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Thai-Ha Le

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AUTHOR AFFILIATION: Centre of Commerce and Management, RMIT University, Vietnam

CONTACT: ha.lethai@rmit.edu.vn

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College of Asia and the Pacific
The Australian National University
Canberra ACT 0200 Australia

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Thai-Ha Le*

Centre of Commerce and Management, RMIT University, Vietnam

702 Nguyen Van Linh Blvd., District 7, HCMC, Vietnam

Email: ha.lethai@rmit.edu.vn; Telephone: +84-983502188

* Corresponding author.

Trade openness, financial depth and economic growth: Causality evidence from Asian economies

ABSTRACT

This study investigates the causality patterns between financial deepening, trade openness and economic development for 14 countries in Asia and the Pacific region. The Gregory Hansen cointegration tests which account for one endogenous structural break and Toda-Yamamoto non-Granger causality tests are used to add to the existing empirical evidence. In general, the evidence indicates (1) a strong link between financial depth and economic growth, (2) a somewhat weaker linkage between financial depth and trade openness and (3) a sceptical linkage between trade openness and economic growth, for most of the sample. Development strategies prioritizing trade sector development hence cannot be supported.

Key words: financial depth, economic growth, trade openness, Toda Yamamoto non Granger causality test, Gregory Hansen cointegration test, Asia and the Pacific.

JEL: N2, O1, O43.

1. Introduction

The last decades have witnessed development strategies adopted by many economies that prioritize the modernization of their financial systems. The countries of Asia and the Pacific (henceforth AP) are no exception. The current remarkable growth in the AP financial markets, particularly with the recent developments in credit markets, is certain to continue. Efforts to develop financial markets are theoretically needed to foster critical economic activities such as the capital allocation process, monetary policy implementation and government borrowing. The current global economic situation further underscores the compelling rationale for the development of sound and integrated financial markets in the region. However, the effectiveness of such policies requires a convenient causal relationship between financial and real sectors.

Even though the relationships between trade, financial development and economic growth have been extensively explored in literature, the majority of the studies have used a bi-variate framework to examine the causal relationship between trade and economic growth and between financial and economic development (e.g., El Khoury and Savvides, 2006; Shahbaz, 2012; Darrat, 1999; Calderon and Lin, 2003; Demetriades and Hussein, 1996). However, it has been clear that the results obtained by conducting bi-variate causality test may be invalid due to the omission of an important variable which affect both the variables included in the causality model. As such, the introduction of a third variable in the causality framework may not only alter the direction of causality but also the magnitude of the estimates (Loizides and Vamvoukas, 2005).

Further, several studies have employed methods for cross-sectional data analysis with a hope that the causalities between the variables of interest could be generalized (e.g., Yanikkaya, 2003; Harrison, 1996). Yet, the problem of using a cross-sectional method is that by grouping countries at different stages of trade openness, financial and economic development, the method could not take into account the country-specific effects of trade openness and financial depth on economic growth and vice versa. Particularly, it fails to explicitly address the potential biases arising from the existence of cross-country heterogeneity, which may lead to inconsistent and misleading estimates (Ghirmay, 2004; Quah, 1993; Casselli et al., 1996). To avoid this backdrop, this study attempts to investigate the causal relationships among trade openness, financial depth and economic growth in a number of AP economies using a tri-variate framework.

This research assesses whether financial depth has led to economic growth in a sample ofAP countries as these markets are expected to play a further important role in the world capital markets for investment and risk management. The study investigates whether a policy focus on financial sector development is appropriate for fostering development. Thus causality between finance and economic growth is tested, capturing indirect linkages also by scrutinizing the relationship between financial depth and trade openness. This study contributes to the existing literature by (1) using econometric methods that are less prone to the misspecifications that occur when testing for causality, (2) employing a composite finance indicator in order to proxy financial depth in a broad sense, and (3) taking into

account the linkages between finance and trade openness that allow for further effects on economic development.

The balance of this paper is structured as follows. Section 2 reviews the related academic literature. Section 3 describes the data, variables and the testing framework. Section 4 presents the empirical results. Section 5 concludes with a summary.

2. Background and Overview

a) Literature review

(i) Trade openness and economic growth

In a static setting, conventional trade theory relates trade patterns to comparative advantage, and suggests that for nations that engage in trade, each will specialize in the production of goods in which it has a comparative advantage, i.e., lower opportunity costs prior to trade than the other country (e.g., Dixit and Norman, 1980). Each country thus exports goods in which it has a comparative advantage, which is usually assumed to be derived from either exogenous technological differences (the classical Ricardian model) or different factor endowments (the Heckscher-Ohlin model). Hence, according to conventional trade theory, international trade is associated with a reallocation of resources within the national borders determined by exogenous differences across countries. This reallocation of resources generates efficiency gains that lead to an increase in the level of aggregate national income.

Two other sources of gain from international trade are suggested by static models of monopolistic competition and economies of scale (Krugman, 1979; 1980). First, opening up for trade between two countries that produce differentiated products implies that there could be more varieties available for consumption, which is a source of gain for consumers. Second, the increased competition lowers the market power of firms and hence the equilibrium prices and the increased size of the market allows firms to realize economies of scale. The lower prices raise real purchasing powers, which is another source of gain for consumers. Even though the size and distribution of the welfare gains from trade may be disputed, there is strong consensus of a positive relationship between international trade and aggregate national income. The same degree of consensus, however, does not appear to hold for the growth effects of international trade. Many empirical analyses estimate positive growth effects of trade openness, but the size of these effects is often rather small, and the empirical methods used to estimate the effects have been subject to substantial criticism.

The new interest in the determinants of economic development has reignited the debate on trade openness and economic growth. The neoclassical growth models developed by Solow (1957) and others, suggest that technological change is exogenous, that is, unaffected by a country's openness to world trade. In the "new" growth theories, however, trade policy affects long-run economic growth through its impact on technological change (e.g., Grossman and Helpman, 1992). In these models, openness to trade provides access to imported inputs, which embody new technology. Further, the effective size of the market

facing producers is increased, which raises the returns on innovation and hence a country's specialization in research-intensive production.

New growth theories, however, do not predict that trade will unambiguously raise economic growth. It is argued that increased competition could discourage innovation by lowering expected profits (Schumpeter, 1934; 1942). Intervention in trade could raise long-run growth if protection encourages investment in research-intensive sectors for countries with an international advantage in these kinds of goods. Since the theoretical literature does not provide a clear answer, empirical work is needed to help resolve the debate.

