

Causality between the pillars of development and economic growth: a panel VAR application

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Abstract: This paper examines the long-term relationship between financial development, social development and economic growth in 15 Asian countries for the period from 1961 to 2012. Using principal component analysis to construct development indices and a panel vector auto-regressive (VAR) model to test Granger causalities, the study identified the presence of bidirectional causality between economic growth and financial development. They predict a country's level of social development. The policy implication of this study is that, in order to maintain sustainable social development in the 15 selected Asian countries, economic policies should recognise differences in the financial development and economic growth of a given country.

Keywords: principal component analysis; panel VAR; Granger causality.

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1 Introduction

This study takes a fresh look at the relationship between financial development and economic growth with the aim of identifying salient issues and making suggestions about how these may be addressed in future. In the empirical literature on this topic, two main econometric methodologies are used (see, for instance, Arestis and Demetriades, 1997), namely cross-country regressions and time series regressions. The cross-country regression method involves averaging out variables over long periods and using them in cross-section regressions to explain cross-country variations in growth rates. Hence, in principle, researchers are able to estimate the average influence of the determinants of economic growth (see, for instance, King and Levine, 1993; Levine and Zervos, 1996; Beck et al., 2000; Beck and Levine, 2004; Cole et al., 2008). By contrast, the time series regression method identifies the limitations associated with cross-country regressions and is able to detect the feedback relationships between variables (see, for instance, Demetriades and Hussein, 1996; Greenwood and Smith, 1997; Luintel and Khan, 1999; Levine et al., 2000; Levine, 2003; Goodhart, 2004; Ang, 2008; Mukhopadhyay et al., 2011). In this study, we employed the time series regression method to find new evidence on the causal relationship between financial development and economic growth.

The innovations in this paper, compared to the existing literature on the finance-growth nexus, are two-fold. The first is the use of a trivariate framework in which, in addition to growth and finance development, we incorporate social development. This marries the Granger causality literature on the finance development-growth nexus, the social development-growth nexus and the finance-social development nexus. The inclusion of social development in the finance development-growth nexus is very relevant, because social development is the ultimate aim of a country's development process. In fact, earlier economic growth theory argued that economic development is a process of innovations whereby the interactions of innovations in both the financial and real sectors provide a driving force for dynamic economic growth (see, for instance, Hassan et al., 2011; Mukhopadhyay, 2013). The second innovation was that we used the composite index concept, employing principal component analysis, to study the interrelationships between financial development, social development and economic growth.

The rest of the paper is organised as follows: Section 2 presents a literature review and the justification for the analysis; Section 3 sets out the methods used in the study; Section 4 discusses the empirical results; and finally, we summarise our findings and provide a conclusion in Section 5.

2 Literature review and justification for the analysis

The proposition that financial development is one of the basic indicators of economic growth (Levine, 1997; Calderon and Liu, 2003; Graff, 2003; Beck and Levine, 2004) has led economists to investigate whether there is in fact such a relationship. Hence, some of the related literature focuses on a possible link between social development and economic growth (for instance, Majumdar, 1996; Haddad et al., 2003; Ranis, 2004; Cutler et al., 2005; Schultz, 2005; Muthu, 2006). Finally, there is a body of literature on the possible nexus between financial development and social development (for instance, Outreville, 1999). In this paper, we explore the possibility that there is a link between all three these variables: financial development, social development, and economic growth. In this section, we highlight three main points. First, we present a review of the three separate sets of literature. This is followed by a rationale for and a discussion of the relevance of the link between these three variables, and a summary of the proposed hypotheses of this study.

2.1 Review of three sets of literature

The literature linking financial development with economic growth began with a study by Schumpeter (1911). Calderon and Liu (2003), Boulila and Trabelsi (2004), Christopoulos and Tsionas (2004), Ketteni et al. (2007), Jalil et al. (2010), Kar et al. (2011), Chaiechi (2012), Hsueh et al. (2013) and Pradhan (2013) have found evidence in support of the hypothesis of financial development-led growth (in other words, the supply leading hypothesis). By contrast, Levine (1997), Liang and Teng (2006), Ang and McKibbin (2007), Panopoulou (2009), Odhiambo (2010), Kar et al. (2011) and Pradhan and Gunashekar (2013) have found evidence in favour of the hypothesis of growth-led financial development (in other words, the demand-following hypothesis). Yet other studies such as those by Ahmed and Ansari (1998), Craigwell et al. (2001), Calderon and Liu (2003), Dritsakis and Adamopoulos (2004), Darrat et al. (2006), Wold-Rufael (2009) and Yucel (2009) support the validity of bidirectional causality between the two, where causality proceeds in both the directions (in other words, the feedback hypothesis). It should be noted that Robinson (1952) and Lucas (1988) maintain that there is no causal relationship between the two variables (in other words, they adopt the neutrality hypothesis). Finally, some studies supply mixed evidence (Pradhan, 2013).

A second strand of the literature attempted to examine the link between social development and economic growth, for example, Hicks (1979), Streeten (1981), Hopkins and Van der Hoeven (1982), Duflo (2001) and Schultz (2005) have demonstrated the validity of the social development-led growth hypothesis. By contrast, Goldstein (1985), Ram (1985), Strauss and Thomas (1995), Haddad et al. (2003) and Cutler et al. (2005) have all found support for the growth-led social development hypothesis or demand-following hypothesis. Support for the feedback hypothesis has been found by Srinivasan (1977), Morand (2005) and Baldacci (2008). Thus there is some support for the validity of both the demand-following hypothesis and the growth-led social development hypothesis simultaneously.

A third set of studies offers an equally mixed set of results which need to be clarified. These studies focus on a possible link between financial development and social development. However, the amount of literature available on this nexus is very limited. In this regard, we expect the existence of bidirectional causality between financial development and social development. For instance, social development can occur in an economy if a high level of financial development is present. Similarly, reverse causality could be present, in other words, social development can cause financial development (see, for instance, Sen, 2010; Mukhopadhyay, 2013).

2.2 Rationale for and relevance of the study

The possible link between financial development and economic growth is obvious from the first rigorous growth model attributed to Schumpeter (1911), which is mentioned in almost every macroeconomics textbook. There is thus no need to discuss it here. Intuitively, social development should also be linked to the nexus between financial development and economic growth, due to an income effect (thus, higher social development leads to higher financial development and economic growth in future). Hence, the remainder of this subsection focuses on the argument for the existence of links between financial development, social development and economic growth.

In recent decades, many economies have adopted development strategies that prioritise a modernisation of their financial systems. Asian countries are no exception. Since the end of the 1980s, these countries have been interested in fostering financial development, for example, by reducing government intervention in the national financial sectors, or by privatising banks. Such policies are expected to promote growth, inter alia, through a higher mobilisation of savings or a rise in domestic and foreign investments (Gries et al., 2008). However, for such policies to be effective, there has to be a causal relationship between development in the financial sector and development in the real sector (see, for instance, Mukhopadhyay, 2013).

