Financial Development and Growth: A Re-Examination using a Panel Granger Causality Test

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Abstract

In this paper we investigate the causal relationship between financial development and economic growth. We use an innovative econometric method which is based on a panel test of the Granger non causality hypothesis. We implement various tests with a sample of 63 industrial and developing countries over the 1960-1995 and 1960-2000 periods. We use three standard indicators of financial development. The results provide support for a robust causality relationship from economic growth to the financial development. On the contrary, the non causality hypothesis from financial development indicators to economic growth can not be rejected in most of the cases. However, these results only imply that, if such a relationship exists, it can not be easily identified in a simply bi-variate Granger causality test.

Keywords: Granger Causality Tests; Panel Data; Financial Development; Economic Growth .

JEL classification: C23; C11; O16; G18; G28

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1 Introduction

Following McKinnon (1973) and Shaw (1973), a very large literature tries to assess the nature of the relationship between financial development and economic growth. But, it seems that "economists hold different views on the existence and direction of causality" in this context (Al-Yousif, 2002). As it was mentioned by Patrick (1966), the both directions of causality between the two variables can be considered as potentially valid. On the one hand, financial deepening may promote economic growth. This approach, called the *supply-leading* hypothesis, assumes that the optimal allocation of resources results from the financial system development. On the other hand, growth can also promote the development of the domestic financial system. This is the *demand-following* approach. It assumes that economic growth leads to an increasing demand for financial services which promotes financial development: in that case, financial system is supposed to respond *passively* to economic growth. Besides, a third approach can be considered in which the two variables are mutually causal. Naturally, the direction of causality is crucial for the choice of the development strategy: "one could argue that, only in the case of supply-leading, policies should aim to financial sector liberalization; whereas in the case of demand-following, more emphasis should be placed on other growth-enhancing policies" (Calderon and Liu, 2003, p. 331).

In the same time, empirical studies have generally failed to clearly identify the direction of causality between financial development and economic growth. For instance, Roubini and Sala-i-Martin (1995) as well as King and Levine (1993a,b), De Gregorio and Guidotti (1995), Levine et al. (2000) or Calderon and Liu (2003) support the *supply-leading* hypothesis whereas Jung (1986) supports the second way of causality and Demetriades and Hussein (1996) or Greenwood and Smith (1997) find a bidirectional causality. Following Al-Yousif (2002), one can consider that the empirical literature on that question is still "mixed and inconclusive" and that the causal relationship between financial development and economic growth remains unclear. That is why we propose a re-examination of this issue using an original panel data approach.

Our methodology is based on the panel non causality test developed by Hurlin (2005, 2007). It consists in a simple test of the Granger (1969) non causality hypothesis in a heterogeneous panel model. The use of a panel data methodology in this context can be justified by the same arguments as those used in the contemporary panel unit root tests literature. The first one is the power deficiencies of the pure time series-based tests of non causality in short sample. The second is the possibility to consider an heterogeneous model to test the non causality hypothesis. As it is the case for the panel unit root tests, the model used in this paper is specific to each country of the sample: the only common feature of the sample is assumed to be the null hypothesis of non causality. So, it is possible to test the relationship between economic growth and financial development without considering the same dynamic model for all the countries of the sample. It allows taking into account the heterogeneity of this relationship not only between developed and developing countries for instance, but also between the developing countries themselves.

Indeed, one of the main issues of a panel Granger causality test is the heterogeneity of the model and of the causality relationship. Let us assume for instance that we test the non causality from financial development (representend by a variable x), to growth (represented by a variable y). For each country, we say that financial development measure (x) is causing growth (y) if we are better able to predict growth using all available information than if the information apart from x had been used (Granger, 1969). But, when growth and financial development are observed on N countries, the issue consists in determining the optimal information set used to forecast y. Several solutions could be adopted. The most general is to test the causality from the variable x (financial development) observed on the i^{th} country to the variable y (growth) observed for the j^{th} country, with $j = i$ or $j \neq i$. It implies that we can identify a causality relationship when the past values of the financial development indicator for France give an information about the future values of growth for Japan. In this paper, we use a more restrictive solution derived from the time series analysis. We say that there is causality from financial development to growth if and only if, the past values of the variable x observed on the i^{th} country improve the forecasts of growth for this country i only. The cross sectional information is then only used to improve the specification of the model and the power of tests as in unit root test literature. In this contexte, we propose to distinguish between the heterogeneity of the model and the heterogeneity of the causal relationships from x to y. Indeed, the model may be different from an country to another, whereas there exists a causal relationship from x to y for all countries. On the contrary, it may be exist a causality relationships only for a sub-group of countries.

The structure of our test is similar to those used in the literature devoted to the panel unit tests. Under the null hypothesis, we assume that there is no causal relationship from x to y for all the countries of the panel. We call this hypothesis the Homogeneous Non Causality (HNC) hypothesis. Under the alternative hypothesis, there exists a causal relationships from x to y for at least one country of the sample.

The approach used is then similar to that used by Im, Pesaran and Shin (2003) to test the unit root hypothesis. Our statistic of test is simply defined as the cross-sectional average of individual Wald statistics defined to test the Granger non Causality hypothesis for each country. under the assumption that the innovations of the model are cross-sectionally independent, Hurlin (2007) show that the average statistic sequentially converges to a normal distribution (under the HNC hypothesis) when T tends to infinity first and N then tends to infinity. Two standardized statistics are then proposed: the first is based on the exact moments of the asymptotic moments of the individual Wald statistics, the second one is based on approximated moments for finite T samples. This last statistic is particularly suitable for the samples of developing countries, as in our case.

We use a sample of 63 industrial and developing countries over the periods 1960-1995 and 1960-2000. In order to assess the sensitivity of our results to the measure of financial development, we consider three indicators as in the seminal paper of Levine et al. (2000). There are two major findings in the paper. First, the homogenous non causality hypothesis from economic growth to financial development is strongly rejected.

