ISSN 2234-8867
Journal of East Asian Economic Integration Vol. 16, No. 1 (March 2012) 97-115

Financial Development and Output Growth: A Panel Study for Asian Countries

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This paper investigates the relationship between financial markets and output growth for a panel of 27 Asian countries over 1960-2009. It utilizes the recently-developed panel cointegration techniques to test and estimate the long-run equilibrium relationship between real GDP and financial development proxies. Real GDP and financial development variables are found to have unit roots and to be cointegrated, based on various panel unit root tests and panel cointegration tests. We find that there is a statistically significant positive bi-directional cointegrating relationship between financial development and output growth by three distinct methods of panel cointegration estimation. Empirical findings suggest that financial market development promotes output growth and in turn output growth stimulates further financial development.

Keywords: Output growth, Financial development, Panel unit root and cointegration, Bi-directional relationship
JEL Classification: O2, O4, E5

I. Introduction

To date, various research results have been reported on the relationship between financial market development and economic growth. Despite the accumulation of research output, there has been no satisfactory consensus in theoretical or empirical aspects. In the theoretical aspect, there are models proposing that financial development promotes economic growth such as Levine (1991), Chakraborty and Ray (2006), and Deidda and Fattouh (2006), while there are models suggesting that economic growth causes financial development, i.e. reverse causation as in Robinson

* The author is grateful to the anonymous referees for helpful comments and suggestions. This work was supported by a Kangnam University research grant in 2011. (***Correspondence Address***: Prof. Sangjoon Jun, Department of International Trade, Kangnam University, Gugal-dong, Giheung-gu, Yongin-si, Gyeonggi-do 446-702, Korea. Tel: +82-31-280-3987, Fax: +82-31-280-3415, E-mail: sjun1@kangnam.ac.kr.)

(1952), and Greenwood and Smith (1997) among others. There are also some scholars who totally deny any relationship between them, including Lucas (1988) and Chandavarkar (1992).

In the empirical aspect, the nexus between finance and growth has been explored, applying diverse models and estimation techniques such as vector autoregression (VAR) and generalized method of moments (GMM) to cross-section, time-series, and panel data sets. An argument that financial development promotes economic growth - Beck and Levine (2004), McCaig and Stengos (2005) - , an assertion that economic growth causes financial development - Ang and McKibbin (2007), Liang and Teng (2006) - , a claim that there could be a bi-directional causality - Luintel and Khan (1999), etc. - , and a view that there is no significant relationship between finance and growth - Naceur and Ghazouani (2006) - coexist in the current literature of empirical studies.

This paper investigates the relationship between financial market development and economic growth for a panel of 27 Asian economies over the 1960-2009 period. To date, numerous researches on the growth-finance nexus have been conducted using data on industrialized nations such as OECD, yet comparable panel studies on Asian developing countries as a whole have been relatively scarce. Most existing researches on this topic have focused only on a small number of Asian countries such as China, Japan, Korea, Malaysia, and Taiwan as in Ang and McKibbin (2007), Liang and Teng (2006), and Liu and Hsu (2006) among others. This and the necessity of policy implications for developing nations are reasons for selecting the 27 Asian economies for this research. Annual macroeconomic data extracted from the World Bank's *World Development Indicators 2010* are utilized in empirical analysis for 27 Asian countries: Bangladesh, Bhutan, Brunei, Cambodia, China, Hong Kong, India, Indonesia, Japan, Kazakhstan, Korea, Kyrgyz Republic, Lao PDR, Macao, Malaysia, Maldives, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Tajiskistan, Thailand, Turkmenistan, Uzbekistan, and Vietnam.

The goal of this research is to find evidence on the direction and relative size of causality between financial development and economic growth and to present guidelines of financial policy for economic development. This study explores the growth-finance link employing the recently-developed panel cointegration techniques to test and estimate the long-run equilibrium relationship between real GDP and financial development proxies.

The empirical analysis in this paper is performed in 3 steps. First, 5 distinct types of panel unit root tests are employed to confirm the nonstationarity of the series in a panel system of the entire Asian countries. Second, 2 types of panel cointegration

tests (Kao 1999 and Pedroni 2004) are used to establish a cointegrating (long-term equilibrium) relationship between output and financial development proxies. Third, 3 types of panel cointegration estimation techniques - canonical cointegrating regression (CCR), dynamic ordinary least squares (DOLS), and fully-modified ordinary least squares (FMOLS) - are utilized to estimate the output-finance regression equation. This estimation is performed in both directions with the dependent and independent variables interchanged to find evidence for the existence of a bi-directional relationship between output growth and financial development.