Therefore, in this study, an attempt is made to assess whether financial sector development has actually swayed economic growth in a sample of 15 Asian countries, and whether a policy focus on financial sector development is appropriate in order to foster economic growth and social development. Since economic growth does not necessarily ensure social development, this study also examines the impact of financial development on social development in the same sample.

2.3 Proposed hypotheses

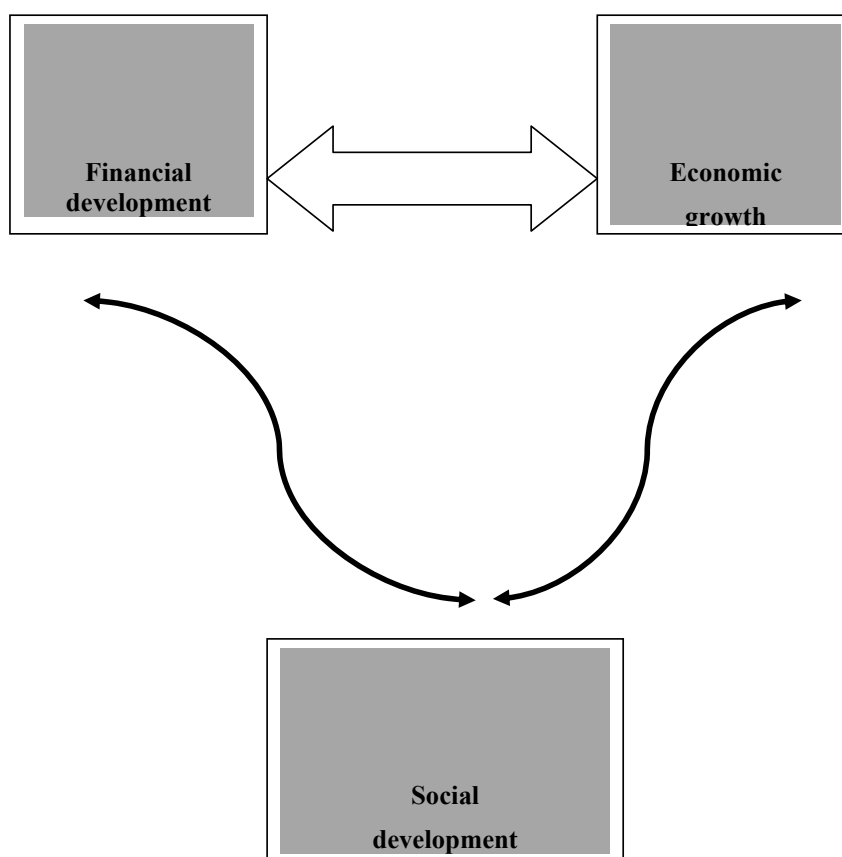
In this study, we used the panel Granger causality test to gather new evidence on the relationship between financial development, social development, and economic growth, using a sample of 15 Asian countries over the period from 1960 to 2012. We also used cointegration tests to ascertain whether these variables are cointegrated, that is, whether there is a long-run equilibrium relationship between them.

The novel features of this paper are that, first, it integrates three separate strands of the empirical literature; second, it uses a large sample of countries, including both developed and developing countries, over a fairly large and recent span of time; and third, it uses fairly sophisticated econometrics, and empirical approaches not adopted in the prior literature, to answer questions concerning the nature of the causal relationship between the variables in both the short and the long run. Figure 1 depicts the possible patterns of causal relations between financial development, social development and economic growth. The study tested the following hypotheses:

- H₁ Financial development (financial sector development index – FSDI) in any year Granger-causes economic growth. This is termed the FSDI-led growth hypothesis.
- H₂ Social development (social sector development index – SSDI) in any year Granger-causes economic growth. This is termed the SSDI-led growth hypothesis.
- H₃ Financial development in any year Granger-causes social development. This is termed the FSDI-led SSDI hypothesis.

The procedures for testing these three hypotheses (H1 – H3) are explained in Section 3.

Figure 1 The conceptual framework of the possible patterns of causality between the variables from a theoretical point of view



3 Methods of study

We deployed two techniques to study the finance-social-growth nexus, namely principal component analysis and the panel vector auto-regressive (VAR) model. The principal component analysis was used to construct the composite indices of finance-social development, which can signal the overall position of financial development and social development respectively. On the other hand, the panel VAR model was used to identify a causal nexus between financial development and social development, and economic growth. The advantage of this method is that it exploits individual time series and cross-sectional variations in data and avoids biases associated with cross-sectional regressions by taking into account the country-specific fixed effect (see, for example, Levine, 2005).

OECD (2008) describes the methodology of composite indices as containing the following ten steps: selecting a theoretical framework, data selection, imputation of missing data, choosing multivariate data analysis, normalisation, weighting and aggregation, uncertainty and sensitivity analysis, going back to the data, finding links to other indices and visualisation of results. Following these steps, variables were selected to construct the two composite indices, namely the FSDI and the SSDI. The indices were prepared using the following steps: first, data were arranged in the same order to create an input matrix for the principal component analysis; then, the data matrix was normalised, based on the min-max method. Using principal component analysis, eigen values, factor loadings and principal components were derived. Finally, the principal components were used to construct these two indices separately for each country for each year (as described in more detail by Manly, 1994; Sharma, 1996; Joliffe, 2002; Hosseini and Kaneko, 2011, 2012). The variables included for these two indices (FSDI and SSDI) are set out in Tables 1 and 2 respectively.

Table 1 Definition of variables for financial sector development

<i>Variables</i>	<i>Definition</i>
MAC	<i>Market capitalisation</i> : Percentage change in the market capitalisation of the listed companies.
TRA	<i>Traded stocks</i> : Percentage change in the total value of traded stocks.
TUR	<i>Turnover ratio</i> : Percentage change in the turnover ratio in the stock market.
BRM	<i>Broad money</i> : The ratio of broad money (currency plus demand deposits and quasi-money) to GDP.
CLM	<i>Claims on private sectors</i> : Credit including gross credit from the financial system to private sector.
DCB	<i>Domestic credit to private sector</i> : The ratio of domestic credit to GDP. It refers to financial resources provided to the private sector.
PSC	<i>Private sector credit</i> : The ratio of private credit by deposit money banks relative to GDP.
RES	<i>Total reserves</i> : Holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities.
LIQ	<i>Liquid liabilities</i> : The ratio of liquid liabilities of the financial system to the GDP.

Notes: All monetary measures are in US dollars.

All these indicators are used here as a proxy for levels of financial sector development.

