The Causality in the Finance-Growth Nexus: Superexogeneity Tests from Five Asian Countries

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Abstract

Unlike earlier empirical studies, all of which relied essentially on the Granger-causality test, our study utilizes the concepts of control causality and superexogeneity to examine the causality between financial development and economic growth in five Asian Countries; Korea, Singapore, Malaysia, Indonesia, and Thailand. We find that for the case of Korea and Singapore the financial development control causes the economic growth, providing empirical evidence supporting the view that 'financial development causes economic growth' in these countries. In the case of Malaysia, on the other hand, we find that the economic growth control causes the financial development. For Indonesia and Thailand, we cannot determine the direction of causality between financial development and growth. Therefore, our overall finding as to the direction of the causal relationship in the finance-growth nexus from five Asian countries is mixed. In evaluating the mixed results for the causal direction in the linkage between financial development and economic growth, we realize that we are in need of the microeconomic analysis of the linkage between financial development and growth. In this regard, a clearly promising area of research is microeconomic analysis of the linkage between the financial development and economic growth.

JEL Classification: O40, G10, C49

Key Words: Control Causality, Superexogeneity, Financial Development, Economic Growth
I. INTRODUCTION

A large volume of literature, both theoretical and empirical, developed over time regarding the relationship between financial development and economic growth. On the theoretical front, Joseph A. Schumpeter (1911) was probably the first to argue that the financial services provided by financial intermediaries were essential for technological innovation and economic growth. McKinnon (1973), Shaw (1973) and others also view financial development exerting influence in the process of economic growth. Other scholar, most notably Robinson (1952), however, presented an opposite view that financial development follows economic growth. More recently, Greenwood and Jovanovic (1990) present a model in which financial intermediation and economic growth are endogenously determined. Finally, a fourth view, which was originally put forth by Lucas(1988), argues that financial development and economic growth are not causally related. Therefore, as far as the theory goes, there are four alternative views on the causality in the finance-growth nexus.

Earlier empirical work by Goldsmith (1969) and McKinnon (1973) confirmed the positive influence of the development of a country's financial sector on the rate of economic growth. In more recent years, much research effort was devoted to the quantitative assessment and reassessment of the finance-growth nexus. For example, King and Levine (1993), Rajan and Zingales (1998), and Levine, Loayza, and Beck (2000) provide empirical evidence, supportive of the 'finance leads and growth follows' view, while Demetrides and Hussein (1999) provide evidence in support of "growth leads and finance follows' view. Still Luintel and Khan (1999) present evidence of bi-directional causality between financial development and economic growth.

While the majority of the findings of these empirical works show that the degree of financial development is a good predictor of economic growth, they simply suggest correlation, and do not resolve the issue of causality. The approach adopted in these recent empirical studies are a post hoc, ergo propter hoc, as Rajan and Zingales (1998) point out. For a similar problem of inferring causality from correlation in studies of whether or not monetary policy matters, one may consult works by Tobin (1970) and
As is well known, temporal predictability does not address the issue of control. Applying this idea to the finance-growth nexus, Granger-causality allows us to answer the question of "Does knowledge of financial development help policy makers predict output growth?". But it cannot answer the question of "Must financial development be put in place first in order to cause economic growth in the future?"

To investigate the causal direction between financial development and economic growth, one may resort to a concept of control causality. As discussed elsewhere, A causes B in Simon (1953) sense if the control of A makes B controllable. The concept of control causality is more fully explained in earlier works by Simon (1953), Hoover (1990, 2001), Hoover and Sheffrin (1992), Perez (1998), and Hoover and Siegler (2000).

The main objective of the present paper is to investigate the control causality between financial development and economic growth for a wide variety of countries, particularly those emerging countries in Asia, Korea, Singapore, Malaysia, Indonesia, and Thailand, which have experience diverse growth experienced and financial reforms.

The remainder of the article is organized as follows. Section 2 discusses the concept of control causality and its application to the testing of causality in the growth and financial development nexus. We also describe in this section how the two conditions of superexogeneity are related to conditions for the control causality. Section 3 outlines an empirical methodology of implementing the test for superexogeneity. Section 4 presents our estimation results for the test of superexogeneity for five Asian countries, and Section 5 concludes.
II. CONTROL CAUSALITY, ECONOMIC GROWTH AND FINANCIAL DEVELOPMENT

To investigate the causal relationship between financial development and economic growth, one may resort to an old but newly resurrected causality concept, namely "control causality". We consider control causality between economic growth ($Y$) and financial development (FD). The concept of control causality is based on the relations of block recursion in the true, unobservable process that generates the observed data. In Simon(1953)'s sense, FD causes $Y$ if control of FD makes $Y$ controllable.\(^1\) If FD causes $Y$, the data may be generated by the following:

\begin{align}
Y_t &= \beta FD_t + \epsilon_t, \quad \epsilon_t \overset{iid}{\sim} N(0, \sigma^2) \tag{1} \\
FD_t &= \delta + u_t, \quad u_t \overset{iid}{\sim} N(0, \sigma^u) \tag{2}
\end{align}

The joint probability distribution of economic growth and financial development, $D(Y, FD)$ can be partitioned into a conditional distribution and a marginal distribution in two ways.

$$D(Y, FD) = D(Y \mid FD)D(FD) = D(FD \mid Y)D(Y)$$

Within a single regime, these factorizations are observationally equivalent. However, under regime change, they show different behavior in stability sense, as will be explained later. The parameters of the income process are $\beta$ and $\sigma^2$, and those of the financial development process are $\delta$ and $\sigma^u$.

