How Does Financial Development Interact with Economic Growth in Five ASEAN Countries?

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[Abstract]

This study examines the causal relationship between financial development, liberalization and economic growth through technological innovation channel in five South East Asia countries during the period 1980 – 2012, using a fully modified ordinary least square estimation technique. We find that technological deepening is driven by deepening in the financial system and financial liberalization rather than changes in a country's market capitalization. We also find a negative effect from the financial openness, and a positive effect from financial deregulation.

[Keyword]: financial development, economic growth, FMOLS, South East Asia, financial liberalization.

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1. Introductions

It is well recognized that financial system plays an important role in economic growth. A more efficient financial system provides better financial services, which in turn promotes economic growth, and a less developed financial system may prevent the economy from growing. An inadequately supervised financial system may be crisis-prone, with potentially devastating effects. The important role of financial intermediaries and financial markets therefore merits more attention from researchers and policy makers (Ang, 2008) . The level of financial development is among the most important macroeconomic variables that the empirical research on economic growth has identified as being highly correlated with growth performance across countries (Beck, 2002).

Due to the importance of financial system, the relationship between financial development and economic growth has received a great deal of attention in recent empirical researches. However, there are different (even conflicting) perspectives about the role that the financial system plays in economic growth. For instant, while Levine (1997) states that financial institutes enhance economic efficiency, and subsequently economic growth, by reallocating capital resource to its best uses, Lucas (1988) believes that the financial sector plays an “badly over-stress” role in economic growth. The recent theoretical literature on the finance–growth relationship combines the endogenous growth theory with microeconomics of financial systems to demonstrate the importance of financial systems , while in contrast development economists frequently express their scepticism about the role of the financial system by ignoring it (Chandavarkar, 1992).

The role of financial system as an important catalyst of economic growth is explained differently from different perspectives. In general, there are two underlying theories, namely the neoclassical and endogenous growth models. Both theories emphasize that financial development promotes growth in economy by building up volume as well as efficiency of physical captital accummulation (Barro, Mankiw et al., 1995) .The difference in the two approches lies in the channel via which the fianacial system impacts the growth. While neoclassical growth theorists emphasize that the contribution of financial system mainly lies in increasing the physical capital in economy, recent

endogenous growth authors consider these financial factors as a more pronounced endogenous source of economic growth via knowledge and technology externalities. In recent years, a strand of research on economic growth, see for example Ang (2011), has widely investigated the relationship between financial development and total factor productivity and the important role of finance and R&D efforts in explaining productivity growth. Aghion and Howitt (2009) analyse the links between financial development and economic growth in the innovation-based growth models, and they find that financial market increases the costs of monitoring and thus encourages the hiding of successful inventions so that firms can avoid loan repayments. The removal of these restrictions encourages more ideas to be produced and patented, thus deepening the technological sector. Hence, a positive relationship between finance and innovative production is predicted (Ang, 2011). As the financial system develops, overall economic productivity improves through efficient reallocations of scarce resources from firms with low productivity to those with promising growth prospects (Xu and Pal, 2010).

While the previous empirical studies analyse the relationship between financial development and economic growth by employing an aggregated production function that directly incorporates financial indicators (Anwar and Cooray, 2012; Harris, 2012). Different from these studies, in this paper we allow for the possibility that financial development enhances total factor productivity, and subsequently promotes economic growth, which is our first contribution to the existing literature. The second contrition is that this study focuses on five countries of the Association of Southeast Asian Nations (ASEAN), namely Indonesia, Malaysia, Philippines, Singapore, and Thailand. Although some previous studies explore this relationship in some countries within ASEAN, to the best of our knowledge, there is no research dedicated to wider coverage of ASEA countries than this paper[1]. ASEAN was established in 1967, aiming to accelerate economic growth in the region. In ASEAN, each member is at a similar stage of economic development, has similar institution, and

[1] Due to data unavailability, we can only confine our study to five ASEAN countries.

endeavours to integrate with each other in the context of globalization. A study of the link between financial development and economic growth in AESAN will provide significant policy implications for policy makers in the region, and allows policymakers in these countries to evaluate the costs and benefits associated with liberalizing and deepening financial systems.

Another feature of this study is that we use three types of indicators to measure financial development, namely the bank-base, market-base, and liberalization aspects of financial development, and thus, we provide a more complete picture on the link between financial development and economic growth, which is the third contribution of this study. The remainder of this paper is structured as follows. Section 2 discuss financial development and economic growth in the five ASEAN countries. Section 3 discuss the theoretical framework of financial development and economic growth. Section 4 presents the analytical framework. In Section 5, we report the empirical strategy, data, and results. Section 6 concludes the paper.

2. Financial Development and Economic Growth in Five ASEAN Countries

2.1 A brief overview of financial development-growth link in the five countries

ASEAN was established in Bangkok, on 8 August 1967, by five founding member countries: Indonesia, Malaysia, the Philippines, Singapore and Thailand. It has three main objectives: to promote economic growth, social progress, and cultural development in the region; to safeguard political and economic stability of regions, and to serve as a forum for resolution of intra-regional differences. Despite of a gap in term of culture and economic growth level, the group of ASEAN countries comprises of market-based economies with a high degree of trading dependencies (Majid, 2007; Wongbangpo, 2000).