Table 2 Definition of variables for social sector development

<i>Variables</i>	<i>Definition</i>
LAB	<i>Labour force participation</i> : The percentage of the working-age population (aged 15+ years) who are in the labour force.
LIF	<i>Life expectancy</i> : The average number of additional years a person can expect to live from a given age onwards.
URB	<i>Urbanisation</i> : The percentage of total population residing in urban areas.
IMR	<i>Infant mortality rate</i> : The number of infant deaths per 1,000 births.
CDR	<i>Crude death rate</i> : The total number of deaths per year per 1,000 members of the population.
GER	<i>Gross enrolment ratio</i> : The number of students enrolled in education as a percentage of the total population.
TEL	<i>Telecommunication</i> : The main telephone lines per 100 inhabitants.

Note: All these indicators are used here as a proxy for levels of social sector development.

The panel VAR model involves three steps: first, a panel unit root test is done to identify the stationarity (order of integration) of time series variables; second, a panel cointegration test is conducted to determine the existence of a long-run relationship between the time series variables; and third, a final VAR model is constructed to ascertain the direction of causality between the time series variables. These three tests are discussed in more detail below.

3.1 Panel data unit root test

We used the Levin-Lin-Chu (LLC) method (Levin et al., 2002) and the Im-Pesaran-Shin (IPS) method (Im et al., 2003) to check the order of integration to see where the time series variable attains stationary. Both the LLC and IPS methods were deployed on the principles of the conventional augmented Dickey Fuller (ADF) test. The LLC method explores the heterogeneity of intercepts across members of the panel, while the IPS method explores the heterogeneity in the intercepts, as well as in the slope coefficients. Both tests were applied by averaging individual ADF t-statistics across cross-section units. The test follows the estimation using the following equation:

$$\Delta Y_{it} = \mu_i + \gamma_i Y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta Y_{it-j} + \lambda_i t + \varepsilon_{it} \quad (1)$$

where $i = 1, 2, \dots, N$; $t = 1, 2, \dots, T$; Y_{it} is the series for country i in the panel over period t ; p_i is the number of lags selected for the ADF regression; Δ is the first difference filter ($I - L$); and ε_{it} refers to independently and normally distributed random variables for all i and t with zero means and finite heterogeneous variances (σ_i^2).

LLC considers the coefficients of the autoregressive term as homogenous across all individuals, in other words, $\gamma_i = \gamma$ for $\forall i$. The LLC tests the null hypothesis that each individual in the panel has an integrated time series, in other words, $H_0: \gamma_i = \gamma = 0$ for $\forall i$

against an alternative $H_A: \gamma_i = \gamma < 0$ for $\forall i$. LLC considers pooling the cross-section time series data, and the test is based on the following t-statistics:

$$t_y^* = \frac{\hat{\gamma}}{s.e.(\hat{\gamma})} \quad (2)$$

Here, in the LLC test, γ is restricted by being kept identical across regions under both the null and alternative hypotheses.

It is clear that the null hypothesis of the LLC test is very restrictive, but the test of IPS (Im et al., 2003) relaxes this assumption by allowing γ to vary across i under the alternative hypothesis. Hence, the null hypothesis of the IPS test is $H_0: \gamma_i = 0$ for $\forall i$, while the alternative hypothesis is that at least one of the individual series in the panel is stationary, in other words, the alternative H_A is $\gamma_i < 0$ for $\forall i$. The alternative hypothesis simply implies that γ_i differs across countries.

Due to the heterogeneity examined, each equation was estimated separately by means of the Ordinary Least Squares technique, and the test statistics were obtained as (studentised) averages of the test statistics for each equation.

The IPS t-bar statistic is simply defined as the average of the individual Dickey-Fuller τ statistics, as follows:

$$\bar{t} = \frac{1}{N} \sum_{i=1}^N \tau_i \quad \text{and} \quad \tau_i = \frac{\hat{\gamma}_i}{s.e.(\hat{\gamma}_i)} \quad (3)$$

Assuming that the cross-sections are independent, the IPS test uses the mean-group approach and obtains τ_i , and then proposes the use of the standardised t-bar statistic as follows:

$$\bar{Z} = \sqrt{N} (\bar{t} - E(\bar{t})) / \sqrt{\text{var}(\bar{t})} \quad (4)$$

where $E(\bar{t})$ represents the mean and $\text{var}(\bar{t})$ represents the variance of each τ statistic. They are generated by simulations, and are tabulated in IPS (Im et al. 1997). The statistic \bar{Z} converges to a standard normal distribution as N and T stands to infinitely large and we can compute the significance level simply (see, for instance, Im et al., 2003; Greasley and Oxley, 2010). Based on Monte Carlo simulation results, the IPS test displayed more favourable finite sample properties than the LLC test.

3.2 Panel data cointegration test

The concept of cointegration, introduced by Granger (1988), is relevant to the problem of the determination of long-run relationships between variables. The basic idea that underpins cointegration is simple. If the difference between two non-stationary series is itself stationary, then the two series are cointegrated. If two or more series are cointegrated, it is possible to interpret the variables in these series as being in a long-run equilibrium relationship. By contrast, a lack of cointegration suggests that the variables have no long-run relationship – thus, in principle, they can arbitrarily move far away from each other.

When a collection of time-series observations becomes stationary only after first being different, the individual time series might have linear combinations that are

stationary without diverging. Such collections of series are usually called cointegrated (Granger, 1988). If ‘order one’ integration is implied, the next step is to employ cointegration analysis in order to establish whether there is a long-run relationship among the set of such possibly integrated variables. Pedroni’s (2000) panel cointegration method can be used to determine the existence of cointegration among these three series. The technique starts with the following regression equation:

$$\begin{aligned} SSDI_{it} &= \beta_{0i} + \beta_{1i}t + \beta_{2i}GDP_{it} + \beta_{3i}FSDI_{it} + \varepsilon_{it} \\ \text{and } \varepsilon_{it} &= \gamma_i\varepsilon_{it-1} + \zeta_{it} \end{aligned} \quad (5)$$

where $i = 1, 2, \dots, N$; $t = 1, 2, \dots, T$. The SSDI, FSDI and gross domestic product (GDP) reflects per capita economic growth. The β_{0i} is a member-specific intercept or fixed-effects parameter which is allowed to vary across individual cross-sectional units. The $\beta_{1i}t$ is a deterministic time trend specific to the individual countries in the panel. The slope coefficients (β_{2i} and β_{3i}) can vary from one individual to another, allowing the cointegrating vectors to be heterogeneous across countries.

Pedroni (2000) proposed seven different statistics for the cointegration test in the panel data setting. Of the seven proposed statistics, the first four are known as panel cointegration statistics and are within-dimension statistics, while the last three are known as group mean panel cointegration statistics and are between-dimension statistics. Their levels are based on the way the autoregressive coefficients are manipulated to arrive at the final statistic. There are basically five steps to obtain these cointegration statistics, as set out below.

