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– Wavelet approach with a focus on Asian economies

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Revisiting the nexus of the financial development and economic growth

- Wavelet approach with a focus on Asian economies –

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Abstract

This paper employs wavelet analysis on the data of 10 Asian economies from 1971 to 2013 to examine both the directions of causality between financial development and economic growth and the signs of the relationships at different time scales. The paper also aims to test if there is a difference on the relationship between developing and developed economies in the Asian region. In order to consider the time-scale issues regarding financial development and economic growth, wavelet decomposition is employed in this paper. This paper finds that (1) financial development in general leads to economic growth for both developing and developed economies in the region; (2) there is bidirectional causality between financial development and economic growth, which nonetheless applies generally only for high-income economies; (3) the positive effects of the financial development on economic growth, however, holds for the long-run; while (4) negative effects of the financial development on the economic activity is observed in the short-run, especially for the low- and lower-middle income economies. This paper thus presents empirical evidence on competing strands of literature linking finance and development on causality at different time scales. Implications of the paper also suggest that financial liberalization for economies at an early economic development stage can harm the real economy in the short-run due to a likely association of the financial sector's expansion to financial crisis.

1. Introduction

Studies on the relationship between financial development and economic growth have shown that financial market developments are associated with economic growth. However, the causal relationship between these two variables still remains unclear. Besides, there are few studies on the nexus between financial development and economic growth examined at different time scales. This study extends the finance-growth literature by providing an assessment of empirical evidence on the causal relationship between financial development and economic growth at different time scales with an emphasis on Asian economies. The paper will focus on three related questions: (1) does financial development promote economic growth or is it the other way around? (2) does the causality between financial development and economic

growth apply the economies with different development stages in the same way? (3) does the causal relationship between financial development and economic growth differ in the short- and long-run?

In dealing with the research question as above, we employ wavelet analysis due to its feature of being able to analyze the time series in both the time and the frequency domain. While standard time series analysis investigates the data mainly in the time domain (in which we consider the relationship between variables at different positions in time) or frequency domain (in which the cyclical movements can be analysed), wavelet decomposition allows us to conduct a robust examination of the relationship between financial development and economic growth at different time scales. That is, wavelet regression analysis enables us to analyze if the nexus between financial development and economic growth is mainly a short run phenomenon or if it is exists in the long run as well. In so doing, this paper lends itself to an understanding of the time-varying relationship of the financial development and economic growth, an issue which has not been addressed thoroughly in previous empirical studies. Using wavelet analysis, additionally, enables problems such as non-stationary trends, autocorrelation and structural breaks to be simultaneously controlled.

In sum, this paper contributes to the debate on the links between financial development and economic growth from an empirical perspective with major findings as below. First, we show that financial development in general leads to economic growth for both developing and developed economies in the region. Second, there is bidirectional causality between financial development and economic growth, which nonetheless applies generally only for high-income (developed) economies. Third, the positive effects of the financial development on economic growth, however, hold for the long-run while negative effects of the financial development on the economic activity are observed in the short-run, especially for the low- and lower-middle income economies. This paper thus presents empirical evidence on competing strands of literature linking finance and development on causality and their nexus at different time scales.

While the main purpose of this paper is to offer empirical evidence rather than to suggest a set of salient financial policy for economic development, our major finding on causal relationships between financial development and economic growth at different time scales have some policy implications on financial liberalization since the measure on financial development is relevant to financial liberalization for expanding financial sector, with an expected desired result of promoting real sector. Our results show that financial development through financial deepening, that may follow liberalization process, can bring about short-run negative effects for developed economies at a rather early stage with financial fragility. This short-run negative effect of financial development through liberalization is in line with the literature on financial crisis. The short-run negative effects, however, can turn to positive effects in the long-run as the economic theories, endogenous growth theory, for example, suggests. In these regards, financial policy measures of a certain group of developing economies should consider that liberalization process can dip the economic activity due to financial crises.