This result is robust to (*i*) the lag-order considered in the autoregressive model, (*ii*) to the period studied and (*iii*) to the indicator of financial development used. Similar results are obtained when the panel is split into two groups: 28 developed countries and 35 developing countries. It suggests that this first causal relationship (*demand-following* hypothesis) can be robustly identified through a simple bi-variate Granger causality test. On the contrary, the *supply-side* hypothesis is more difficult to identify with such an approach, even for developed countries. We reject the homogenous non causality hypothesis for the total panel (63 countries) only for some lag-orders, but these results are not robust to the choice of the proxi used to measure the financial development. Besides, when only developing countries are considered the homogenous non causality hypothesis is generally not rejected. These conclusions do not imply that the financial development has no effect on the economic growth. It only indicates that if such a relationship exists it can not be identified in a simple bi-variate causality approach.

The rest of the paper is organized as follows. Section 2 briefly presents the methodology of the panel test of the Granger non causality hypothesis. Data and measure of financial development are presented in section 3. Section 4 presents the results. Then we conclude in section 5.

2 A panel test of the Granger Non Causality Hypothesis

Here, we briefly present the panel test of the Granger non causality hypothesis developed by Hurlin (2005). Let us consider two covariance stationary variables, denoted x

and y, observed on T periods and on N countries. For each country $i = 1, .., N$, at time $t = 1, .., T$, we consider the following heterogeneous autoregressive model:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \tag{1}$$

with $\beta_i = \left(\beta_i^{(1)}, ..., \beta_i^{(K)}\right)'$. Individual effects α_i are assumed to be fixed. We assume that the lag-order K is common, but we will propose a sensitivity analysis on this parameter. We prefer this approach rather than using some criteria information for each individual equation with a small sample T. The autoregressive parameters $\gamma_i^{(k)}$ and the regression coefficients slopes $\beta_i^{(k)}$ differ across countries. However, contrary to Weinhold (1996) or Nair-Reichert and Weinhold (2001), parameters $\gamma_i^{(k)}$ and $\beta_i^{(k)}$ are constant. It is important to note that our model is not a random coefficient model as in Swamy (1970): it is a fixed coefficients model with fixed individual effects. For each country $i = 1, .., N$, the innovations $\varepsilon_{i,t}$, $\forall t = 1, .., T$ are $i.i.d.$ $\left(0, \sigma_{\varepsilon,i}^2\right)$ and are independently distributed across groups. As we will see later, this cross-sectional independence assumption is crucial for the asymptotics of our test.

In this heterogeneous panel model, we propose to test the Homogenous Non Causality (HNC) hypothesis as follows:

$$H_0 : \beta_i = 0 \quad \forall i = 1, ..N \tag{2}$$

with $\beta_i = \left(\beta_i^{(1)}, ..., \beta_i^{(K)}\right)'$. Under the alternative hypothesis, there is a causality relationship from x to y for at least one cross-section unit. We also allow for some, but not all, of the individual vectors to be equal to 0. We assume that there are $N_1 < N$

individual processes with no causality from x to y.

$$H_1: \qquad \beta_i = 0 \quad \forall i = 1, .., N_1 \tag{3}$$

$$\beta_i \neq 0 \quad \forall i = N_1 + 1, N_1 + 2, .., N$$

where N_1 is unknown but satisfies the condition $0 \leq N_1/N < 1$. The structure of the test is similar to the unit root test in heterogeneous panels proposed by Im, Pesaran and Shin (2003). In our context, if the null is accepted the variable x does not Granger cause the variable y for all the countries of the panel. On the contrary, let us assume that the HNC is rejected and if $N_1 = 0$, we have seen that x Granger causes y for all the countries of the panel: in this case we get an homogenous result as far as causality is concerned. The model may be not homogenous, but the causality relations are observed for all countries. On the contrary, if $N_1 > 0$, then the causality relationships is heterogeneous: the model and the causality relationships are different according the countries of the sample.

The test statistic is simply defined as the average of individual Wald statistics associated to the test of the non causality hypothesis for the countries $i = 1, .., N$. Let $W_{N,T}^{Hnc}$ be this average statistic.

$$W_{N,T}^{Hnc} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \tag{4}$$

where $W_{i,T}$ denotes the individual Wald statistics for the i^{th} country associated to the individual test $H_0 : \beta_i = 0$. Under the null hypothesis of non causality, each individual Wald statistic converges to a chi-squared distribution with K degrees of freedom. Besides, under the assumption of cross sectional independence, these N statistics are independent. So, the cross section average $W_{N,T}^{Hnc}$ converges toward a normal distribution when T tends to infinity and then N tends to infinity (see Hurlin 2007 for more details). Let $Z_{N,T}^{Hnc}$ be the corresponding standardized statistic.

$$Z_{N,T}^{Hnc} = \sqrt{\frac{N}{2K}} \left(W_{N,T}^{Hnc} - K \right) \underset{T,N \rightarrow \infty}{\overset{d}{\longrightarrow}} N\left(0,1\right) \tag{5}$$

where $T, N \rightarrow \infty$ denotes the fact that $T \rightarrow \infty$ first and then $N \rightarrow \infty$. For a large N and T sample, if the realization of the standardized statistic $Z_{N,T}^{Hnc}$ is superior in absolute mean to the normal corresponding critical value for a given level of risk, the homogeneous non causality (HNC) hypothesis is rejected.