In the presence of panel unit roots and cointegration, it is required to estimate the output-finance equation by panel cointegration techniques: CCR proposed by Park (1992), DOLS as in Saikkonen (1992) and Kao and Chiang (2000), and FMOLS of Phillips and Hansen (1990), Kao and Chiang (2000), and Pedroni (2004).

The remainder of this paper is organized as follows. In Section 2, the hypotheses and regression models for empirical analysis are specified and panel unit root and cointegration testing and estimation techniques for econometric analyses are explained. Section 3 provides data descriptions for analysis and empirical results. In Section 4, the findings are recapitulated and the contributions of this paper are presented.

II. MODEL AND ECONOMETRIC FRAMEWORK

1. Hypotheses and Model Specification

This paper explores the following three hypotheses.

Hypothesis 1: Financial development may have significant positive effects on economic growth.

To test this hypothesis, we need to estimate a regression equation with real GDP as the dependent variable, and a proxy variable for financial market development - M2/GDP, M3/GDP, domestic credit/GDP, market capitalization/GDP - and other control variables - the investment ratio, the inflation rate, etc. as explanatory variables. Prior to regressions, we have to conduct panel unit root and panel cointegration tests to detect the existence of nonstationarity and of long-run equilibrium relationship and to apply proper estimation techniques for panel cointegration.

Hypothesis 2: In contrast, there may be a reverse causation or feedback effect such that economic growth causes or generates financial market development.

To test this hypothesis, performing the panel cointegration estimation of a regression model with a proxy variable for financial development as the dependent

variable and real GDP as an explanatory variable is required.

Hypothesis 3: There could be a bi-directional relationship between financial development and economics growth such that economic growth promotes financial development and financial development further stimulates economic growth.

Testing this hypothesis will involve carefully comparing the regression results from testing of the above two hypotheses.

We can set up a generalized form of the output equation to examine the relationship between financial development and economic growth as follows.

$$y = f(FD, Controls, \varepsilon). \tag{1}$$

In contrast, we can consider a reverse causation or feedback effect such that economic growth causes financial development.

$$FD = g(y, Controls, \eta), \tag{2}$$

where y = real GDP , FD = proxy variable for financial development, Controls = other control variables that affect real GDP or financial development, ε and η = error terms.

Based on the generalized model and the selected variables of regression equations used in existing empirical studies, this paper employs the following regression equation applied to heterogeneous panel data.

$$y_{it} = \beta_{0i} + \beta_{1i} FD_{it} + \beta_{2i} IR_{it} + \beta_{3i} \pi_{it} + \varepsilon_{it}, \tag{3}$$

$$FD_{it} = \gamma_{0i} + \gamma_{1i} y_{it} + \gamma_{2i} IR_{it} + \gamma_{3i} \pi_{it} + \eta_{it}, \tag{4}$$

where i = 1, ⋯ , N, t = 1, ⋯ , T, IR = investment/GDP, π = consumer price index(CPI) inflation, ε and η = disturbance terms.

In general, economic theory dictates that the higher financial development and the investment ratio, the higher real GDP is and the lower inflation, the higher real output is. Thus the coefficients on financial development and the investment ratio are expected to be positive and the coefficient on inflation negative. However, in contrast with cross-section data where the signs on coefficient estimates are relatively obvious, we may observe signs different from those expected by theory in panel data, since various real economic and policy factors interact.

We may express the regressions in equations (3) and (4) as a standard panel

regression equation as follows.

$$y_{it} = \alpha_i + b_{1i}\chi_{1it} + \cdots + b_{Mi}\chi_{Mit} + e_{it},$$
$$i = 1, \cdots, N; t = 1, \cdots, T; m = 1, \cdots, M. \quad (5)$$

where y_{it} is real GDP or a proxy for financial development as the dependent variable, α_i is the intercept term representing individual fixed effects, b_i is the coefficient vector on the explanatory variables χ_{it}, χ_{it} is an m-dimensional vector of explanatory variables including financial development or real GDP, the investment ratio(IR), the inflation rate(π), etc, and e_{it} is a disturbance term.

This paper employs three different techniques to estimate the panel cointegration regression model established above: CCR (canonical cointegrating regression) proposed by Park (1992), DOLS (dynamic OLS) as in Saikkonen (1992) and Kao and Chiang (2000), and FMOLS (fully-modified OLS) of Phillips and Hansen (1990), Kao and Chiang (2000), and Pedroni (2004).

2. Panel Cointegration Tests and Estimation

The cointegration methodology as applied to time series data was first introduced in the 1980s as in Engle and Granger (1987), Johansen (1988, 1991, 1992a, 1992b), Johansen and Juselius (1990, 1992), and others. In the early 1990s, cointegration techniques had been extended to apply to panel data. There has been much research on panel cointegration since the late 1990s. Excellent surveys on nonstationary panels, panel cointegration, and dynamic panels are presented in Baltagi (2008: Ch. 12), Baltagi and Kao (2000), and Banerjee (1999), among others.

