-2.36	-1.41	-2.50	-4.62***	-4.10**	-3.55**
Thailand	-1.98	-1.79	-2.56	-3.88**	-3.45**	-2.70
Panel	-2.73***	-2.40**	-2.58***	-2.57**	-3.44***	-2.58***
Panel (trunc.)	-2.73***	-2.40**	-2.58***	-2.57**	-3.44***	-2.67***
Level						
D=2						
	GDP	LL	PRIV	MKTCAP	TURN	VALTRAD
Malaysia	0.02	-1.94	-1.49	-0.39	-2.74	-2.88
Mexico	-1.67	-1.21	-3.53*	-2.98	-3.02*	-2.98*
Nigeria	-1.32	-1.76	-1.52	1.13	1.41	5.77
Philippines	-0.56	-1.45	-2.87	-2.57	-2.57	-2.25
Thailand	-1.24	-2.21	-1.96	-2.49	-3.11*	-3.62**
Panel	-0.95	-1.71	-2.27	-1.46	-2.01	-1.19
Panel (trunc.)	-0.95	-1.71	-2.27	-1.46	-2.01	-2.01

Note: ***,** and * respectively denote significance at the 1%, 5% and 10 % level. D=0, 1, 2 respectively mean without deterministic term, with an intercept only and with an intercept and a trend. Critical values are obtained from Pesaran (2007).

cross-country contemporaneous correlation.[17] Indeed, residual-based tests which are based on the assumption of a single known cointegration relation might provide biased results if the number of cointegrating vectors is higher than one. This paper is the first attempt to apply Johansen-like panel cointegration approach to the link between banks, stock markets and economic growth. In addition, we must notice that the Groen and Kleibergen (2003) methodology makes the assumption of a common number of cointegrating vectors for each country. This is in line with our objective which is to determine a global relation between financial development and economic growth and not any country-specific effect. The number of lags is selected by using information criteria in country-by-country maximum likelihood estimations and is allowed to lie between 0 and 2.[18] Cointegration testing corresponds in this context to a test of the rank of the matrix Π. This can be done by using the likelihood ratio test methodology proposed by Johansen (1995) and extended to the panel framework by Groen and Kleibergen (2003). We start with a number of cointegrating vectors equal to zero ($rank(\Pi) = 0$) and compute the likelihood ratio statistic against full rank. We then progressively increase the rank of matrix Π until non-rejection of the null hypothesis whose rank corresponds to the estimated number of cointegrating vectors. Cointegrating vectors are allowed to be heterogeneous across individuals. The homogeneous hypothesis will nonetheless be tested. We report the results of Groen and Kleibergen (2003) cointegration tests in Table 2.

Cointegration test outcomes in Table 2 conclude to the existence of a single cointegrating vector among GDP, bank and financial market development except for the combination of GDP, LL and VALTRAD. On the whole, these results suggest that there exists a single long run relationship between

[17] Cross-country cointegration is not permitted in this context which is nevertheless not a strong restriction given our topic of interest. Indeed, long run relationships between financial development and economic growth of different countries are not expected to be significant given the domestic nature of all the variables in our data set.

[18] Higher number of lags is not allowed because of the sample size.

Table 2: Panel cointegration tests

	Rank	Tstat	Crit. Val. 10%	5%	1%
GDP-LL-MKTCAP	0	141,81*	133,75	147,02	175,51
	1	54,87	66,50	76,74	99,10
	Rank				
GDP-LL-TURN	0	161,24**	133,46	146,20	175,60
	1	62,03	66,39	76,78	98,79
	Rank				
GDP-LL-VALTRAD	0	173,99**	133,61	147,49	177,97
	1	67,83*	66,65	77,09	98,06
	2	1,26	13,49	18,97	34,20
	Rank				
GDP-PRIV-MKTCAP	0	145,31*	133,80	147,01	174,44
	1	42,19	66,43	76,53	98,63
	Rank				
GDP-PRIV-TURN	0	145,38*	133,11	146,33	174,60
	1	66,53	67,12	77,30	99,18
	Rank				
GDP-PRIV-VALTRAD	0	150,36**	133,32	146,51	175,04
	1	39,38	66,46	76,79	98,33

Note: ***,** and * respectively denote significance at the 1%, 5% and 10 % level.