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Asymptotically, individual Wald statistics $W_{i,T}$ for each $i = 1, .., N$, converge toward an identical chi-squared distribution. However, this convergence result can not be achieved for any time dimension T, even if we assume the normality of residuals. In this case, we propose to approximate the two first moments of the unknown distribution of individual Wald statistics by the corresponding moments of a Fisher distribution. Given the restrictions of our model, this distribution is a $F\left(K, T - 2K - 1\right)$. Indeed it is well known that in a dynamic model the F distribution can be used as an approximation of the true distribution of the statistic $W_{i,T}/K$ for a small T sample. Given these approximations, we propose to compute an approximated standardized statistic $\widetilde{Z}_{N,T}^{Hnc}$ for the average Wald average statistic $W_{N,T}^{Hnc}$ of the HNC hypothesis.

$$\widetilde{Z}_{N,T}^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} E\left(W_{i,T}\right)\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var\left(W_{i,T}\right)}} \tag{6}$$

where for an unbalanced panel :

$$\frac{1}{N}\sum_{i=1}^{N}E\left(W_{i,T}\right)\simeq K\times\sum_{i=1}^{N}\frac{\left(T_i-2K-1\right)}{\left(T_i-2K-3\right)} \tag{7}$$

$$\frac{1}{N}\sum_{i=1}^{N}Var\left(W_{i,T}\right)\simeq 2K\times\sum_{i=1}^{N}\frac{\left(T_i-2K-1\right)^2\times\left(T_i-K-3\right)}{\left(T_i-2K-3\right)^2\times\left(T_i-2K-5\right)} \tag{8}$$

For a large N sample, under the HNC hypothesis, we assume that the statistic $\widetilde{Z}_{N,T}^{Hnc}$ follows approximately the same distribution as the standardized average Wald statistic $Z_{N,T}^{Hnc}$.

$$\widetilde{Z}_{N,T}^{Hnc}\underset{N\rightarrow\infty}{\overset{d}{\longrightarrow}}N\left(0,1\right) \tag{9}$$

The test of the HNC hypothesis is built as follows. For each individual of the panel, we compute the standard Wald statistics $W_{i,T}$ associated to the individual hypothesis $H_{0,i}:\beta_i=0$ with $\beta_i\in\mathbb{R}^K$ Given these N realizations, we get a realization of the average Wald statistic $W_{N,T}^{Hnc}$. Given the formula (9) we compute the realization of the approximated standardized statistic $\widetilde{Z}_{N,T}^{Hnc}$ for the T and K values. For a large N sample, if the value of $\widetilde{Z}_{N,T}^{Hnc}$ is superior in absolute mean to the normal corresponding critical value for a given level of risk, the homogeneous non causality (HNC) hypothesis is rejected.

What is the main advantage of this Granger non causality panel test? For instance, let us assume that there is no causality from x to y for all the N countries. Given the Wald statistics properties in small sample, the analysis based on N individual tests is likely to be inconclusive. With a small T sample, some of the realizations of the individual Wald statistics are likely to be superior to the asymptotic critical values of the chi-square distribution. These "large" values of individual statistics lead to wrongly reject the null hypothesis of non causality for at least some countries. The conclusions are then no clear cut. On the contrary, in our panel average statistic, these "large" values of individual Wald statistics are crushed by the others which converge in probability to zero. When N tends to infinity, the cross-sectional average is likely to converge to zero. The null hypothesis of homogeneous non causality hypothesis will not be rejected. In this sense, our testing procedure may be more restrictive and may result in more clear-cut conclusions as compared to those obtained with pure time series tests.

3 Data and measures of financial development

We consider three unbalanced panels: the first one includes 63 industrial and developing countries, the second one corresponds to 35 developing countries and the last includes 28 developed countries. The countries considered in this study are globally the same as those considered in Levine et al. (2000) or Calderon and Liu (2003), given the data availability (see appendix A). We consider two periods: the first one (1960-1995) is the same as Levine et al. (2000) and the second one (1960-2000) includes the end of 90s. Given the data availability, all these panel are unbalanced, but this is not a problem in our heterogeneous approach. Finally, for each panel we use three different measures of financial development which were elaborated by Levine et al. (2000).

- **BANCRED**: Private credit by deposit money banks to GDP calculated using the following deflation method:

$$\{(0.5) * [F_t/P_t^e + F_{t-1}/P_{t-1}^e]\}/[GDP_t/P_t^a] \quad (10)$$

where F denotes credit by deposit money banks to the private sector (line 22d), GDP denotes gross domestic product (line 99b), P^e is end-of period consumer price index (line 64) and P^a is the average consumer price index for the year. This first measure isolates credits issued to the private sector as opposed to credits issued to the public sector.

- **PRIVCRED:** This indicator is calculated according the formula (equation 10), where F denotes the credit by deposit money banks and other financial institutions to the private sector (lines 22d + 42d). PRIVCRED is the preferred Levine et al. (2000) financial development indicator .

- **LIQLIAB**: Liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries) to GDP, calculated using the same deflation method (equation 10) where F denotes liquid liabilities (line 55l).

These three indicators address the stock-flow problem of financial intermediary balance sheets items being measured at the end of the year, whereas nominal GDP is measured over the year[1] . The economic growth indicator is the real GDP per capita (PIBR) (growth and log levels). It is taken from the Penn World Tables 6.1. All the series are expressed in log-differences. To check the stationarity of the variables used in this model, we use the two main panel unit root tests based on heterogeneous models and on the cross-sectional independence assumption: Im, Pesaran and Shin (2003) and Maddala and Wu (1999). The results of these tests are reported on table 1 for a model with fixed individual effects. All these tests conclude to the rejection of the non stationarity hypothesis.

[1] See Levine and al. (2000), note 6, p. 37 for a more fully justification of this methodology.

Insert table 1

4 Results

For all the samples considered, we test the causality from financial development to growth and the reverse causality relationship. In each case, we compute three statistics: the average Wald statistic $W_{N,T}^{HNC}$, the standardized statistic $Z_{N,T}^{HNC}$ based on the asymptotic moments and the standardized statistic $\widetilde{Z}_{N,T}^{HNC}$ based on the approximation of finite sample moments. In order to assess the sensitivity of our results to the choice of the common lag-order, we compute all these statistics for one, two and three lags.