(ii) Financial depth and economic growth

Financial markets provide an economy with certain services such as risk and information management and the pooling and mobilization of savings. Liquid and deep financial markets sway economic development. At a very broad level, financial markets are the venues where borrowers and lenders interact, and capital is raised for real investment and then gets reallocated among investors. Financial development thus contributes to increased mobilisation of savings as well as a reduction in information asymmetries, which leads to better allocation of resources. Further, developing liquid financial markets is essential for governments and central banks for the conduct of their fiscal and monetary policy implementation. At a micro level, financial development involves improved monitoring ofmanagers and a higher level of corporate control which facilitates risk reduction (Roubini and Sala-i-Martin, 1992 and Kingand Levine, 1993).A variety of theoretical models have been proposed to analyse the linkage between financial depth and economic growth. Levine (2005) presented a survey of theories on the issue and listed five possible channels through which financial development may influence economic growth. These channels include: (i) providing information about possible investments for efficient capital allocation; (ii) monitoring firms and exerting corporate governance; (iii) ameliorating risk; (iv) mobilizing and pooling savings; and (v) easing the exchange of goods and services.

The debate regarding the direction of causality between financial development and economic growth has been ongoing since the 19th century (e.g., Bagehot, 1873). For a long time the conventional wisdom has been in favour of the supply-leading response where the development of the financial sector is expected to precede the development of the real sector. There have been four views existing in the literature regarding the relationship between financial development and economic growth. The first view argues that financial development is important and leads to economic growth since the financial sector may influence growth through the accumulative and the allocative channel. The former emphasizes the finance-induced effects of physical and human capital accumulation on economic growth (e.g., Pagano, 1993). Meanwhile, the latter focuses on the finance-induced gains in resource allocation efficiency which translates into augmented growth (e.g., King and Levine, 1993). The second view, however, maintains that economic growth drives the development of the financial sector. For instance, in an expanding economy the private sector

may demand new financial instruments and a better access to external finance, so finance activities simply amplify instep with general economic development (e.g., Robinson, 1952). The third view contends that finance and growth may be mutually dependent, i.e. there is bidirectional causality between financial development and economic growth. The real sector may provide the financial system with the funds necessary to enable financial deepening, eventually allowing for a capitalization on financial economies of scale which in turn facilitates economic development (e.g., Berthelemy and Varoudakis, 1996). That is, the theory provides ground for several causation patterns, where finance leads growth (supply-leading hypothesis), finance follows growth (demand-following hypothesis), or where the real and financial sector influence each other mutually (bidirectional causality). Finally, the forth view follows more skeptical views as discussed in Chandavarkar (1992) that finance and growth may also evolve independently of each other, so no causality exists between them (insignificant causation).

There is also a vast empirical literature on the issue. The majority of them are cross-sectional studies based on cross-sectional regressions and documented a positive connection between financial development and economic activity (e.g., King and Levin, 1993; La Porta et al, 2002). None of these cross-country studies, however, gave a satisfactory answer to the causality question between financial depth and economic growth.

A few recent papers studied the relationship between finance and growth in individual countries. Compared with cross-country studies, in studies of individual countries, researchers can design specific measures of financial development according to the particular characteristics of the country. These studies can also avoid dealing with country-specific factors in regression analysis.

(iii) Financial depth and trade openness

Firstly, in terms of financial development, it is shown that the countries with a relatively well-developed financial sector have a comparative advantage in industries and sectors that rely on external finance (Kletzer and Bardhan, 1987). Extending this argument and allowing both sectors to use external finance, one being more credit intensive due to increasing returns to scale, the level of financial development is found to have an effect on the structure of the trade balance (Beck, 2002). On the one hand, reforming the financial sector might have implications for the trade balance if the level of financial development is a determinant of countries' comparative advantage. On the other hand, the effect of trade reforms on the level and structure of the trade balance might depend on the level of financial development. More recently, in building a model with two sectors, one of which is financially extensive, Do and Levchenko (2004) find that openness to trade will affect demand for external finance, and thus financial depth, in the trading countries. In particular, their model predicts that in wealthy countries, trade should be related with faster financial development. On the contrary, in poor countries, more trade should slow financial development, because these countries import financially intensive goods rather than develop their own financial system.

(iv) Finance-openness links and development

Links between financial depth and trade openness allow for more complex paths to economic development. On the one hand, if increasing trade openness leads to an increase in financial development, this may promote economic growth where financial depth is found to enhance growth via the allocative and accumulative channels. On the other hand, if financial deepening induces trade openness, it may subsequently foster economic growth where openness to trade is found to be a growth factor. Openness may induce economic growth in several ways, for example, by increasing a country's level of specialization or by positively affecting innovation and technological diffusion. Empirical evidence suggests that trade openness may indeed positively affect economic performance (e.g., Edwards, 1998; Harrison, 1996).

b) Economic development in Asia and the Pacific

The Asia-Pacific is characterized by a larger population and stronger economic growth than any other, and an abundance of natural resources including tropical rain forests and marine products. The region is very diverse in terms of its nations' cultures, political systems, economic institutions and living standards. The countries (and territories) of the region are at various levels of economic growth. While Australia, Japan, Republic of Korea, New Zealand, and Singapore are categorized as highly industrialized countries, Bangladesh, Cambodia, China, India, Pakistan, and Vietnam are regarded as low-income countries. Indonesia and Philippine could be categorized as middle income countries, and Thailand and Malaysia be as high income countries.

In 1991, the region's combined GDP came to 3.481 trillion (US) dollars and accounted for about one-sixth of the combined global GDP. Over the last 20 years, the AP region has continued to keep high economic growth rates exceeding those in other regions. Having accounted for more than half of global economic growth, the region has consequently come to be known as the growth centre of the global economy. Moreover, the scale is expanding. Whereas the average real GDP growth rate for the world as a whole was 2.3 percent in 1993, UN estimates put the corresponding rate for the developing countries that are members of the Economic and Social Commission for Asia and the Pacific (ESCAP) for the same year at 6.7 percent.

The overall Asia-Pacific economy is growing faster than any other regional economy and, is anticipated to be larger than that of Western Europe, and be equal with that of the Americas (North and South), by 2025. Over the coming years, it is expected to continue to enjoy the highest growth rates in the world and to serve as the engine of the world economy. The region's share of world GDP will expand from 28% today to 36% by 2031. In particular, China and India will lead the region's economic growth with 4.6% growth per year for the next 20 years, significantly outpacing the world's average growth rate. The ascendency of many Asian nations, notably China and India, stems directly from their stellar economic performance over recent decades. This dynamic is causing substantial change in the global

business environment through changes in international prices (for commodities, manufactures, exchange rates and equities).