Table 3: Likelihood ratio test of the homogeneous restriction on the cointegrating vector

	Tstat	Rank	Crit. val. 10%	5%	1%
GDP-LL-MKTCAP	46,72	1	13,36	15,51	20,09
GDP-LL-TURN	84,73	1	13,36	15,51	20,09
GDP-PRIV-MKTCAP	52,27	1	13,36	15,51	20,09
GDP-PRIV-TURN	48,07	1	13,36	15,51	20,09
GDP-PRIV-VALTRAD	40,50	1	13,36	15,51	20,09

financial developments and economic growth i.e. the process is driven by two stochastic trends. This might intuitively speak in favor of the hypothesis of the financial development indicators driving economic development since it may be somewhat counterintuitive to see GDP and one financial variable driving the other financial indicator. It is the purpose of the next sections to determine if we can identify a causal linkage between financial development and economic growth and vice-versa. In the remainder of the paper, we focus on the 5 combinations growth-banks-stock markets for which panel cointegration tests provide evidence of the existence of a single cointegrating vector.

In addition to testing the number of cointegrating relations in a framework with heterogeneous cointegrating vectors, we can also test the homogeneous alternative. We report the results of the tests for the homogeneous restriction in Table 3. The homogeneous restriction is rejected for all triplets economic growth, banking system and financial market development for which the rank of matrix Π is equal to one. Beside providing a test for the number of cointegrating relationships, the Groen and Kleibergen (2003) methodology also computes maximum likelihood estimates of the cointegrating vector and adjustment coefficients. We report these estimates in Table 4.

Table 4: Adjustment parameters and cointegrating vectors estimation

GDP-LL-MKTCAP					
	α_1	α_2	α_3	$-\beta_2$	$-\beta_3$
Malaysia	0,007	0,097	0,090	-5,819	0,699
Mexico	-0,011	0,057	0,096	-7,975	0,263
Nigeria	-0,006	-0,005	0,003	71,543	42,957
Philippines	-0,079	-0,039	-0,034	2,158	-1,735
Thailand	0,054	0,089	1,025	-1,084	-0,636
GDP-LL-TURN					
	α_1	α_2	α_3	$-\beta_2$	$-\beta_3$
Malaysia	0,020	0,087	-0,037	-3,716	0,749
Mexico	-0,017	0,041	-0,527	-5,604	0,407
Nigeria	-0,256	0,039	-0,030	1,644	-2,748
Philippines	-0,387	-0,114	0,046	-0,025	0,282
Thailand	-0,001	0,027	-0,597	-2,603	0,737
GDP-PRIV-MKTCAP					
	α_1	α_2	α_3	$-\beta_2$	$-\beta_3$
Malaysia	0,034	0,108	-0,072	-2,498	0,618
Mexico	-0,469	-0,302	-0,138	1,781	-1,021
Nigeria	-0,148	-0,086	0,045	6,009	0,256
Philippines	-0,227	-0,172	-0,129	1,557	-0,488
Thailand	0,039	0,173	0,026	-1,830	0,697
GDP-PRIV-TURN					
	α_1	α_2	α_3	$-\beta_2$	$-\beta_3$
Malaysia	-0,010	0,056	-0,598	-1,995	2,263
Mexico	-0,116	-0,028	-1,623	1,093	0,604
Nigeria	-0,295	0,011	0,005	7,428	-4,160
Philippines	-0,092	-0,173	0,018	0,909	-0,022
Thailand	0,002	0,000	0,044	7,392	-16,247
GDP-PRIV-VALTRAD					
	α_1	α_2	α_3	$-\beta_2$	$-\beta_3$
Malaysia	0,010	0,041	-0,619	-3,421	1,301
Mexico	-0,079	-0,089	0,026	5,829	-6,511
Nigeria	-0,363	-0,026	-0,038	3,698	-18,709
Philippines	-0,022	-0,064	0,007	5,250	-2,335
Thailand	-0,001	0,307	0,540	-0,287	-1,648

We use the following normalization under the assumption of a single cointegrating vector:

$$\beta_i = \begin{pmatrix} 1 \\ -\beta_{2,i} \\ -\beta_{3,i} \end{pmatrix}$$

If economic growth is positively linked to financial development in the long, we should expect the sign of the cointegrating vector estimates ($-\beta_2$ and $-\beta_3$) to be negative.[19] Cointegrating vector estimates indicate that for almost all possible triplets and countries we can find a positive link between economic development and banking or stock market development but rarely with both banks and financial markets. This may be seen as a first indication of the impact of financial development in its widest sense (i.e. banks and financial markets) on economic growth since at least one source of fund provision and risk diversification a positive role with respect to long run economic development. However, this does not support the idea that banks and financial markets offer different services with different impacts on economic growth. In addition, we need to check the significance of these long run relationships. The purpose of the next sections is to test the significance of long run causality between financial development and economic growth as well as the opposite causality from economic growth to financial development. Ljung-Box tests for serial correlation in the residuals are reported in Table 5.