The results for the complete sample of 63 developed and developing countries are reported in tables 2 and 3. When the inference is based on the asymptotic standardized statistic $Z_{N,T}^{HNC}$, the homogenous non causality (HNC) from financial development to economic growth is generally rejected at a 5% significant level, whatever the variable used. The only exception is for the PRIVCRED indicator in a model with three lags. However, these results are not robust to the use of the second standardized statistic based on the approximation of the moments in a finite T sample. When the inference is based on $\widetilde{Z}_{N,T}^{HNC}$, the HNC hypothesis from PRIVCRED to PIBR is not rejected for all lags. The results are ambiguous for the two other indicators. Such results clearly indicate that the use of the asymptotic Wald distribution in pure time series Granger causality tests may lead to a fallacious inference in panel with a relatively short time dimension as in our case. These first conclusions must be put in prospect compared to those which one obtains for the causality analysis from economic growth to financial development. In this case (table 3), the HNC hypothesis is strongly rejected and this conclusion is robust to the choice of the lag-order and the financial indicator. Moreover, the rejection of the null hypothesis is so robust that similar conclusions are obtained with the asymptotic standardized statistic. The past values of the economic growth are then useful when one comes to forecast the development of the domestic financial system, in at least one country of the panel.

Insert tables 2 *and* 3

Our results clearly indicate that in one case (from economic growth to financial development) the non causality hypothesis is strongly and robustly rejected, whereas in the other case (from financial development to economic growth) the same homogeneous non causality hypothesis is not robustly rejected. The value of the average of individual Wald statistics is representative of this opposition: for instance, with the PRIVCRED indicator and $K = 1$, the value of $W_{N,T}^{HNC}$ is slightly superior to 3 when we consider the influence of growth on financial development, whereas the realisation of the same statistic is only equal to 1.39 when the reverse relationship is considered. The same results can be obtained when we extend the period from 1960-1995 to 1960-2000 (see tables 11 and 12, in appendix B).

One important issue is to determine if the lack of robustness of the supply-leading hypothesis is a common characteristic of developed and developing countries. For that, we consider the same tests for a sub-sample of 35 developing countries (tables 4 and 5) and a sub-sample of 28 developed countries (tables 6 and 7).

Insert tables 4 *and* 5

In both cases, the conclusions are similar to those obtained in the complete sample. As far as the developing countries sample are concerned, the conclusions are even clearer. We can observe that the HNC hypothesis from financial development to economic growth is not strongly and robustly rejected when the inference is based on the finite sample properties. Similar conclusions are drawn with LIQLIAB and BANCRED when the asymptotic standardized statistic is used. On the contrary, the causality from economic growth to financial development is largely and robustly accepted, except with the first indicator LIQLIAB. Of course, it seems inappropriate to invoke the demand-following hypothesis in this context. On the contrary, if there is a causal relationship from the real side of the economy to the financial system in developing countries, it is perhaps and paradoxically in respect to Patrick's point of view, a signs of a developing economy. This causal relationship may reveal an endemic "fragility" of the developing countries' financial system. Because of the incomplete diversification of risks (due to incomplete financial markets) or a lack of financial skills of bankers due to a lack of training and/or corruption for example, the financial system's condition depends mainly on the real side of the economy. Then, economic growth might cause financial depth in the short run in less-developed countries. Some recent financial crises, like in Argentina, Brazil or South Korea for example, seem to have been the direct consequence of real factors.

Insert tables 6 *and* 7

The conclusions for the developed countries are more in favour of the supply-side hypothesis, even if the results depend on the indicator used and on the lag structure. With the PRIVCRED indicator, the HNC is not rejected for all lags, whereas the opposite conclusion is founded with LIQLIAB. But, it is important to note that the value of the average Wald statistic for a given indicator is always superior in the developed countries sample than in the developing countries one. So, it seems that the supply-side hypothesis is more likely to be accepted in our panel of developed countries than in the panel of developing countries. The more the countries are developed, the more the financial development is useful in the forecasts of real GDP growth. Finally, as for the two others samples, the causality from economic growth to financial development is founded to be very robust in this sample. This is conform to the *demand-following* hypothesis: this economic growth which generates a demand for financial services and consequently have a positive influence on financial deepening.

To sum it up, the lack of robustness of the causal relationship from financial development to economic growth is conform to the idea that *supply-leading* hypothesis is inaccurate for developed economies. Nevertheless, our results do not validate the Patrick's hypothesis for the developing countries. We find almost the same results when the working period is extended over a 1960-2000 period (see appendix B). This result does not mean that there is no impact of financial development on economic growth. In our opinion, this only shows that the relationship between the two variables is perhaps too complex to be identified in a short run bivariate Granger causality approach. In a moral hazard or adverse selection context, the financing capacity becomes indeed very largely dependant of the quality of financial governance (Stulz, 2000). The latter is strongly determined both by the efficiency of legal framework and by its capacity to guarantee investors' rights: "In the end, the rights create finance" (La Porta et al., 1999). Empirically, La Porta et al. (1997) attempted to assess the contributions of the legal framework type[2], of different variables measuring the quality of legal framework, and of various instrumental variables (e.g. growth of GDP, level of GDP) to external capitalization[3]. They found that even if the kind of legal framework is not always a significant variable, the one called "rule of law" is generally very significant. Identically, Beck et al. (2000) revealed a significant impact of legal framework on growth and financial efficiency[4]. This empirical studies illustrate the fact that both financial development and economic growth might be tied to a third variable: the quality of the institutional framework. That is perhaps why we do not find any *direct* observable Granger causality between the two variables.

There is also a second way to explain this result: the causality from financial development to economic growth could indeed be a long run relationship. In this case, the causal relationship must be identified as in Toda and Philips (1993). However, none generalization in a panel model of the Toda and Phillips approach have been yet proposed. Such a development is in our work program. So, as far as Granger non causality tests, there is trade-off between implementing tests on individual time series with a long-run causality dimension but poor properties due to the short time dimension, and implementing a panel data test with no long-run dimension but better finite

[2] According to them, every legal framework is tied to one of these four historical types: Anglo-Saxon Common Law, French Code Civil, German tradition and Scandinavian tradition.