Before proceeding, we want to acknowledge that this analysis treats only some important issues as above and cannot tackle at least the two issues as below. First, we do not discuss in much depth different measures on financial development. Financial development occurs when the problems of information asymmetries and transactions costs are reduced with financial instruments, markets and intermediaries (Levine, 2005). The conceptual issue on financial development involving various functions of financial systems thus leads to a broad spectrum of measures on financial development such as size, activity, efficiency, stability of banking institutions and financial market openness and so on (Beck et al., 2000). Due to the conceptual issue, quite a few empirical studies were done in the literature on finance and growth using different measures on development. Without ignoring the weakness of using a measure on financial development, liquid liabilities to GDP, we note that this measures financial depth that captures degree of financial development of an economy. However, as a robustness check we also included bank deposits to GDP in the empirical analysis and found qualitatively identical results. Second, policy determinants on financial development such as legal and regulatory frameworks are beyond the scope of this paper, and thus do not tackle the question of choosing appropriate institutional environment for healthy financial sector and economic growth. Most measures regarding legal and regulatory frameworks are qualitative data and it is thus impossible to perform a wavelet analysis of this data (since there is no difference in the variation at different time scales). Furthermore, in this paper, we employ dynamic Vector Autoregressive models (VAR) in a wavelet framework. In this framework one handles the potential non-included variables using lagged dependent variables (the information regarding legal and regulatory frameworks are included in the lagged variables and one may after that determine the causal impact of for example financial development on the economic growth). Moreover, using wavelet analysis decreases the problem of misspecification since we focus of the relationship of the variables at different time scales. Therefore, this issue is not of statistical importance but it would have been interesting to investigate the impact of these variables from an economic perspective.

The rest of the paper is organized as follows. Section 2 describes an overview of the literature on the links between financial development and economic growth as well as the conceptual issues on the measurement of financial development. Section 3 presents wavelet analysis and data, which is followed by description of the estimation and testing methodologies used in the paper in section 4. Empirical results are presented in section 5. In section 6, some concluding remarks are offered.

2. An overview of the literature on the nexus between financial development and economic growth

2.1. Causality and stage of economic development[1]

[1] Literature included in this section is focused on the role of financial intermediaries in the financial system. The functions of financial system, however, fall within a broader spectrum including those of equity markets, for instance. Theoretical and empirical studies hence stress competing or complementary roles of equity markets and

Different perspectives on the relationships between financial development and economic growth trace back to Schumpeter (1911) and Robinson (1952). While Schumpeter (1911) mainly focused on the role of credit markets in financing new production technologies for entrepreneurs, thereby asserting that well-developed financial system promotes economic growth, Robinson (1952) contends that financial development is what follows passively as a result of economic growth. These two different perspectives relate to the issue of causality between financial development and economic growth. Theoretical supports for the two possible causal directions are explained by two hypotheses proposed Patrick (1996): supply-leading and demand-following hypothesis. The supply-leading hypothesis asserts the causal direction from financial development to economic growth since financial development which enables the supply of financial services growth with deliberate creation of financial institutions contributes to economic growth. According to this view, governmental supports for establishing and promoting financial institutions in many less developed economies might reflect the belief that supply of the services would enhance economic growth. Gurley and Shaw (1955), Goldsmith (1969) and Hicks (1969) are early works that argue that a financial system is crucially important in expanding real sector (Ang, 2008).[2] On the contrary, demand following hypothesis presupposes the causal relationship from economic growth to financial development, translating passive responsiveness of the financial sector to economic growth. This means that less-developed financial systems of development countries are simply due to the lack of demand for financial services. This view would support the policy making for increasing demand for financial services, which would expand the financial sector and boost real economy. Earlier works supporting this hypothesis is Jung (1986).

Along with the two hypotheses mentioned above, Patrick asserted that the direction of causality between financial development and economic growth can differ at different stages of economic development. The stage of economic development hypothesis (1966) postulates that supply-leading role of financial services on economic growth holds at the early stage of development since new and expanding financial services provide new opportunities for investors, whereas demand-following financial development gradually dominates as development proceeds.

2.2.Long-run and short-run relationships

banks. Among others Levine and Zervos (1998) stressed on the different services provided by stock market liquidity and banking development, which positively influences growth. The paper, nevertheless, focuses on the role of financial intermediations in parallel with the financial development measurement used in the empirical analysis. See Levine (2005) for a through literature review on the nexus between finance and growth.