[19] Indeed, the normalization allows us to rewrite the equilibrium relation as:

$$GDP = \beta_2 BANK + \beta_3 STOCKMARKETS$$

4.3 Does financial development foster long run economic growth?

So far, we have found evidence in favor of the existence of a single long run relationship between economic growth, banking system and financial market development. We have also shown that the sign of financial development indicators in the cointegrating vectors supports the hypothesis of a positive impact of finance on growth in the long run.[20] Our final objective is now to test whether the causal link from finance to economic development and/or from economic development to finance is statistically significant. We follow the methodology proposed by Toda and Phillips (1993, 1994) to test for causality within a VECM framework. Their procedure consists in testing both short run and long run causality. Short run causality is based on a test of the coefficients on the lagged differences while long run causality requires a stepwise procedure where the corresponding α and β significance is tested. Since our interest lies in the long run causal link between finance and growth, we focus on the long run causality part of the test. In addition, the specifications of our tests (the causal link between variables two by two, one cointegrating vector) are such that Toda and Phillips (1994) assumptions are fulfilled and we can start by testing the corresponding α and, if it is significant, the corresponding β by using chi-square distributed test statistics.[21] The results of causality test from financial development to economic growth are reported in Table 6.

Joint tests of long run causality all support the hypothesis that finance causes economic growth in the long run. In two specifications (GDP-LL-TURN and GDP-PRIV-MKTCAP), both banks and financial markets are shown to significantly affect economic growth in the long run. Results from

[20]Even if we do not find that both segments of the financial system have a positive impact.

[21]Chi-square distribution of the test statistics is also confirmed by Groen and Kleibergen (2003) in their framework.

Table 5: P-values of Ljung-Box tests for autocorrelation in the residuals (up to 4 lags)

		LL-MKTCAP	LL-VALTRAD	PRIV-MKTCAP	PRIV-TURN	PRIV-VALTRAD
	GDP	6.8%	68.9%	51.7%	41.9%	28.4%
Malaysia	Bank	38.7%	29.1%	46.0%	27.9%	35.7%
	Mkt	28.0%	4.6%	21.2%	34.6%	8.5%
	GDP	89.6%	72.9%	18.2%	83.4%	52.0%
Mexico	Bank	55.5%	83.5%	7.7%	65.6%	7.1%
	Mkt	44.2%	85.4%	29.1%	56.4%	93.9%
	GDP	31.9%	56.8%	9.6%	74.2%	0.0%
Nigeria	Bank	94.4%	64.7%	44.8%	73.9%	12.0%
	Mkt	98.8%	24.2%	99.3%	42.1%	93.5%
	GDP	65.2%	9.5%	5.6%	73.4%	0.1%
Phillipines	Bank	9.4%	42.7%	0.7%	10.7%	3.0%
	Mkt	16.8%	77.3%	20.4%	60.2%	38.5%
	GDP	28.4%	33.1%	30.3%	4.4%	49.8%
Thailand	Bank	51.4%	51.7%	9.5%	6.0%	27.2%
	Mkt	50.6%	90.9%	12.9%	45.4%	39.5%

country-by-country tests are less clear-cut. Evidence of causality from finance to growth is not present under all combinations of indicators (e.g. there is no evidence of causality in the triplet GDP-PRIV-VALTRAD) and does not have the expected sign in every case. Nevertheless, causality from finance to growth is supported by the data for all countries under at least one specification. We can also notice a slightly more preponderant role of banking system (9 significant causalities) than financial markets (7 significant causalities). As a result, even if there is no strong evidence of long run causality from financial development to economic growth, our results indicate a consistent impact of finance on growth when using joint tests and a less clear-cut but still present causality for individual tests.