[3] Measured by the ratio: capitalization controlled by external shareholders / GDP.

[4] Financial efficiency is an index developed by Demirgürc-Kunt & Levine [1999]. It is equal to the logarithm of the ratio: financial transactions / index of banking operations cost.

sample properties. The only point that we can mention here, is the recent work of Christopoulos and Tsionas (2004). Using panel unit root and cointegration tests, they investigate the long run relationship between financial depth[5] and economic growth over the 1970-2000 period for 10 developing countries[6]. One of their conclusions is that "there is fairly a strong evidence in favor of the hypothesis that long run causality runs from financial development to growth. [...] The empirical evidence also points out to the direction that there is no short run causality" (p. 72). Our panel Granger non causality tests confirm the second part of their results.

5 Conclusion

This paper re-examines the causal relationship between financial development and economic growth in 63 industrial and developing countries over the 1960-1995 and 1960-2000 periods. We use a new panel test of the Granger non causality hypothesis. The findings can be summarized as follows. First, the Homogenous Non Causality (HNC) hypothesis from financial development to economic growth is very often accepted at 5% level. We find the same result when the panel is split into two subgroups: developed and developing countries. This suggests that either there is no empirical evidence of a causal influence of financial depth on economic growth in the short run or that the causality from finance to the real side of the economy is too complex relationship to be identified by a bivariate Granger causality test. Then, our results are then conform to some conclusions of previous empirical studies (Christopoulos and Tsionas, 2004, for example). In terms of economic policy recommendations, it implies that financial

[5] In their paper, financial depth is the ratio of total bank deposits liabilities to nominal GDP.

[6] Colombia, Paraguay, Peru, Mexico, Ecuador, Honduras, Kenya, Thailand, Dominican Republic and Jamaica.

liberalization could have only delayed positive effect on economic development, or have an indirect effect on it. That is perhaps why most financial liberalization policies which were implemented in developing countries have been very often unsuccessful in the short run. *Second*, the HNC hypothesis is robustly and strongly rejected when we investigate the causal relationship from economic growth to financial development. This result are conform to Patrick's *demand-following* hypothesis when we focus on developed countries. In that context, economic growth can actively stimulate the demand for financial services. But the reason why this causal relationship exists in developing countries might be quite different. It could be a sign of the fragility of financial environment which prevents the financial system from being isolated of the business cycle.

A Data appendix

All individual financial series can be downloaded at the following internet address:

http://legacy.csom.umn.edu/WWWPages/FACULTY/RLevine/Index.html.

All GDP series can be downloaded at the following internet address:

http://datacentre2.chass.utoronto.ca/pwt/alphacountries.html.

The classification of countries used in the paper is the following.

Insert tables 8 *and* 9

Most individual series starts in 1960 and ends in 2000. However, some of them are incomplete in the sense that they begin later or / and finish earlier. This implies that panels we use are unbalanced ones. Individual samples for countries which data are incomplete are reported in the table 10.

B Sensitivity analysis

The two first tables 11 and 12, the results obtained with a panel of 63 countries over the period 1960-2000, are reported.

Insert tables 11 *and* 12

On tables 13 and 14, the results for the sample of 28 countries over the period 1960-2000, are reported.

Insert tables 13 *and* 14

On tables 15 and 16, the results for the sample of 35 developing countries over the period 1960-2000, are reported.

Insert tables 15 *and* 16

References

[1] Al-Yousif, Y. K., 2002. Financial development and economic growth. Another look at the evidence from developing countries. Review of Financial Economics 11, 131–150.

[2] Beck, T., Demirguc-Kunt, A., Levine, R. and Maksimovic, V., 2000. Financial structure and economic development: firm, industry, and country evidence. World Bank working paper 2423, World Bank, Washington, DC.

[3] Calderon, C., Liu, L., 2003. The direction of causality between financial development and economic growth. Journal of Development Economics 72, 321–334.

[4] Christopoulos, D. M., Tsionas, E. G., 2004. Financial development and economic growth: evidence from panel unit root and cointegration tests. Journal of Development Economics 73, 55–74.

[5] Demetriades, P.O., Hussein, K.A., 1996. Does financial developement cause economic growth? Time-series evidence from 16 countries. Journal of Development Economics 51, 378–411.

[6] Demirgüc-Kunt, A., Levine, R., 1999. Financial Structures Across Countries:Stylized Facts. Washington, D.C.: World Bank, mimeo.

[7] De Gregorio, J., Guidotti, P.E., 1995. Financial Development and Economic Growth. World Development 23(3), 433–448.

[8] Granger, C.W.J., 1969. Investigating causal relationd by econometric models and cross-spectral methods. Econometrica 37, 424–438.

[9] Greenwood, J. Smith, B.D., 1997. Financial markets in development and the development of financial markets. Journal of Economic Dynamics and Control 21, 145–181.

[10] Hurlin C., 2005, Un Test Simple de l'Hypothèse de Non Causalité dans un Modèle de Panel Hétérogène, Revue Economique, 56(3), 799-809.

[11] Hurlin, C., 2007., Testing for Granger Non Causality in Heterogeneous Panels, Working Paper LEO, Université d'Orléans, 2007-10

[12] Im, K.S., Pesaran, M.H., Shin, Y., 2003. Testing for Unit Roots in Heterogeneous Panels. Journal of Econometrics 115(1), 53–74.

[13] Jung, W.S., 1986. Financial Development and Economic Growth: International Evidence. Economic Development and Cultural Change 34(2), 336–346.

[14] King, R.V, Levine, R., 1993a. Finance and Growth: Schumpeter might be right. Quarterly Journal of Economics 108, august, 717–738.