In recent years, a particularly notable trend in the region is the on-going largely spontaneous formation and development of several economic spheres, in the Huanan, Yellow Sea rim, and Baht Economics Sphere, for example. These subrelations are unfolding without any special systemic provisions or official decisions, and underscore the vitality of the private sector in the region. There has also been a quickening of intraregional trade and rise in intraregional interdependence. In the East Asian growth economies, outward-looking policies of trade liberalization and relaxation of restrictions on foreign capital are stimulating trade and investment activities and powering export-oriented growth. In a sequence beginning with the NIES and continuing with the ASEAN members and China, in that order, countries which got late economic starts are catching up with those ahead of them. And in the process, the latter are finding it necessary to restructure their industries. This expansion is expected to continue.

3. Data and Methodology

a) Variables and data

Annual time-series observations are used as they are sufficient to ensure the quality of the analysis, as argued by Hakkio and Rush (1991). As for economic growth, the logarithm of real GDP per capita (log-level data) is used and labelled as GROWTH. For trade openness, the logarithm of the sum of exports plus imports to real GDP (log-level data) is used and labelled as TRADE because this measure is a simple and common indicator of trade openness as suggested (Harrison, 1996).

There is a large literature discussing the possible measures of financial development. In the related literature, several proxies for financial depth have been suggested, for instance, money aggregates such as M2 to GDP (e.g., Odhiambo, 2008) but there has been no consensus on the superiority of any indicator. For measuring overall financial development, the most popular measure is the ratio of liquid liabilities to GDP (LL). Basing on the liquid liabilities of the financial system, this measure has been used in King and Levine (1993). This measure, however, can be too high in countries with undeveloped financial markets. Other standard measures are the ratio to GDP of credit issued to the private sector by banks and other financial intermediaries (PC) and the ratio of the commercial bank assets to the sum of commercial bank assets and central bank assets (DBMAs).

This study follows a recent study by Ang and McKibbin (2007) to construct a composite indicator of financial deepening which is as broad as possible. Specifically the finance proxies commercial bank assets to commercial bank plus central bank assets (DBMAs), liquid liabilities to GDP (LL), and private credit by deposit money banks to GDP (PC) are used to construct this index labelled DEPTH via a principal component analysis. Since most financial systems in Asia are bank-based, the financial indicators that are primarily associated

with bank development are used. Data for the individual finance indicators is taken from the Financial Development and Structure Database of Beck, Demirguc-Kunt, and Levine (2001).

The principal component analysis is employed to reduce data sets to lower dimensions while retaining as much information of the original sets as possible. In this case, the finance indicators are transformed into natural logarithms and only the first unrotated principal component is extracted as DEPTH.

b) Methodology

This study uses unit root and cointegration tests to identify the stationary properties and possible cointegration relationships of the investigated time series. Specifically, the unit root test by Phillips and Perron (1988), the PP test, is employed to check whether the considered time series is stationary, that is, I(0), or first difference stationary, that is, I(1). The PP test is used as it is particularly powerful when low frequency data are used (Choi and Chung, 1995).

Different methodological alternatives have been proposed in econometric literature to empirically analyse the long-run relationships and dynamics interactions between time-series variables. The two-step procedure of Engle and Granger (1987) and the full information maximum likelihood-based approach of Johansen (1988) and Johansen and Juselius (1990) are the most widely used methods. The cointegration frameworks in these studies, however, have limitations when dealing with data as major economic events may affect the data generating process. In the presence of structural breaks, tests for the null hypothesis of cointegration are severely oversized in which they tend to reject the null hypothesis despite one with stable cointegrating parameters. The presence of structural breaks in turn leads to inefficient estimation and lower testing power (Gregory et al., 1996). The sensitivity of the outcome of the tests to structural breaks has been documented in several studies (e.g., Wu, 1998; Lau and Baharumshah, 2003). This study thus employed the Gregory and Hansen (GH hereafter) (1996) tests for cointegration to account for the possible presence of a structural break as suggested from the preliminary observations.

The GH (1996) tests for threshold cointegration explicitly incorporate a break in the cointegrating relationship. The GH statistics can be seen as a multivariate extension of the endogenous break univariate approach and enable to test for cointegration by taking into account for a breaking cointegrated relationship under the alternative. This approach is implemented to take into account breaks occurred in the investigated AP economies. Cointegration tests are conducted by allowing a break in the long-run equation, following the approach suggested by Gregory and Hansen (1996). The advantage of this test is the ability to treat the issue of a break (which can be determined endogenously) and cointegration altogether.

Following GH test, this study employed the TY methodology to do causality test. The most common way to test for causal relationships between two variables is the Granger causality proposed by Granger (1969) but it has probable shortcomings of specification bias and

spurious regression (Gujarati, 1995). The TY procedure is adopted to improve the power of the Granger-causality test. The procedure is a methodology of statistical inference, which makes parameter estimation valid even when the VAR system is not co-integrated. One advantage of the TY procedure is that it makes Granger-causality test much easier as researchers do not have to test for cointegration or transform VAR into ECM. This interesting yet simple procedure requires the estimation of an augmented VAR that guarantees the asymptotic distribution of the Wald statistic, since the testing procedure is robust to the integration and cointegration properties of the process. This technique is thus applicable irrespective of the integration and cointegration properties of the system, and fitting a standard VAR in the levels of the variables rather than first differences like the case with the Granger causality test. Thereby, the risks associated with possibly wrongly identifying the orders of integration of the series, or the presence of cointegration are minimized and so are the distortion of the tests' sizes as a result of pre-testing (Giles, 1997; Mavrotas and Kelly, 2001).

The method involves using a Modified Wald statistic for testing the significance of the parameters of a VAR(p) model where p is the optimal lag length in the system. The estimation of a VAR($p+d_{max}$) guarantees the asymptotic χ^2 distribution of the Wald statistic, where d_{max} is the maximum order of integration in the model. In this study, the lag lengths in the causal models were selected based on the SC and the VAR was made sure to be well-specified by, for instance, ensuring that there is no serial correlation in the residuals. If need be, the lag length was increased until any autocorrelation issues are resolved. Needless to say, the system must satisfy the stability conditions and the common assumptions to yield valid inferences. The null of "no Granger causality" is rejected if the test statistic is statistically significant. Rejection of the null implies a rejection of Granger non-causality. That is, a rejection supports the presence of Granger causality.

4. Empirical results and discussion

First, the principal component analysis is performed using Eviews 7. Table 1 gives an overview of the results of the principal component analysis and a descriptive overview of the investigated countries. The index DEPTH used in this study is usually the only component to show fitting characteristics. In all the cases, this index exhibits at least 60% of the initial variance of the considered series and an eigenvalue that is significantly larger than one. Thus, the index provides sufficient information on financial depth.

[Please insert Table 1 here]

Next, this study uses the Phillips and Perron (PP)'s (1988) unit root test to check whether the considered time series is stationary, that is, I(0), or first difference-stationary, that is, I(1). The PP test is used as it is particularly powerful when the low frequency data are used (Choi and Chung, 1995).