Table 6: Long run causality test: Finance → Growth

GDP-LL-MKTCAP	α_1	$-\beta_2$	$-\beta_3$	Conclusion
Malaysia	0,007***	-5,819***	0,699	B
Mexico	-0,011	-7,975***	0,262	NC
Nigeria	-0,006*	71,543***	42,957	B
Philippines	-0,079**	2,158	-1,735	NC
Thailand	0,054	-1,084	-0,636	NC
Joint test (Tstat)	16,131***	28,993***	6,82	B
GDP-LL-TURN	α_1	$-\beta_2$	$-\beta_3$	Conclusion
Malaysia	0,0199***	-3,716***	0,749*	B, M
Mexico	-0,017	-5,604	0,407	NC
Nigeria	-0,256***	1,644***	-2,748	B
Philippines	-0,387	-0,025	0,282	NC
Thailand	-0,001	-2,603***	0,737**	NC
Joint test (Tstat)	20,019***	16,166***	16,571***	B, M
GDP-PRIV-MKTCAP	α_1	$-\beta_2$	$-\beta_3$	Conclusion
Malaysia	0,034***	-2,498***	0,618***	B, M
Mexico	-0,469***	1,781***	-1,021***	B, M
Nigeria	-0,148***	6,009***	0,256	B
Philippines	-0,227***	1,557***	-0,488***	B, M
Thailand	0,039***	-1,830*	0,697***	B, M
Joint test (Tstat)	54,252***	51,427***	62,476***	B, M
GDP-PRIV-TURN	α_1	$-\beta_2$	$-\beta_3$	Conclusion
Malaysia	-0,010	-1,995***	2,263***	NC
Mexico	-0,116***	1,093	0,604***	M
Nigeria	-0,295	7,428	-4,160	NC
Philippines	-0,092	0,909	-0,022	NC
Thailand	0,002**	7,392	-16,247***	M
Joint test (Tstat)	17,856***	7,294	28,508***	M
GDP-PRIV-VALTRAD	α_1	$-\beta_2$	$-\beta_3$	Conclusion
Malaysia	0,010	-3,421***	1,301***	NC
Mexico	-0,079***	5,829	-6,511	NC
Nigeria	-0,363	3,698***	-18,709***	NC
Philippines	-0,022	5,250***	-2,335	NC
Thailand	-0,001	-0,287	-1,648	NC
Joint test (Tstat)	19,893***	29,983***	1,408	B

Note: ***,** and * respectively denote significance at the 1%, 5% and 10 % level. B, M and NC respectively mean causality from banking development to economic growth, causality from financial markets to economic growth and no evidence of causality from finance to growth.

4.4 Does economic growth cause financial development?

While we have found some evidence of long run causality from finance to growth in the previous section, we can test the reverse causality: from economic growth to financial development. For instance, evidence of bi-directionality between finance and growth is provided in Luintel and Khan (1999), Calderon and Liu (2003) or Demetriades and Hussein (1996). As a consequence, we apply the same methodology as in the previous section to long run causality from economic growth to in turn banking system and financial market development. The results are reported in Tables 7 and 8. Starting with long run causality from economic growth to banking system development, our methodology does not support the demand-following hypothesis. Indeed, none of the joint tests but one rejects the null hypothesis of absence of causality. Individual country statistics do not provide more support to the hypothesis of a long run relation going from economic growth to banks since the absence of causality is rejected in only 5 (out of the 25) specifications. Turning to the results of causality tests from economic growth to financial markets, we reach the same conclusion of no strong evidence of causality from economic growth to finance in the long run. Once again, the joint tests reject the absence of causality only in one specification while individual tests rarely conclude to causality from economic growth to stock markets development. As a result, our tests support neither the bi-directional hypothesis under which finance would cause economic growth and vice-versa nor the demand-following hypothesis under which financial markets would simply respond to the need of the developing real economy for institutions able to efficiently allocate capital. Our results are in line with Xu (2000), Christopoulos and Tsionas (2004) (who also focus on developing countries) and Apergis et al. (2007) who support the supply-leading hypothesis using indicators of the banking sector only while Demetriades and Hussein (1996), Luintel and Khan (1999) and Calderon and Liu (2003) support the bi-directional hypothesis. Regarding the studies which consider both stock market and banking development, our results are consistent with those of Rousseau and Wachtel (2000), Arestis et al. (2001), Caporale et al. (2004) and Beck and Levine (2004).