According to Yean (1997), ASEAN recorded a remarkably consistent economic growth for the last two decades, before the 1997 financial crisis. ASEAN has been one of the fastest growing regional groups in the world. For example, individually, ASEAN's average annual real GDP growth rate, during the period 1987-1995, was around 9% for Malaysia, Singapore and Thailand, while Indonesia and the Philippines achieved respectively, 6.6% and 3.3%. These performances were

significantly above the 2.8% experienced by developed countries as a group, exceeded the 2.5% achieved by North America, and surpassed the 2.2% realized by the world (Majid, 2007; Wongbangpo, 2000). This rapid growth went hand in hand with liberalized cross border capital flows, which encouraged banks to take on foreign currency debt with relatively short terms of maturity to take advantage of the increased local demand for credit. ASEAN banks generally engaged in a one-way intermediation process where household savings were transformed into bank deposits and eventually converted into corporate credit (Gochoco-Bautista and Remolona, 2012).

After the 1997 financial crisis, ASEAN's accommodative monetary and fiscal policies continued to underpin growth, as structural reforms were actively pursued, such as corporate restructuring and fiscal consolidation. As a result, the gradual return of foreign investment in the region, as well as rising stock prices helped strengthen their financial system, which in turn boost the ASEAN economies in 2007 with GDP growth rate increasing from 6.0% to 7.0 % .

ASEAN economies experienced slow growth since the global financial crisis of 2008-2009, and subsequently a well-functioning and efficient financial system appears to matter more than ever for the ASEAN group. First, a robust financial system is required for resources to be allocated efficiently. Second, safeguarding financial stability must be the priority of the financial development agenda. Financial instability, especially financial crisis, can derail growth and harm the poor, wiping out the benefits from financial deepening (Estrada, Park et al., 2010).

In summary, by examining the history of financial development and economic growth, particularly the period before 2008-2009 financial crisis, one can expect that financial development is closely linked to economic growth in ASEAN.

2.2. Empirical studies on ASEAN countries

To the best of our knowledge, there are no empirical studies on the relationship between financial development and economic growth that covers the whole group of ASEAN. However, there are few papers which examine this relationship in one country or small group of countries within ASEAN.

Anwar and Nguyen (2011), using panel data for 61 provinces in Vietnam for the period 1997–2006, find that financial development contributes significantly to economic growth in Vietnam. This study is based on the endogenous growth theory and reveals that high ratio of credit to the gross provincial product has accelerated economic growth in Vietnam.

Anwar and Sun (2011), based on annual data for the period 1970–2007 in Malaysia, reveal that the level of financial development has contributed to the growth of the domestic capital stock in Malaysia but its impact on economic growth is statistically insignificant. Ang (2008) finds that financial development leads to higher output growth via promoting both private saving and private investment by estimating a six-equation model for Malaysia.

Murinde and Eng (1994) focus on Singapore. By drawing on a bivariate vector autoregressive (BVAR) model, their evidence supports the supply-leading hypothesis when broad monetary aggregates and a monetization variable are used as surrogates for financial development. It is therefore concluded that there is a plausible case for those economies which intend to adopt a financial restructuring strategy driven by a supply-leading policy stance, to promote enhanced monetization of the economy and bank intermediation.

Majid and Mahrizal (2007) empirically re-examine the short and long run relationships between financial development and economic growth in the ASEAN-4 economies, i.e., Indonesia, Malaysia, Thailand and the Philippines during the period of post 1997 ASEAN financial turmoil. They find a long-run equilibrium between economic growth, finance depth, share of investment and inflation. Their study points out the non-existence of causality between financial development and economic growth in the Indonesian economy. As for Malaysia, the study finds a unidirectional causality that supports the "supply-leading view". However, the opposite direction is true for Philippine that supports the "demand-following view". As for Thailand, they find evidence to support the "bidirectional causality view".

3. Theoretical Framework of Financial Development and Growth

The theoretical underpinnings of the link between financial development and economic growth was first studied by Schumpeter (1912), Goldsmith (1969), McKinnon (1973), and Shaw (1973), from the perspective of the role of financial development in promoting economic growth. Since then, the relationship between economic growth and financial development has remained an important issue of debate among academics and policymakers (Abu-Bader and Abu-Qarn, 2008). In the early stage of development in economic growth theory, researchers think that exogenous technological progress determines the long-run growth rate, and do not explicitly model the financial system (Hassan, Sanchez et al., 2011). Later researchers go beyond the exogenous growth model by considering the role of financial system in economic growth. Greenwood and Jovanovic (1990) and Jbili, Enders et al. (1997) demonstrate how financial intermediation and financial markets mobilize savings, allocate resources, diversify risks, influence decisions to invest in productivity-enhancing activities through evaluating prospective entrepreneurs and funding the most promising ones, and hence, contribute to the long-term growth.