As reported in Table 2, in almost all cases the PP test fails to reject the null hypothesis of the existence of a unit root for the data at log level. Meanwhile, in all but two cases the null hypothesis is rejected strongly when the first difference is taken. The examined time series are thus I(1) at log level and I(0) at first log difference.

[Please insert Table 2 here]

Next, this study tests for cointegration in trivariate VAR models using log-level data, following Gregory-Hansen (1996). Table 3a, 3b and 3c report the cointegration results for trivariate VAR models using all three statistics: ADF*, Z_α^* and Z_t^*, with DEPTH, GROWTH and TRADE as the dependent variables in cointegrating equations, respectively. For Korea, the results indicate two cointegrating relations between the series at 10% significance level. For Japan, Nepal, China and Israel, the common suggestion is at most one cointegration relationship at 10% significance level. When a cointegrating relationship is present, financial depth, economic growth and trade openness share a common trend and long-run equilibrium as suggested theoretically. With respect to the other countries in the sample of this study, however, there is not enough evidence to conclude on the existence of cointegration between the three series.

[Please insert Table 3a, b, c here]

The unit root test results indicate that the maximum order of integration among the variables of interest is 1. Based on this, this study performs Toda-Yamamoto test in the next stage. In order to obviate the possibility of spurious causality, TY causality analyses are run in trivariate models. That is, causality between two series is test, conditional upon the presence of a third one. The discussion of possible interactions between financial depth, economic growth and trade openness provides the ground for such specifications.

Finance-growth causality

The theory suggests that financial depth may be either a critical factor or a negligible one for economic development. The former supports for the supply-leading or bidirectional causality hypothesis while the latter supports for demand-following or insignificant finance-growth causation.

Table 4a presents the results of the interaction between DEPTH and GROWTH, conditional on TRADE. The results generally show no sign of autocorrelation or multicollinearity and are statistically significant and stable, in particular with respect to the lag orders chosen in accordance with the causality testing procedure.

The analysis reveals relatively strong causal linkages between financial depth and economic growth for the investigated countries. Particularly, the evidence of finance-led growth is found in the cases of Malaysia and New Zealand. For China, Indonesia and Japan, the findings suggest a feedback relationship between finance and growth, that is, bidirectional finance-growth causality. For Australia, Nepal and Philippines, the results support the

demand-following hypothesis, so financial depth is caused by economic development. With respect to the other countries in the sample, the analysis does not show any significant causal linkages between finance and growth.

[Please insert Table 4a here]

Based on the findings, it can be concluded that there are indeed interactions between financial depth and economic development in Asia and Pacific countries, as theories on the finance-growth nexus imply. With respect to the previous discussion on financial systems of Asia-Pacific region, the results fit in reasonably well. Because of generally continuous improvements in financial depth and related institutions, it appears reasonable to find that for the considered Asia-Pacific countries, financial sectors interact with real sectors significantly. As such, a policy focus on financial sector development in order to stimulate economic growth seems to be justified.

Finance-openness causality

Theoretical considerations suggest that finance may unilaterally lead openness or that openness may induce financial development. A nexus between finance and openness may additionally allow for bidirectional causality. More skeptical views, however, may suggest no evidence of significant causality between finance and openness.

Table 4c shows the results for causal inferences of DEPTH and TRADE, controlling for GROWTH. The results again show no sign of autocorrelation or multicollinearity and appear to be stable, particularly with respect to the chosen lag orders.

The findings appear to confirm the existence of a nexus between financial depth and trade openness. Nevertheless, this study is unable to identify a predominant causation pattern for many investigated countries. Specifically, the evidence of the hypothesis that financial depth Granger causes trade openness is found for India and Malaysia. Meanwhile, the findings suggest that trade openness has unilaterally influenced financial depth in the cases of China, Indonesia, Japan, Korea, Nepal, New Zealand and Philippines. For the rest of the countries included in the sample, the results do not indicate any stable long-run causality.

[Please insert Table 4c here]

The findings thus offer support for theoretical and empirical considerations on finance-openness linkages. Still, such linkages do not appear to be of particular importance and strength for the Asia-Pacific countries in the sample, as indicated by many cases where finance and openness are unrelated or the relationship lacks long-run stability. Policies that aim at enhancing a country's financial depth are thus rather unlikely to significantly shape trade structures as a by-product. Along the line of this argument, policies that are targeted at increasing the levels of openness cannot be expected to have substantial finance-promoting effects.

Further, the effect of finance-openness linkages on general economic development in the investigated Asia-Pacific countries appears to be rather marginal. On the one hand, the influence of trade openness on financial depth has not translated into economic growth, as shown by the previous results. Only in the cases of China, Indonesia, Japan and New Zealand does it seem that trade openness has interacted with financial depth, which in turn has contributed to economic growth. In other words, there is rather limited evidence of an indirect effect of trade openness on economic growth via the channel of financial development.

On the other hand, neither does this study find strong evidence of the hypothesis that finance-induced advances in trade openness have translated into enhanced economic performance. This is apparent from the causality analysis results of GROWTH and TRADE, conditional on DEPTH, which is presented in Table 4b. Here is most cases either trade openness Granger-causes growth or both series share a feedback relationship. When combining the findings from Table 4b and 4c, the results indicate that in all cases, no indirect effect of financial deepening on economic growth through the channel of trade openness can be demonstrated.

[Please insert Table 4b here]

Robustness

This study relies on a composite indicator of financial depth. While the use of this index yields some advantages as discussed, it may also have disadvantages. Such shortcomings may, for example, be associated with a limited interpretability of the index. As such, this study once again performs the empirical analysis using liquid liabilities to GDP (LL) as the indicator of financial depth. This measure is a more traditional finance indicator and has been employed by a number of studies in literature (e.g. King and Levin, 1993). Using LL instead of DEPTH should help to assess the validity of the previous empirical findings. The same econometric procedure as introduced is followed. In general, the robustness findings confirm the previous results. Unit root and cointegration tests show almost identical patterns when using LL instead of DEPTH. Causal linkages between the variables in the sample are also qualitatively the same.

Discussion and policy implications

The findings indicate (1) a strong link between financial depth and economic growth, (2) a somewhat weaker linkage between financial depth and trade openness and (3) a sceptical linkage between trade openness and economic growth, for most of the sample.