A panel unit root and cointegration approach has many benefits compared to a conventional time series approach. First, by pooling time series and cross sections, finite sample power of test is significantly improved. The conventional unit root tests such as augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are widely reported to have low power performance when the time-series sample size is small. Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (1997, 2003) among others demonstrate that the power of unit root tests using panel data is substantially improved over univariate testing procedures. Ahn and Oh (2001), Mark and Sul (2001), and Pedroni (1999, 2004) also report power improvement of the panel cointegration approach. Second, pooling time series and cross sections (using panel data) may provide more useful information on the nature of the economic system of equations for a group of countries or institutions, than individually analyzing a single equation for each country or institution.

This paper allows heterogeneity in individual specific fixed effects across countries by use of nonstationary, dynamic panel testing procedures. This study contributes to the literature by applying panel unit root and cointegration testing and estimation methods to research on the finance-growth nexus and thereby improving the power performance of the relevant estimation and inference procedures. If the existence of unit roots in the various panel data series is proved by panel unit root tests, the existing studies that do not consider panel unit roots can suffer from reduced confidence on their estimation and inference results, due to the spurious regression problem of Granger and Newbold (1974). Entorf (1997) finds similar spurious regression phenomena and misleading inference results in panel data models. Kao (1999) and Phillips and Moon (1999) derive the least squares dummy variable (LSDV) estimator and asymptotic distributions of various conventional statistics for spurious regression panel data models.

In the presence of panel unit roots, it is required to estimate the regression equation by panel cointegration techniques - CCR (canonical cointegrating regression), DOLS (dynamic OLS), and FMOLS (fully-modified OLS) - , based on panel cointegration tests. Panel unit root tests can be categorized into tests assuming a common unit root process across cross sections and those positing individual unit root processes. Levin, Lin, and Chu (LLC, 2002), Breitung (2000), Hadri (2000), and Harris and Tzavalis (1999) all postulate that there is a common unit root process across cross sections. Im, Pesaran, and Shin (IPS, 2003), Choi (2001), Maddala and Wu (MW, 1999) propose panel unit root tests that allow for individual unit root processes, so that the persistence parameter (autocorrelation coefficient) may vary across cross sections. Among these, only Hadri (2000)'s panel unit root test has the null hypothesis of no unit root, similar to the single series unit root test of Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992). All other panel unit root tests have the null of unit roots. All the researchers above corroborate the fact that panel unit root tests have a greater power than conventional single-series unit root tests by Monte Carlo simulations.

Kao (1999), McCoskey and Kao (1998), and Pedroni (1999, 2004) have proposed panel cointegration tests. Kao (1999) presents residual-based tests for cointegration regression in panel data. He constructs Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) tests for the null of no cointegration. McCoskey and Kao (1998) propose a residual-based Lagrange multiplier (LM) test for the null of cointegration in panel data. They find that the empirical sizes of the LM-FM and LM-DOLS are close to the true size even in small samples. In the model that McCoskey and Kao (1998) use, both intercepts and slope coefficients may vary across cross-sectional

units as in Im, Pesaran, and Shin (1997, 2003), and Pedroni (1999, 2004).

Pedroni (1999, 2004) examines the properties of residual-based tests for the null of no cointegration for dynamic panels in which both the short-run dynamics and the long-run slope coefficients are permitted to be heterogeneous across individual members of the panel. He considers both pooled within dimension tests and group mean between dimension tests. He shows that the limiting distributions of the tests are normal and free of nuisance parameters. He derives seven test statistics for the null of no cointegration in heterogeneous panels with multiple regressors. He demonstrates that following appropriate standardizations, each of the seven statistics above will be distributed as standard normal when both the time series and cross-sectional dimensions of the panel grow large.

Kao and Chiang (2000) study the asymptotic distributions for OLS, FMOLS, and DOLS estimators in cointegrated regression models of panel data. Their Monte Carlo simulation results show that the OLS estimator has a non-negligible bias in finite samples, the FMOLS estimator does not improve over the OLS estimator in general, and the DOLS outperforms both the OLS and FMOLS estimators. Pedroni (2000, 2004) also presents independently estimation methods of the panel cointegration model using FMOLS. In this paper, we estimate the panel regression model of the output-finance equation, utilizing CCR, DOLS, and FMOLS techniques, after properly considering the panel unit root test results on the data variables. Due to space limitations, technical details of specific panel cointegration tests and estimation procedures have been omitted from the paper. Readers may refer to the papers summarized above for technical details.