4.5 Robustness check: testing the absence of long run causality between finance and growth

As an additional robustness check, we test the null hypothesis of the absence of long run causality from finance (banks and stock markets) to growth and from economic development to finance. Rejecting the absence of causality in both direction would reinforce our conclusions based on unidirectional causality tests. Indeed, if the absence of causality in both direction is rejected, this implies that there must exist at least one direction of causality which is significant. In this case, results from unidirectional tests support the causality going from finance to growth. This test corresponds to jointly testing $\alpha_{1,i} = 0$ and $\beta_{1,i} = 0$. Results of this test can be found in Table 9. The existence of long run causality between economic development and finance is confirmed in most of the specifications. Based on these results, we can conclude that there must exist long run causality between finance and growth in at least one direction. Since unidirectional tests tend to favor the causality going from finance to growth, the results that we have obtained in this section somewhat strengthen our initial conclusions.

5 Conclusions and policy implications

While the debate on the role of financial development on the process of economic growth is far from being new, it has been receiving a renewed interest for several decades. Indeed, knowing whether financial development can promote long run economic growth is of prime importance in terms of development policy in developing country. If there exists a positive linkage

Table 7: Long run causality test: Growth → Banks

GDP-LL-MKTCAP	α_2	$-\beta_1$	Conclusion
Malaysia	-0.564**	-0.172	NC
Mexico	-0.457***	-0.125	NC
Nigeria	-0,351	0.0140	NC
Philippines	-0.084***	0.463	NC
Thailand	-0.097**	-0.922	NC
Joint test (Tstat)	19.958***	0.066	NC
GDP-LL-TURN	α_2	$-\beta_1$	Conclusion
Malaysia	-0.325***	-0.269***	C
Mexico	-0.229	-0.178	NC
Nigeria	0.064	0.608***	NC
Philippines	0.003	-40.260	NC
Thailand	-0.070*	-0.384***	C
Joint test (Tstat)	22.519***	4.720	NC
GDP-PRIV-MKTCAP	α_2	$-\beta_1$	Conclusion
Malaysia	-0.270***	-0.400**	C
Mexico	-0.538***	0.561**	C
Nigeria	-0.517	0.166***	NC
Philippines	-0.268***	0.642	NC
Thailand	-0.317***	-0.546	NC
Joint test (Tstat)	22.755***	11.317**	C
GDP-PRIV-TURN	α_2	$-\beta_1$	Conclusion
Malaysia	-0.111	-0.501**	NC
Mexico	-0.031**	0.915	NC
Nigeria	0.082	0.135	NC
Philippines	-0.157***	1.100***	C
Thailand	-0.000	0.135	NC
Joint test (Tstat)	2.261	15.328***	NC
GDP-PRIV-VALTRAD	α_2	$-\beta_1$	Conclusion
Malaysia	-0.140	-0.292	NC
Mexico	-0.519	0.172	NC
Nigeria	-0.097	0.270	NC
Philippines	-0.336	0.190	NC
Thailand	-0.088	-3.483	NC
Joint test (Tstat)	10.828*	0.106	NC

Note: ***,** and * respectively denote significance at the 1%, 5% and 10 % level. C and NC respectively mean causality from economic growth to bank development and absence of evidence of causality. Betas are based on normalization on the tested dependent variable.

Table 8: Long run causality test: Growth → Stock Markets

GDP-LL-MKTCAP	α_3	$-\beta_1$	Conclusion
Malaysia	0.063	1.431	NC
Mexico	0.025	3.809	NC
Nigeria	0.116	0.023	NC
Philippines	0.059	-0.576	NC
Thailand	-0.652	-1.572	NC
Joint test (Tstat)	0.771	0.066	NC
GDP-LL-TURN	α_3	$-\beta_1$	Conclusion
Malaysia	-0.028	1.336***	NC
Mexico	-0.214	2.458	NC
Nigeria	0.083	-0.364***	NC
Philippines	0.013	3.552	NC
Thailand	-0.440	1.356***	NC
Joint test (Tstat)	0.055	4.720	NC
GDP-PRIV-MKTCAP	α_3	$-\beta_1$	Conclusion
Malaysia	-0.044***	1.619**	C
Mexico	0.141***	-0.979**	C
Nigeria	0.012**	3.909***	C
Philippines	0.063***	-2.048	NC
Thailand	0.018	1.434	NC
Joint test (Tstat)	4.056	11.317**	NC
GDP-PRIV-TURN	α_3	$-\beta_1$	Conclusion
Malaysia	-1.353***	0.442**	C
Mexico	-0.980***	1.656	NC
Nigeria	-0.021	-0.240	NC
Philippines	-0.000	-45.285***	NC
Thailand	-0.714***	-0.062	NC
Joint test (Tstat)	54.622***	15.328***	C
GDP-PRIV-VALTRAD	α_3	$-\beta_1$	Conclusion
Malaysia	-0.805***	0.769	NC
Mexico	-0.170	-0.154	NC
Nigeria	0.708**	-0.053	NC
Philippines	-0.016	-0.428	NC
Thailand	-0.890	-0.607	NC
Joint test (Tstat)	21.171***	0.106	NC

Note: ***,** and * respectively denote significance at the 1%, 5% and 10 % level. C and NC respectively mean causality from economic growth to stock markets and absence of evidence of causality. Betas are based on normalization on the tested dependent variable.