3.1 Whether financial development affects economic growth

The first concern about the relationship between the development of financial system and economic growth is that whether the links exist or not. Many theoretical and empirical studies suggest that development of financial market is a key factor in economic growth. Levine (1997) argues that financial markets help to increase the efficiency in allocating resources. Other researchers, from a theoretical perspective, also demonstrate that a more financially liberal economic environment allows investors to reduce risk more easily, which hence lowers the cost of borrowing, increases investment, and subsequently leads to economic growth (Bekaert and Harvey, 2003). Moreover, other authors also find the positive role of financial development in economic growth (Demirgüç-Kunt and Levine, 2004). The endogeneous growth theorists also support that hypothesis that financial development positively affects economic growth. King and Levine (1993)

reveal that developed financial systems increase the likelihood of innovation and are thus important for productivity and economic growth in an endogenous growth model.

On the other hand, not every researcher agrees with the key role of finance in economic development. Robinson (1952) asserts that financial development has no effect on economic growth. Khan and Senhadji (2003) find that the link is insignificant, although there may be a nonlinear relationship between them. They also find that while financial development may progress slowly in some countries, economic growth may progress much faster, and thus those indicators used to measure the latter cannot be used to reflect the former. Lucas (1988) argues that the significance of financial development is highly over-stressed. Recent studies, for example, Kar, Nazlioğlu et al. (2011), examine the causality of financial development and economic growth. Their findings also show no evidence of causality

3.2 Financial development leads to economic growth or vice versa

There are many empirical papers that tried to find out the causality between financial development and economic growth. Although many studies find a high level of financial development would encourage economic growth, it is also confirmed that high growth in an economy may in fact boost financial development in stock markets and the banking sector (Tang, 2006). Lewis (1955) argues that GDP growth contributes to the development of the financial system, and then, financial markets in turn stimulate real GDP growth. Patrick (1966) analyses the stage of development hypothesis. This study finds that at the early stage, finance leads to growth by inducing real per capita capital formation, but at later stages economic growth influences financial development by increasing demand for financial services, which induces an expansion in the financial sector as well as the real sector. Others also support for a positive bi-directional causality between growth and financial development (Khan, 2001).

However, not every researcher agrees with the bi-directional causality between financial development and economic growth. Some authors have both theoretically and empirically shown that there is causality from financial development to economic growth (Chang and Caudill, 2005).

On the other hand, other authors argue that the causal direction runs from economic growth to financial development. This view is supported by Liang and Teng (2006), among others. These different views indicate that the issue of the supply-leading (causality from economic growth to financial development) and demand-following (causality from financial development to economic growth) hypotheses remains unresolved.

3.3 Channels through which financial development affects economic growth

There are two possible channels, through which financial development may affect economic growth, namely the capital accumulation and technological innovation. The capital accumulation channel, also known as the quantitative channel, is conceptually straightforward. Economic growth depends on capital accumulation through both domestic and foreign capital investment. To mobilize savings and channel them to capital accumulation, an efficient financial system is essential. In this way, financial development and economic growth are linked. For example, Levine (2005) suggests that financial development affects economic growth by: (i) acquiring information and providing information about possible investments so as to allocate capital efficiently; (ii) monitoring businesses, firms and exerting corporate governance; (iii) managing risks; (iv) mobilizing and pooling savings to their highest valued use; and (v) facilitating trading that eases the exchange of goods and services. These functions ultimately result in a more efficient allocation of resources, a more rapid accumulation of human and physical capital, and a faster technological progress, which in turn boosts economic growth.

The total factor productivity (TFP) channel (technology innovation channel), which is also referred to as the qualitative channel, suggests that an efficient financial system facilitates the adoption of modern technology to boost development of the knowledge and technology intensive industries, through the provision of efficient credit facilities and other financial services (Ang, 2008). McKinnon (1973) also suggest that the financial system plays an important role in enabling the adoption of better technology in that better savings mobilization can improve resource allocation and boost technological innovation and thus encouraging growth. Hausmann and Rodrik

(2003) suggest that through facilitating entrepreneurship financial development might boost productivity. In a more advanced financial system, it is easier for entrepreneurs to adopt new technological innovation by investing in R&D.

4. Analytical Framework

Following previous research (see for example Ang, 2011), this study employs an aggregate Cobb-Douglas production function to examine the relationship between financial development and economic growth, as follows:

$$Y_t = A_t^{\sigma} K_t^{\alpha} L_t^{1-\alpha} \quad (1)$$

where A_t is the total stock of knowledge or ideas available in the economy, K_t is physical capital and L_t is the labor force. The production function (equation 1) exhibits constant returns to scale with respect to K_t and L_t, holding A_t unchanged, and increasing returns to scale with respect to A_t, K_t and L_t.