III. EMPIRICAL ANALYSIS

1. Data

Empirical analysis of this paper uses annual macroeconomic data on the panel of 27 Asian countries over the 1960-2009 period, extracted from the *World Development Indicators (WDI) 2010* of the World Bank. The 27 Asian countries consist of Bangladesh, Bhutan, Brunei, Cambodia, China, Hong Kong, India, Indonesia, Japan, Kazakhstan, Korea, Kyrgyz Republic, Lao PDR, Macao, Malaysia, Maldives, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Tajiskistan, Thailand, Turkmenistan, Uzbekistan, and Vietnam.

The macroeconomic data include real GDP, proxies for financial development - M2/GDP, M3/GDP, domestic credit/GDP, and market capitalization/GDP -, investment/GDP, inflation in consumer prices, etc. Real GDP is an index with 100

in 2000, converted from constant 2000 US dollars. In the panel regression model, real GDP or a financial development proxy is used as the dependent variable and financial development or real GDP, the investment ratio, consumer price inflation, etc. are included as explanatory variables.

In the World Bank's *WDI* data set, M2 is defined as money and quasi money, M3 as liquid liabilities, domestic credit as domestic credit to the private sector, and market capitalization as the market value of listed companies' stocks. Recent studies using M2, M3, domestic credit and market capitalization ratios involve Ang and McKibbin (2007), Beck and Levine (2004), Levine et al. (2000), Calderon and Liu (2003), Liang and Teng (2006), McCaig and Stengos (2005), and Rousseau and Wachtel (2000). Among monetary aggregates, M2 is a broad money comprising currency, demand and savings deposits, while M3 is defined as a measure of comprehensive financial development covering liquid liabilities of financial

Table 1. Descriptive statistics of the variables for Asian countries (1960-2009)

Variable Name	Definition	Mean	Median	Std.Dev.	Minimum	Maximum	No.of Obs.
RGDP (real GDP)	Real GDP index (2000=100)	75.26	71.03	51.53	4.00	321.45	1,017
M2R (M2 ratio)	M2(Money&quasi-money)/GDP	52.48	35.68	48.77	1.60	298.89	867
M3R (M3 ratio)	M3(Liquid liabilities)/GDP	54.59	38.40	50.19	5.41	243.84	368
DCR(domestic credit ratio)	Domestic credit to private sector/GDP	44.27	25.65	46.08	0	231.08	882
DCBR(domestic credit provided by banking sector ratio)	Domestic credit provided by banking sector/GDP	56.29	40.92	60.73	-19.14	439.97	881
MCR(market capitalization ratio)	Securities market capitalization/GDP	62.15	31.15	87.52	0.04	617.05	356
IR (investment ratio)	Gross capital formation/GDP	24.70	23.69	9.99	4.35	70.23	1,039
FIR(fixed investment ratio)	Gross fixed capital formation/GDP	24.69	23.57	9.13	6.18	65.56	954
INF (inflation rate)	Inflation rate (consumer prices)	13.04	6.12	77.56	-13.23	1,877.37	846

Note: The entire sample (1960-2009) consists of 27 Asian countries. RGDP is an index variable with 2000=100 as the benchmark.
Source: World Bank(2010), *World Development Indicators 2010.*

institutions, including deposits at nonbank financial intermediaries, financial bonds, negotiable certificates of deposit (CDs), sales of commercial papers (CPs), repurchase agreements(RPs), etc.

Some scholars argue that the domestic credit ratio is a superior measure of the development of the financial intermediation (indirect finance) market, since the banking sector's domestic credit to the private sector is more directly linked to investment and economic growth than monetary aggregates such as M2 and M3. For instance, McCaig and Stengos (2005) find that there is a strong positive effect of financial development on economic growth, when financial development is measured as domestic credit (to the private sector) or M3 over GDP. Rousseau and Wachtel (2000) employ the market capitalization (of listed companies)/GDP ratio to measure the development of the capital (direct finance) markets in addition to the above variables.

Table 1 presents the definitions of the variables, descriptive statistics, and sources of data used in this paper.

2. Empirical Results

The empirical analysis in this paper is performed in 3 steps. First, 5 distinct types of panel unit root tests are employed to confirm the nonstationarity of the series in a panel system of the entire Asian countries. Second, 2 types of panel cointegration tests (Kao and Pedroni) are used to establish a cointegrating (long-term equilibrium) relationship between output and financial development proxies. Third, 3 types of panel cointegration estimation techniques - CCR, DOLS, and FMOLS - are utilized to estimate the output-finance regression equation. This estimation is performed in both directions with the dependent and independent variables interchanged to find evidence for the existence of a bi-directional relationship between output growth and financial development.

