Hitotsubashi Journal of Economics 55 (2014), pp.33-50. C Hitotsubashi University

## FINANCIAL DEVELOPMENT-ECONOMIC GROWTH NEXUS: A PANEL DATA ANALYSIS UPON OECD COUNTRIES

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Received February 2013; Accepted October 2013

## Abstract

In this paper, the link between financial development and economic growth in OECD member countries is investigated using unbalanced panel cointegration and causality analysis for the period 1980-2011. The results of the Pedroni and Kao Cointegration Analysis show the existence of long-run relationship between financial development and economic growth. The result of Granger Causality Analysis indicates that there is a unidirectional causality relationship running from economic growth to the three proxy variables for financial development while a bidirectional relationship between broad measure of money and economic growth is observed. Therefore, it can be said that the demand-following phenomenon is dominant.

Keywords: financial development, economic growth, panel cointegration test, panel Granger causality test

JEL Classification Codes: C23, G10, O11, O16, O57

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### I. Introduction

Since Schumpeter (1911), the relationship between financial development and economic growth has been extensively studied. Therefore, in order to examine the relationship between financial development and economic growth in OECD member countries for the period 1980-2011 unbalanced panel data analysis is applied. It is now well recognized that financial development is crucial for economic growth. Furthermore, the direction of causality between financial development and economic growth is vital because it has significantly different implications for development policy (Calderon and Liu 2003). Schumpeter (1911) contends that well-functioning financial markets spur technological innovation by identifying and funding entrepreneurs with the best chances of successfully implementing innovative products and production process. Following Schumpeter (1911), most studies<sup>1</sup> argue that financial development accelerates the process of economic growth. Specifically, these studies advocate a liberalised financial system which is able to mobilise an increased volume of financial saving and allocate capital to more productive uses, both of which enhance the volume and productivity of physical capital and contribute to economic growth (Luintel and Khan 1999).

In contrast, several economists are sceptical of the view that finance plays a major role in economic development. Robinson (1952) declares that where enterprise leads finance follows. Kuznets (1955) states that financial markets begin to grow as the economy approaches the intermediate stage of the growth process and develop once the economy matures. According to these views, economic development creates demands for particular types of financial arrangements and financial system responds to these demands automatically (Levine 1997). Furthermore, some economists do not believe that finance-growth relationship is important. Lucas (1988) asserts that economists "badly over-stress" the role of financial factors in economic growth. Apart from Lucas (1988), Chandavarkar (1992) notes that "none of the pioneers of development economics...even list finance as a factor in development".

Despite Lucas (1988) and Chandavarkar (1992)'s claims, Lewis (1955) postulates a twoway relationship between financial development and economic growth. This view is supported by Patrick (1966). Likewise, a number of endogenous growth models<sup>2</sup> show a two-way relationship between financial development and economic growth.

Because the main arguments indicate that the financial system accommodates or restricts the growth of real per capita output, the financial development-economic growth nexus is collected around the two basic views. The first view is called the "demand-following" phenomenon in which the creation of modern financial institutions, their financial assets and liabilities and related financial services respond to the demand for these services by investors and savers in the actual economy. In this case, the evolutionary development of the financial system is a continuing consequence of the pervasive, sweeping process of economic development. The nature of demand for financial services depends upon the growth of real

<sup>&</sup>lt;sup>1</sup> For the examples of these studies please see: Goldsmith (1969), McKinnon (1973), Shaw (1973), Kapur (1976), Galbis (1977), Fry (1978, 1995) and Mathieson (1980).

<sup>&</sup>lt;sup>2</sup> See also: Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Roubini and Sala-i-Martin (1992), Pagano (1993), King and Levine (1993), Barthelemy and Varoudakis (1996), Greenwood and Bruce (1997) and Levine (1997).

output and upon the commercialization and monetization of various sectors in the economy. The more rapid the growth rate of real national income, the greater the demand by enterprises for external funds and financial intermediation will be. Correspondingly, with a given aggregate growth rate, the greater the variance in the growth rates among different sectors or industries, the greater the need for financial intermediation to transfer saving from slow growing industries and from individuals to fast growing industries will be (Patrick 1966).

The second view, "supply-leading", suggests that financial markets may promote long-run growth. Financial markets encourage specialization as well as the acquisition and dissemination of information and may reduce the cost of mobilizing savings, thereby facilitating investments. Well-developed financial systems may enhance corporate control by mitigating the principal agent problem through aligning the interests of managers and capitalists, in which case managers would strive to maximize firm value (Diamond and Verrecchia 1982, Jensen and Murphy 1990). In addition, financial markets make the financial assets traded in them less risky because they allow savers to buy and sell quickly and cheaply when they wish to alter their portfolios. Less risky assets and easy access to capital markets improve the allocation of capital, which is an important channel of economic growth. More savings and investments thereby may also ensure long-run economic growth (Arestis et al. 2001). Therefore, supply-leading has two functions: to transfer resources from traditional sectors to modern sectors and to promote and stimulate an entrepreneurial response in these modern sectors. Financial intermediation, which transfers resources from traditional sectors to modern sectors, is akin to the Schumpeterian concept of innovative financing. Financial intermediaries assist the establishment of firms in new industries or the merger of firms, not only by underwriting a substantial portion of the capital, but more importantly by assuming the entrepreneurial initiative (Patrick 1966).