Expressing equation (1) in per worker term, we can obtain the following equation:

$$y_t = A_t^{\sigma} k_t^{\alpha} \quad (2)$$

Where $y_t = Y_t/L_t$ and $k_t = K_t/L_t$. Taking logarithms with respect to time on both sides of the equation, we can obtain the output equation in period *t* as follows:

$$\ln(y_t) = \sigma \ln(A_t) + \alpha \ln(k_t) \quad (3)$$

From equation (3), it is clear that the rate of knowledge creation plays an important role in long-term growth. According to Romer (1990) and Ang (2011), the number of new innovations created depends on the amount of resources which is devoted to R&D (R_t),the existing knowledge stock (A_t), and the level of financial development (F_t) in the economy. Therefore, the generation of new ideas ($\dot{A}_t$) is captured by a Cobb-Douglas knowledge production function in the following way:

$$\dot{A}_t = \lambda R_t^{\delta} A_t^{\phi} F_t^{\theta} \quad (4)$$

The empirical findings of Ang (2011) confirm that in a steady state, if the growth rate of ideas accumulation ($\dot{A}_t/A_t$) is stationary, the stock of ideas converges to a balanced growth path. Therefore at the steady state, equation (4) implies that knowledge stock (A) is a function of R&D (R) and financial development (F). We use a logarithm linear functional form to capture this relationship, as follows:

$$\ln(A_t) = \beta_0 + \beta_1 \ln(R_t) + \beta_2 \ln(F_t) + \eta_t \qquad (5)$$

where η is the error term that captures other factors not included in the model. Therefore, from Equation (5), the Equation (3) can be rewritten as:

$$\ln(y_t) = \beta_0 + \beta_1 \ln(R_t) + \beta_2 \ln(F_t) + \alpha \ln(k_t) + \varepsilon_t \qquad (6)$$

where $\varepsilon = \sigma\eta$ is a normally distributed disturbance. Equation (6) suggests that financial development plays an important role in the creation of new technology and scientific knowledge, and subsequently positively affect economic growth.

To estimate the impact of financial development, we need to first measure it. Most of ASEAN countries start to develop their stock markets only from late 1990s, therefore it is necessary to focus more on the bank-based financial indicators in the empirical exercise, as the market-based aspects of financial development in this area is relatively less developed.

Another aspect of financial development is financial liberalization. However, the role of financial liberalization in economic growth is not consensus. On the one hand, McKinnon (1973) and Shaw (1973) expect that financial liberalization influences productivity positively because it is associated with greater mobilization of savings and more efficient allocation of resources. On the other hand, Stiglitz and Weiss (1981) and Stiglitz (2000) disagree with the positive link of the financial reform and innovation. They argue that the main point of financial reform is interest rate liberalization which tends to reduce interest rate and then weakens the saving feature of financial system. Thus, in principle, the discouraged savings in turn indirectly retard technological deepening, as with more funds allocated to the high-tech sector it is likely to increase innovative output (Ang, 2011). Therefore, the role of financial liberalization is ambiguous and thus an

empirical matter. In our subsequent empirical exercise, we use different financial indicators to capture different aspects of financial development.

5. Empirical Strategies, Data and Results

5.1 Measurement of variables

Due to data availability, this study uses a panel data of five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand) from 1980 to 2012. Data are collected from the World Bank Indicators (WDI) 2015 database, World Intellectual Property Organization (WIPO), and IMF's Annual Reports. One issue in estimating Equation 6 is how to obtain a satisfactory empirical measure of the variables. A major problem in collecting data of developing countries is the lack of data that last for sufficiently long time. Therefore, we try to follow the standard practice in the literature to choose the most appropriate data which is available for ASEAN.

Different measures have been used in the literature to proxy for economic growth. In our study, we use the annual real GDP per capita as a measure of economic output. To measure the R&D activities, previous studies use R&D expenditure as percentage of GDP as its proxy. However, due to lack of data, we use total patent applications as an alternative proxy of R&D activities. As patents contain rich and timely information on inventive activities, patent statistics are widely used to analyse and measure innovations. While R&D expenditures are frequently used as a proxy for innovation input, patent statistics can measure the output. This measure is also more readily available than other proxies for outputs, such as total factor productivity (TFP) (Nagaoka, Motohashi et al., 2010). Therefore, the total patent applications is an appropriate indicator for the R&D activities.

To measure the capital per worker, we use the ratio of gross capital formation against labor force. As discussed earlier, we consider three aspects of financial development (bank-based, market-based and financial liberalization) to capture the effect of financial development in economic growth. Financial development is usually defined as a process that marks improvement in quantity, quality, and efficiency of financial intermediary services. This process involves the

interaction of many activities and institutions. Consequently, it cannot be captured by a single measure. In this study, we employ nine commonly used measures of financial development for the purpose of testing the robustness of our findings.

To measure the bank-based financial development, we use the six traditional quantity-based indicators employed in empirical studies drawn from the World Development Indicators database: (1) the ratio of total deposits in the financial system to GDP, which measures the overall size of financial intermediaries; (2) deposit money bank assets to GDP (%), which measures the depth of bank in financial system (Anwar and Cooray, 2012); (3) to measure the depth of financial intermediation, we employ the domestic credit to private sector (% of GDP), which measures the level of credit to private sector (Nyamongo, Misati et al., 2012); (4) we also use credit to government and state-owned enterprises to GDP (%) to capture the effect of credit to public sector (Kabir and Hoque, 2007); (5) domestic credit provided by banking sector (% of GDP), which measures the role of bank in term of provide domestic credit (Hassan, Sanchez et al., 2011); and (6) bank private credit to GDP (%) to capture the role of bank in term of provide private credit (Liu and Hsu, 2006).

To measure the market-based financial development, we employ the market capitalization of listed companies (% of GDP) (Carp, 2012).