This section reports the results of panel unit root and cointegration tests on the variables, and estimation of the growth-finance equation by three panel cointegration estimation procedures: CCR, DOLS, and FMOLS.

First, Table 2 exhibits the results of five distinct panel unit root tests on the variables of 27 Asian countries over 1960-2009: Levin, Lin, and Chu (LLC 2002)'s t*, Breitung (2000)'s t, Hadri (2000)'s Z, Im, Pesaran, and Shin (IPS 2003)'s W, and Maddala and Wu (1999)'s ADF-Fisher χ^2 statistics. Among these, LLC, Breitung, and Hadri's tests are based on the common unit root process assumption that the autocorrelation coefficients of the tested variables across cross sections are identical. However, IPS and ADF-Fisher χ^2 tests rely on the individual unit root

process assumption that the autocorrelation coefficients vary across cross sections. All the other 4 panel unit root tests except for Hadri (2000)'s have the null hypothesis of unit roots, while Hadri's test posits the null of no unit roots (stationarity).

The five distinct panel unit root tests in Table 2 confirm that the variables of 27 Asian countries - Real GDP (RGDP), M3/GDP(M3R), M2/GDP(M2R), domestic credit/GDP(DCR), market capitalization/GDP(MCR), the (fixed) investment ratio ((F)IR), consumer price inflation(INF) - have unit roots and are thus nonstationary, respectively.

Table 2. Panel unit root tests for the variables in Asian countries (1960-2009)

	Tests Assuming a Common Unit Root Process			Tests Assuming Individual Unit Root Processes	
Series Name	LLC t*-stat: H_0: Unit root	Breitung t-stat: H_0: Unit root	Hadri Z-stat: H_0: No unit root	IPS W-stat: H_0: Unit root	ADF-Fisher χ^2: H_0: Unit root
RGDP	13.80 (1.00)	16.17 (1.00)	25.52 (0.00**)	15.75 (1.00)	8.83 (1.00)
M2R	3.43 (1.00)	2.01 (0.98)	19.64 (0.00**)	7.27 (1.00)	22.23 (1.00)
M3R	0.27 (0.61)	0.65 (0.74)	11.79 (0.00**)	2.43 (0.99)	11.88 (0.96)
DCR	2.71 (1.00)	6.31 (1.00)	19.58 (0.00**)	4.12 (1.00)	60.71 (0.19)
DCBR	2.17 (0.98)	2.52 (0.99)	22.01 (0.00**)	2.80 (1.00)	57.23 (0.29)
MCR	-0.83 (0.20)	-1.4E-12 (0.50)	16.92 (0.00**)	-0.41 (0.34)	45.34 (0.19)
IR	-0.56 (0.29)	-0.22 (0.41)	11.04 (0.00**)	0.49 (0.69)	52.72 (0.52)
FIR	0.68 (0.75)	2.03 (0.98)	9.60 (0.00**)	1.07 (0.86)	47.49 (0.72)
INF	-1.25 (0.11)	-7.80 (0.12)	6.29 (0.00**)	-7.92 (0.12)	53.24 (0.99)

Note: Numbers in parentheses denote marginal significance levels (p-values). * and ** denote significance at 5% and 1%, respectively. All the other 4 panel unit root tests above except for Hadri (2000)'s have the null hypothesis of unit roots (nonstationarity), while Hadri's test posits the null of no unit roots (stationarity).

Table 3 presents the results of panel cointegration tests for 27 Asian countries over 1960-2009. The Table shows two different kinds of panel cointegration tests: residual-based tests of Kao (1999) and Pedroni (2004). The null hypothesis of all the tests is no cointegration. The majority of Pedroni's test statistics for heterogeneous panels and Kao's ADF t statistics indicate the possibility of a bi-directional cointegrating (or long-run equilibrium) relationship between RGDP and a proxy of financial development: M2R, DCR, DCBR, and MCR.

Table 4 reports estimation results of the RGDP-M2R (=M2/GDP=money&quasi-money/GDP ratio) regression model by three types of panel cointegration estimation techniques: CCR, DOLS, and FMOLS. The estimation results show that there is a statistically significant positive relationship between RGDP and M2R in both

Table 3. Panel cointegration tests of the regression equation in Asian countries (1960-2009)