Apart from the main views called "demand-following" and "supply-leading", there are also two other views in the literature. Firstly, financial activity and economic growth are seen as not causally related. In this view, the observable correlation between them is spurious: economies grow and so do their financial sectors, although they follow their own logic (Graff 2002). Secondly, financial activity is an impediment to actual economic activity. Therefore, the direction of causation runs from financial activity to actual activity; although the focus lies on the potentially destabilizing effects of financial overtrading and crises. Specifically, this view sees the financial system as inherently unstable. Therefore, economists supporting this view contend that financial development can hinder growth by reducing the available credit to domestic firms (Van Wijnbergen 1983, Buffie 1984, Xu 2000).

In this study, in order to examine the relationship between financial development and economic growth in OECD member countries for the period 1980-2011 unbalanced panel data analysis is applied. For this purpose, this will be carried out in five parts. The literature summary is introduced in the second part, while the method and data belonging to the empirical research of the study are described in the third part and research findings are shown in the fourth part. The study concludes with the fifth part, where a general evaluation is conducted.

#### II. Literature Summary

The case of finance-growth nexus, while not new, has been strengthened by a growing body of empirical evidence. Different results have been obtained, since the country sample and

econometric methods used in the analysis are different. Therefore, there is no consensus about the presence and direction of this relationship. Furthermore, some authors call this state the "egg-chicken" problem. Nonetheless, although most empirical studies have supported the supply-leading phenomenon, some have reached the results showing the demand-following, bidirectional causal links between the related variables, negative effect of financial development on the process of growth and not a nexus between finance and growth. Therefore, in order to examine the relationship between financial development and economic growth in OECD member countries for the period 1980-2011, unbalanced panel data analysis is applied. The studies conducted by Murinde and Eng (1994), De Gregorio and Guidotti (1995), Demetriades and Hussein (1996), Ahmed and Ansari (1998), Ghali (1999), Khan (2001), Shan et al. (2001), Evans et al. (2002), Hermes and Lensink (2003), Bhattacharya and Sivasubramanian (2003), Khan and Senhadji (2003), Christopoulos and Tsionas (2004), Ghirmay (2004), Choong et al. (2005), Shan (2005), Papaioannou (2007), Halicio/u0000011flu (2007), Ang (2008), Abu-Bader and Abu-Qarn (2008), Kıran et al. (2009), Ahmad and Malik (2009), Caporale et al. (2009), Akinlo and Egbetunde (2010), Hassan et al. (2011), Ak and Kara (2011), Eng and Habibullah (2011) and Ağayev (2012) support the concept of supply-leading.

Apart from the supply-leading view, the demand-following hypothesis is found in the works conducted by Agbetsiafa (2003), Waqabaca (2004), Al-Awad and Harb (2005), Liang and Teng (2006), Yılmaz and Kaya (2006), Ang and McKibbin (2007), Odhiambo (2008) and Özcan and Arı (2011).

While Wood (1993), Blackburn and Hung (1998), Akinboade (1998), Al-Yousif (2002), Odhiambo (2005), Apergis et al. (2007), Singh (2008), Pradhan (2009) and Oluitan (2012) point out the bidirectional causality between financial development and economic growth, no causal link is detected by Chang (2002), Andersen and Tarp (2003), Dawson (2003), Tang (2006), Lu and Yao (2009) and Chakraborty (2010). Only two studies introduced by Ram (1999) and Halkos and Trigoni (2010) indicate that financial development has a negative impact on the process of economic growth.

In this study, the annual time series for the period of 1980-2011 in OECD member countries is taken into consideration and the finance-growth nexus is examined using unbalanced panel data analysis. Therefore, the aim of the paper is to contribute to the literature on the link between financial development and economic growth in the context of large scale countries and to determine the causality relationship as part of finance-growth nexus for the countries mentioned. Since the previous studies did not take into account all the OECD member countries in their analysis section, this paper has superiority thanks to considering all member countries.

The Appendix Table shows the literature summary containing information on the empirical studies of the finance-growth nexus in the appendix section.