Step 1 Compute the residuals ($\hat{\varepsilon}_{it}$) from the panel regression [equation (4)]. The estimation involves the inclusion of all appropriate fixed effects, time trends or common time dummies.

Step 2 Compute the residuals ($\hat{\zeta}_{it}$) from the following regression:

$$\Delta Y_{it} = \beta_{1i}\Delta X_{1it} + \beta_{2i}\Delta X_{2it} + \dots + \beta_{mi}\Delta X_{mit} + \varepsilon_{it} \quad (6)$$

for $t = 1, 2, \dots, T$; $i = 1, 2, \dots, N$; $m = 1, 2, \dots, M$

where Y_i is the dependent variable and X_{mi} are regression variables. In this equation, T refers to the number of observations over time, N refers to the number of individual members in the panel, and M refers to the number of regression variables. $\beta_{1i}, \beta_{2i}, \dots, \beta_{mi}$ are the slope coefficients and ε_{it} shows the deviations from the modelled long-run relationship. If the series involved in the equation are cointegrated, ε_{it} should be stationary.

Step 3 Compute (\hat{L}_{1ii}^2), the long-run variance of $\hat{\zeta}_{it}$:

$$\hat{L}_{1ii}^2 = \frac{1}{T} \sum_{t=1}^T \hat{u}_{it}^2 + \frac{2}{T} \sum_{s=1}^{K_i} \left(1 - \frac{s}{K_i + 1}\right) \sum_{t=s+1}^T \hat{u}_{it} \hat{u}_{it-s} \quad (7)$$

where u_{it} is residual, and is obtained from the error of the cointegration equation (6), S and K are lag lengths, and T is the number of observations over time (as discussed in more detail, by Newey and West, 1987; Pedroni, 1999).

Step 4 Compute the residuals of the ADF test for $\hat{\varepsilon}_{it}(\hat{u}_{it})$ and compute the following variances of these residuals:

$$\hat{S}_i^2 = \frac{1}{T} \sum_{t=1}^T \hat{u}_{it}^2 \quad \text{and} \quad \tilde{S}_{NT}^2 = \frac{1}{T} \sum_{t=1}^T \hat{S}_i^2 \quad (8)$$

where \hat{S}_i^2 is the individual contemporaneous variance and \hat{u}_{it}^2 is the long-run variance of the residual \hat{u}_{it} ; and \tilde{S}_{NT}^2 is the contemporaneous panel variance estimator.

Step 5 Compute the panel-t and group-t statistics (Pedroni, 2000). These statistics are asymptotically normally distributed.

Based on the cointegration residuals, Pedroni (2000) developed seven panel cointegration statistics (four panel-t and three group-t statistics). The mathematical exposition and the asymptotic distributions of these panel cointegration statistics are explained by Pedroni (1999). Under an appropriate standardisation, based on the moments of the vector of the Brownian motion functionality, these statistics have a standard normal distribution. Accordingly, the null hypothesis of no cointegration was then tested, based on the above description of a standard normal distribution. The null hypothesis of no cointegration of the pooled (within-dimension) estimation follows $H_0: \gamma_i = 1$ for $\forall i$ against an alternative hypothesis $H_A: \gamma_i = \gamma < 1$ for $\forall i$, in the residuals from the panel cointegration. The within-dimensional estimation assumes a common value for $\gamma_i = \gamma$.

By contrast, the group means panel cointegration statistics (pooled between-dimension) tested the null hypothesis of no cointegration $H_0: \gamma_i = 1$ for $\forall i$ against an alternative hypothesis $H_A: \gamma_i < 1$ for $\forall i$. Hence, under the alternative hypothesis, the between-dimensional estimation did not assume a common value for $\gamma_i = \gamma$. Therefore, this allowed an additional source of possible heterogeneity across the individual country members of the panel. These statistics diverged to negative infinity under the alternative hypothesis. The left tail of the normal distribution is usually employed here to reject the null hypothesis.

3.3 Panel data Granger causality test

The panel causality test proposed by Holtz-Eakin et al. (1988) was employed to ascertain the direction of causality between finance-social development and economic growth in the 15 Asian countries selected. The following three models were used:

$$\begin{aligned} \Delta PGDP_{it} = & \eta_{1j} + \sum_{k=1}^{p_1} \alpha_{1ik} \Delta GDP_{it-k} + \sum_{k=1}^{p_2} \beta_{1ik} \Delta FSDI_{it-k} \\ & + \sum_{k=1}^{p_3} \delta_{1ik} \Delta SSDI_{it-k} + \omega_{1i} ECT_{1it-1} + \varepsilon_{1it} \end{aligned} \quad (9)$$

$$\begin{aligned} \Delta FSDI_{it} = & \eta_{2j} + \sum_{k=1}^{p_1} \alpha_{2ik} \Delta FSDI_{it-k} + \sum_{k=1}^{p_2} \beta_{2ik} \Delta PGDP_{it-k} \\ & + \sum_{k=1}^{p_3} \delta_{2ik} \Delta SSDI_{it-k} + \omega_{2i} ECT_{2it-1} + \varepsilon_{2it} \end{aligned} \quad (10)$$

$$\begin{aligned} \Delta SSDI_{it} = & \eta_{3j} + \sum_{k=1}^{p_1} \alpha_{3ik} \Delta SSDI_{it-k} + \sum_{k=1}^{p_2} \beta_{3ik} \Delta FSDI_{it-k} \\ & + \sum_{k=1}^{p_3} \delta_{3ik} \Delta PGDP_{it-k} + \omega_{3i} ECT_{3it-1} + \varepsilon_{3it} \end{aligned} \quad (11)$$

where FSDI is the composite index of financial sector development; SSDI is the composite index of social sector development; PGDP is the per capita GDP growth; and p_1 , p_2 and p_3 are the lag lengths for the differenced variables in the respective equations.

The ECTs are error-correction terms derived from the cointegrating equations. The ECTs represent long-run dynamics, while differenced variables represent short-run dynamics between variables. The above model is meaningful if the time series variables are $I(1)$ and are cointegrated. If the time series variables are $I(1)$ but not cointegrated, the ECT component was removed in the estimation process. We looked for both short-run and long-run causal relationships. Short-run causal relationships were measured using F-statistics and the significance of the lagged changes in independent variables, whereas long-run causal relationships were measured using the significance of the t-test of the lagged ECTs. Based on equations (9) to (11), Table 5 lists various possible hypotheses on causal relationships among the financial sector development and the social sector development indices, and economic growth.