Panel coint. tests	Dep. var. of coint. reg.		Dep. var. of coint. reg.		Dep. var. of coint. reg.		Dep. var. of coint. reg.	
Pedroni (H_0: No coint.)	RGDP	M2R	RGDP	DCR	RGDP	DCBR	RGDP	MCR
Panel V (nu)	18.89 (0.00**)	13.10 (0.00**)	0.54 (0.30)	7.81 (0.00**)	6.43 (0.00**)	3.05 (0.00**)	-2.84 (1.00)	6.67 (0.00**)
Panel ρ (rho)	-5.38 (0.00**)	-5.93 (0.00**)	-2.38 (0.01**)	-4.00 (0.00**)	-3.58 (0.00**)	-2.39 (0.01**)	-5.24 (0.00**)	-7.05 (0.00**)
Panel PP	-2.61 (0.00**)	-3.60 (0.00**)	-5.37 (0.00**)	-4.34 (0.00**)	-1.78 (0.04*)	-1.58 (0.06)	-5.57 (0.00**)	-8.09 (0.00**)
Panel ADF	-10.80 (0.00**)	-12.08 (0.00**)	-6.95 (0.00**)	-8.22 (0.00**)	-3.50 (0.00**)	-2.67 (0.00**)	-5.58 (0.00**)	-7.87 (0.00**)
Group ρ (rho)	-2.39 (0.01**)	-2.90 (0.00**)	1.79 (0.96)	-1.26 (0.10)	3.85 (1.00)	0.27 (0.61)	-1.19 (0.12)	-3.23 (0.00**)
Group PP	-1.18 (0.12)	-2.35 (0.01**)	-5.21 (0.00**)	-3.05 (0.00**)	4.06 (1.00)	-2.06 (0.02*)	-4.13 (0.00**)	-6.26 (0.00**)
Group ADF	-10.90 (0.00**)	-12.42 (0.00**)	-7.40 (0.00**)	-7.25 (0.00**)	4.10 (1.00)	-5.49 (0.00**)	-4.46 (0.00**)	-7.69 (0.00**)
Kao ADF t (H_0: No coint.)	-16.46 (0.00**)	-19.22 (0.00**)	-7.91 (0.00**)	-10.02 (0.00**)	-3.07 (0.00**)	-4.77 (0.00**)	2.53 (0.01**)	-7.12 (0.00**)

Note: Dep. var. of coint. reg.=dependent variable of the cointegrating regression. H_0=null hypothesis, coint.= cointegration. Numbers in parentheses denote marginal significance levels (p-values). * and ** denote significance at 5% and 1%, respectively.

directions. This suggests that financial development proxied by M2R enhances output growth and economic growth tends to deepen financial development.

Due to the errors arising from the insufficient number of data points on M3R (M3/GDP=liquid liabilities/GDP ratio), panel regressions could not be run using M3R, so that DCR and domestic credit by banking sector (DCBR) have been employed instead of M3R for robustness tests. Table 5 exhibits estimation results of the RGDP-DCR (=domestic credit to private sector/GDP ratio) regression model by three types of panel cointegration estimation techniques. The estimation results show that there is a statistically significant positive relationship between RGDP and DCR in both directions. This suggests that the banking sector's financial development proxied by DCR boosts output growth and economic growth tends to stimulate further financial development.

Table 4. Panel cointegration estimation results using M2R (1960-2009)

Dep. var.: real GDP (RGDP)				Dep. var.: M2/GDP (M2R)			
Regressor	CCR	DOLS	FMOLS	Regressor	CCR	DOLS	FMOLS
M2R	0.51(0.00**)	0.39(0.00**)	0.50(0.00**)	RGDP	0.71(0.00**)	1.66(0.00**)	1.05(0.00**)
FIR	0.05(0.00**)	0.06(0.00**)	0.05(0.00**)	FIR	0.03(0.00**)	-0.07(0.00**)	-0.002(0.77)
INF	0.01(0.00**)	-0.02(0.00**)	0.01(0.00**)	INF	0.01(0.02*)	-0.05(0.00**)	0.00(0.20)
R^2	0.98	0.99	0.98	R^2	0.92	0.98	0.95
Adjusted R^2	0.98	0.99	0.98	Adjusted R^2	0.92	0.98	0.94

Note: M2R=M2 ratio=Money and quasi-money(M2)/GDP. Dep.var.=dependent variable, CCR=canonical cointegrating regression, DOLS=dynamic OLS, and FMOLS=fully-modified OLS. * and ** denote significance at 5% and 1%, respectively. Numbers in parentheses represent marginal significance levels(p=p-value) from the cointegrating regressions. Figures in the Table are organized in the order of coef(prob)=coefficient estimate(p-value). The standard errors used in the calculations of the t-statistics in all the Tables are panel heteroskedasticity consistent standard errors of the White (1980) type.