## III. Method and Data

In this study, in order to examine the relationship between financial development and economic growth the unbalanced panel data analysis is applied. Since the number of time periods is not the same for all observations, the unbalanced panel data analysis is taken into account. To estimate the relations between the related variables in OECD countries<sup>3</sup>, the time

series for the period 1980-2011 is used. Because the data set for OECD member countries before the year 1980 can not be obtained, the time period that is taken into account is 1980-2011. In order to measure the financial development the domestic credits (DC) by the banking sector as a percentage of GDP, the ratio of broad measure of money, namely M2, to GDP (BM), the ratio of total bank deposits to GDP (BD) and the ratio of financial system deposits to the GDP (FSD) are used. The percentage change of GDP in constant prices (REG) is also used as a proxy for the economic growth process. The data are taken from the official websites of the World Bank and International Monetary Fund (IMF).

A panel data set is the one that follows a given sample of individuals over time and thus provides multiple observations on each individual in the sample. Therefore, panel data represent a nexus of time series and cross-section data. The description of panel data comes from surveys of individuals. In this context, it can be said that a panel is a group of individuals surveyed repeatedly over time (Frees 2004). Because of several major advantages over conventional cross-sectional or time series data sets, panel data analysis is widely used in economic studies. Panel data usually gives the researcher a large number of data points, therefore improves the efficiency of econometric estimates. More importantly, longitudinal data allows a researcher to analyse a number of important economic questions that cannot be addressed using cross-sectional or time series data sets. Besides, panel data is advantageous to construct and test more complicated behavioural models than purely cross-sectional or time series data (Hsiao 2003).

In panel data analysis, the long-run or else co-integrated relationship between the variables can be tested. To identify this relation Pedroni Cointegration Analysis is used. The cointegration test introduced by Pedroni (1999) begins with the help of the following equation:

$$y_{it} = \alpha_{it} + \delta_{it}t + X_{it}\beta_i + \varepsilon_{it} \tag{1}$$

where  $y_{ii}$  and  $X_{ii}$  are the observable variables with dimension of  $(N^*T)x1$  and  $(N^*T)xm$ , respectively. This cointegration test is based on the asymptotic and finite-sample properties of testing statistics to examine the null hypothesis of non-cointegration in the panel. The test allowing for heterogeneity among individual members of panel, including heterogeneity in both long-run co-integrating vectors and dynamic models, consists of two groups of test statistics. The first type is based on the within-dimension approach, which includes four statistics. They are panel v-statistic, panel  $\rho$ -statistic, panel PP-statistic and panel ADF-statistic. These statistics pool the autoregressive coefficients across different members for the unit root tests on the estimated residuals. The second type is based on the between-dimension approach, which includes three statistics. They are group  $\rho$ -statistic, group PP-statistic and group ADF-statistic. These statistics are based on estimators that simply average the individually estimated coefficients for each member (Lee 2005).

The two groups of test statistics introduced by Pedroni (1999) can be computed via the equations shown below: (Pedroni 1999)

Panel v-Statistic:

$$Z_{\nu} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2}\right)^{-1}$$
(2)

<sup>&</sup>lt;sup>3</sup> Korea could not be included in the analysis because of the inadequate data set.

Panel *p*-Statistic:

$$Z_{\rho} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2}\right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{it} - \hat{\lambda}_{i}\right)$$
(3)

**Panel PP-Statistic:** 

$$Z_{t} = \left(\hat{\sigma}^{2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2}\right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{it} - \hat{\lambda}_{i}\right)$$

$$(4)$$

Panel ADF-Statistic:

$$Z_{t}^{*} = \left(\hat{s}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*2}\right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{it}^{*}$$
(5)

**Group** *ρ***-Statistic:** 

$$\tilde{Z}_{\rho} = \sum_{i=1}^{N} \left( \sum_{i=1}^{T} \hat{e}_{i,i-1}^{2} \right)^{-1} \sum_{i=1}^{T} \left( \hat{e}_{i,i-1} \Delta \hat{e}_{ii} - \hat{\lambda}_{i} \right)$$
(6)

Group PP-Statistic:

$$\tilde{Z}_{t} = \sum_{i=1}^{N} \left( \hat{\sigma}^{2} \sum_{t=1}^{T} \hat{e}_{i,t-1}^{2} \right)^{-1/2} \sum_{t=1}^{T} \left( \hat{e}_{i,t-1} \Delta \hat{e}_{it} - \hat{\lambda}_{i} \right)$$
(7)

Group ADF-Statistic:

$$\tilde{Z}_{i}^{*} = \sum_{i=1}^{N} \left( \hat{s}_{i}^{2} \sum_{t=1}^{T} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \left( \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{it}^{*} \right)$$
(8)

Here,  $\hat{e}_{ii}$  is the estimated residuals from the equation numbered (1) and  $\hat{L}_{11i}^2$  is the estimated long-run covariance matrix  $\Delta \hat{e}_{ii}$ . Similarly,  $\hat{\sigma}_i^2$  and  $\hat{s}_i^2(\hat{s}_i^{*2})$  are, respectively, the long-run and contemporaneous variances for individual *i*. All seven tests are distributed as standard normal asymptotically. The panel *v*-statistic is a one-sided test where large positive values reject the null of no cointegration, while the remaining statistics diverge to negative infinitely which means that large negative values reject the null.