The measurement of financial liberalization is subject to debate in the literature. The most common measurement uses such readily observable financial variables as the ratio of bank loans to GDP to represent liberalization. However, at best, it measures the outcome of the liberalization process and not the process itself and, furthermore, it is likely to be the outcome of the interaction between liberalization and other economic factors (Groenewold, Peng et al., 2008). Alternative measurements of financial liberalization are to examine some particular deregulatory events, and then assign numerical value to construct an artificial index of liberalization. This approach has been widely used in the literature. For example, Quinn (1997) uses a financial liberalization index which is calculated from three components (namely one component covering the capital account, one on

the current account and one on the international legal agreements), focusing on openness of the balance of payments. In our exercise, we use two measurements to capture financial liberalization. The first measure is the Chinn-Ito index (KAOPEN) which is an index measuring a country's degree of capital account openness. The index was initially introduced by Chinn and Ito (2008). KAOPEN is based on the binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). It is constructed from four aspects, namely the presence of multiple exchange rates, restrictions on current account transactions, restrictions on capital account transactions, and requirement of the surrender of export proceeds. For the second measure, the new database of financial reform by Abiad, Detragiache et al. (2010) is utilized to capture the nature of financial reform and record financial policy changes along seven different dimensions: credit controls and reserve requirements, interest rate controls, entry barriers, state ownership, policies on securities markets, banking regulations, and restrictions on the capital account. All measurements are listed in the table 1.

<Table 1 above here>

5.2 Econometric specification

We capture the financial development from three aspects (bank base, market base, and financial liberalization), and therefore we can re-write Equation (6) as follows:

$$\ln(y_t) = \beta_0 + \beta_1 \, lnR_t + \beta_2 \, FD_{1t} + \beta_3 \, FD_{2t} + \beta_4 \, FD_{3t} + \beta_4 lnk_t + \mathcal{E}_t \qquad (7)$$

where y_{it} refers to the real economic output per capita in year t, R_t is the R&D activities, FD_{1t} is bank-based indicator, FD_{2t} is financial liberalization indicator, FD_{3t} is market-based indicator , k_t is physical capital per capita, and $\mathcal{E}_{it}$ is disturbance term.

Our empirical exercise involves three steps. First, we begin by testing the existence of unit root in each variables to determine its order of integration. We use the Maddala and Wu (1999), Im, Pesaran et al. (2003), and Choi (2001) panel unit root tests in this study. The IPS, ADF–Fisher and Phillips–Perron–Fisher (PP–Fisher) tests allow for individual unit root processes to vary across

cross-sections. They combine individual unit root tests to derive a panel-specific result. After estimation of separate ADF regressions, the IPS method averages the t-statistics from the individual ADF regressions to produce a standardized test. The Fisher–ADF and PP–Fisher tests are derived by combining the p-values from individual unit root tests, which is essentially a nonparametric test for a panel unit root. In the tests, the optimal lag length is automatically selected using the Schwarz Information Criterion (SIC).

Second, since our unit root tests suggest that the data are not stationary (I(1)), the next step is to test for a long-run equilibrium relationship among the variables. Therefor the second step is to test for co-integration using Kao (1999) cointegration methods. We test the null hypothesis that the variables are not cointegrated. If we reject the null hypothesis we can conclude that the residuals are stationary. Given that all regression variables are I(1) and the residuals are stationary, we can say that financial development, R&D activities, capital per worker, and GDP per capita are cointegrated. Kao (1999) extends the Engle–Granger methodology to the panel data context. The Engle and Granger (1987) cointegration test is residuals based. If the residuals, obtained from the regression of the I(1) variables, are I(0) then these variables are cointegrated.

After confirming the existence of cointegration, the last step is to apply an appropriate panel estimator to estimate the long run relationship among the cointegrated variables. In this regard, researchers have used the dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS) estimators, which are proposed by Saikkonen (1991) and Stock and Watson (1993), and Pedroni (2000). We decide to apply the FMOLS for the following reasons. Firstly, FMOLS corrects for potential simultaneity bias among regressors, and accounts for any serial correlation in the residuals and endogeneity effects (Narayan and Sun, 2007). Secondly, our panel data include five cross-sections and cover a period of 32 years (from 1980 to 2012). Therefore, our data set does not span a very long period of time. Given the short time period, we do not use DOLS as it includes lags and leads to account for the potential simultaneity bias.

5.3 Results

Result of the unit root tests are shown in Table 2. It can be observed from Table 2 that most level variables contain a unit root as the test statistics are insignificant. For the first differenced variables, all tests reject the null hypothesis of unit root at the 10%. Hence these variables are I(1).

<Table 2 above here>

To confirm the presence of a long-run relationship, we perform the panel cointegration test of Kao (1999). The results are reported in Table 3. In Table 3 we report the cointegration tests for different specifications, where financial development is measured by different variables. In the model VII, we add the market-based financial development indicator (FD3) where the data cover a period from year 1989. As is evident, the null hypothesis of no cointegration is strongly rejected at the 5% level of significance, regardless of what indicators are used in the test. Taken together, these results suggest the presence of a robust long-run relationship for the variables.