Simon's analysis identifies the control causality as a property that is invariant to interventions in the data generating process. The intervention is represented by the change in parameters of the process. Because data from a single regime cannot give us information on the causal relation, we should consider regime change, i.e. intervention by change in parameters.

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\(^1\) See Hoover(1990), Hoover and Sheffrin(1992), and Perez(1998).
From the bivariate joint normal distribution of Y and FD, \( D(Y_i | FD_i) \) is given by

\[
D(Y_i | FD_i) = N(\mu'_i + \theta_i (FD_i - \mu'_FD), \eta_i)
\]

where

\[
\theta_i = \rho_i \frac{\sigma'_i}{\sigma'_FD}, \quad \rho_i = \frac{\sigma'_i,FD}{\sigma'_i \sigma'_FD}, \quad \eta_i = \sigma'_y (1 - \rho^2_i).
\]

On the other hand, \( D(FD_i | Y_i) \) can be expressed similarly. From the bivariate joint normal distribution of Y and FD with equation (3), the resulting distributions can be obtained as follows:

\[
D(Y | FD) = N(\beta FD, \sigma^2_e),
\]

\[
D(FD) = N(\delta, \sigma^2_e),
\]

\[
D(FD | Y) = N(\frac{\beta \sigma^2_e Y + \delta \sigma^2_Z}{\beta^2 \sigma^4_u + \sigma^2_e}, \frac{\sigma^2_e \sigma^2_Z}{\beta^2 \sigma^4_u + \sigma^2_e}),
\]

\[
D(Y) = N(\beta \delta, \beta^2 \sigma^2_e + \sigma^2_Z).
\]

If equations (1) and (2) are true, i.e., if FD causes Y, then structural changes in the financial development, changes in \( \delta \) and \( \sigma^2_e \), result in the instability of \( D(FD) \), \( D(FD | Y) \), and \( D(Y) \), and the stability of \( D(Y | FD) \). Structural changes in economic growth (changes in \( \beta \) and \( \sigma^2_Z \)), however, result in the instability of \( D(Y | FD) \), \( D(FD | Y) \), and \( D(Y) \), and the stability of \( D(FD) \).

However, if Y causes FD, then the corresponding results in the conditional and marginal distributions and stability conditions are reversed. Therefore, one-way control causation indicates three unstable and one stable distribution; and mutual control causation means four unstable distributions.

3) For the derivations, one may again consult works by Mood, Graybill, and Boes (1974), Hoover (1990), and Hoover and Sheffrin (1992). For more details on the derivations of these equations, see Appendix 1.
The stability conditions in the control causality are closely related to parameter invariance, and control causality is closely related to superexogeneity. Perez (2002) shows that the complexity of determining control causality is simplified by adopting the concept of superexogeneity proposed by Engle, Hendry and Richard (1983).

As discussed above, control causality from FD to Y holds if the parameters (\( \beta \) and \( \sigma^2_\varepsilon \)) of the conditional equation (1) are constant with respect to changes in the parameters (\( \delta \) and \( \sigma^2_u \)) of the marginal equation (2).

The superexogeneity of FD for the parameters (\( \beta \) and \( \sigma^2_\varepsilon \)) of the conditional equation for Y holds if the inference on is not affected by the way the parameters (\( \delta \) and \( \sigma^2_u \)) of the marginal equation for FD are specified (weak exogeneity of FD for \( \beta \)), and changes in do not imply changes in (invariance of \( \beta \)). These two conditions in the test of superexogeneity under the stable conditional equation are equivalent to the conditions for the test for control causality.
III. EMPIRICAL METHODOLOGY

The conditional and marginal distributions can be interpreted as regression equations, as in Hoover (1990, p. 226) and Engle and Hendry (1993, p. 123). Equations (1) and (2) are generalized as follows, following Engle and Hendry (1993).

\[ Y_t = \beta FD_t + z_t \gamma + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma^2_{\epsilon}) \]  
\( t \) (4)

\[ FD_t = x_t \delta + u_t, \quad u_t \sim N(0, \sigma^2_u) \]  
\( t \) (5)

where \( z_t \) is a set of variables included in the information set, and \( x_t \) is a set of variables explaining \( FD_t \). We allow \( \beta \) to be a variable, \( \beta' \), and take a linear approximation of the mean of the first term of RHS in Equation (4), \( \beta' \mu_{FD} \), with respect to \( \mu_{FD} \) and \( \sigma_{FD,FD} \),

\[ \beta' \mu_{FD} = \beta (\mu_{FD}, \sigma_{FD,FD}) \mu_{FD} = \beta_0 \mu_{FD} + \beta_1 \sigma_{FD,FD} \]  
\( t \) (6)