Unlike Pedroni test, Kao (1999) test specifies cross-section specific intercepts and homogeneous coefficients on the first-stage regressors. In this case, Kao (1999) test is based on the following panel regression model:

$$y_{it} = x_{it}^{'}\beta + z_{it}^{'}\gamma + \varepsilon_{it} \tag{9}$$

where  $y_{it}$  and  $x_{it}$  are I(1) and non-cointegrated. For  $z_{it} = \{\mu_i\}$  Kao (1999) proposed DF and ADF type of unit root tests for  $\varepsilon_{it}$  where the null is specified of no cointegration. The DF type test can be calculated from the regression of  $\hat{\varepsilon}_{it} = \rho \hat{\varepsilon}_{i, t-1} + v_{it}$ , while the ADF version of the specification is computed with the help of the regression of  $\hat{\varepsilon}_{it} = \rho \hat{\varepsilon}_{i, t-1} + \sum_{j=1}^{p} \varphi_j \Delta \hat{\varepsilon}_{i, t-j} + v_{itp}$  where  $\hat{\varepsilon}_{it} = \tilde{\gamma}_{it} - \tilde{\chi}_{it} \hat{\beta}$  and  $\tilde{\gamma} = y_{it} - \bar{\gamma}_i$ . The Ordinary Least Squares (OLS) of  $\rho$  and *t*-statistics are given as:

$$\hat{\rho} = \frac{\sum_{i=1}^{N} \sum_{t=2}^{T} \hat{\varepsilon}_{it} \hat{\varepsilon}_{i,t-1}}{\sum_{i=1}^{N} \sum_{t=2}^{T} \hat{\varepsilon}_{it}^{2}} \quad \text{and} \quad t_{\rho} = \frac{(\hat{\rho} - 1) \sqrt{\sum_{i=1}^{N} \sum_{t=2}^{T} \hat{\varepsilon}_{i,t-1}^{2}}}{S_{e}}$$
(10)

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Under the null of no cointegration, DF and ADF test statistics computed by Kao (1999) can be shown via following equations:

$$DF_{\rho} = \frac{\sqrt{N}T(\hat{\rho} - 1) + 3\sqrt{N}}{\sqrt{51/5}}$$
(11)

$$DF_{i} = \sqrt{\frac{5t_{\rho}}{4}} + \sqrt{\frac{15N}{8}} \tag{12}$$

$$DF_{\rho}^{*} = \frac{\sqrt{N}T(\hat{\rho} - 1) + \frac{3\sqrt{N}\hat{\sigma}_{\nu}^{2}}{\hat{\sigma}_{0\nu}^{2}}}{\sqrt{3 + \frac{36\hat{\sigma}_{\nu}^{4}}{5\hat{\sigma}_{0\nu}^{4}}}}$$
(13)

$$DF_{\rho}^{*} = \frac{t_{\rho} + \frac{\sqrt{6N}\delta_{\nu}}{2\delta_{0\nu}}}{\sqrt{\frac{\delta_{0\nu}^{2}}{2\delta_{\nu}^{2}} + \frac{3\delta_{\nu}^{2}}{10\delta_{0\nu}^{2}}}}$$
(14)

$$ADF = \frac{t_{ADF} + \frac{\sqrt{6N\delta_v}}{2\delta_{0v}}}{\sqrt{\frac{\delta_{0v}^2}{2\delta_v^2} + \frac{3\delta_v^2}{10\delta_{0v}^2}}}$$
(15)

where  $\hat{\sigma}_v^2 = \hat{\Sigma}_{VV} - \hat{\Sigma}_{VX} \hat{\Sigma}^{-1} xx$  and  $\hat{\sigma}_{0v}^2 = \hat{\Omega}_{VV} - \hat{\Omega}_{VX} \hat{\Omega}^{-1} xx$ , while  $t_{ADF}$  shows the *t*-statistics of ρ.

Following the cointegration analysis, whether or not any causal relations between the variables can be tested via causality analysis introduced first by Granger (1964, 1969) and developed later by Hamilton (1994). In the Granger approach, the direction of the causality between the variables namely X and Y shall be investigated. The Granger analysis to the question of whether X causes Y is to see how much of the current Y can be explained by past values of Y and then to see whether adding lagged values of X can improve the explanation. Y is said to be Granger caused by X if X helps in the prediction of Y, or equivalently if the coefficients on the lagged X's are statistically significant (Charemza and Deadman 1993). If the cointegration relationship is found between the variables, the error correction term in the context of Vector Error Correction Model (VECM) is needed to include in the causality model. The following equations that should be used as the causal relations between the two variables are investigated (Kutlar 2007):

$$Y_{ii} = \sum_{j=1}^{n} \alpha_{i} Y_{ii-j} + \sum_{j=1}^{n} \beta_{i} X_{ii-j} + \varepsilon_{1ii} E C_{r, i-1} + u_{1ii}$$
(16)

$$X_{it} = \sum_{j=1}^{n} \gamma_{i} X_{it-j} + \sum_{j=1}^{n} \varsigma_{i} Y_{it-j} + \varepsilon_{2it} E C_{r, t-1} + u_{2it}$$
(17)