The empirical analysis in this paper is based on a panel of 15 Asian countries, namely Bangladesh, Bhutan, China, Hong Kong, India, Indonesia, Japan, Malaysia, Pakistan, the Philippines, Singapore, South Korea, Sri Lanka, Thailand and Vietnam, over the period from 1960 to 2012. The annual data used for the analysis were obtained from World Development Indicators, the World Bank, Washington, DC. The variables incorporated in the panel VAR model were used in natural logarithms so that their first differences approached the growth rates. Table 4 summarises the statistics on the variables, while Table 5 shows the correlation matrix.

4 Empirical results and discussion

The investigation started with the integration and cointegration properties of time series variables. The estimated results confirmed that the variables were integrated of order one [$I(1)$] and were cointegrated (see Tables 3 and 4 respectively), indicating the presence of a long-run equilibrium relationship between financial development, social development and economic growth.

Table 3 Hypotheses tested in this study

<i>Causal flow</i>	<i>Restrictions</i>
FSDI => PGDP	$\beta_{1ik} \neq 0; \omega_{1i} \neq 0$
PGDP => FSDI	$\beta_{2ik} \neq 0; \omega_{2i} \neq 0$
SSDI => PGDP	$\delta_{1ik} \neq 0; \omega_{1i} \neq 0$
PGDP => SSDI	$\delta_{3ik} \neq 0; \omega_{3i} \neq 0$
SSDI => FSDI	$\delta_{2ik} \neq 0; \omega_{2i} \neq 0$
FSDI => SSDI	$\beta_{3ik} \neq 0; \omega_{3i} \neq 0$

Notes: FSDI: Financial sector development index; PGDP: per capita economic growth rate; and SSDI: social sector development index.

FSDI is defined in terms of MAC, TRA, TUR, BRM, CLM, DCB, PSC, RES and LIQ; and SSDI is defined in terms of LAB, LIF, URB, IMR, CDR, GER and TEL.

The definitions of all these variables are presented in Tables 1 and 2 respectively.

Table 4 Summary statistics on the variables

<i>Variables</i>	<i>Mean</i>	<i>Med</i>	<i>Max</i>	<i>Min</i>	<i>Std</i>	<i>Skew</i>	<i>Kur</i>	<i>JB</i>	<i>Pr</i>
Case 1: East Asia (EA)									
FSDI	0.42	0.47	0.92	-0.04	0.24	-0.23	1.98	6.90	0.03
SSDI	1.46	1.49	1.63	1.21	0.14	-0.52	1.91	12.7	0.00
PGDP	3.73	3.96	4.63	2.29	0.73	-0.54	1.95	12.7	0.00
Case 2: South Asia (SA)									
FSDI	0.49	0.47	0.92	0.01	0.25	0.12	1.93	7.93	0.00
SSDI	1.39	1.29	3.32	0.91	0.52	2.59	9.08	41.9	0.00
PGDP	2.62	2.58	3.38	1.08	0.31	-0.40	6.05	65.3	0.00
Case 3: South East Asia (SEA)									
FSDI	0.29	0.36	0.63	-0.31	0.21	-0.81	2.94	22.5	0.00
SSDI	1.51	1.54	1.75	1.14	0.17	-0.31	1.86	14.6	0.00
PGDP	3.23	3.10	4.64	2.28	0.54	0.74	2.96	19.2	0.00
Case 4: Total Asia (TA)									
FSDI	0.39	0.39	0.92	-0.31	0.25	-0.09	2.78	1.76	0.41
SSDI	1.46	1.48	3.32	0.91	0.32	2.85	16.2	43.9	0.00
PGDP	3.17	2.99	4.64	1.07	0.69	0.59	2.41	36.2	0.00

Notes: Med: median; Max: maximum; Min: minimum; Std: standard deviation; Skew: skewness; Kur: kurtosis; JB: Jarque Bera statistics; Pr: probability.

FSDI: Financial sector development index; PGDP: per capita economic growth rate; and SSDI: social sector development index.

Values reported here are the natural logs of the variables. We use natural log forms in our estimation.

East Asia refers to four countries: China, Hong Kong, Japan and South Korea;

South Asia refers to five countries: Bangladesh, Bhutan, India, Pakistan and

Sri Lanka; South East Asia refers to six countries: Indonesia, Malaysia,

the Philippines, Singapore, Thailand and Vietnam; and

total Asia refers to all 15 Asian countries.

Table 5 The correlation matrix

<i>Variables</i>	<i>FSDI</i>	<i>SSDI</i>	<i>PGDP</i>
Case 1: East Asia (EA)			
FSDI	1.00		
SSDI	0.06	1.00	
PGDP	0.75*	0.63*	1.00
Case 2: South Asia (SA)			
FSDI	1.00		
SSDI	-0.10	1.00	
PGDP	0.16	0.36**	1.00
Case 3: South East Asia (SEA)			
FSDI	1.00		
SSDI	0.37**	1.00	
PGDP	0.59*	0.30	1.00
Case 4: Total Asia (TA)			
FSDI	1.00		
SSDI	-0.03	1.00	
PGDP	0.30**	0.27**	1.00

Notes: FSDI: Financial sector development index; PGDP: per capita economic growth rate; SSDI: social sector development index.

*Indicates statistical level of significance at a 5% level; and ** indicates statistical level of significance at a 10% level.

Once the status of cointegration was known, the next step was to check the direction of causality between them. The panel Granger causality test, based on the panel VAR model, was used for this purpose. Figure 1 illustrates the symmetric representation of the Granger causal relationships among financial development, social development and economic growth.

The estimated results reveal the presence of bidirectional causality between financial development and economic growth, supporting both the demand-following and supply-leading hypotheses on the finance-growth nexus. This result is consistent with the earlier findings of Demetriades and Hussein (1996), Demetriades and Luintel (1996), Blackburn and Hung (1998), Levine (1999), Luintel and Khan (1999), Shan et al. (2001), Calderon and Liu (2003), Ang (2008), Wolde-Rufael (2009), Pradhan (2011), Bangake and Eggoh (2011) and Hassan et al. (2011). However, it differs from the results of Christopoulos and Tsionas (2004), who found unidirectional causality from financial development to growth, and Jung (1986), who found unidirectional causality from growth to financial development. The latter finding is, in fact, more appropriate in developing countries because of the increasing demand for financial services.