After substituting the conditional mean of \( Y_t \), \( \mu_t = \beta_0 \mu_{FD} + \beta_1 \sigma_{FD,FD} \), into Equation (3) yields

\[ D(Y_t | FD_t) = N(\beta_0 FD_t + z_t \gamma + (\theta_t - \beta_0)(FD_t - \mu_{FD}) + \beta_1 \sigma_{FD,FD}, \eta_t) \]  
\( t \) (10)

Finally, we can have the Y conditional equation for regression,

\[ Y_t = \beta_0 FD_t + z_t \gamma + (\theta_t - \beta_0) \tilde{u}_t + \beta_1 \tilde{u}_t^2 + \epsilon_t \]  
\( t \) (7)
where $\hat{u}_t = FD_t - \mu_{FD}$, $\sigma^2_{FD}$ is used for the proxy of $\sigma^2_{FD,FD}$. The weak exogeneity condition requires that $\theta_t = \beta_0$, and the invariance condition requires that $\beta_1 = 0$. The test for superexogeneity of FD for $\beta$ can be performed by the F-test of exclusion of $\hat{u}_t$ and $\hat{u}_t^2$ in Equation (7).

To consider the case of reverse causality from economic growth to financial development, we may set up the conditional and marginal equations similarly. The conditional equation for FD may be expressed as

$$FD_t = \beta_0 Y_t + z_t \gamma + (\theta_t - \beta_0) \hat{u}_t + \beta_1 \hat{u}_t^2 + \epsilon_t$$

where $\hat{u}_t = Y_t - \mu_{Y}$. The test for superexogeneity of Y for $\beta$ can be again performed by the F-test of exclusion of $\hat{u}_t$ and $\hat{u}_t^2$ in the above equation.

The final step in the empirical implementation of the test requires the parameterization of conditional equation (4) and the marginal equation (5), which are presented as follows:

$$D(Y_t | FD_t, R_t) = \Delta \ln Y_t = \alpha + \sum \beta_i \Delta FD_{t-1} + \sum \gamma_i \Delta \ln Y_{t-1} + d \ln Y_{t-1} + e FD_{t-1} + \sum j_i R_{t-1} + \epsilon_t$$  \hspace{1cm} (8)

$$D(FD_t | R_t) = \Delta FD_t = a + \sum b_i \Delta FD_{t-1} + c FD_{t-1} + \sum g_i R_{t-1} + u_t$$ \hspace{1cm} (9)

where R represents the real interest rate, which is a control variable, to account for both the contribution of investment to economic growth and its effect on financial development. In Equations (8) and (9), the variables FD and Y are introduced both in

4) Engle and Hendry (1993) used a three-period moving average of $u_t^2$ for the proxy of $\sigma^2_{FD,FD}$, and Perez (2002) used $u_t^2$ for the proxy of $\sigma^2_{FD,FD}$. For the simplicity, this paper follows Perez(2002).
the level and the first difference in the spirit of the error correction form to allow for both the short run and long run effects.

To test the superexogeneity of FD for the parameters of \( D(Y_t \mid FD_t, R_t) \), we insert \( \hat{u}_t \) and \( \hat{u}_t^2 \) into equation (8) and obtain the following:

\[
\Delta \ln Y_t = D(Y_t \mid FD_t, R_t) + h\hat{u}_t + k\hat{u}_t^2
\]

where \( \hat{u}_t \) and \( \hat{u}_t^2 \) are derived from the marginal equation after introducing the dummy variables to account for structural changes.
IV. EMPIRICAL RESULTS

4.1 Data

For the estimation of the conditional equation (8) and the marginal equation (9) with dummy variables, we use annual data for five Asian countries: Korea, Singapore, Malaysia, Indonesia, and Thailand. It would be ideal to add China and Taiwan to our list of five important Asian countries, which have experienced diverse economic growth and financial reforms in recent years. However, the lack of consistent and long-term data for China and Taiwan did not allow us to include them in our list. The period covered is 1972-2000 for the first four countries, but data for a somewhat shorter period of 1977-2000 is used for Thailand. The data required for the estimation are the economic growth rate (ΔlnY), the degree of financial development (FD), real interest rate (R), and real GDP (Y). FD is measured by the ratio of private credit to nominal GDP. Various measures on the size, activity and efficiency of financial development and structure were used in earlier papers by Luintel and Khan (1999) and King and Levine (1993). Following Levine, Loyza and Beck (2000), we used a broad measure of credit, "Private Credit", measured as the ratio of 'claims on private sector' by the central bank and deposit money banks to nominal GDP, multiplied by 100. The real interest rate is calculated as the nominal interest rate minus the current rate of inflation derived from the CPI. For Singapore, Malaysia, and Thailand, the money market rate (line 60b, IFS) was used, while for Korea and Indonesia the deposit rate (line 60l, IFS) was used. All data are extracted from the International Financial Statistics (IFS) database, which are internationally comparable time-series data.

4.2 Estimation of Conditional and Marginal Equations and Their Stability

Both equations (8) and (9) are first estimated by allowing for four lagged terms
for $\Delta \ln Y$ and $\Delta FD$. The final estimation results for the conditional equation, based on Hendry and Richard's (1982) 'general to specific' approach, are presented in Table 1.