It is assumed at this point that the error terms  $u_{1ii}$  and  $u_{2ii}$  are not related to each other. EC

Variable Stats	REG	DC	FSD	BM	BD
Mean	2.610	103.930	73.583	89.213	73.702
Median	2.800	94.050	57.800	68.700	57.500
Maximum	12.200	340.900	675.500	669.800	675.500
Minimum	-14.200	11.200	0.100	11.000	9.100
Std. Dev.	2.981	57.323	71.383	79.023	71.524
Skewness	0.782	0.281	5.036	4.275	5.052
Kurtosis	3.500	3.969	35.663	27.926	35.647
Jarque-Bera	611.345	424.897	45810.77	23987.94	45403.24
Probability	0.000	0.000	0.000	0.000	0.000
Observation	998	976	941	829	933

TABLE 1.DESCRIPTIVE STATISTICS

implies the error correction term which is obtained from cointegration relationship. Therefore, as much as the equations (16) and (17) are dependent on the past values of the variables, they are also a function of their own past values. In Granger causality, as much as unidirectional and bidirectional causality relations may exist between  $Y_{it}$  and  $X_{it}$ , also no relation between the variables may occur.

### IV. Research Findings

In econometric studies it is important to introduce some features of the data used in the analysis. Therefore, Table 1 shows the descriptive statistics of the variables mentioned above.

In order to obtain robust results in the panel data analysis, it is important to determine whether or not the data sets have the some features. Therefore, the data needs to be made stationary in the panel data analysis. As Granger and Newbold (1974) noted, a model which is estimated through non-stationary data may lead to the spurious regressions. Therefore, to determine whether or not the variables used in the model are stationary; LLC, Breitung, IPS, ADF-Fisher, PP-Fisher and Hadri unit root tests are applied. Thanks to unit root test both the problem of spurious regression will be eliminated and the results of the analysis will be reliable (MacKinnon 1991). Table 2 shows the results of the various types of the unit root tests. According to the results of the various types of the unit root tests, the variables used in the model are stationary at the different significance levels.

In order to determine the long-run relationship between the variables, Pedroni and Kao Cointegration Analysis were applied in the study. The results of the Pedroni and Kao Cointegration Analysis illustrated in Table 3 show the existence of cointegration relations among REG, DC, FSD, BM and BD. In this context, it is possible to say that the long-run relationship is valid among the related variables and hence at least unidirectional causality process is expected among them.

Obtaining the long-run relationship among domestic credits, financial system deposits, a broad measure of money, total bank deposits and real economic growth demonstrates that at least unicausality relations could be among the mentioned variables. Since the cointegration relationship is found between the variables, the error correction term (EC) obtained from cointegration models need to be included in the causality model. Therefore, Table 4 shows the

		LLC t St	tatistic			Breitung t	Statistic	
Variable	Level	First Difference	NCS	NOS	Level	First Difference	NCS	NOS
REG	-12.711***	-	33	954	-6.922***	-	33	921
DC	-0.212	-20.416***	33	887	3.424	-7.776***	33	847
FSD	1.634	-14.503***	33	826	2.914	-4.701***	33	775
BM	0.029	-20.387***	33	750	2.966	-5.900***	33	716
BD	1.077	-13.795***	33	816	2.152	-4.328***	33	767
		IPS W S	tatistic			ADF-Fisher	x <sup>2</sup> Statistic	
Variable	Level	First Difference	NCS	NOS	Level	First Difference	NCS	NOS
REG	-10.772***	-	33	954	247.847***	-	33	954
DC	1.518	-16.055***	33	880	54.725	561.037***	33	887
FSD	2.690	-10.068***	33	808	52.759	336.700***	33	826
BM	0.389	-13.792***	33	749	67.147	561.607***	33	750
BD	2.329	-8.872***	33	800	50.473	315.904***	33	816
		PP-Fisher x	<sup>2</sup> Statistic			Hadri Z S	Statistic	
Variable	Level	First Difference	NCS	NOS	Level	First Difference	NCS	NOS
REG	247.077***	-	33	965	6.756	0.773	33	965
DC	39.849	591.242***	33	898	11.453	0.004	33	937
FSD	34.792	364.494***	33	841	3.235	0.420	33	891
BM	60.447	656.970***	33	761	11.396	0.936	33	795
BD	35.188	344.512***	33	832	2.832	0.556	33	882

TABLE 2. THE RESULTS OF PANEL UNIT ROOT TESTS

*Note:* NCS and NOS imply "number of cross-section" and "number of observation", respectively. The statistics for Fisher tests are computed using an asymptotic  $x^2$  distribution and all other tests assume asymptotic normality. \*\*\*\* indicates the stationary of the variables at the significance level of 1 per cent. While the statistics are computed, SIC is taken into consideration to select the optimum lag length. Besides, both Barlett Kernel is made allowance for LLC, PP-Fisher and Hadri tests and Newey-West Bandwith criterion is taken into account to calculate the statistics.

results of the panel Granger Causality Analysis.