<Table 3 above here>

Having confirmed the existence of cointegration, we proceed to estimate the long-run relationship using the FMOLS estimator of Pedroni (2000). In the empirical exercise, we employ seven different measures of financial development, which proxy for either the size or depth of bank based financial development (FD1). To avoid the multicolinearity problem, we use only one measure of FD1, and FD2 in each regression. For market-based indicators, data of FD3 are only available from 1989 to 2012 as most of ASEAN countries start to develop their stock market from 1989. We impose cross-country homogeneity of the cointegrating vector in the regressions. All estimations include unreported country-specific constants. Table 4 reports the regression results.

<Table 4 above here>

Table 4 suggests that the estimated coefficients of both the R&D activities *(RDpatent)* and capital per worker *(lnk)* are significantly positive, which is consistent with findings of previous empirical research. This suggests that domestic R&D activities have played a significant role in technological deepening in the five ASEAN countries.

To estimate the influence of the depth of financial system on economic growth, we employ the six measures in the regression, namely the ratio of financial system deposits to GDP (FD1DEPTH1) and the ratio of deposit money bank assets to GDP (FD1DEPTH2), the ratio of domestic credit to private sector against GDP (FD1DEPTH3), credit to government and state-owned enterprises to GDP (FD1DEPTH4), domestic credit provided by banking sector (FD1DEPTH5), and bank private credit to GDP (FD1DEPTH6). We also employ the Openness Index in Model 1 to Model 6, and the financial reform Index in Model 7 to Model 12. What is surprising is that the ratio of deposit money bank asset to GDP (FD1DEPTH2) does not have any significant influence on economic growth as shown in models 2 and 8. While the other bank base financial factors have negative impact on the dependent variable, only the credit to government and state-owned enterprises to GDP has a positive effect on economic growth.

FD1DEPTH1 and FD1DEPTH2 are utilized to capture the size of financial system. The estimated coefficients of FD1DEPTH1 are -0.00239 and -0.00262 in models 1 and 7 respectively, which are statistically significant, while there was no evidence that FD1DEPTH2 has significant influence on the growth. These results suggest that economies with bigger financial system grow slower. FD1DEPTH3 and FD1DEPTH4 are used to capture the channels through which credit promotes economic growth. There are two channels that credit is injected into economy, namely private sector (FD1DEPTH3) and public sector (FD1DEPTH4). FD1DEPTH5 and FD1DEPTH6 are employed to capture the role of bank sector in economic growth. Interestingly, we find that credit used by public sector has a significantly positive effect on economic growth. In contrast, credit to private sector significantly and negatively influence the economy, with an estimated coefficient of -0.00466, -0.00345 in models 3 and 9 respectively. These results suggest that using credit in the public sector, the economies are more able to adopt new technological innovation by investing in R&D (King and Levine, 1993). Higher credit to public sector also enables the adoption of better technology, which can improve resource allocation and boost technological innovation and subsequently promote growth.

The fifth measure is the domestic credit provided by banking sector as a percentage of GDP (*FD1DEPTH5*). It is assumed that banks are not subject to mandated loans to priority sectors, or obligated to hold government securities. Therefore, higher *FD1DEPTH5* indicates higher degree of dependence upon banking sector for financing. The estimated coefficient of *FD1DEPTH5* is negative (-0.00278 and -0.00247) and significant at the one percent level. The significant coefficient suggests that the domestic credit provided via the banking sector does not improve economic growth through technological innovation channels. Nevertheless the domestic credit from banking sector may feed into economic growth through the channel of capital accumulation in ASEAN (See Rioja and Valev, 2004). Moreover, the coefficient of the bank private credit to GDP ratio (*FD1DEPTH6*) is also negative (-0.00485 and -0.00306) and significant at the one percent level. Therefore, the financial size and depth generally appear to negatively affect economic growth in the ASEAN five countries. Such negative impact can be due to an ineffectiveness in allocative efficiency and the crowding out of human capital from the real sector (Cecchetti and Kharroubi, 2015). In addition, financial depth may no longer contribute to economic growth via investment when an economy reach to a specific point (De Gregorio and Guidotti, 1995).

In the regressions, we also include a market-base indicator of financial development (market capitalization of listed companies, *FD3*). This indicator measures the level of stock market development in ASEAN countries. ASEAN is a group of mainly developing economies, and their stock markets just start from late 1989. Therefore, data of *FD3* are not available from 1980 to 1989. With 125 observations, our regression finds that the coefficient of *FD3* is insignificant, suggesting that market capitalization does not significantly affect the growth via technology innovation channels.

The two financial openness and financial reform index are utilized to capture the effect of financial liberalization. We estimate these variables separately in order to avoid possibly multicollinearity issue. A negative effect of financial openness is found to be statistically significant in the ASEAN five countries. Conceptually financial liberalization may negatively influence

innovation through a number of channels. It may do so by reducing savings, triggering instability in financial systems or enabling the financial sector to offer higher returns than the technology sector in attracting the most talented people (Ang, 2011). The negative finding is also in line with Stiglitz (1994), Taylor (1983), Bayoumi (1993), Bandiera, Caprio et al. (2000), Gylfason, Holmström et al. (2010), and Ang (2011). In contrast, financial reform appears to positively affect economic growth. Therefore it suggests that the ASEAN countries should encourage their financial deregulation process in order to foster economic growth.