[Insert Table 1]

In examining the regression results, we first want to find if the exogenous changes in the financial development exert any systematic influence on economic growth, both in the short run and long run. Focusing on the significant coefficients for $\Delta FD$ and $FD$, we first find that the short-run effect of financial development hurts growth in Korea and Malaysia, while it helps growth in Indonesia and Thailand. We also find that its longrun effect is negative in Singapore, Malaysia, and Thailand, while it is positive for Korea and Indonesia. Therefore, our results indicate that the direction of both the short-run and long-run effects of financial development on growth is mixed. A wide variety of theoretical models also suggest that financial development and improvements in financial systems can either boost or hinder growth in the long run. For example, Levine (2002) lists Hamilton, Bagehot, and Schumpeter, each putting forth a view for positive effects of financial development on growth. He also lists two situations in which financial development and improvements in the financial system can hurt growth in the long run. First, when financial development successfully allocates capital, the returns to savings may increase, which may lower the saving rate and growth rate. Second, if financial development reduces investors' riskiness, investors' precautionary savings may decline, which will in turn slow growth.

Focusing again on the significant coefficients for real interest rate (R), we find another interesting result. For Korea, we obtained a positive interest rate effect on growth in the second year, which is partly offset by a negative effect in the third year. For the rest of the countries, we noted a negative and substantial interest rate effects on growth in the first year, which are again partially offset by positive effects. In Table 1, we find that the p-value for Breusch-Godfrey serial correlation LM test statistics show no serial correlation for the conditional equation for $\Delta \ln Y$, at the 5% significance level. Overall, while the direction and significance of regression coefficients are mixed, the
specification for the regression appears reasonable to be used for its stability tests in examining the control causality.

In order to test the control causality from financial development to economic growth, the stability for the conditional equation for $\Delta \ln Y_i$ first needs to be examined. To this end, we perform three stability tests, namely, CUSUM of squares, recursive residuals, and recursive coefficients. The graphs of CUSUM of squares and recursive residuals are presented in Figures 1a through 5a in the Appendix. The results of examining the opposing case of control causality from economic growth to financial development are presented in Figures 1b through 5b in the Appendix and will be discussed later.

Briefly, the path of CUSUM of squares for Korea in Figure 1a lies within a 5% significance level and the path of recursive residuals in Figure 1a also lies within the two-standard error bands, both of which indicate the stability for the conditional equation. Additionally, the path of recursive coefficients with two-standard error bands shows relatively stable patterns. The graphs of the recursive coefficients are not presented hereafter for space consideration, but they are available upon request.

The results of these three stability tests imply that there is no structural change for the conditional equation for the case of Korea. For Singapore, we find similar results to those of Korea, as evident in Figure 2a, indicating that there is no structural change for Singapore. These stability test results for Korea and Singapore indicate that there is no structural change for the conditional equation for $\Delta \ln Y_i$ in these countries.

Continuing the same stability tests of conditional equation for Malaysia, Indonesia, and Thailand, we find that the paths of CUSUM of squares and recursive residuals in Figures 3a through 5a broke off the 5% significance line and the lower two-standard error band, indicating the instability of the conditional equations for $\Delta \ln Y_i$ in these three countries. The path of recursive coefficients for the three countries also displays large fluctuations in estimated parameters over time. These results of the stability tests for the conditional equation for the three countries clearly indicate the instability of the conditional equation for $\Delta \ln Y_i$. 

- 12 -
4.3 Test for Superexogeneity

As discussed earlier, the control causality from FD to Y requires both the stability of the conditional equation and superexogeneity of FD for parameters of the conditional equation. Since we found the stability of conditional equation only for Korea and Singapore from the above stability tests, we now need to examine the superexogeneity of FD for parameters of the conditional equation for the two countries. The first step in doing this requires us to test the existence or absence of structural breaks in the marginal equation for $\Delta FD_t$ for these two countries. To this end, we introduce the dummy variables in the marginal equation (9) on the basis of visual inspection of the path of FD over time: $D_1=1$ if year $\geq 1988$, $D_2=1$ if year $\geq 1994$ for Korea, and $D_1=1$ if year $\geq 1985$, $D_2=1$ if year $\geq 1998$ for Singapore. The results of estimated marginal equations with dummy variables are presented below:

**Korea**

$$\Delta FD_t = 1.16 + 0.28 \Delta FD_{t-1} + 0.004 FD_{t-1} - 0.01 R_{t-4} - 0.67 D_1 + 3.12*D_2$$

\begin{align*}
(3.07) & \quad (0.18) & \quad (0.07) & \quad (0.08) & \quad (1.26) & \quad (1.74) \\
R^2 = 0.37 & \quad LM(2) = 0.88 \ [0.43] & \quad \text{Jaque-Bera } \chi^2 = 0.23 \ [0.89]
\end{align*}