The results of Granger Causality Analysis show that there is a unidirectional causality relationship among DC, FSD, BD and REG, while there is a bidirectional causality relationship between BM and REG. Besides, because the error correction term, *EC*, is found to be negative and statistically significant, it can be said that the variables converge to equilibrium quickly, and short-term imbalances will be overcome in the long-term. According to Granger Causality Analysis it can be said that the demand-following phenomenon is dominant. Therefore, to maintain sustainable economic growth, governments have to accelerate the economic deepening and undertake essential measures to strengthen the long-run relationship between financial development and economic growth. The findings support the view that countries having a less sophisticated financial system tend to experience more of a demand-following relationship where economic growth induces financial development. Therefore, OECD member countries should take more measures to help increase financial development resulting in more efficient allocation of funds and connections between savers and investors.

R	EG-DC		RI	EG-FSD	
PEDRONI COINTI	EGRATION ANA	LYSIS	PEDRONI COINT	EGRATION ANA	LYSIS
Test	Statistic	Probability	Test	Statistic	Probability
Panel v Statistic	-4.505	1.000	Panel v Statistic	-0.570	0.715
Panel rho Statistic	-7.050***	0.000	Panel rho Statistic	-6.177***	0.000
Panel PP Statistic	-11.130***	0.000	Panel PP Statistic	-8.333***	0.000
Panel ADF Statistic	-12.197***	0.000	Panel ADF Statistic	-10.337***	0.000
Group rho Statistic	-3.499***	0.000	Group rho Statistic	-2.101**	0.017
Group PP Statistic	-10.419***	0.000	Group PP Statistic	-6.492***	0.000
Group ADF Statistic	-10.587***	0.000	Group ADF Statistic	-8.610***	0.000
KAO COINTEG	RATION ANALY	YSIS	KAO COINTEG	RATION ANALY	/SIS
Test	Statistic	Probability	Test	Statistic	Probability
Kao-ADF	-6.713***	0.000	Kao-ADF	-8.846***	0.000
RI	EG-BM		R	EG-BD	
PEDRONI COINTI	EGRATION ANA	LYSIS	PEDRONI COINTI	EGRATION ANA	LYSIS
Test	Statistic	Probability	Test	Statistic	Probability
Panel v Statistic	-5.031	1.000	Panel v Statistic	-0.673	0.749
Panel rho Statistic	-6.697***	0.000	Panel rho Statistic	-6.272***	0.000
Panel PP Statistic	-10.715***	0.000	Panel PP Statistic	-8.447***	0.000
Panel ADF Statistic	-11.404***	0.000	Panel ADF Statistic	-10.395***	0.000
Group rho Statistic	-1.327*	0.092	Group rho Statistic	-2.161**	0.015
Group PP Statistic	0 000***	0.000	Group PP Statistic	6 6 5 0 ***	0.000
	-0.000	0.000	Gloup II Statistic	-0.039	01000
Group ADF Statistic	-8.880 -9.559 <sup>***</sup>	0.000	Group ADF Statistic	-8.575***	0.000
Group ADF Statistic KAO COINTEG	-9.559**** RATION ANALY	0.000 0.000 7SIS	Group ADF Statistic KAO COINTEG	-8.575*** RATION ANALY	0.000 7SIS
Group ADF Statistic KAO COINTEG Test	-9.559*** RATION ANALY Statistic	0.000 0.000 YSIS Probability	Group ADF Statistic KAO COINTEG Test	-8.575*** RATION ANALY Statistic	0.000 /SIS Probability

TABLE 3. THE RESULTS OF PEDRONI AND KAO COINTEGRATION ANALYSIS

*Note:* The computed test statistics implying the cointegration relationship are determined by taking into consideration both Barlett Kernel and Newey-West Bandwith criterion. The optimum lag length for the related variables is computed by taking SIC into account. <sup>\*</sup>, <sup>\*\*</sup> and <sup>\*\*\*</sup> show the significance of the statistics at 10 per cent, 5 per cent and 1 per cent significance level, respectively.