[2] This line of thinking is dubbed as 'financial structuralist view'. In the 1970s, Mckinnon (1973) and Shaw (1973) developed the early ideas of the financial structuralist view. The Mckinnon model, with an assumption of self-financed economy, emphasized the role of financial intermediaries that allow accumulating sufficient saving for investment and thus economic growth. Shaw (1973) presented a view that financial intermediation promotes economic growth. These two views suggest that an increase in output growth is caused by financial development, which can be a result of financial liberalization (Ang, 2008). Therefore, the supply-leading hypothesis, overall, has an implication on financial policies regarding financial liberalization.

Examining the nexus of the financial development and economic growth requires differentiating between long-run and short-run relationships, which finds support both from empirical evidence and theoretical underpinnings. Well-functioning financial system mitigates market frictions caused by asymmetric information and transaction costs, which can change incentives and constraints for economic agents for making saving and investment decisions. By providing information to savers about possible uses of their funds, financial markets and financial intermediaries improves the allocation of saving by channeling the funds to their best uses. Financial markets not only make it possible to direct resources to investment projects but help savers share risks of individual investments from bearing excessive risks. Financial systems thus enhance resource allocation and eventually foster long-run economic growth. The endogenous growth literature that emerged in the early 1990s stressed the role of financial markets on long-run economic growth. This line of research include financial intermediaries, information collection and risk sharing and so on in the models for analysis and argue that there is a positive relationship between financial development and total factor productivity (Obstfeld, 1994; Bencivenga et al, 1995 and Greenwood and Smith, 1997).

On the contrary to the positive long-run effects of financial development on economic growth, in the short-run, the relationship can be negative according to the literature on banking and currency crisis. The banking and currency literature have found that both banking and currency crises have been linked to rapid growth of domestic credit, thus it signals the onset of financial crises and economic downturns (Demirguc-Kunt and Detragiache 1998 and 2000; Gourinchas, Landerretche, and Valdés, 2001; Kaminsky and Reinhart, 1999 among others). Rapidly growing domestic credit, for example, signals overlending which may occur due to various factors such as monitoring incapability of regulatory authorities, carelessness or inability of financial intermediaries. Loayza and Ranciere (2002) considered the competing long-run and short-run effects of financial development on economic activity and documented that positive association of financial development and economic growth, which, however, does not hold for a set of countries in Latin America that have experienced severe and repeating banking crises.

Nor surprisingly, each strand of the literature suggests different sets of policy implications. Those who support the endogenous growth literature or supply-leading hypothesis argue that policies should aim at financial liberalization and deepening (Roubini and Sala-i-Martin, 1992 among others): whereas in the case of concentrating on crisis, more emphasis should be placed against "excessive financial liberalization and deepening. (Balino and Sundarajan, 1991; Gavin and Hausmann, 1995; Rousseau and Wachtel, 2008). We will bring back the issue of policy implication in combination with our empirical results in later sections.

3. Wavelet analysis and data description

3.1. Wavelet analysis

Due to the importance of time scale in the issue of nexus between financial development and economic growth, a time series methodology that is able to consider the movements of the variables of interest at different various scales is clearly desirable. Wavelet decomposition, therefore, is chosen in this paper to analyze the relationship of the two variables of major interest since it is often compared to the activity of a camera-lens that provides a multi-scale analysis. A broad landscape can be brought in with zoom-out, whereas details that were not found in the landscape portrait can be observable with zoom-in. Mathematically, "wavelets are local orthonormal bases consisting of small waves that dissect a function into layers of different scale" (Schleicher, 2002, p.1).[3] This dissection of time series into different layers makes wavelet analysis a very useful tool in analyzing economic variables since there are variables, for example, prices that are associated with time scale – the long-run, in which product prices are perfectly flexible, or the short-run in which this is not the case. Besides, wavelet analysis makes a useful tool in most economic time series that consist of different layers due to economic agents making decisions with different time horizons such as the currency market, for instance, where intraday traders, day traders, and long-term traders coexist. The exchange rates are the result of an aggregation of the activities of all traders with different time horizons. For these reasons, there is an increasing literature in economics using wavelet analysis since it was introduced by Ramsey and Lampart (1998). For example, Almasri & Shukur (2003) used what is called *discrete wavelet decomposition* (DWT)[4] to examine the causality in a Granger sense between government spending and revenue. Another strand of wavelet literature applies multi-resolution analysis (MRA) based on the maximal overlap discrete wavelet transform (MODWT) and revisit relationships of the variables that were puzzling (Hacker et al., 2014; Reboredo and Rivera-Castro, 2014 among others). For example, Hacker et al. (2014) revisit the causal relationship between spot exchange rates and nominal interest rate differentials.