**Singapore**

$$\Delta FD_t = 61.75^{**} + 0.40^{**} \Delta FD_{t-2} - 0.71^{**} FD_{t-1} - 0.47^{**} R_{t-2} + 2.87 D_1 + 8.75^{***} D_2$$

\begin{align*}
(26.88) & \quad (0.18) & \quad (0.28) & \quad (0.17) & \quad (2.71) & \quad (2.71) \\
R^2 = 0.49 & \quad LM(2) = 2.17 \ [0.15] & \quad \text{Jaque-Bera } \chi^2 = 0.22 \ [0.89]
\end{align*}

The $R^2$'s for each country are 0.37 and 0.49 respectively. In addition, the p-values for Breusch-Godfrey serial correlation LM test statistics are 0.43 and 0.15 respectively, showing no serial correlation for the marginal equation for $\Delta FD_t$ in these
two countries. The standard errors reported in the regression are corrected for heteroskedasticity and serial correlation. The p-value for the Jarque-Bera normality test is 0.89 for both Korea and Singapore, which indicates that the series are normally distributed.

Now in testing the superexogeneity of FD for the parameters of the conditional equation for Korea and Singapore, we estimate and test the significance of $\hat{u}_t$ and $\hat{u}_t^2$ in Equation (10), the results of which are reported in Table 2.

[Insert Table 2]

For Korea, the estimated coefficients for $\hat{u}_t$ and $\hat{u}_t^2$ are both insignificant at the 5% level and the p-value for the joint F-test of excluding $\hat{u}_t$ and $\hat{u}_t^2$ is 0.65. For Singapore, the estimated coefficients for $\hat{u}_t$ and $\hat{u}_t^2$ are both insignificant at the 5% level and the p-value for the joint F-test of excluding $\hat{u}_t$ and $\hat{u}_t^2$ is 0.31. Therefore, the parameters of the conditional equations for economic growth in Korea and Singapore are stable during the estimation period from 1972 to 2000. This result suggests that FD is superexogeneous for the parameters of the conditional equation. From the stable conditional equation for economic growth and the superexogeneity of FD, it can then be inferred that financial development control causes economic growth in the cases of Korea and Singapore.

4.4 Test of Reverse Causality

Let us turn our attention now to the case of the reverse causality from Y to FD. To do this, we estimate the conditional equations for FD for the five Asian countries, whose results are summarized in Table 3.

[Insert Table 3]
Focusing again on the significant coefficients for $\Delta \ln Y$ in Table 3, we find that the short-run effect of economic growth on financial development is mixed with the short-run negative effects for Korea, Singapore, and Thailand and with a positive effect for Indonesia. As to its corresponding long-run effect from the coefficients for $\ln Y_{t-1}$, we find only positive effects for Singapore, Malaysia and Thailand. Thus we obtained same mixed results across countries as to the direction of the effect of economic growth on financial development. Similar mixed results were obtained for the interest rate effect on financial development. Turning to regression statistics, we note that the p-value for Breusch-Godfrey serial correlation LM test statistics show no serial correlation for the conditional equation for $\Delta FD_t$ at 5% significance level. As in Table 2, the standard errors reported in the regression are corrected for heteroskedasticity and serial correlation.

In order to test the control causality from economic growth to financial development, the stability for the conditional equation for $\Delta FD_t$ is first examined. As before, we perform three stability tests: CUSUM of squares, recursive residuals, and recursive coefficients. The graphs of the paths of CUSUM of squares and recursive residuals for the five Asian countries are presented in Figures 1b through 5b in the Appendix. Examining these figures, we first find that for Korea, Singapore, Indonesia, and Thailand, the path of CUSUM of squares went outside the 5% significance lines. At the same time, the path of recursive residuals went outside the lower two-standard error band. These results clearly indicate the instability of the conditional equations for $\Delta FD_t$ in these countries. In contrast, the path of the CUSUM of squares for Malaysia lies within a 5% significance line, and the path of recursive residuals also stays within the two-standard error bands. These results then show the stability for the conditional equation for $\Delta FD_t$ for Malaysia. Additionally, the path of recursive coefficients with two-standard error bands also shows relatively stable patterns. The results of these three stability tests imply that the conditional equation for Malaysia is found to be stable.

Since the testing control causality from Y to FD for Malaysia again requires both the stability of the conditional equation and the superexogeneity of Y for the parameters of the conditional equation, we now move on to the testing of the existence
of superexogeneity. As before, the first step in checking the superexogeneity is to examine whether or not there were structural breaks in the marginal equation for $\Delta \ln Y_t$ over time for Malaysia. To do this, we again introduce the two dummy variables in the marginal equation: $D_1=1$ if year=1985, $D_2=1$ if year=1998 for Malaysia. The estimated marginal equation for Malaysia is presented below:

\[
\Delta \ln Y_t = -5.26 + 0.39^{***} \Delta \ln Y_{t-1} + 0.90^{*} \ln Y_{t-1} - 0.16 R_{t-1} + 0.28^{**} R_{t-4} - 8.00^{***} D_1 - 15.40^{***} D_2 \\
(5.37) \quad (0.07) \quad (0.48) \quad (0.12) \quad (0.09) \quad (1.23) \quad (1.03)
\]

$R^2 = 0.96$ \quad $LM(2) = 2.69 [0.14] \quad Jaque-Bera \quad \chi^2 = 0.89 [0.64]$

The $R^2$ for Malaysia is 0.96. The $p$-value for Breusch-Godfrey serial correlation LM test statistic is 0.14, showing no serial correlation for the marginal equation for $\Delta \ln Y_t$. The $p$-value for the Jaque-Bera normality test is 0.64 for Malaysia, which indicates that the series are normally distributed.