TABLE 4. TH	e Results of	GRANGER	CAUSALITY	ANALYSIS
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Variable	The Direction	F	FC	Variable	The Direction	F	FC
Pairs	of Causality	Statistic	$LC_{t-1}$	Pairs	of Causality	Statistic	$EC_{t-1}$
REG - DC(1)	$\rightarrow$	4.259**	-0.016**	REG - BM(1)	$\rightarrow$	6.175**	-0.025***
DC - REG(1)	-	1.600	-0.019	BM - REG(1)	$\rightarrow$	$3.710^{*}$	-0.032*
REG - FSD(1)	<b>→</b>	7.578***	-0.206***	REG - BD(1)	$\rightarrow$	7.523***	-0.057*
FSD - REG(1)	-	0.025	0.032	BD - REG(1)	-	0.001	0.168

*Note:* Values in parenthesis show the optimum lag lengths determined by taking AIC and SIC into consideration. \*, \*\* and \*\*\* indicate the significance at 10 per cent, 5 per cent and 1 per cent significance level, respectively. *EC* implies the error correction term.

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#### V. Conclusion

In this paper, the relationship between financial development and economic growth for OECD member countries is investigated for the period 1980-2011 using unbalanced panel cointegration and causality analysis. For this purpose, firstly to determine the stationary information of the variables the various types of unit root tests are applied and the results show that variables used in the model are stationary at the different significance levels. Following unit root process, Pedroni and Kao Cointegration Analysis is used to investigate the long-run relationship between financial development and economic growth. The results of the Pedroni and Kao Cointegration Analysis show the existence of cointegration relations among REG, DC, FSD, BM and BD. In this context, it can be said that the long-run relationship is valid among the related variables. Since the cointegration findings indicate the long-run relationship between financial development and economic growth, at least unidirectional causality relationship between the related variables is expected and therefore Granger Causality Analysis is applied. The results of Granger Causality Analysis show that there is a unidirectional causality relationship among DC, FSD, BD and REG, while there is a bidirectional causality relationship between BM and REG. Besides, since the error correction term, EC, is found to be negative and statistically significant, it can be said that the variables converge to equilibrium quickly, and short-term imbalances will be overcome in the long-term. According to Granger Causality Analysis it is possible to say that the demand-following phenomenon is dominant. Therefore, the dynamism of economic growth process in the country will foster financial development. Therefore, to maintain sustainable economic growth, governments have to accelerate the economic deepening and undertake essential measures to strengthen the long-run relationship between financial development and economic growth. The findings support the view that countries, having a less sophisticated financial system tend to experience more of a demandfollowing relationship where economic growth induces financial development. Therefore, OECD member countries should take more measures to help increase financial development which results in more efficient allocation of funds and connections between savers and investors. Otherwise, the Lucas (1988) argument that the financial sector has no important role in real economic activity may find its greatest support in OECD member countries. Increasing the volume of savings and capital accumulation and transferring these factors to the actual economy are important components to sustain the process of economic growth. For OECD member countries the elements that trigger the economic growth must be warranted and the evolutionary development of the financial system will be a continuing consequence of the pervasive, sweeping process of economic development. The nature of demand for financial services will depend upon the growth of real output and the commercialization and monetization of various sectors in the economy. The more rapid the growth rate of the actual national income, the greater the demand by enterprises for external funds and ensuing financial intermediation. Correspondingly, with a given aggregate growth rate, the greater the variance in the growth rates among different sectors or industries, the greater the need for financial intermediation to transfer saving from slow growing industries and from individuals to fast growing industries will be. At the end of the process, the long-run relationship between financial development and economic growth will take place and they will be mutually reinforcing factors for each other.