6. Concluding remarks

In this paper we explore the importance of financial development and financial liberalization in economic growth through the process of technological deepening channels. Motivated by recent developments in the theories of endogenous growth that highlight the effects of financial development and liberalization on the accumulation of ideas, we use data of five ASEAN countries (Indonesia, Philippine, Malaysia, Singapore, and Thailand) over the period 1980-2012 to estimate the impacts of financial development and liberalization. We find a statistically robust long run relationship between economic growth and R&D activities, financial development, and capital per worker.

Our findings suggest that technological deepening in ASEAN five economies is driven by financial deepening and liberalization rather than changes in country's market capitalization. In the case of financial depth, the only positive impact is found in credit used by public sector, which implies that a policy of encouraging credit in public sector will promote economic growth. However, in the case of other aspects of financial depth, we find significant and negative impacts on economic growth and no significant role of deposit money bank assets. The finding suggests that these financial indicators may feed into growth mainly through the channel of capital accumulation in ASEAN five countries.

We confirm the importance of financial liberalization to economic growth. Financial openness and financial reform, however, have different effects on improvements in technology in examined

countries. While empirical measures of financial liberalisation are more difficult to construct than most measures of financial development, analysis of the relationship between financial liberalization and economic growth is of importance in the sense that financial liberalization is more closely related to policy. In this study, we employ the Chinn-Ito index (KAOPEN), an index measuring a country's degree of capital account openness, and the financial reform index to capture the effects of financial liberalization. We find a significantly negative effect by the financial openness and, in contrast, a significantly positive effect from financial deregulation in the ASEAN five countries. Therefore policymakers that intend to liberalize the financial system to promote economic growth are likely to achieve their target by deregulation, rather than by opening up.

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Table 1: Summary of Variables

Variables		Measurements	No of Observation	Source of Data
Economic output	y	GDP per capita (constant 2005 US$)	165	WDI
Physical capital	k	Gross capital formation per capita (constant 2005 US$)	165	WDI
R&D activity	RDpatent	Total patent applications (direct and PCT national phase entries)	160	WIPO
Bank-based Financial development	FD1DEPTH1	Deposit money banks' assets to GDP (%)	164	WFD
	FD1DEPTH2	Financial system deposits to GDP (%)	164	WFD
	FD1DEPTH3	Domestic credit to private sector (%)	165	WFD
	FD1DEPTH4	Credit to government and state owned enterprises to GDP (%)	165	WFD
	FD1DEPTH5	Domestic credit provided by financial sector (%)	165	WFD
	FD1DEPTH6	Private credit by deposit money banks to GDP (%)	164	WDI
Financial liberalization	FD2Openness	Chinn-Ito index – Financial openness index	165	Chinn-Ito
	FD2Reform	Abiad and Mody – Financial reform index	130	Abiad
Market-based Financial development	FD3Market	Market capitalization of listed companies (%)	125	WFD

Note: WDI denotes World Development Indicators; WFD denotes Global Financial Development - World Bank; WIPO denotes World Intellectual Property Organization; Chinn-Ito (2008); Abiad (2008).

Table 2: Panel Unit Root Tests

	Im, Pesaran and Shin W-stat		ADF - Fisher Chi-square		PP - Fisher Chi-square	
	Level					
	Statistic Value	P-Value	Statistic Value	P-Value	Statistic Value	P-Value
lny	0.82	0.794	14.87	0.137	2.10	0.996
lnk	-0.92	0.180	28.56***	0.001	8.17	0.612
lnRDpatent	-2.38***	0.009	37.57***	0.000	22.45**	0.013
FD1DEPTH1	-0.87	0.193	31.24***	0.001	3.65	0.962
FD1DEPTH2	-0.32	0.374	29.87***	0.001	5.44	0.860
FD1DEPTH3	0.28	0.611	28.31***	0.002	3.63	0.963
FD1DEPTH4	-0.05	0.482	23.24**	0.010	3.87	0.953
FD1DEPTH5	0.24	0.595	37.07***	0.000	6.73	0.751
FD1DEPTH6	-0.91	0.181	28.79***	0.001	2.64	0.989
lnFD2Openness	-1.48*	0.070	34.81***	0.000	24.15***	0.002
lnFD2Reform	-0.75	0.225	51.20***	0.000	19.37**	0.036
FD3Market	-2.26**	0.012	50.66***	0.000	22.21**	0.014
	First Difference					
lny	-6.22***	0.000	88.09***	0.000	58.29***	0.000
lnk	-7.75***	0.000	115.09***	0.000	92.24***	0.000
lnRDpatent	-15.28***	0.000	178.40***	0.000	204.17***	0.000
FD1DEPTH1	-3.82***	0.000	64.78***	0.000	27.66***	0.002
FD1DEPTH2	-4.16***	0.000	76.14***	0.000	40.85***	0.000
FD1DEPTH3	-5.72***	0.000	94.30***	0.000	62.18***	0.000
FD1DEPTH4	-5.79***	0.000	94.83***	0.000	60.41***	0.000
FD1DEPTH5	-7.02***	0.000	106.00***	0.000	82.30***	0.000
FD1DEPTH6	-4.02***	0.000	64.67***	0.000	27.85***	0.002
lnFD2Openness	-8.32***	0.000	83.50***	0.000	90.03***	0.000
lnFD2Reform	-7.32***	0.000	98.60***	0.000	83.66***	0.000
FD3Market	-9.39***	0.000	124.16***	0.000	119.05***	0.000

Note: All unit root tests include intercept and deterministic trend; The bandwidth is selected using the Newey West procedure for all test; Maximum lag length is selected by means of the Schwarz Information Criteria (SIC); *, **, *** Denote significance at 1%, 5%, 10% level respectively.