Table 6 Results from panel unit root test

	<i>FSDI</i>		<i>SSDI</i>		<i>PGDP</i>	
	<i>LD</i>	<i>FD</i>	<i>LD</i>	<i>FD</i>	<i>LD</i>	<i>FD</i>
Case 1: East Asia (A)E						
Model 1: With intercept only						
LLC	0.10	-2.57*	-1.43	-3.31*	-1.41	-5.32*
IPS	1.91	-6.03*	-0.08	-3.73*	-0.42	-4.15*
Model 2: With intercept and trend						
LLC	1.85	-0.53	0.06	-1.37	-0.59	-0.53
IPS	-0.20	-5.13*	0.86	-3.10*	0.68	-4.04*
Case 2: South Asia (SA)						
Model 1: With intercept only						
LLC	1.43	-2.85*	-2.82	-3.78*	2.77	-2.95*
IPS	1.77	-5.75*	1.16	-5.17*	3.60	-3.01
Model 2: With intercept and trend						
LLC	0.46	-0.54	-2.03	-1.04	2.97	-0.99
IPS	0.28	-3.53*	-0.99	-3.45*	0.67	-3.99*
Case 3: South East Asia (SEA)						
Model 1: With intercept only						
LLC	-1.99	-4.31*	-0.51	-3.96*	-1.37	-5.74*
IPS	0.03	-6.07*	-0.23	-6.13*	1.19	-5.37*
Model 2: With intercept and trend						
LLC	-0.86	-3.78*	0.44	-4.03*	-1.44	-4.65*
IPS	-0.20	-5.36*	2.03	-6.49*	-1.56	-3.99*
Case 4: Total Asia (TA)						
Model 1: With intercept only						
LLC	-0.82	-4.76*	-1.65	-5.24*	-1.49	-7.73
IPS	2.03	-10.3*	0.50	-8.83*	3.09	-7.24
Model 2: With intercept and trend						
LLC	0.50	-3.86*	-0.67	-3.92*	-1.17	-6.76*
IPS	-0.43	-7.81*	1.09	-7.48*	-0.23	-5.06*

Notes: FSDI: Financial sector development index; PGDP: per capita economic growth rate; SSDI: social sector development index.
 LLC: Levine-Lin-Chu statistics; IPS: Im-Pesaran-Shin statistics; LD: level data; FD: first difference data. **Indicates significance at a 1% level; and * indicates significance at a 5% level.

Table 7 Results of Pedroni panel cointegration test

	<i>Test statistics</i>	<i>Deterministic intercept</i>	<i>Deterministic intercept and trend</i>	<i>Test statistics</i>
Case 1: East Asia (EA)				
Panel ν -statistics	1.12	[0.13]	8.13	[0.00]
Panel ρ -statistics	-0.66	[0.25]	-4.51	[0.00]
Panel PP-statistics	-1.09	[0.14]	-6.19	[0.00]
Panel ADF-statistics	0.35	[0.64]	-2.64	[0.00]
Group ρ -statistics	-1.53	[0.06]	-0.33	[0.37]
Group PP-statistics	-1.84	[0.03]	-1.29	[0.09]
Group ADF-statistics	-1.76	[0.04]	-3.12	[0.00]
Case 2: South Asia (SA)				
Panel ν -statistics	2.09	[0.99]	2.09	[0.38]
Panel ρ -statistics	-1.17	[0.00]	-0.45	[0.91]
Panel PP-statistics	-1.40	[0.00]	-1.12	[0.82]
Panel ADF-statistics	-0.89	[0.05]	-0.25	[0.92]
Group ρ -statistics	0.26	[0.00]	0.71	[0.99]
Group PP-statistics	-0.78	[0.00]	-0.49	[0.81]
Group ADF-statistics	-1.41	[0.00]	-0.64	[0.93]
Case 3: South-East Asia (SEA)				
Panel ν -statistics	-0.14	[0.55]	-1.61	[0.95]
Panel ρ -statistics	0.26	[0.60]	1.02	[0.85]
Panel PP-statistics	-0.58	[0.27]	-0.32	[0.37]
Panel ADF-statistics	-0.11	[0.46]	0.69	[0.76]
Group ρ -statistics	0.79	[0.78]	1.63	[0.95]
Group PP-statistics	-3.99	[0.00]	-3.37	[0.00]
Group ADF-statistics	-1.31	[0.00]	-0.21	[0.42]
Case 4: Total Asia (TA)				
Panel ν -statistics	1.01	[0.15]	-0.23	[0.59]
Panel ρ -statistics	-0.53	[0.29]	0.16	[0.56]
Panel PP-statistics	-1.55	[0.06]	-2.01	[0.02]
Panel ADF-statistics	-0.23	[0.41]	-0.38	[0.64]
Group ρ -statistics	-0.16	[0.44]	1.27	[0.89]
Group PP-statistics	-4.02	[0.00]	-3.16	[0.00]
Group ADF-statistics	-2.48	[0.00]	-2.15	[0.00]

Notes: Variables and regions shown above are defined in the text. Natural log forms are used in our estimation.

Figures in square brackets are probability levels indicating significance.

Table 8 Granger causality test results

<i>Dependent variables</i>	<i>Independent variables</i>			<i>Inferences</i>
Case 1: East Asia (EA)				
Δ FSDI	Δ SSDI	Δ PGDP	ECT	
Δ FSDI	0.83	2.88*	-2.54*	PGDP => FSDI
Δ SSDI	1.08	0.03	-0.89	
Δ PGDP	0.29	0.50	3.17	
Case 2: South Asia (SA)				
Δ FSDI	0.06	4.74*	-2.05*	PGDP => FSDI
Δ SSDI	0.88	0.61	-0.89	
Δ PGDP	0.19	0.05	-0.07	
Case 3: South-East Asia (SEA)				
Δ FSDI	7.24*	7.58*	-4.31*	PGDP => FSDI
Δ SSDI	1.03	2.88*	-2.43*	SSDI <=> PGDP
Δ PGDP	1.06	0.59	-2.28	
Case 4: Total Asia (TA)				
Δ FSDI	0.29	14.8*	-2.48*	PGDP => FSDI
Δ SSDI	0.08	2.96*	-6.21	SSDI => FSDI
Δ PGDP	0.37	1.47	3.17	