APPENDIX

APPENDIX 1.	THE LITERATURE SUMMARY ON THE EMPIRICAL	STUDIES	of Finance-growth <b>I</b>	NEXUS
Author(s)	Method	Period	Country	Direction of Causality
	The Studies Consistent with the Supply-Lea	iding Respoi	ıse	
Murinde and Eng (1994)	Bivariate Vector Autoregressive Model (BVAR), Johansen Cointegration Analysis, Granger Causality Analysis	1979-1990	Singapore	Finance → Growth
De Gregorio and Guidotti (1995)	Panel Data Analysis	1960-1985	100 Countries	Finance $\rightarrow$ Growth
Demetriades and Hussein (1996)	Time Series Analysis, Granger Causality Analysis	1960-1987	16 Countries	Finance → Growth
Ahmed and Ansari (1998)	Time Series Analysis, Granger Causality Analysis	1973-1991	India, Pakistan, Sri Lanka	Finance → Growth
Ghali (1999)	Vector Autoregressive Model (VAR), Engle-Granger Cointegration Analysis, Johansen Cointegration Analysis, Granger Causality Analysis	1963-1993	Tunisia	Finance → Growth
Shan <i>et al.</i> (2001)	VAR, Granger Causality Analysis	1960-1998	9 OECD Countries and China	Finance - Growth
Evans et al. (2002)	Panel Data Analysis	1972-1992	82 Countries	Finance → Growth
Hermes and Lensink (2003)	Panel Data Analysis	1970-1995	67 Countries	Finance → Growth
Bhattacharya and Sivasubramanian (2003)	Time Series Analysis, Johansen Cointegration Analysis, Granger Causality Analysis	1970-1999	India	Finance → Growth
Khan and Senhadji (2003)	Cross-Section Analysis	1960-1999	159 Countries	Finance $\rightarrow$ Growth
Christopoulos and Tsionas (2004)	Threshold Cointegration Analysis, Dynamic Panel Data Analysis	1970-2000	10 Countries	Finance $\rightarrow$ Growth
Ghirmay (2004)	Johansen Cointegration Analysis, Granger Causality Analysis, VAR	1965-2000	13 Countries	Finance $\rightarrow$ Growth
Choong et al. (2005)	Autoregressive Distributed Lag Bounds Test (ARDL)	1978-2000	Malaysia	Finance → Growth
Shan (2005)	VAR	1985-1998	10 OECD Countries and China	Finance - Growth
Halıcıo\u0000011flu (2007)	Granger Causality Analysis, Vector Error Correction Model (VECM)	1968-2005	Turkey	Finance - Growth
Ang (2008)	ARDL	1960-2003	Malaysia	Finance - Growth
Abu-Bader and Abu-Quarn (2008)	Granger Causality Analysis, VECM	1960-2001	Egypt	Finance → Growth
Kıran <i>et al.</i> (2009)	Pedroni Cointegration Analysis, Panel Fully Modified Ordinary Least Squares (FMOLS)	1968-2007	10 Countries	Finance → Growth
Ahmad and Malik (2009)	Panel Data Analysis	1970-2003	35 Countries	Finance → Growth
Caporale et al. (2009)	Dynamic Panel Data Analysis	1994-2007	10 Countries	Finance → Growth
Akinlo and Egbetunde (2010)	VECM, Granger Causality Analysis	1980-2005	10 Countries	Finance → Growth
Hassan et al. (2011)	Panel Data Analysis, Granger Causality Analysis	1980-2007	168 Countries	Finance $\rightarrow$ Growth
Ak and Kara (2011)	Johansen Cointegration Analysis, VECM	1985-2006	Turkey	Finance $\rightarrow$ Growth
Eng and Habibullah (2011)	Panel Generalized Method of Moments (GMM)	1990-1998	Africa, Asia, Europe, Weshern Hampshire	Finance → Growth
Ağayev (2012)	Pedroni Cointegration Analysis, Panel Causality Analysis	1995-2009	20 Countries	Finance → Growth

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	The Childre Consistent with the Domand Eall.	no Docimo	00400	
Waqabaca (2004)	BVAR, Johansen Cointegration Analysis, Granger Causality Analysis	1970-2000	Fiji	Growth → Finance
Al-Awad and Harb (2005)	Panel Data and Cointegration Analysis, Granger Causality Analysis	1969-2000	10 Countries	Growth → Finance
Liang and Teng (2006)	VAR, Johansen Cointegration Analysis, Granger Causality Analysis	1952-2001	China	Growth → Finance
Yılmaz and Kaya (2006)	Johansen Cointegration Analysis, Granger Causality Analysis	1986-2004	Turkey	Growth - Finance
Ang and McKibbin (2007)	Johansen Cointegration Analysis, Granger Causality Analysis	1960-2001	Malaysia	Growth - Finance
Odhiambo (2008)	Johansen Cointegration Analysis, VECM, Granger Causality Analysis	1969-2005	Kenya	Growth - Finance
Ozcan and Arı (2011)	VAR, Granger Causality Analysis	1998-2009	Turkey	Growth → Finance
	The Studies Consistent with the Bi-Directional C	Causality Re	sponse	
Wood (1993)	Time Series Analysis, Hsiao Causality Analysis	1946-1990	Barbados	Finance <> Growth
Akinboade (1998)	Time Series Analysis, Granger Causality Analysis, VECM	1976-1995	Botswana	Finance <> Growth
Al-Yousif (2002)	Time Series Analysis, BVAR, Panel Data Analysis	1970-1999	30 Countries	Finance <> Growth
Apergis et al. (2007)	Panel Data Analysis, Panel Cointegration Analysis	1975-2000	15 OECD Countries and 50 Non-OECD Countries	Finance $\Leftrightarrow$ Growth
Singh (2008)	Johansen Cointegration Analysis, VECM, Toda-Yamamoto Causality Analysis, Granger Causality Analysis	1951-1996	India	Finance $\Leftrightarrow$ Growth
Pradhan (2009)	VECM, Johansen Cointegration Analysis, Granger Causality Analysis	1993-2008	India	Finance $\Leftrightarrow$ Growth
Oluitan (2012)	Panel GMM, Panel Data Analysis	1970-2005	31 Countries	Finance
	The Studies Consistent with the Negative Impact of Fin	ance on Gr	owth Response	
Ram (1999)	Time Series Analysis	1960-1989	95 Countries	Negative Impact of Finance on Growth
Halkos and Trigoni (2010)	Panel Data Analysis, Pedroni Cointegration Analysis		European Union Countries	Negative Impact of Finance on Growth

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