Table 3: KAO Panel Cointegration Test

Model	ADF Statistics value	P-value
Model 1: FD1 = FD1DEPTH1, FD2= lnFD2Openness	-4.2	0
Model 2: FD1 = FD1DEPTH2, FD2= lnFD2Openness	-2.99	.001
Model 3: FD1 = FD1DEPTH3, FD2= lnFD2Openness	-4.54	0
Model 4: FD1 = FD1DEPTH4, FD2= lnFD2Openness	-3.68	0
Model 5: FD1 = FD1DEPTH5, FD2= lnFD2Openness	-4.3	0
Model 6: FD1 = FD1DEPTH6, FD2= lnFD2Openness	-4.43	0
Model 7: FD1 = FD1DEPTH1, FD2= lnFD2Reform	-2.95	.002
Model 8: FD1 = FD1DEPTH2, FD2= lnFD2Reform	-2.82	.002
Model 9: FD1 = FD1DEPTH3, FD2= lnFD2Reform	-2.91	.002
Model 10: FD1 = FD1DEPTH4, FD2= lnFD2Reform	-2.99	.001
Model 11: FD1 = FD1DEPTH5, FD2= lnFD2Reform	-2.93	.002
Model 12: FD1 = FD1DEPTH6, FD2= lnFD2Reform	-2.81	.002

Note: The bandwidth is selected using the Newey West procedure for all test; Maximum lag length is selected by means of the Schwarz Information Criteria (SIC), the test include intercept, no deterministic trend; *, **, *** denote significance at 1%, 5%, 10% level respectively.

Table 4: Long Run Relation Estimations – FMOLS

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
lnk	0.988***	0.968***	1.009***	0.943***	0.947***	1.006***	0.886***	0.845***	0.897***	0.842***	0.840***	0.894***
	(0.0385)	(0.0414)	(0.0321)	(0.0223)	(0.0303)	(0.0337)	(0.0347)	(0.0363)	(0.0294)	(0.0315)	(0.0281)	(0.0322)
lnRDpatent	0.188***	0.177***	0.168***	0.123***	0.184***	0.175***	0.187***	0.108*	0.188***	0.0883*	0.199***	0.180***
	(0.0500)	(0.0489)	(0.0421)	(0.0309)	(0.0417)	(0.0440)	(0.0616)	(0.0646)	(0.0506)	(0.0536)	(0.0528)	(0.0570)
FD1DEPTH1	-0.00239*						-0.00262***					
	(0.00124)						(0.000992)					
FD1DEPTH2		9.38e-07						-2.92e-05				
		(0.00180)						(0.00165)				
FD1DEPTH3			-0.00466***						-0.00345***			
			(0.00100)						(0.000810)			
FD1DEPTH4				0.0124***						0.0103***		
				(0.00185)						(0.00332)		
FD1DEPTH5					-0.00278***						-0.00247***	
					(0.000886)						(0.000699)	
FD1DEPTH6						-0.00485***						-0.00306***
						(0.00114)						(0.000921)
lnFD2Openness	-0.0607***	-0.0711***	-0.0552***	-0.0698***	-0.0601***	-0.0521***						
	(0.0220)	(0.0212)	(0.0186)	(0.0135)	(0.0186)	(0.0195)						
lnFD2Reform							0.730***	0.877***	0.526***	0.688***	0.634***	0.604***
							(0.182)	(0.186)	(0.158)	(0.179)	(0.162)	(0.173)
lnFD3Market	0.0301	-0.0145	0.0715*	0.00408	0.0474	0.0738*	0.00861	-0.0234	0.0560	-0.00147	0.0343	0.0373
	(0.0444)	(0.0430)	(0.0374)	(0.0253)	(0.0385)	(0.0392)	(0.0439)	(0.0479)	(0.0372)	(0.0418)	(0.0394)	(0.0407)
Constant	-0.0953	0.136	-0.131	0.475**	0.152	-0.182	-1.243***	-0.810	-0.933**	-0.363	-0.897**	-1.022**
	(0.379)	(0.390)	(0.313)	(0.223)	(0.301)	(0.331)	(0.473)	(0.521)	(0.385)	(0.446)	(0.395)	(0.432)

Note: The estimation is implemented using the panel fully modified ordinary least squares (FMOLS) with data of 1981- 2011; In estimations, the country-specific constants are included in cointegration equation. Standard errors in parentheses; *, **, *** Denote significance at 1%, 5%, 10% level respectively.