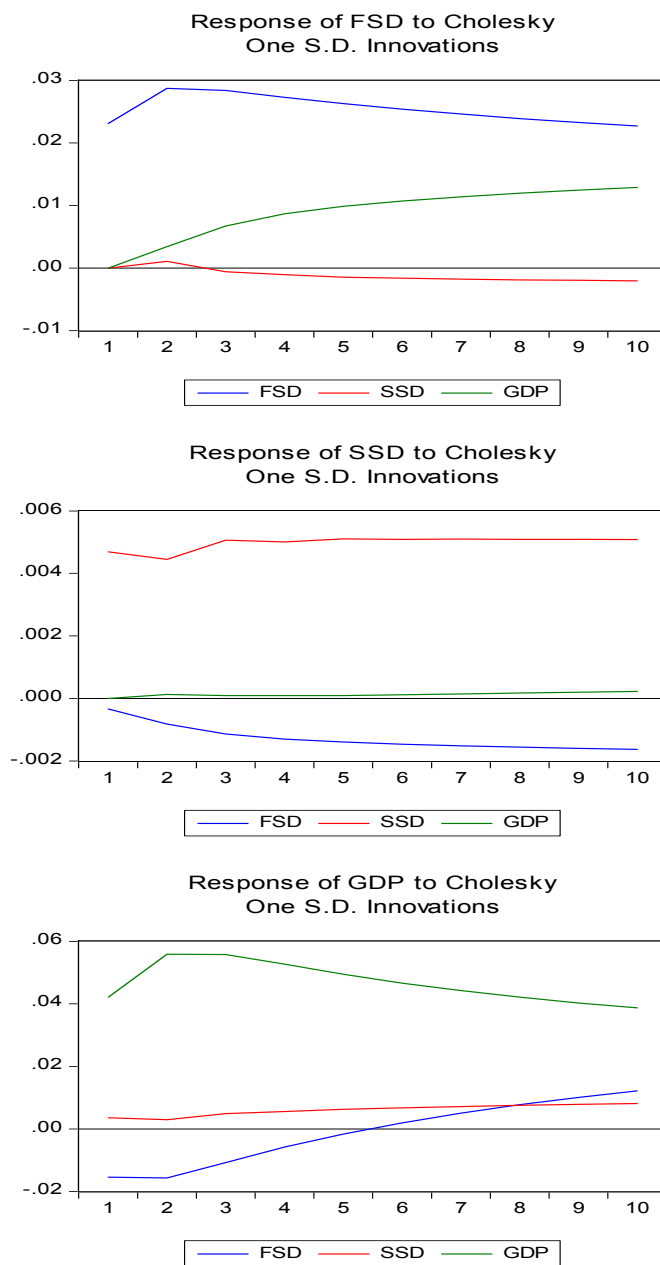
Notes: FSDI: Financial sector development index; PGDP: per capita economic growth rate; SSDI: social sector development index; ECT: error correction term.

*Indicates significance at a 1% level; ** indicates significance at a 5% level.

The study further found unidirectional causality from economic growth to social development. This implies that social sector development depends on the level of economic growth in a country. These results are consistent with the findings of Goldstein (1985), Ram (1985), Strauss and Thomas (1995), Majumdar (1996), Haddad et al. (2003), Cutler et al. (2005), Iqbal and Nadeem (2006) and Hosseini and Kaneko (2012). The study also found unidirectional causality from financial development to social development and therefore supports the findings of Outreville (1999). The estimated results of these three findings are supported by the generalised impulse response functions (GIRFs), which are very responsive to panel VAR results.

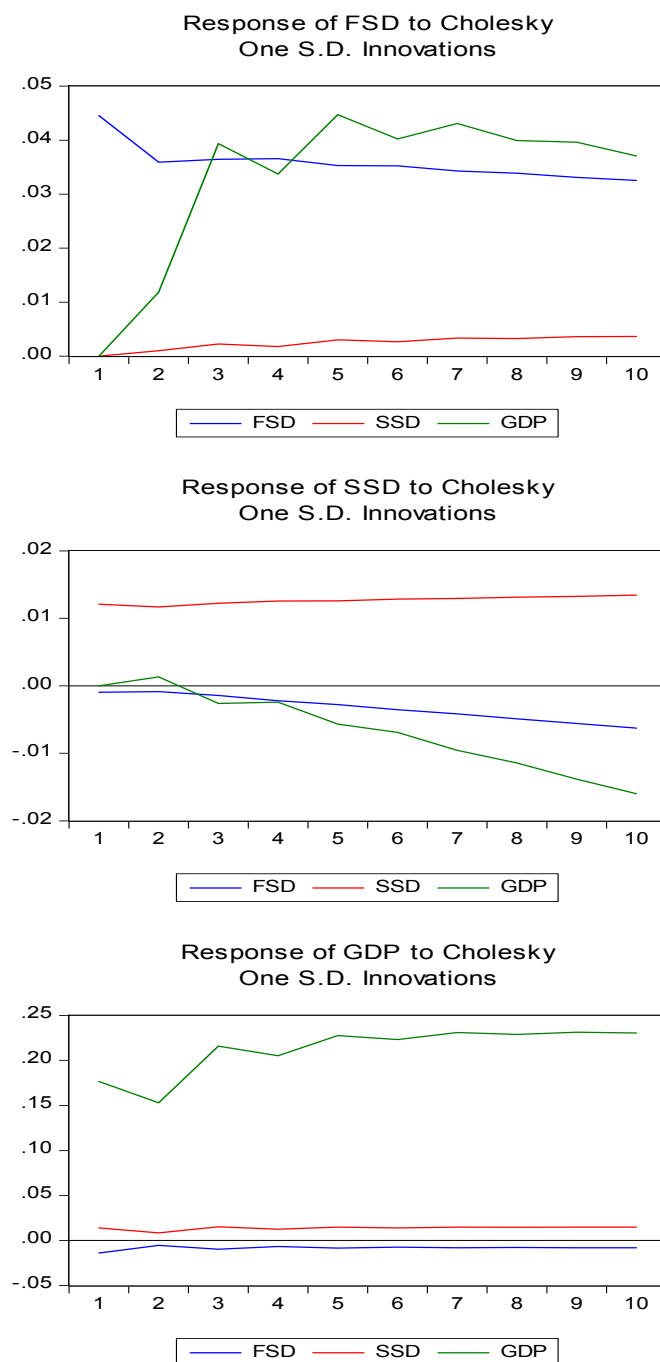
In brief, the empirical results suggest that financial development and economic growth cause each other and that they are very helpful indicators to determine the level of social development in a given country. These results are consistent with the assumption that well-developed financial sectors may have helped to increase both economic growth and social development in the 15 selected Asian countries.

Figure 2 Granger causal relations between the variables in East Asia (see online version for colours)