Table 9: Long run causality test: Growth $\leftrightarrow$ Finance

	Malaysia	Mexico	Nigeria	Philippines	Thailand
GDP-LL-MKTCAP	C**	NC	C**	C***	NC
GDP-LL-TURN	C***	NC	C***	NC	C*
GDP-PRIV-MKTCAP	C***	C***	C***	C***	NC
GDP-PRIV-TURN	C**	C**	NC	C***	C*
GDP-PRIV-VALTRAD	NC	C*	NC	NC	NC

Note: ***,** and * respectively denote significance at the 1%, 5% and 10 % level. C and NC respectively mean rejection of the absence of long run causality between finance and growth and absence of evidence in favor of any causality between finance and growth.

going from finance to economic growth, then developing countries should encourage the development of such institutions. A large body of theoretical literature has been developing since the early 1980's in which the role of financial intermediaries as efficient providers of capital and risk diversifiers to support economic development has been stressed. This supply-leading hypothesis is challenged by the reverse point of view under which financial institutions grow in response to the demand of the real economy. In this case, financial development is a result of economic growth and may not be a requirement for it. In addition, the recent crisis which has affected the financial system and the real economy also accentuates the need to determine whether financial development and innovation promote real growth in the long run while the crisis has shown that misusing instruments intended to better diversify risk could lead to (short run?) destabilization of the real economy.

Given the importance of the question, many empirical works have tried to determine which of both alternatives is the most relevant. Starting with cross-sectional and panel based analyses, the empirical literature has progressively evolved to time series techniques. While early findings tended to support the supply-leading hypothesis, more recent studies give a less clear-cut answer regarding the direction of the causality (in some cases, the relation is found to be bi-directional). Recent studies increasingly focus on time series techniques such as cointegration and causality tests. However, these techniques have been proven to be affected by power and size distortion in small samples. A potential answer to the biased results from time series analysis is to use dynamic panels. While these techniques have already been used in the current literature, our paper is the first (to the best of our knowledge) to use Johansen-like cointegration analysis in a panel context allowing for potential cross-dependence across countries (which seems quite realistic in macroeconomic panels). In addition, we also extend the analysis to the potentially different impact of two different segments of financial system i.e. banks and financial markets, which has never been studied in a panel-based cointegration context.

Our results indicate that there exists a single long run (cointegration) relationship between indicators of both financial development and economic growth. Focusing on the cointegrating vector with economic growth as the explained variable, we find that the long run equilibrium integrates in most cases at least one indicator of financial development with a positive impact on long run economic growth. Nevertheless, the positive impact is rarely coming from both segments of financial development. This is evidence in favor of a positive long run effect of financial development on economic growth but it does not support the idea according to which banks and financial markets do not fulfill the same role with respect to economic development. We also test long run causality. Joint tests support the hypothesis of a long run causality from financial development (once again we do not find strong evidence in favor of banks rather than stock markets, stock markets rather than banks nor the combination of banks and stock markets). While country-by-country tests show less clear-cut results, they nevertheless tend to support the causal link going from financial development to economic growth. As a test of potential bi-directionality, we perform the same causality analysis from economic growth to financial development. These tests conclude to the absence of causality from growth to finance.

From our analysis, it then appears that, if a long run causality exists between financial development and economic growth, it should go from the former to the latter. In addition, the structure of the financial system (bank or market-oriented) does not seem to make a strong difference while banks and markets are not shown to provide different services as far as economic growth is concerned. From the analysis of our data set of developing countries, it seems that promoting the development of the financial system may support long run economic growth. In terms of policy implication our results suggest that developing countries could promote their long-run economic growth by supporting the development of their financial sectors, be they banks or stock markets.

References

Aghion, P. and Howitt, P. (1992). A model of growth through creative destruction. *Econometrica*, 60(2):323–351.

Apergis, N., Filippidis, I., and Economidou, C. (2007). Financial deepening and economic growth linkages: A panel data analysis. *Review of World Economics (Weltwirtschaftliches Archiv)*, 143(1):179–198.