The next step in testing the superexogeneity of $Y$ for the parameters of the conditional equation for Malaysia is to estimate and test the significance of $\hat{u}_t$ and $\hat{u}_t^2$ in the conditional equation, whose results are presented in Table 4.

[Insert Table 4]

The estimated coefficients of $\hat{u}_t$ and $\hat{u}_t^2$ are both insignificant at the 5% level and the $p$-value for the joint F-test of excluding $\hat{u}_t$ and $\hat{u}_t^2$ is 0.09. Therefore, the parameters of the conditional equation for financial development are found to be stable during the estimation period from 1972 to 2000. This result suggests that $Y$ is superexogenous for the parameters of the conditional equation for FD. As a result, we obtained the stable conditional equation for financial development and the superexogeneity of $Y$, thus it can be inferred that the economic growth control causes...
the financial development for the case of Malaysia. While this finding of causality running from growth to finance in Malaysia is interesting in itself, one has to wonder whether or not recent capital controls, or other unique factors in Malaysia, might have contributed to this finding.

Summarizing our finding thus far, we find that for the case of Korea and Singapore the financial development control causes the economic growth. However, we did not find any evidence of reverse causality from growth to financial development for the two countries. Together, these findings suggest that for Korea and Singapore there is no evidence of bi-directional causality between financial development and economic growth. For Malaysia, however, we find that the causality runs from growth to financial development. For the remaining two countries, namely Indonesia and Thailand, we cannot determine the direction of causality between financial development and growth. Therefore, our overall finding as to the direction of the causal relationship in the finance-growth nexus from five Asian countries is mixed. This shows that it is difficult to generalize across countries about the direction of causality in the relationship between financial development and economic growth. The mixed result may be partly due to the fact that economic policies and the development of financial institutions are country specific, and the direction of causation in the linkage between them is expected to be different across countries.

In evaluating our finding that for the case of Korea and Singapore the financial development control causes the economics growth, we note that per capita GDP are significantly higher in Singapore and Korea than in the remaining three Asian Countries. Specifically, per capita GDP in US dollars for Singapore and Korea are $12,616 and $5,821 in 1990 and $22,970 and $8,732 in 2000, respectively. Comparable figures for the year 2000 for the remaining countries reveal substantially lower amounts of $3,855, $1,819, and $639 for Malaysia, Indonesia, and Thailand, respectively. The same can be said in general about the degree of financial development, as measured by the ratio of private credit to nominal GDP. Given the fact that the causality runs from finance to growth in Korea and Singapore and that their economies are far more advanced compared to the three remaining Asian countries, one may be tempted to
speculate that the direction of causality somehow depends on the stage of development.

In comparing and evaluating our finding with those of earlier empirical studies on the direction of causal relationship between finance and growth, we need to first point out that virtually all earlier empirical studies are essentially based on examining the co-movement or association between variables in the context of Granger causality. This is true with two earlier studies by King and Levine (1993) and Levine and Zervo (1996), which are basically simple studies of contemporaneous and lagged correlations among financial indicators across countries. Lintel and Khan (1999) also examine the finance-growth nexus in a multivariate VAR framework. However, their long-run causality tests are based on the test of weak exogeneity. In the most recent and comprehensive study, Levine, Loayza, and Beck (2000) again examine the causality between financial intermediation and growth, utilizing dynamic panel techniques. It is true that while their methods of testing are more sophisticated than those used in earlier empirical studies, findings from all empirical studies are simply confirming the positive association between financial development and economic growth. From this perspective, our finding is unique.

In reconciling our finding with the evidence of bi-directional causation for Korea and Thailand among others by Luintel and Khan (1999, Table 8, p. 400), it is quite possible that the direction of influence between financial development and growth goes both ways. If the direction of influence between financial development and growth is bi-directional, as indicated by Luintel and Khan (1999), it is quite possible that a knowledge of financial development helps policy makers predict output growth, and vice versa. However, our finding indicates that control of financial development makes economic growth controllable, but the opposite is not true in Korea and Singapore.

Finally, to evaluate country-specific finding as to the direction of the causality between financial development and economic growth, we are definitely in need of more satisfactory microeconomic analysis of how financial development affects economic growth, or vice versa. Unfortunately the microeconomic analysis of the linkage between them, either by raising the proportion of saving funneled to investment, social marginal productivity of capital, the private saving rate, or other channels is not yet fully
examined at this point. What is sorely needed in making more sense of mixed evidence as to the causality in the finance-growth nexus is a microeconomic analysis of the process where finance and economic growth acts and reacts from each other.
V. SUMMARY AND CONCLUSIONS

In this paper, we have empirically examined the causality between financial development and economic growth in five Asian Countries (South Korea, Singapore, Malaysia, Indonesia, and Thailand). These countries have experienced diverse economic growth and financial reforms in recent years and, as a group, make good case studies. What distinguishes this paper from earlier empirical studies is the method of the causality test. Unlike earlier empirical studies, all of which relied essentially on the Granger-causality test, our study utilizes the concepts of control causality and superexogeneity to examine the causal direction in financial development and economic growth.