[15] King, R.V, Levine, R., 1993b. Finance, Entrepreneurship, and Growth: Theory and evidence. Journal of Monetary Economics 32, 513–542.

[16] La Porta, R., Lopez-de Silanes, F., Shleifer, A., Vishny, F., 1997. Legal determinants of external finance. Journal of Finance 52(3), 1131–50.

[17] La Porta, R., Lopez-de Silanes, F., Shleifer, A., 1999. Corporate ownership around the world. Journal of Finance 54(2), 471–517.

[18] Levine, R., Loayza, N., Beck, T., 2000. Financial intermediation and growth: causality and causes. Journal of Monetary Economics 46, 31–77.

[19] Maddala, G.S. Wu, S., 1999. A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. Oxford Bulletin of Economics and Statistics, special issue, 631–652.

[20] McKinnon, R.I., 1973. Money and Capital in Economic Development. The Brookings Institution, Washington DC.

[21] Nair-Reichert, U. Weinhold, D., 2001. Causality tests for cross-countries panels: a look at FDI and economic growth in less developed countries. Oxford Bulletin of Economics and Statistics 63, 153–171.

[22] Patrick, H.T., 1966. Financial Development and Economic Growth in Underdeveloped Countries. Economic Development and Cultural Change 14, 174–189.

[23] Roubini, N., Sala-i-Martin, X., 1995. A growth model of inflation, tax evasion, and financial repression. Journal of Monetary Economics 39, 275–301.

[24] Shaw, E.S., 1973. Financial Deepening in Economic Development. Oxford University Press, New-York.

[25] Stulz, R., 2000. Does financial structure matter for economic growth? a corporate finance perspective, in: Demirgürç-Kunt, A., Levine R. (Eds.), Financial Structure and Economic Growth, the MIT Press, Cambridge, pp. 143–188.

[26] Swamy, P. A., 1970. Efficient inference in a random coefficient regression model. Econometrica 38, 311–323.

[27] Toda, H.Y. Phillips, P.C.B., 1993. Vector AutoRegressions and Causality. Econometrica 61, 1367–1393.

[28] Weinhold, D., 1996. Tests de causalité sur données de panel: une application à l'étude de la causalité entre l'investissement et la croissance. Economie et Prévision 126, 163–175.

Table 1: Panel Unit Root Tests

$Variable$	W_{IPS}	P_{MW}	Z_{MW}
PIBR	-30.11 (0.00)	901.0 (0.00)	48.82 (0.00)
BANCRED	-20.27 (0.00)	648.8 (0.00z)	32.93 (0.00)
PRIVCRED	-23.24 (0.00)	714.3 (0.00)	37.06 (0.00)
LIQLIAB	-27.17 (0.00)	830.3 (0.00)	45.85 (0.00)

Notes: W_{IPS} denotes the standardized IPS statistic based on simulated approximated moments (Im, Pesaran and Shin, 2003, table 3). P_{MW} denotes the Fisher's test statistic proposed by Maddala and Wu (1999) and on individual ADF p-values. Under H_0, P_{MW} has a χ^2 distribution with $2N$ of freedom when T tends to infinity and N is fixed. Z_{MW} is the Choi (2001) standardized statistic used for large N samples: under H_0, Z_{MW} has a $N(0,1)$ distribution when T and N tend to infinity. Corresponding p-values are in parentheses.

Table 2: Causality from Financial Development to Economic Growth. 63 Countries

Lag order	$K=1$	$K=2$	$K=3$
	LIQLIAB to PIBR		
W_{HNC}	1.625	2.738	4.118
Z_{HNC}	3.426^a	2.858^a	3.536^a
$\widetilde{Z}_{HNC}$	2.637^a	1.848	2.082^a
	PRIVCRED to PIBR		
W_{HNC}	1.397	2.497	3.568
Z_{HNC}	2.232^a	1.975^a	1.843
$\widetilde{Z}_{HNC}$	1.577	1.072	0.618
	BANCRED to PIBR		
W_{HNC}	1.513	2.655	4.005
Z_{HNC}	2.881^a	2.600^a	3.259^a
$\widetilde{Z}_{HNC}$	2.144^a	1.595	1.684

Notes: ^{a} indicates rejection at 5% level.

Table 3: Causality from Economic Growth to Financial Development. 63 Countries

Lag order	$K = 1$	$K = 2$	$K = 3$
	PIBR to LIQLIAB		
W_{HNC}	2.257	2.953	4.297
Z_{HNC}	6.890^a	3.691^a	4.103^a
$\widetilde{Z}_{HNC}$	5.667^a	2.545^a	2.528^a
	PIBR to PRIVCRED		
W_{HNC}	3.099	4.172	4.888
Z_{HNC}	11.78^a	8.621^a	6.123^a
$\widetilde{Z}_{HNC}$	9.929^a	6.635^a	3.833^a
	PIBR to BANCRED		
W_{HNC}	3.420	4.640	5.350
Z_{HNC}	13.58^a	10.48^a	7.616^a
$\widetilde{Z}_{HNC}$	11.50^a	8.192^a	4.959^a

Notes: ^{a} indicates rejection at 5% level.

Table 4: Causality from Financial Development to Economic Growth . 35 Developing Countries

Lag order	$K = 1$	$K = 2$	$K = 3$
	LIQLIAB to PIBR		
W_{HNC}	1.083	2.113	3.472
Z_{HNC}	0.341	0.325	1.108
$\widetilde{Z}_{HNC}$	0.022	-0.152	0.312
	PRIVCRED to PIBR		
W_{HNC}	1.217	2.685	4.015
Z_{HNC}	0.908	2.026^a	2.452^a
$\widetilde{Z}_{HNC}$	0.497	1.219	1.149
	BANCRED to PIBR		
W_{HNC}	1.290	2.614	4.168
Z_{HNC}	1.215	1.818	2.821^a
$\widetilde{Z}_{HNC}$	0.764	1.047	1.411

Notes: ^{a} indicates rejection at 5% level.