Arellano, M. and Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2):277–297.

Arellano, M. and Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1):29 – 51.

Arestis, P. and Demetriades, P. (1997). Financial development and economic growth: Assessing the evidence. *The Economic Journal*, 107(442):783–799.

Arestis, P., Demetriades, P. O., and Luintel, K. B. (2001). Financial development and economic growth: The role of stock markets. *Journal of Money, Credit and Banking*, 33(1):16–41.

Atje, R. and Jovanovic, B. (1993). Stock markets and development. *European Economic Review*, 37(2-3):632–640.

Barro, R. J. (1991). Economic growth in a cross section of countries. *The Quarterly Journal of Economics*, 106(2):407–443.

Beck, T., Demirguc-Kunt, A., and Levine, R. (2009). A new database on financial development and structure. World Bank Policy Research Working Papers 4943.

Beck, T. and Levine, R. (2004). Stock markets, banks, and growth: Panel evidence. *Journal of Banking and Finance*, 28(3):423 – 442.

Beck, T., Levine, R., and Loayza, N. (2000). Finance and the sources of growth. *Journal of Financial Economics*, 58(1-2):261–300.

Bencivenga, V. R. and Smith, B. D. (1991). Financial intermediation and endogenous growth. *The Review of Economic Studies*, 58(2):195–209.

Benhabib, J. and Spiegel, M. M. (2000). The role of financial development in growth and investment. *Journal of Economic Growth*, 5(4):341–60.

Berthelemy, J. C. and Varoudakis, A. (1996). Economic growth, convergence clubs, and the role of financial development. *Oxford Economic Papers*, 48(2):300–328.

Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1):115 – 143.

Calderon, C. and Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of Development Economics*, 72(1):321–334.

Caporale, G., Howells, P., and Soliman, A. (2004). Stock market development and economic growth: the causal linkage. *Journal of Economic Development*, 29(1):33–50.

Christopoulos, D. K. and Tsionas, E. G. (2004). Financial development and economic growth: evidence from panel unit root and cointegration tests. *Journal of Development Economics*, 73(1):55 – 74.

Dawson, P. J. (2003). Financial development and growth in economies in transition. *Applied Economics Letters*, 10(13):833–836.

Deidda, L. and Fattouh, B. (2002). Non-linearity between finance and growth. *Economics Letters*, 74(3):339 – 345.

Demetriades, P. O. and Hussein, K. A. (1996). Does financial development cause economic growth? time-series evidence from 16 countries. *Journal of Development Economics*, 51(2):387 – 411.

Devereux, M. B. and Smith, G. W. (1994). International risk sharing and economic growth. *International Economic Review*, 35(3):535–550.

Diamond, D. W. and Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *The Journal of Political Economy*, 91(3):401–419.

Gengenbach, C., Palm, F., and Urbain, J.-P. (2010). Panel unit root tests in the presence of cross-sectional dependencies: Comparison and implications for modelling. *Econometric Reviews*, 29(2):111–145.

Geweke, J. (1982). Measurement of linear dependence and feedback between multiple time series. *Journal of the American Statistical Association*, 77(378):304–313.

Goldsmith, R. (1969). *Financial Structure and Development*. Yale University Press, New Haven, CT.

Greenwood, J. and Jovanovic, B. (1990). Financial development, growth, and the distribution of income. *The Journal of Political Economy*, 98(5):1076–1107.

Greenwood, J. and Smith, B. D. (1997). Financial markets in development, and the development of financial markets. *Journal of Economic Dynamics and Control*, 21(1):145 – 181.

Gregorio, J. D. and Guidotti, P. E. (1995). Financial development and economic growth. *World Development*, 23(3):433 – 448.

Groen, J. J. J. and Kleibergen, F. (2003). Likelihood-based cointegration analysis in panels of vector error-correction models. *Journal of Business & Economic Statistics*, 21(2):295–318.

Harris, R. D. F. (1997). Stock markets and development: A re-assessment. *European Economic Review*, 41(1):139 – 146.

Im, K. S., Pesaran, M. H., and Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1):53 – 74.

Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models*. Oxford University Press.

King, R. G. and Levine, R. (1993a). Finance and growth: Schumpeter might be right. *The Quarterly Journal of Economics*, 108(3):717–737.

King, R. G. and Levine, R. (1993b). Finance, entrepreneurship and growth. *Journal of Monetary Economics*, 32(3):513 – 542.