We find that for the case of Korea and Singapore the financial development control causes the economic growth, providing empirical evidence supporting the view that 'financial development causes economic growth' in these countries. However, for these countries we did not find any evidence of reverse causality from growth to financial development. These findings suggest that there is no evidence of bi-directional causality between financial development and economic growth. In the case of Malaysia, on the other hand, we find that the economic growth control causes the financial development, but the reverse is not true. For Indonesia and Thailand, we cannot determine the direction of causality between financial development and growth. Therefore, our overall finding as to the direction of the causal relationship in the finance-growth nexus from five Asian countries is mixed. In evaluating the mixed results for the causal direction in the linkage between financial development and economic growth, we realize that we are in need of the microeconomic analysis of the linkage between financial development and growth. In this regard, a clearly promising area of research is microeconomic analysis of the linkage between the financial development and economic growth.
<table>
<thead>
<tr>
<th>Explanatory Variables</th>
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<th>Indonesia</th>
<th>Thailand</th>
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<td>0.47***</td>
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<td>0.47***</td>
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<td>(0.22)</td>
<td>(0.18)</td>
<td>(0.04)</td>
<td>(0.09)</td>
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<td>(4.01)</td>
<td>(10.33)</td>
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<tr>
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<td>-0.37*</td>
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<tr>
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<td>-0.38**</td>
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<td>-0.53***</td>
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<td>(0.69)</td>
<td>(0.12)</td>
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<td>26.22**</td>
<td>30.24***</td>
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<td>(10.33)</td>
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<td>(0.04)</td>
<td>(0.22)</td>
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<td>$R_{t}$</td>
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<td>-0.61***</td>
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<td>(0.46)</td>
<td>(0.28)</td>
<td>(0.15)</td>
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<td>$R_{t+1}$</td>
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<td>$R_{t+2}$</td>
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<td>(0.24)</td>
<td>(0.06)</td>
<td>(0.20)</td>
<td>(0.09)</td>
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</table>

| $R^2$                 | 0.53   | 0.32      | 0.53     | 0.63      | 0.94     |
| LM(2)                 | 3.34[0.07] | 0.45[0.65] | 2.40[0.13] | 0.96[0.41] | 1.94[0.20] |

***: 1%, **: 5%, *: 10% significant level respectively, LM: Breusch–Godfrey serial correlation test statistics
( ): heteroskedasticity and serial correlation consistent standard error, [ ]: p-value
Table 2. Test for Superexogeneity

<table>
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<tr>
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<td>[0.65]</td>
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( ): heteroskedasticity and serial correlation consistent standard error, [ ]: p-value

Joint F is statistics for the null hypothesis that the coefficients of $\hat{u}_t$ and $\hat{u}_t^2$ are zero.
Table 3. Conditional Equations for Financial Development

<table>
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<th>Thailand</th>
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<td>-1.50***</td>
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<td>(0.48)</td>
<td>(0.46)</td>
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<tr>
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</tr>
<tr>
<td>ΔlnY_{t-4}</td>
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<td>-0.57***</td>
<td>0.63***</td>
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<td>(0.19)</td>
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<td>(0.27)</td>
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<tr>
<td>R_{t-3}</td>
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See footnote in Table 1
## Table 4. Test for Superexogeneity

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<tr>
<td>Joint F</td>
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<td>3.16</td>
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<tr>
<td></td>
<td></td>
<td>[0.09]</td>
</tr>
</tbody>
</table>

( ): heteroskedasticity and serial correlation consistent standard error, [ ]: p-value

Joint F is statistics for the null hypothesis that the coefficients of $\hat{u}_t$ and $\hat{u}_{i_t}^2$ are zero.
Appendix 1

If financial development (FD) control causes economic growth (Y), then the data-generating process can be set as follows:

\[ Y_t = \beta F_D + \varepsilon_t \quad \varepsilon_t \sim N(0, \sigma^2_\varepsilon) \]  
\[ F_D = \delta + u_t \quad u_t \sim N(0, \sigma^2_u) \]

where \( \sigma_{\varepsilon u} = 0 \). Means of Y and FD are \( \mu_Y = \beta \mu_{F_D} = \beta \delta \) and \( \mu_{F_D} = \delta \). Variances are \( \sigma^2_Y = V(\beta F_D + \varepsilon) = \beta^2 \sigma^2_{F_D} + \sigma^2_\varepsilon = \beta^2 \sigma^2_u + \sigma^2_\varepsilon \), \( \sigma^2_{F_D} = V(\delta + u) = \sigma^2_u \), respectively. And covariance is \( \sigma_{F_D,Y} = E[\varepsilon (\beta u + \varepsilon)] = E[\beta u^2 + u \varepsilon] = \beta \sigma^2_u \).