The findings support the empirical studies that find strong linkages between financial depth and economic growth (e.g., King and Levin, 1993; Robinson, 1952; Berthelemy and Varoudakis, 1996). Still, other studies do not find significant links (e.g., Chandavarkar, 1992). It might be concluded that the different findings of studies on finance-growth causality are attributable to different country samples rather than differences in methodology. This is

because the robustness check indicates that the findings in this study are not random, so different methodologies are less likely to account for varying results than different country samples. Generally, the findings of this study support the view that "one size does not fit all" when analysing finance-growth interactions (Rioja and Valey, 2004). That is, the actual effect of finance on growth (and vice versa) seems to depend on the level of financial development. When the level of financial development is low, the effect of finance on growth is uncertain (Rioja and Valey, 2004).

5. Concluding remarks

Drawing on conflicting considerations about the connections between financial deepening, economic development, and trade openness, this study tests for causality for 14 AP countries. Specifically, this study used a principal component analysis to obtain a broad indicator of financial deepening. The paper employed unit root and cointegration tests to analyze the properties of the investigated time series and to identify possible long-run relationships between them. This study then employed Toda-Yamamoto non Granger causality test within unrestricted VAR frameworks due to its methodological advantages over standard causality tests.

The empirical results show that (1) a strong link between financial depth and economic growth, (2) a somewhat weaker linkage between financial depth and trade openness and (3) a sceptical linkage between trade openness and economic growth, for most of the countries.

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Table 1: Summary statistics and results of principal component analysis

Income category	Country (data availability)	DEPTH (principal component), %	Component matrix		
			DBMA	LL	PC
East Asia and Pacific (Lower-middle-income economies)	Indonesia (1981-2011)	65.63	0.507	0.500	0.701
South Asia (Lower-middle-income economies)	India (1961-2011)	96.09	0.571	0.580	0.581
High-income OECD members	Japan (1961-2011)	60.28	-0.164	0.726	0.668
High-income OECD members	Korea (1971-2011)	89.75	0.571	0.585	0.576
East Asia and Pacific (Upper-middle-income economies)	Malaysia (1961-2011)	71.10	0.349	0.667	0.658
East Asia and Pacific (Lower-middle-income economies)	Philippines (1961-2011)	69.58	0.516	0.584	0.626
East Asia and Pacific (Upper-middle-income economies)	Thailand (1966-2011)	91.51	0.561	0.585	0.586
East Asia and Pacific (Upper-middle-income economies)	China (1987-2011)	92.36	0.559	0.587	0.586
High-income OECD members	New Zealand (1961-2010)	86.42	0.570	0.585	0.576
High-income OECD members	Australia (1961-2011)	81.37	0.524	0.587	0.617
South Asia (Lower-middle-income economies)	Pakistan (1961-2011)	76.62	0.524	0.596	0.609
High-income OECD members	Israel (1961-2009)	89.11	0.540	0.588	0.602
South Asia (Lower-income economies)	Nepal (1964-2011)	67.98	0.207	0.690	0.694
South Asia (Lower-middle-income economies)	Sri Lanka (1961-2011)	82.20	0.565	0.573	0.593

Note: The column DEPTH contains the value of the initial eigenvalues as a percentage of the total variance the first principal component contains (percentage of variance criterion) that represents the composite indicator of financial depth. Following the standard income measurement of the World Bank as taken from Beck et al. (2001), Indonesia, India, Philippines, Pakistan and Sri Lanka can be classified as Lower Middle Income countries; Thailand, Malaysia and China can be classified as Upper Middle Income countries; Japan, Korea, New Zealand, Australia and Israel can be classified as High Income countries; Nepal is classified as Lower Income country.

Table 2: Phillips-Perron unit root test statistics

Country		Log level		First log difference	
		INT	INT& TREND	INT	INT& TREND
Australia	G	-0.861	-2.139	-6.004***	-6.022***
	T	-0.201	-1.988	-5.954***	-5.885***
	D	-0.272	-1.619	-5.575***	-5.516***
China	G	1.031	-1.748	-2.567	-2.736
	T	0.064	-1.728	-4.673***	-4.596***
	D	-1.133	-1.319	-3.335**	-3.378*
India	G	9.462	2.090	-5.834***	-8.231***
	T	0.462	-2.142	-6.065***	-6.151***
	D	-0.425	-1.781	-5.177***	-5.126***
Indonesia	G	-0.710	-1.738	-4.051***	-3.968**
	T	-0.235	-1.890	-4.988***	-4.988***
	D	-2.594	-2.211	-2.967**	-3.024
Israel	G	-2.675	-2.512	-5.207***	-5.349***
	T	-1.043	-1.612	-7.268***	-7.294***
	D	-2.041	-3.242*	-6.248***	-6.214***
Japan	G	-6.449	-2.223	-3.910***	-5.344***
	T	-1.414	-1.219	-6.547***	-6.655***
	D	-3.440**	-2.227	-4.357***	-4.243***
Korea	G	-1.694	-0.603	-5.320***	-5.563***
	T	-3.620***	-3.537**	-4.751***	-5.148***
	D	-0.344	-3.099	-5.005***	-4.859***
Malaysia	G	-0.943	-1.931	-6.161***	-6.162***

	T	-0.269	-2.339	-5.645***	-5.578***
	D	-0.973	-2.036	-7.147***	-7.656***
Nepal	G	2.181	-1.300	-8.756***	-10.318***
	T	0.449	-2.772	-7.386***	-7.476***
	D	-1.017	-2.981	-6.346***	-6.306***
New Zealand	G	-1.257	-2.970	-5.198***	-5.090***
	T	-1.401	-1.324	-7.010***	-7.437***
	D	-1.127	-2.324	-6.112***	-6.135***
Philippines	G	-0.742	-1.648	-3.826***	-3.778**
	T	-0.632	-2.246	-6.263***	-6.182***
	D	-1.871	-2.472	-4.612***	-4.548***
Pakistan	G	-0.742	-1.648	-3.826***	-3.778***
	T	-0.705	-2.418	-5.534***	-5.496***
	D	-3.544**	-2.952	-3.906***	-4.166***
Sri Lanka	G	3.500**	-1.070	-4.945***	-6.131***
	T	-0.322	-2.965	-6.451***	-6.411***
	D	-1.385	-2.492	-4.669***	-4.643***
Thailand	G	-0.931	-1.562	-4.389***	-4.422***
	T	-0.154	-2.533	-5.513***	-5.460***
	D	-1.054	-1.218	-3.966***	-3.853**

Note: ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. The critical values are taken from MacKinnon (1996). G, T and D indicate the series for growth, trade openness and financial depth, respectively.