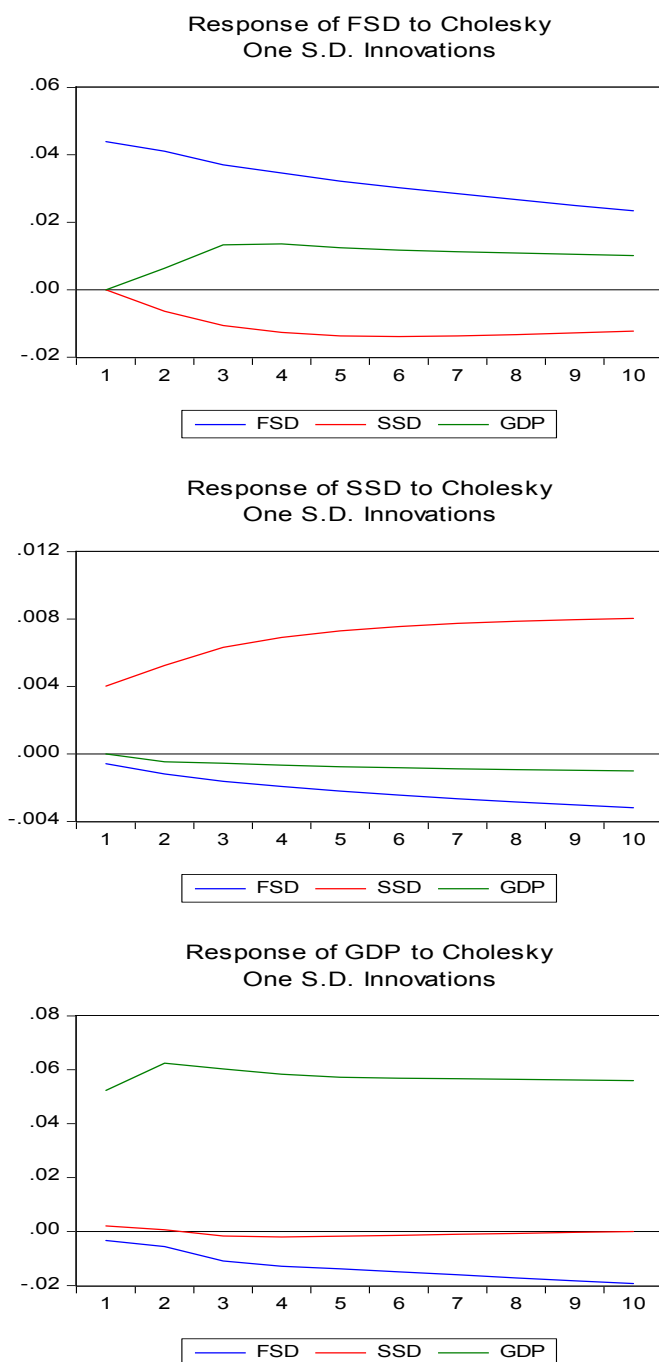
Notes: FSD: Financial sector development index; SSD: social sector development index; GDP: per capita economic growth rate.

Figure 3 Granger causal relations between the variables in South Asia (see online version for colours)



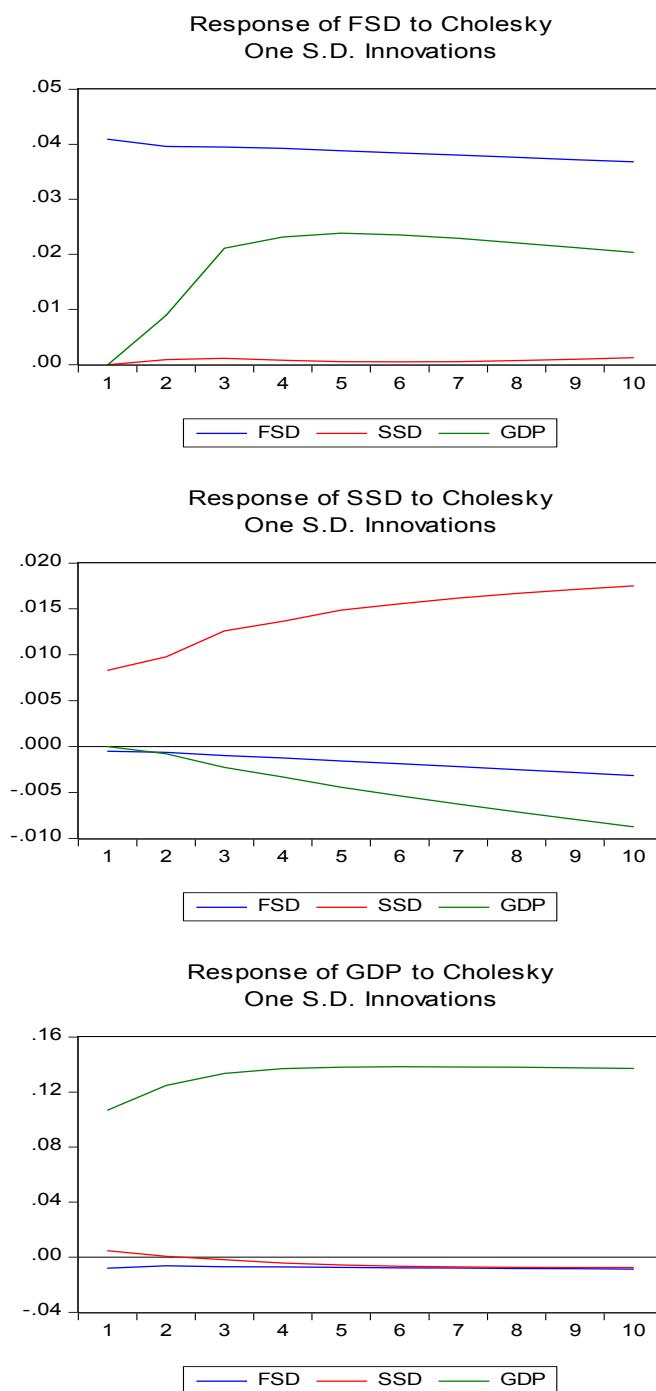
Notes: FSD: Financial sector development index; SSD: social sector development index; GDP: per capita economic growth rate.

Figure 4 Granger causal relations between the variables in South-East Asia (see online version for colours)



Notes: FSD: Financial sector development index; SSD: social sector development index; GDP: per capita economic growth rate.

Figure 5 Granger causal relations between the variables in total Asia (see online version for colours)



Notes: FSD: Financial sector development index; SSD: social sector development index; GDP: per capita economic growth rate.

5 Conclusions and policy implications

Understanding the policy implications of the nexus between financial development, social development and economic growth is critical in development economics. Much still needs to be understood about the various integrations among these three factors in order for policy-makers to make the right decisions about development policy.

We assume that financial development and economic growth are keys to long-run social development – there is, however, some debate about whether they cause each other, or they predict the level of social development in the economy. The existing literature provides very inconclusive findings, particularly on the causal nexus between financial development and economic growth (see, for instance, De Gregorio and Guidotti, 1995; Hassan et al., 2011). The current study casts some light on this debate by investigating 15 Asian countries over the period from 1960 to 2012.

The findings demonstrate the presence of a long-run relationship between financial development, social development and economic growth. A causality analysis confirmed the presence of bidirectional causality between financial development and economic growth and predicted the level of social development in the panel of 15 Asian countries. The policy implications of these empirical findings are clear: if policymakers want to promote social development, they should focus on the long-run relationships between financial development and economic growth. This requires financial systems that function well, particularly in respect of sound financial intermediation and liberalised financial indicators such as market capitalisation, the turnover ratio and liquid liabilities, all of which are important for the efficient allocation of financial resources, which in turn helps to maintain sustainable economic growth and social development in these countries.

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