Table 5: Causality from Economic Growth to Financial Development. 35 Developing Countries

Lag order	$K=1$	$K=2$	$K=3$
	PIBR to LIQLIAB		
W_{HNC}	2.013	2.852	4.058
Z_{HNC}	4.115^a	2.448^a	2.482^a
$\widetilde{Z}_{HNC}$	3.318^a	1.629	1.405
	PIBR to PRIVCRED		
W_{HNC}	2.251	3.854	4.754
Z_{HNC}	5.234^a	5.486^a	4.237^a
$\widetilde{Z}_{HNC}$	4.252^a	4.073^a	2.413^a
	PIBR to BANCRED		
W_{HNC}	2.242	3.876	4.533
Z_{HNC}	5.197^a	5.552^a	3.703^a
$\widetilde{Z}_{HNC}$	4.219^a	4.127^a	2.033^a

Notes: ^{a} indicates rejection at 5% level.

Table 6: Causality from Financial Development to Economic Growth. 28 Industrial Countries

Lag order	$K=1$	$K=2$	$K=3$
	LIQLIAB to PIBR		
W_{HNC}	2.287	3.501	4.907
Z_{HNC}	4.731^a	3.901^a	4.046^a
$\widetilde{Z}_{HNC}$	3.919^a	2.937^a	2.774^a
	PRIVCRED to PIBR		
W_{HNC}	1.623	2.263	3.010
Z_{HNC}	2.333^a	0.697	0.022
$\widetilde{Z}_{HNC}$	1.821	0.229	-0.469
	BANCRED to PIBR		
W_{HNC}	1.791	2.705	3.803
Z_{HNC}	2.962^a	1.867	1.735
$\widetilde{Z}_{HNC}$	2.377^a	1.228	0.928

Notes: ^{a} indicates rejection at 5% level.

Table 7: Causality from Economic Growth to Financial Development. 28 Industrial Countries

Lag order	$K = 1$	$K = 2$	$K = 3$
	PIBR to LIQLIAB		
W_{HNC}	2.557	3.076	4.590
Z_{HNC}	5.721^a	2.795^a	3.373^a
$\widetilde{Z}_{HNC}$	4.785^a	1.994^a	2.220^a
	PIBR to PRIVCRED		
W_{HNC}	4.160	4.569	5.056
Z_{HNC}	11.82^a	6.797^a	4.443^a
$\widetilde{Z}_{HNC}$	10.20^a	5.432^a	3.141^a
	PIBR to BANCRED		
W_{HNC}	4.893	5.595	6.371
Z_{HNC}	14.56^a	9.513^a	7.284^a
$\widetilde{Z}_{HNC}$	12.62^a	7.749^a	5.461^a

Notes: ^{a} indicates rejection at 5% level.

Table 8: High income countries (28)

Argentina	Chile	Ireland	Netherlands	United Kingdom
Australia	Denmark	Israel	New Zealand	United States
Austria	Finland	Italy	Norway	Uruguay
Barbados	France	Japan	Sweden	Venezuela
Belgium[1]	Germany	Mauritius	Switzerland	
Canada	Iceland	Mexico	Trinidad and Tobago	

[1] Not in the liquid liabilities panel data set.

Table 9: Low- and middle-income countries (35)

Bolivia	Gambia, The	Kenya	Portugal[1]
Cameroon	Ghana	Malaysia	Rwanda
Colombia	Greece[1]	Nepal	Senegal
Costa Rica	Guatemala	Niger	Sierra Leone
Cyprus	Haiti	Pakistan	South Africa
Dominican Rep.	Honduras	Panama	Sri Lanka
Ecuador	India	Paraguay	Syrian Arab.Rep.
Egypt	Indonesia	Peru	Thailand
El Salvador	Jamaica	Philippines	

[*] Countries with real per capita GDP less than US$2500 in 1960. [1] Not in the liquid liabilities data set

Table 10: Samples for incomplete individual series

GDP	LIQLIAB	BANCRED	PRIVCRED
Cyprus: 1960-1997	Austria: 1960-1982	Argentina: 1961-2000	Argentina: 1961-2000
Germany: 1970-2000	Belgium: non available	Barbados: 1967-2000	Barbados: 1967-2000
Haiti: 1967-1998	Barbados: 1967-2000	Chile: 1961-2000	Chile: 1961-2000
Sierra Leone: 1961-1996	Cameroon: 1968-2000	Cameroon: 1969-2000	Cameroon: 1969-2000
	Cyprus: 1960-1999	Ghana: 1964-1997	Ghana: 1964-1997
	Finland: 1960-1998	Gambia: 1965-1994	Gambia: 1965-1994
	France: 1960-1990	Indonesia: 1980-2000	Indonesia: 1980-2000
	Gambia: 1965-1994	Iceland: 1961-2000	Iceland: 1961-2000
	Germany: 1960-1998	Italy: 1964-2000	Italy: 1964-2000
	Ghana: 1964-1997	Kenya: 1963-2000	Kenya: 1963-2000
	Greece: non available	Mauritius: 1963-2000	Mauritius: 1963-2000
	Iceland: 1961-2000	Nepal: 1964-2000	Nepal: 1964-2000
	Indonesia: 1969-2000	Rwanda: 1966-2000	Rwanda: 1966-2000
	Ireland: 1960-1998	Senegal: 1969-2000	Senegal: 1969-2000
	Italy: 1964-2000	Sierra Leone: 1964-2000	Sierra Leone: 1964-2000
	Kenya: 1967-2000	South Africa: 1966-2000	South Africa: 1966-2000
	Mauritius: 1963-2000	Syrian Ar. Rep.: 1963-2000	Syrian Ar. Rep.: 1963-2000
	Nepal: 1964-2000	Thailand: 1966-2000	Thailand: 1966-2000
	Netherlands: 1960-1997		
	Niger: 1969-2000		
	Portugal: non available		
	Rwanda: 1966-2000		
	Senegal: 1969-2000		
	Sierra Leone: 1964-2000		
	South Africa: 1966-2000		
	Syrian Arab Rep.: 1963-2000		