Table 3a: Gregory-Hansen cointegration test: Dependent variable DEPTH

		Level shift C	Level shift with trend C/T	Regime shift C/S
Australia	ADF*	-3.599 (2)	-3.941 (2)	-5.256 (3)*
		[1971]	[1972]	[1985]
	Z_α^*	-17.497	-26.137	-28.131
		[1973]	[1976]	[1984]
	Z_t^*	-3.216	-4.065	-4.191
		[1973]	[1976]	[1985]
China	ADF*	-4.347 (0)	-4.620 (0)	-5.794 (3)**
		[2005]	[2005]	[2000]
	Z_α^*	-25.229	-26.483	-26.000
		[2006]	[2006]	[2005]
	Z_t^*	-4.893**	-5.342**	-5.097
		[2006]	[2006]	[2005]
India	ADF*	-3.685 (2)	-3.906 (2)	-3.605 (1)
		[1972]	[1984]	[1973]
	Z_α^*	-19.974	-19.138	-19.810
		[1968]	[1986]	[1973]
	Z_t^*	-3.363	-3.345	-3.328
		[1968]	[1986]	[1982]
Indonesia	ADF*	-4.101 (0)	-6.039 (1)***	-4.099 (0)
		[1999]	[1993]	[1997]
	Z_α^*	-20.826	-21.689	-21.705
		[1999]	[1993]	[1997]
	Z_t^*	-4.176	-4.468	-4.174
		[1999]	[1993]	[1997]
Israel	ADF*	-4.996 (6)**	-5.001 (2)	-5.224 (6)
		[1999]	[1998]	[1999]
	Z_α^*	-27.472	-26.895	-27.619
		[1998]	[1998]	[1998]

	Z_t^*	-4.370	-4.422	-4.431
		[1998]	[1981]	[1981]
Japan	ADF*	-5.389 (1)**	-5.662 (1)**	-5.373 (1)*
		[2002]	[2002]	[2002]
	Z_α^*	-31.996	-34.695	-31.974
		[2002]	[2002]	[2002]
	Z_t^*	-4.632	-5.034*	-4.629
		[2002]	[2002]	[2002]
Korea	ADF*	-5.641 (3)***	-6.015 (0)***	-5.610 (0)**
		[1983]	[1978]	[1979]
	Z_α^*	-34.835	-39.408	-37.406
		[1979]	[1979]	[1979]
	Z_t^*	-5.545***	-6.233***	-5.716**
		[1979]	[1979]	[1979]
Malaysia	ADF*	-4.747 (1)*	-4.832 (1)	-4.994 (1)
		[1992]	[1969]	[1992]
	Z_α^*	-26.545	-30.979	-27.965
		[1993]	[1968]	[1986]
	Z_t^*	-4.133	-4.529	-4.320
		[1994]	[1968]	[1986]
Nepal	ADF*	-5.996 (4)***	-4.729 (4)	-5.572 (1)**
		[1971]	[1982]	[1969]
	Z_α^*	-34.875	-24.547	-35.281
		[1967]	[1984]	[1969]
	Z_t^*	-5.161**	-4.097	-5.482*
		[1967]	[1982]	[1974]
New Zealand	ADF*	-4.538 (3)	-5.063 (3)*	-4.246 (3)
		[1988]	[1988]	[1992]
	Z_α^*	-17.670	-29.481	-23.926
		[1975]	[1999]	[1975]
	Z_t^*	-3.253	-4.411	-3.995
		[1975]	[1999]	[1972]

Pakistan	ADF*	-5.412 (1)***	-5.835 (1)***	-4.547 (1)
		[1982]	[1967]	[1987]
	Z_{α}^{*}	-22.867	-20.992	-23.135
		[1983]	[1979]	[1973]
	Z_{t}^{*}	-3.665	-3.553	-3.664
		[1983]	[1968]	[1973]
Philippines	ADF*	-4.973 (1)**	-5.415 (1)**	-4.902 (1)
		[1983]	[1993]	[1985]
	Z_{α}^{*}	-23.928	-26.350	-30.562
		[1984]	[1984]	[1984]
	Z_{t}^{*}	-4.171	-4.707	-4.674
		[1984]	[1994]	[1984]
Sri Lanka	ADF*	-4.375 (1)	-5.238 (1)*	-5.377 (1)*
		[1968]	[1997]	[1997]
	Z_{α}^{*}	-18.155	-25.903	-27.126
		[1967]	[1995]	[1995]
	Z_{t}^{*}	-3.125	-3.932	-4.138
		[1995]	[1995]	[1995]
Thailand	ADF*	-5.261 (1)**	-5.218 (1)*	-6.080 (1)***
		[2002]	[2002]	[2002]
	Z_{α}^{*}	-17.758	-19.988	-24.722
		[2003]	[1984]	[1986]
	Z_{t}^{*}	-3.224	-3.393	-4.005
		[2003]	[1984]	[1986]

Table 3b: Gregory-Hansen cointegration test: Dependent variable GROWTH

		Level shift C	Level shift with trend C/T	Regime shift C/S
Australia	ADF*	-3.742 (2)	-3.860 (2)	-4.052 (2)
		[1984]	[1986]	[1984]
	Z_α^*	-12.133	-18.926	-17.370
		[1970]	[1968]	[1986]
	Z_t^*	-2.567	-3.378	-3.178
		[1996]	[1968]	[1986]
China	ADF*	-3.832 (2)	-4.654 (2)	-4.793 (0)
		[2006]	[2006]	[2006]
	Z_α^*	-26.603	-14.670	-26.471
		[2006]	[2006]	[2003]
	Z_t^*	-5.247**	-3.023	-5.225
		[2006]	[2006]	[2003]
India	ADF*	-3.134 (0)	-4.301 (0)	-3.985 (0)
		[1975]	[1975]	[1986]
	Z_α^*	-16.498	-28.628	-26.377
		[1975]	[1975]	[1986]
	Z_t^*	-3.105	-4.345	-4.052
		[1975]	[1975]	[1986]
Indonesia	ADF*	-4.816 (3)*	-5.519 (1)**	-5.480 (3)*
		[1998]	[1994]	[1992]
	Z_α^*	-22.803	-22.858	-24.974
		[1985]	[1993]	[1992]
	Z_t^*	-4.169	-4.426	-4.560
		[1985]	[1993]	[1992]
Israel	ADF*	-4.522 (4)	-4.886 (0)	-5.531 (0)**
		[1978]	[1969]	[1974]
	Z_α^*	-22.498	-30.918	-38.189
		[1976]	[1969]	[1974]
	Z_t^*	-4.004	-4.947	-5.584**