Table 6 presents estimation results of the RGDP-DCBR(=domestic credit provided by banking sector/GDP ratio) regression model by three types of panel cointegration estimation techniques. The estimation results show that there is a strong positive relationship between RGDP and DCBR in both directions. This implies that the

Table 5. Panel cointegration estimation results using DCR (1960-2009)

Dep. var.: real GDP (RGDP)				Dep. var.: domestic credit to private sector/ GDP (DCR)			
Regressor	CCR	DOLS	FMOLS	Regressor	CCR	DOLS	FMOLS
DCR	0.72(0.00**)	1.29(0.00**)	0.66(0.00**)	RGDP	0.47(0.00**)	0.08(0.10)	0.52(0.00**)
FIR	0.02(0.00**)	-0.04(0.00**)	0.03(0.00**)	FIR	0.06(0.00**)	0.14(0.00**)	0.05(0.00**)
INF	0.003(0.07)	-0.01(0.00**)	0.003(0.03*)	INF	0.01(0.00**)	0.07(0.00**)	0.01(0.00**)
R^2	0.96	0.99	0.96	R^2	0.96	0.98	0.96
Adjusted R^2	0.96	0.99	0.96	Adjusted R^2	0.96	0.98	0.96

Note: DCR=Domestic credit ratio=Domestic credit to private sector/GDP. Dep.var.=dependent variable, CCR=canonical cointegrating regression, DOLS=dynamic OLS, and FMOLS=fully-modified OLS. * and ** denote significance at 5% and 1%, respectively. Numbers in parentheses represent t-ratios(t) and marginal significance levels(p=p-value) from the cointegrating regressions. Figures in the Table are organized in the order of coef(t; prob)=coefficient estimate(t-ratio; p-value). The standard errors used in the calculations of the t-statistics in all the Tables are panel heteroskedasticity consistent standard errors of the White (1980) type.

Table 6. Panel cointegration estimation results using DCBR (1960-2009)

Dep. var.: Real GDP (RGDP)				Dep. var.: Domestic credit by banking sector/GDP (DCBR)			
Regressor	CCR	DOLS	FMOLS	Regressor	CCR	DOLS	FMOLS
DCBR	0.31(0.00**)	0.44(0.00**)	0.33(0.00**)	RGDP	0.03(0.77)	0.39(0.00**)	0.44(0.00**)
FIR	0.06(0.00**)	0.15(0.00**)	0.06(0.00**)	FIR	0.11(0.00**)	0.13(0.00**)	0.08(0.00**)
INF	0.01(0.00**)	0.03(0.00**)	0.01(0.00**)	INF	0.01(0.00**)	0.03(0.00**)	0.01(0.00**)
R^2	0.95	0.99	0.95	R^2	0.91	0.97	0.92
Adjusted R^2	0.95	0.99	0.95	Adjusted R^2	0.90	0.97	0.92

Note: DCBR=Domestic credit provided by banking sector/GDP. Dep.var.=dependent variable, CCR=canonical cointegrating regression, DOLS=dynamic OLS, and FMOLS=fully-modified OLS. * and ** denote significance at 5% and 1%, respectively. Numbers in parentheses represent marginal significance levels(p=p-value) from the cointegrating regressions. Figures in the Table are organized in the order of coef(prob)=coefficient estimate(p-value). The standard errors used in the calculations of the t-statistics in all the Tables are panel heteroskedasticity consistent standard errors of the White (1980) type.

positive link between output and domestic credit is as strong as the link between output and monetary aggregates such as M2.

Table 7 exhibits estimation results of the RGDP-MCR(=market capitalization ratio) regression model by three types of panel cointegration estimation techniques. The estimation results show that there is a statistically significant positive relationship between RGDP and MCR in both directions. This suggests that securities market development proxied by MCR promotes output growth and economic growth tends to accelerate securities market development.

Summing up the results in Tables 2-7, we find that the variables used in the output-finance regression equation are integrated of order one or nonstationary in a panel system of 27 Asian countries by 5 panel unit root tests. The residual-based panel cointegration tests of Kao (1999) and Pedroni (2004) both provide evidence suggesting that there is one bi-directional cointegrating relationship between real GDP and financial development proxies: the M2, M3, and domestic credit ratios.

Estimation results of the output-finance regression equation by 3 types of panel cointegration methodology - CCR, DOLS, and FMOLS - indicate that there is a statistically significant positive (long-run equilibrium) relationship between real GDP and the M2, domestic credit, and market capitalization ratios (M2R, DCR, and MCR) in both directions. This suggests that financial development in banking and securities markets has enhanced output growth and economic growth has stimulated further financial development for 27 Asian countries over the 1960-2009 period.