La Porta, R., Lopez-De-Silanes, F., Shleifer, A., and Vishny, R. W. (1997). Legal determinants of external finance. *The Journal of Finance*, 52(3):1131–1150.

La Porta, R., Lopez-de Silanes, F., Shleifer, A., and Vishny, R. W. (1998). Law and finance. *The Journal of Political Economy*, 106(6):1113–1155.

Levine, R. (1991). Stock markets, growth, and tax policy. *The Journal of Finance*, 46(4):1445–1465.

Levine, R. (1997). Financial development and economic growth: Views and agenda. *Journal of Economic Literature*, 35(2):688–726.

Levine, R. (1998). The legal environment, banks, and long-run economic growth. *Journal of Money, Credit and Banking*, 30(3):596–613.

Levine, R. (1999). Law, finance, and economic growth. *Journal of Financial Intermediation*, 8(1-2):8 – 35.

Levine, R., Loayza, N. V., and Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics*, 46(1):31–77.

Levine, R. and Zervos, S. (1998). Stock markets, banks, and economic growth. *The American Economic Review*, 88(3):537–558.

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1):3 – 42.

Luintel, K. B. and Khan, M. (1999). A quantitative reassessment of the finance-growth nexus: evidence from a multivariate var. *Journal of Development Economics*, 60(2):381–405.

Mankiw, N. G., Romer, D., and Weil, D. N. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics*, 107(2):407–437.

McCaig, B. and Stengos, T. (2005). Financial intermediation and growth: Some robustness results. *Economics Letters*, 88(3):306 – 312.

McKinnon, R. (1973). *Money and Capital in Economic Development*. Brooking Institutions, Washington, DC.

Mosconi, R. and Giannini, C. (1992). Non-causality in cointegrated systems: Representation estimation and testing. *Oxford Bulletin of Economics and Statistics*, 54(3):399–417.

Neusser, K. and Kugler, M. (1998). Manufacturing growth and financial development: Evidence from oecd countries. *The Review of Economics and Statistics*, 80(4):638–646.

Pagano, M. (1993). Financial markets and growth: An overview. *European Economic Review*, 37(2-3):613–622.

Patrick, H. (1966). Financial development and economic growth in underdeveloped countries. *Economic Development and Cultural Change*, 14(2):174–189.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2):265–312.

Rebelo, S. (1991). Long-run policy analysis and long-run growth. *The Journal of Political Economy*, 99(3):500–521.

Rioja, F. and Valev, N. (2004a). Does one size fit all?: a reexamination of the finance and growth relationship. *Journal of Development Economics*, 74(2):429 – 447.

Rioja, F. and Valev, N. (2004b). Finance and the sources of growth at various stages of economic development. *Economic Inquiry*, 42(1):127–140.

Robinson, J. (1952). The generalization of the general theory. In Fomby, T. and Hill, R., editors, *The Rate of Interest and Other Essays*, pages 67–142. London, MacMillan.

Romer, P. M. (1986). Increasing returns and long-run growth. *The Journal of Political Economy*, 94(5):1002–1037.

Romer, P. M. (1990). Endogenous technological change. *The Journal of Political Economy*, 98(5):S71–S102.

Rousseau, P. L. and Wachtel, P. (1998). Financial intermediation and economic performance: Historical evidence from five industrialized countries. *Journal of Money, Credit and Banking*, 30(4):657–678.

Rousseau, P. L. and Wachtel, P. (2000). Equity markets and growth: Cross-country evidence on timing and outcomes, 1980-1995. *Journal of Banking and Finance*, 24(12):1933 – 1957.

Saint-Paul, G. (1992). Technological choice, financial markets and economic development. *European Economic Review*, 36(4):763 – 781.

Schumpeter, J. (1912). *Theorie Der Wirtschaftlichen Entwicklung [The Theory of Economic Development]*. Translated by R. Opie, Harvard University Press, 1934.

Sims, C. A., Stock, J. H., and Watson, M. W. (1990). Inference in linear time series models with some unit roots. *Econometrica*, 58(1):113–144.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1):65–94.

Toda, H. and Phillips, P. (1993). Vector autoregressions and causality. *Econometrica*, 61(6):1367–1393.

Toda, H. and Phillips, P. (1994). Vector autoregression and causality: a theoretical overview and simulation study. *Econometric Reviews*, 13(2):259–285.

Xu, Z. (2000). Financial development, investment, and economic growth. *Economic Inquiry*, 38(2):331–44.