		[1976]	[1969]	[1974]
Japan	ADF*	-4.607 (4)	-4.503 (4)	-5.376 (4)*
		[2001]	[2001]	[1990]
	Z_α^*	-19.602	-21.123	-28.637
		[2002]	[1967]	[1972]
	Z_t^*	-3.315	-3.458	-4.288
		[1975]	[1967]	[1972]
Korea	ADF*	-5.125 (0)**	-3.626 (1)	-5.303 (1)*
		[1979]	[1988]	[1984]
	Z_α^*	-33.637	-20.344	-33.064
		[1979]	[1988]	[1984]
	Z_t^*	-5.239**	-3.392	-5.020
		[1979]	[1988]	[1984]
Malaysia	ADF*	-4.578 (0)	-3.850 (0)	-4.956 (1)
		[1996]	[1967]	[1995]
	Z_α^*	-22.946	-25.658	-24.397
		[1995]	[1967]	[1980]
	Z_t^*	-4.625	-4.041	-4.800
		[1996]	[1967]	[1995]
Nepal	ADF*	-4.640 (1)	-4.503 (0)	-7.164 (0)***
		[1968]	[1969]	[1985]
	Z_α^*	-27.437	-29.480	-49.709
		[1968]	[1968]	[1985]
	Z_t^*	-4.364	-4.552	-7.241***
		[1969]	[1969]	[1985]
New Zealand	ADF*	-5.215 (3)**	-5.388 (3)**	-5.390 (3)*
		[2001]	[1996]	[1998]
	Z_α^*	-21.308	-28.871	-24.154
		[2002]	[1999]	[2000]
	Z_t^*	-3.455	-4.402	-3.809
		[2002]	[1999]	[2000]
Pakistan	ADF*	-3.343 (1)	-4.222 (1)	-3.159 (1)

		[1982]	[1987]	[1987]
	Z_{α}^{*}	-16.853	-23.122	-17.674
		[1983]	[1986]	[1983]
	Z_{t}^{*}	-2.751	-3.771	-3.198
		[1983]	[1986]	[1983]
Philippines	ADF*	-3.019 (6)	-3.682 (3)	-2.563 (6)
		[1980]	[1989]	[1968]
	Z_{α}^{*}	-8.454	-17.941	-8.348
		[1987]	[1985]	[1991]
	Z_{t}^{*}	-1.902	-3.265	-1.705
		[1985]	[1985]	[2002]
Sri Lanka	ADF*	-4.169 (6)	-3.519 (3)	-3.536 (2)
		[1998]	[1999]	[1995]
	Z_{α}^{*}	-14.299	-16.488	-18.649
		[2002]	[2002]	[1991]
	Z_{t}^{*}	-2.759	-2.705	-3.217
		[2002]	[2002]	[1994]
Thailand	ADF*	-5.163 (1)**	-4.719 (3)	-5.673 (3)**
		[1974]	[1989]	[1989]
	Z_{α}^{*}	-22.677	-20.641	-26.723
		[1975]	[1990]	[1979]
	Z_{t}^{*}	-3.888	-3.590	-4.696
		[1975]	[1990]	[1979]

Table 3c: Gregory-Hansen cointegration test: Dependent variable TRADE

		Level shift C	Level shift with trend C/T	Regime shift C/S
Australia	ADF*	-4.372 (5)	-4.619 (3)	-4.054 (3)
		[1980]	[1995]	[1983]
	Z_α^*	-20.756	-24.987	-18.459
		[1975]	[1995]	[1975]
	Z_t^*	-3.359	-3.901	-3.079
		[1975]	[1994]	[1974]
China	ADF*	-4.608 (0)	-5.732 (0)**	-5.786 (0)**
		[2006]	[2003]	[2004]
	Z_α^*	-24.101	-29.403	-32.611
		[2006]	[2003]	[2003]
	Z_t^*	-4.712	-5.856***	-6.702***
		[2006]	[2003]	[2003]
India	ADF*	-4.265 (6)	-4.692 (3)	-4.150 (3)
		[1973]	[1979]	[1974]
	Z_α^*	-20.448	-24.784	-20.519
		[1976]	[1976]	[1976]
	Z_t^*	-3.448	-3.962	-3.503
		[1975]	[1975]	[1975]
Indonesia	ADF*	-4.890 (3)*	-7.617 (3)***	-5.391 (3)*
		[1998]	[2004]	[1996]
	Z_α^*	-23.123	-23.096	-20.891
		[1985]	[1985]	[1987]
	Z_t^*	-4.117	-4.113	-3.827
		[1985]	[1985]	[1987]
Israel	ADF*	-5.176 (0)**	-5.598 (0)**	-5.787 (0)**
		[1976]	[1974]	[1974]
	Z_α^*	-34.351	-39.376	-41.338
		[1975]	[1974]	[1974]
	Z_t^*	-5.484***	-5.734**	-5.939**

		[1975]	[1974]	[1974]
Japan	ADF*	-4.016 (6)	-4.774 (0)	-4.382 (0)
		[1968]	[1973]	[1973]
	Z_α^*	-21.564	-31.798	-29.326
		[1975]	[1973]	[1973]
	Z_t^*	-3.566	-4.802	-4.382
		[1975]	[1973]	[1973]
Korea	ADF*	-4.774 (0)*	-5.973 (1)***	-5.387 (1)*
		[1978]	[1978]	[1984]
	Z_α^*	-31.528	-39.230	-32.274
		[1978]	[1978]	[1984]
	Z_t^*	-4.858*	-6.061***	-4.825
		[1978]	[1978]	[1984]
Malaysia	ADF*	-5.024 (6)**	-4.787 (1)	-5.111 (6)
		[1980]	[1967]	[1980]
	Z_α^*	-22.198	-31.466	-28.662
		[1967]	[1967]	[1975]
	Z_t^*	-4.164	-4.759	-4.308
		[1975]	[1967]	[1975]
Nepal	ADF*	-4.348 (2)	-4.171 (0)	-4.329 (2)
		[1978]	[1967]	[1978]
	Z_α^*	-25.120	-28.062	-27.839
		[1976]	[1967]	[1976]
	Z_t^*	-3.992	-4.191	-4.253
		[1976]	[1967]	[1973]
New Zealand	ADF*	-4.400 (3)	-4.637 (1)	-4.314 (1)
		[1975]	[1976]	[1977]
	Z_α^*	-24.744	-32.420	-27.796
		[1976]	[1999]	[1977]
	Z_t^*	-3.913	-4.821	-4.192
		[1976]	[1999]	[1977]
Pakistan	ADF*	-4.047 (1)	-5.274 (5)*	-4.697 (0)

		[1982]	[1978]	[1973]
	Z_α^*	-21.582	-21.478	-30.615
		[1982]	[1977]	[1973]
	Z_t^*	-3.443	-3.465	-4.688
		[1982]	[1977]	[1973]
Philippines	ADF*	-5.579 (1)***	-6.439 (1)***	-5.279 (1)*
		[1983]	[1976]	[1983]
	Z_α^*	-27.139	-28.881	-32.936
		[1983]	[1975]	[1989]
	Z_t^*	-4.376	-4.829	-4.590
		[1984]	[1975]	[1990]
Sri Lanka	ADF*	-3.826 (5)	-4.019 (5)	-4.447 (1)
		[1980]	[1980]	[1976]
	Z_α^*	-17.516	-19.993	-28.747
		[1976]	[1967]	[1976]
	Z_t^*	-3.520	-3.580	-4.252
		[1976]	[1967]	[1976]
Thailand	ADF*	-4.188 (1)	-4.387 (1)	-5.367 (0)*
		[1976]	[1976]	[1973]
	Z_α^*	-23.227	-24.206	-37.111
		[1975]	[1975]	[1973]
	Z_t^*	-3.817	-3.942	-5.428*
		[1975]	[1975]	[1973]

Note: VAR consists of DEPTH, TRADE and GROWTH (m=2).*, ** and *** denote significance, i.e. rejection of the null hypothesis of no cointegration at 10%, 5% and 1% levels, respectively. Numbers in (.) are lag orders to include in equations. Lag lengths are determined automatically based on AIC (max=6). Time breaks are in [.]