Conditional distribution of Y, and marginal distribution of FD are as follows:

\[ D(Y | F_D) = N(\beta F_D, \sigma^2_\varepsilon) \]  
\[ D(F_D) = N(\delta, \sigma^2_u) \]

And marginal distribution of FD is \( D(F_D | Y) = N(\mu_{F_D} + \Theta(Y - \mu_Y), \eta) \), where

\[ \Theta = \rho(\sigma^2_{F_D} \sigma^2_Y) \quad \text{and} \quad \eta = \sigma^2_{F_D}(1 - \rho^2) = \frac{\sigma^2_{F_D} \sigma^2_Y - \sigma^2_{F_D,Y}}{\sigma^2_Y} \]


Mean and variance of FD in conditional distribution of FD are

\[ \text{mean} = \mu_{F_D} + \Theta(Y - \mu_Y) = \delta + \frac{\sigma_{F_D,Y}(Y - \beta \delta)}{\sigma^2_Y} \]
\[ \text{variance} = \frac{\sigma^2_{F_D} \sigma^2_Y - \sigma^2_{F_D,Y}}{\sigma^2_Y} = \frac{\sigma^2_u (\beta^2 \sigma^2_u + \sigma^2_\varepsilon) - (\beta \sigma^2_\varepsilon)^2}{\beta^2 \sigma^2_u + \sigma^2_\varepsilon} = \frac{\sigma^2_u \sigma^2_\varepsilon}{\beta^2 \sigma^2_u + \sigma^2_\varepsilon} \]

Therefore, we can get

\[ D(F_D | Y) = N\left( \frac{\beta \sigma^2_Y + \delta \sigma^2_\varepsilon}{\beta^2 \sigma^2_u + \sigma^2_\varepsilon}, \frac{\sigma^2_u \sigma^2_Y}{\beta^2 \sigma^2_u + \sigma^2_\varepsilon} \right) \]  
\[ D(Y) = N(\beta \delta, \beta^2 \sigma^2_u + \sigma^2_\varepsilon) \]
Appendix 2

Figure 1a. Stability Tests of Conditional Equation for Economic Growth - Korea

CUSUM of Squares: $\Delta \ln Y_t$

Recursive Residuals: $\Delta \ln Y_t$

* ——: CUSUM of Squares ———: 5% Significance
* ——: Recursive Residuals ———: ±2 Standard Error

Figure 1b. Stability Tests of Conditional Equation for Financial Development - Korea

CUSUM of Squares: $\Delta FD_t$

Recursive Residuals: $\Delta FD_t$

* ——: CUSUM of Squares ———: 5% Significance
* ——: Recursive Residuals ———: ±2 Standard Error
Figure 2a. Stability Tests of Conditional Equation for Economic Growth - Singapore

CUSUM of Squares: $\Delta \ln Y_t$

Recursive Residuals: $\Delta \ln Y_t$

Figure 2b. Stability Tests of Conditional Equation for Financial Development - Singapore

CUSUM of Squares: $\Delta FD_t$

Recursive Residuals: $\Delta FD_t$
Figure 3a. Stability Tests of Conditional Equation for Economic Growth - Malaysia

CUSUM of Squares: $\Delta \ln Y_t$

Recursive Residuals: $\Delta \ln Y_t$

* — CUSUM of Squares  - - - : 5% Significance  * — Recursive Residuals  - - - : ± 2 Standard Error

Figure 3b. Stability Tests of Conditional Equation for Financial Development - Malaysia

CUSUM of Squares: $\Delta FD_t$

Recursive Residuals: $\Delta FD_t$

* — CUSUM of Squares  - - - : 5% Significance  * — Recursive Residuals  - - - : ± 2 Standard Error
Figure 4a. Stability Tests of Conditional Equation for Economic Growth - Indonesia

CUSUM of Squares: $\Delta \ln Y_t$

Recursive Residuals: $\Delta \ln Y_t$

* ---- : CUSUM of Squares  - - - : 5% Significance   * ---- : Recursive Residuals  - - - : ± 2 Standard Error

Figure 4b. Stability Tests of Conditional Equation for Financial Development - Indonesia

CUSUM of Squares: $\Delta FD_t$

Recursive Residuals: $\Delta FD_t$

* ---- : CUSUM of Squares  - - - : 5% Significance   * ---- : Recursive Residuals  - - - : ± 2 Standard Error
Figure 5a. Stability Tests of Conditional Equation for Economic Growth - Thailand

CUSUM of Squares: $\Delta \ln Y_t$

Recursive Residuals: $\Delta \ln Y_t$

* ---- : CUSUM of Squares  - - - : 5% Significance
* ---- : Recursive Residuals  - - - : $\pm 2$ Standard Error

Figure 5b. Stability Tests of Conditional Equation for Financial Development - Thailand

CUSUM of Squares: $\Delta FD_t$

Recursive Residuals: $\Delta FD_t$

* ---- : CUSUM of Squares  - - - : 5% Significance
* ---- : Recursive Residuals  - - - : $\pm 2$ Standard Error
REFERENCES