Table 11: Causality from Financial Development to Economic Growth . 63 Countries, 1960-2000

Lag order	$K = 1$	$K = 2$	$K = 3$
	LIQLIAB to PIBR		
W_{HNC}	1.747	2.698	4.075
Z_{HNC}	4.095^a	2.705^a	3.399^a
$\widetilde{Z}_{HNC}$	3.337^a	1.856	2.188^a
	PRIVCRED to PIBR		
W_{HNC}	1.473	2.653	3.978
Z_{HNC}	2.657^a	2.593^a	3.171^a
$\widetilde{Z}_{HNC}$	2.053^a	1.757	1.992^a
	BANCRED to PIBR		
W_{HNC}	1.628	2.969	4.461
Z_{HNC}	3.526^a	3.849^a	4.735^a
$\widetilde{Z}_{HNC}$	2.830^a	2.847^a	3.299^a

Notes: ^{a} indicates rejection at 5% level.

Table 12: Causality from Economic Growth to Financial Development. 63 Countries, 1960-2000

Lag order	$K = 1$	$K = 2$	$K = 3$
	PIBR to LIQLIAB		
W_{HNC}	2.188	3.231	4.829
Z_{HNC}	8.822^a	4.768^a	5.786^a
$\widetilde{Z}_{HNC}$	7.551^a	3.636^a	4.167^a
	PIBR to PRIVCRED		
W_{HNC}	3.699	4.336	5.275
Z_{HNC}	15.14^a	9.271^a	7.373^a
$\widetilde{Z}_{HNC}$	13.22^a	7.553^a	5.503^a
	PIBR to BANCRED		
W_{HNC}	4.188	5.143	6.340
Z_{HNC}	17.89^a	12.47^a	10.82^a
$\widetilde{Z}_{HNC}$	15.73^a	10.39^a	8.467^a

Notes: ^{a} indicates rejection at 5% level.

Table 13: Causality from Financial Development to Economic Growth . 28 Countries, 1960-2000

Lag order	$K=1$	$K=2$	$K=3$
	LIQLIAB to PIBR		
W_{HNC}	2.630	3.932	5.250
Z_{HNC}	5.990^a	5.020^a	4.773^a
$\widetilde{Z}_{HNC}$	5.143^a	4.032^a	3.558^a
	PRIVCRED to PIBR		
W_{HNC}	1.748	2.374	3.183
Z_{HNC}	2.799^a	0.991	0.396
$\widetilde{Z}_{HNC}$	2.313^a	0.557	-0.07
	BANCRED to PIBR		
W_{HNC}	1.984	2.937	3.932
Z_{HNC}	3.683^a	2.480^a	2.015^a
$\widetilde{Z}_{HNC}$	3.108^a	1.862	1.299

Notes: ^{a} indicates rejection at 5% level.

Table 14: Causality from Economic Growth to Financial Development. 28 Countries, 1960-2000

Lag order	$K=1$	$K=2$	$K=3$
	PIBR to LIQLIAB		
W_{HNC}	2.907	3.662	5.449
Z_{HNC}	7.007^a	4.318^a	5.195^a
$\widetilde{Z}_{HNC}$	6.040^a	3.409^a	3.884^a
	PIBR to PRIVCRED		
W_{HNC}	3.863	4.326	5.334
Z_{HNC}	10.71^a	6.156^a	5.043^a
$\widetilde{Z}_{HNC}$	9.434^a	5.082^a	3.868^a
	PIBR to BANCRED		
W_{HNC}	5.070	5.907	7.096
Z_{HNC}	15.22^a	10.33^a	8.849^a
$\widetilde{Z}_{HNC}$	13.49^a	8.744^a	7.097^a

Notes: ^{a} indicates rejection at 5% level.

Table 15: Causality from Financial Development to Economic Growth . 35 Developing Countries, 1960-2000

Lag order	$K = 1$	$K = 2$	$K = 3$
	LIQLIAB to PIBR		
W_{HNC}	1.025	1.688	3.113
Z_{HNC}	0.103	-0.893	0.265
$\widetilde{Z}_{HNC}$	-0.146	-1.138	-0.263
	PRIVCRED to PIBR		
W_{HNC}	1.253	2.876	4.614
Z_{HNC}	1.061	2.593^a	3.899^a
$\widetilde{Z}_{HNC}$	0.695	1.850	2.705^a
	BANCRED to PIBR		
W_{HNC}	1.628	2.969	4.884
Z_{HNC}	3.526^a	3.849^a	4.551^a
$\widetilde{Z}_{HNC}$	2.830^a	2.847^a	3.242^a

Notes: ^{a} indicates rejection at 5% level.

Table 16: Causality from Economic Growth to Financial Development. 35 Developing Countries, 1960-2000

Lag order	$K = 1$	$K = 2$	$K = 3$
	PIBR to LIQLIAB		
W_{HNC}	2.013	2.852	4.058
Z_{HNC}	4.115^a	2.448^a	2.482^a
$\widetilde{Z}_{HNC}$	3.318^a	1.629	1.405
	PIBR to PRIVCRED		
W_{HNC}	3.567	4.343	5.227
Z_{HNC}	10.74^a	6.932^a	5.380^a
$\widetilde{Z}_{HNC}$	9.309^a	5.588^a	3.928^a
	PIBR to BANCRED		
W_{HNC}	4.348	5.182	5.241
Z_{HNC}	18.79^a	12.62^a	5.413^a
$\widetilde{Z}_{HNC}$	16.48^a	10.46^a	3.955^a

Notes: ^{a} indicates rejection at 5% level.