Note: Approximate asymptotic critical values for C, C/T and C/S respectively: m=2: -5.44, -5.80, -5.97 for ADF* and Z_t^* and -57.01, -64.77, -68.21 for Z_α^* (at 1% level); -4.92, -5.29, -5.50 for ADF* and Z_t^* and -46.98, -53.92, -58.33 for Z_α^* (at 5% level); -4.69, -5.03, -5.23 for ADF* and Z_t^* and -42.49, -48.94, -52.85 for Z_α^* (at 10% level). Critical values are taken from Table 1, page 109, Gregory and Hansen, 1996, Residual-based tests for cointegration in models with regime shifts, Journal of Econometrics, 70, p. 99-126.

Table 4a: Toda-Yamamoto non-Granger causality test: DEPTH AND GROWTH

	Null hypothesis	Lag	Wald statistic	p-value
Australia	D → G	2	1.249	0.536
	G → D	2	5.125*	0.077
China	D → G	2	8.047**	0.018
	G → D	2	5.154*	0.076
India	D → G	4	1.828	0.767
	G → D	4	5.329	0.255
Indonesia	D → G	5	9.498*	0.091
	G → D	5	11.638**	0.040
Israel	D → G	3	3.314	0.346
	G → D	3	5.451	0.142
Japan	D → G	2	9.072**	0.011
	G → D	2	6.999**	0.030
Korea	D → G	1	0.158	0.691
	G → D	1	0.581	0.446
Malaysia	D → G	3	8.787**	0.032
	G → D	3	0.880	0.830
Nepal	D → G	2	1.736	0.420
	G → D	2	4.638*	0.098
New Zealand	D → G	2	5.651*	0.059
	G → D	2	1.532	0.465
Philippines	D → G	2	0.378	0.828
	G → D	2	8.646**	0.013
Pakistan	D → G	2	2.591	0.274
	G → D	2	0.821	0.663
Sri Lanka	D → G	2	1.096	0.578
	G → D	2	2.569	0.277
Thailand	D → G	2	0.350	0.839
	G → D	2	0.110	0.946

Note: VAR consists of DEPTH, GROWTH and TRADE (satisfy stability condition). The maximum order of integration among the variables of interest is 1.Lag lengths are determined based on Schwarz Information Criterion (SIC). *, ** and *** denote significance, i.e. rejection of the null hypothesis of no causality at 10%, 5% and 1% levels, respectively.

Table 4b: Toda-Yamamoto non-Granger causality test: TRADE AND GROWTH

	Null hypothesis	Lag	Wald statistic	p-value
Australia	T → G	2	3.778	0.151
	G → T	2	2.415	0.299
China	T → G	2	5.335*	0.069
	G → T	2	1.237	0.539
India	T → G	4	1.498	0.827
	G → T	4	2.310	0.679
Indonesia	T → G	5	9.315*	0.097
	G → T	5	13.077**	0.023
Israel	T → G	3	7.755*	0.051
	G → T	3	2.721	0.437
Japan	T → G	2	1.835	0.400
	G → T	2	0.779	0.677
Korea	T → G	1	2.846	0.092
	G → T	1	0.035	0.853
Malaysia	T → G	3	0.305	0.959
	G → T	3	5.928	0.115
Nepal	T → G	2	10.567***	0.005
	G → T	2	1.451	0.484
New Zealand	T → G	2	1.450	0.484
	G → T	2	3.804	0.149
Philippines	T → G	2	4.667*	0.097
	G → T	2	3.371	0.185
Pakistan	T → G	2	3.165	0.205
	G → T	2	1.561	0.458
Sri Lanka	T → G	2	0.447	0.800
	G → T	2	1.266	0.531
Thailand	T → G	2	0.649	0.723
	G → T	2	2.161	0.339

Note: VAR consists of DEPTH, GROWTH and TRADE (satisfy stability condition). The maximum order of integration among the variables of interest is 1.Lag lengths are determined based on Schwarz Information Criterion (SIC). *, ** and *** denote significance, i.e. rejection of the null hypothesis of no causality at 10%, 5% and 1% levels, respectively.

Table 4c: Toda-Yamamoto non-Granger causality test: DEPTH AND TRADE

	Null hypothesis	Lag	Wald statistic	p-value
Australia	D → T	2	2.585	0.275
	T → D	2	1.020	0.600
China	D → T	2	0.935	0.627
	T → D	2	7.497**	0.024
India	D → T	4	13.788***	0.008
	T → D	4	2.304	0.680
Indonesia	D → T	5	4.057	0.541
	T → D	5	12.549**	0.028
Israel	D → T	3	1.761	0.623
	T → D	3	1.047	0.790
Japan	D → T	2	0.609	0.737
	T → D	2	5.038*	0.080
Korea	D → T	1	0.403	0.526
	T → D	1	4.205**	0.040
Malaysia	D → T	3	10.120**	0.018
	T → D	3	0.280	0.960
Nepal	D → T	2	2.957	0.228
	T → D	2	5.249*	0.073
New Zealand	D → T	2	0.933	0.627
	T → D	2	4.842*	0.089
Philippines	D → T	2	0.213	0.899
	T → D	2	5.011*	0.082
Pakistan	D → T	2	0.679	0.712
	T → D	2	0.743	0.690
Sri Lanka	D → T	2	1.898	0.387
	T → D	2	1.617	0.445
Thailand	D → T	2	1.164	0.559
	T → D	2	0.226	0.893

Note: VAR consists of DEPTH, GROWTH and TRADE (satisfy stability condition). The maximum order of integration among the variables of interest is 1.Lag lengths are determined based on Schwarz Information Criterion (SIC). *, ** and *** denote significance, i.e. rejection of the null hypothesis of no causality at 10%, 5% and 1% levels, respectively.

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