Table 7. Panel cointegration estimation results using MCR (1960-2009)

Dep. var.: Real GDP (RGDP)				Dep. var.: Market Capitalization/GDP (MCR)			
Regressor	CCR	DOLS	FMOLS	Regressor	CCR	DOLS	FMOLS
MCR	0.08(0.00**)	0.06(0.00**)	0.07(0.00**)	RGDP	3.84(0.00**)	8.08(0.00**)	2.84(0.00**)
FIR	0.09(0.00**)	0.08(0.00**)	0.09(0.00**)	FIR	-0.19(0.00**)	-0.41(0.00**)	-0.11(0.00**)
INF	0.08(0.00**)	0.02(0.00**)	0.01(0.00**)	INF	0.001(0.88)	0.18(0.00**)	0.01(0.14)
R^2	0.93	0.99	0.93	R^2	0.51	0.82	0.57
Adjusted R^2	0.93	0.99	0.93	Adjusted R^2	0.51	0.82	0.57

Note: MCR=market capitalization ratio=market capitalization of listed companies/GDP. Dep.var.= dependent variable, CCR=canonical cointegrating regression, DOLS=dynamic OLS, and FMOLS=fully-modified OLS. * and ** denote significance at 5% and 1%, respectively. Numbers in parentheses represent marginal significance levels(p=p-value) from the cointegrating regressions. Figures in the Table are organized in the order of coef(prob)=coefficient estimate(p-value). The standard errors used in the calculations of the t-statistics in all the Tables are panel heteroskedasticity consistent standard errors of the White (1980) type.

IV. CONCLUDING REMARKS

This paper explores the nexus between economic growth and financial development for a panel of 27 Asian economies over the 1960-2009 period. Annual macroeconomic data extracted from the World Bank's *World Development Indicators 2010* are utilized in empirical analysis for 27 Asian countries.

This research differs from the existing literature on the output-finance nexus in the following respects. First, this paper contributes to the literature on the growth-finance link by enhancing the power and accuracy of inference and estimation using recently developed panel cointegration techniques, combined with more expanded panel datasets over time and space (including more time series and cross-section countries) to derive policy implications. In the current literature on the output-finance nexus, most studies have used only cross-section or time-series data, and even when panel data were used, they did not perform panel unit root or cointegration test and estimation. We explore the growth-finance relationship for a full set of 27 Asian countries over 50 years in a panel cointegration framework, in contrast to most existing studies employing other methodologies and smaller subsets of countries over shorter periods.

Second, we find that there is a statistically significant bi-directional cointegration (long-run equilibrium) relationship between output growth and financial development proxies encompassing both indirect-finance (banking) and direct-finance (securities) sectors for a sample of 27 Asian countries over the 1960-2009 period. To date, conflicting,

controversial, and mixed evidence, ranging from a uni-directional and bi-directional relationship, to no relationship at all between finance and growth has been reported in the current literature. Empirical results in this paper imply that financial-market development policy is essential in the growth strategy of developing countries.

In this paper, real GDP and financial development proxies - the M2, domestic credit, and market capitalization ratios - are found to be nonstationary and cointegrated, based on 5 different panel unit root tests and 3 types of panel cointegration tests. The residual-based panel cointegration tests of Pedroni (2004) and Kao (1999) all indicate rejection of the null hypothesis of no cointegration at conventional significance levels, implying the existence of panel cointegration.

Empirical findings of this paper may be summarized as follows. First, we find that real GDP and financial development proxy series - the M2, M3, domestic credit, and market capitalization ratios - are integrated of order one (nonstationary) in a panel system of 27 Asian countries. The residual-based panel cointegration tests of Kao (1999) and Pedroni (2004) both provide evidence suggesting that there is one bi-directional cointegrating relationship between real GDP and financial development proxies. Second, estimation results of the output-finance regression equation by 3 types of panel cointegration methodology - CCR, DOLS, and FMOLS - indicate that there is a statistically significant positive (long-run equilibrium) relationship between real GDP and the M2, domestic credit, and market capitalization ratios in both directions. This suggests that financial market development has enhanced output growth and economic growth in turn has stimulated financial development for 27 Asian countries over the 1960-2009 period.

Third, this has a significant policy implication that a well-planned financial policy for promoting the development of domestic financial markets encompassing the banking and securities sectors is a crucial growth strategy for developing economies. The parallel development strategy of the indirect (banking) and direct finance (securities) markets in the economy is essential to the acceleration of economic growth as advocated by many researchers such as Beck and Levine (2004), Benhabib and Spiegel (2000), Chakraborty and Ray (2006), Deidda and Fattouh (2006), Liu and Hsu (2006), Naceur and Ghazouani (2006), Nili and Rastad (2007) among others.

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First version received on 28 November 2011
Peer-reviewed version received on 29 February 2012
Final version accepted on 13 March 2012