[3] A wavelet means a 'small wave' which can be compared to a sine function, for example, that is considered to be a 'big wave'. A real-valued function, $\varphi(\cdot)$ defined over the real axis $(-\infty, \infty)$ leads to 'small waves' with the two basic properties: (1) the integral (summing) of $\varphi(\cdot)$ is zero; (2) the square of $\varphi(\cdot)$ integrates (sums) to unity. The sine function do not satisfy the second property, thus it is not a 'small wave', but a 'big wave' (Percival and Walden, 2006).

[4] Under *discrete wavelet decomposition* (DWT), the wavelet transformation is an orthogonal one since using DWT makes that there are half the number of averages than those at the previous scale level at each successively higher scale level. This results in reducing the amount of observable variation in the averages series associated with higher scale levels. Its MRA thus has no redundancy. Unlike DWT, the methodology referred to as *maximum overlap discrete wavelet decomposition* (MODWT), which is the methodology used in this paper, does not lead to an orthogonal transformation since it reuses observations in a circular loop, yet it and avoids the problems of calculating the moving averages consistently throughout the series. MODWT has the number of values for the averages at every scale level equal to the number of values in the original series, which is a useful property for our analysis (Percival and Walden, 2006, Ch. 5). More in-detail explanations follow in the following paragraphs.

In this paper we decompose various series according to maximum overlap discrete wavelet decomposition (MODWT), which utilizes moving averages of the original data and moving averages of moving averages. The basic discrete wavelet transformation (DWT) uses averages of the data and averages of averages, where average of a particular series does not reuse any values in that series (i.e. it does not utilize moving averages). The DWT suffers from being sensitive to the point at which one starts the averaging, being limited to observation sizes that are an element of the didactic series ($N = 2^n$ for some integer n). It also suffers from having fewer distinct values from the averages as the scale increases since a value from the original series can be used only once for the average calculations at a particular scale. Due to the limited number of observations in our data set, the last problem is a severe one for the research in this paper, so instead of DWT we use the MODWT. However, by using moving averages, the MODWT loses the orthogonality which is characteristic of DWT. To maintain consistency in the transformation of the data series using MODWT, the data is considered as a circular loop, with the observation following the last one simply being the first observation. This "trick" however makes the resulting differences and averages for the endpoint data at the lower scales especially sensitive to the distance between the last and first observation, so the affected endpoint differences and averages are dropped from the subsequent analysis at the lower scales.

Multiresolution analysis for MODWT generates at each scale level λ, (a) a set of smooth series $\mathbf{s}_\lambda$, in which each smooth series at scale λ represents the moving averages over the smooth series at scale level $\lambda - 1$, and (b) a set of detail series $\mathbf{d}_\lambda$, in which each detail series at scale λ represents the differences of the smooth series at scale level $\lambda - 1$ from the smooth series at scale λ.[5] In the case of the Haar wavelet, which is used for the decompositions in this paper, element t of the scale λ smooth series, $\boldsymbol{s}_{\lambda,t}$, is generated according to

$$\mathbf{s}_{\lambda,t} = \frac{\mathbf{s}_{\lambda-1,t-2^{\lambda-1}} + 2\mathbf{s}_{\lambda-1,t} + \mathbf{s}_{\lambda-1,t+2^{\lambda-1}}}{4} \qquad (1)$$

with $\boldsymbol{s}_{0,t}$ representing element t of the original data series.[6] The detail series at scale λ reflects patterns in the original data series, indicating movements occurring every $2^{\lambda-1}$ periods. Therefore the detail series with $\lambda = 1$ reflects changes happening after one period, that with $\lambda = 2$ reflects changes happening after two periods, and that with $\lambda = 5$ reflects changes happening after 16 periods.

Since the multiresolution analysis is an additive decomposition we get the original series $\mathbf{y}$ by summing up the level-1 to level-Λ detail series, where Λ is the highest considered scale level, and adding the result to the level-Λ smooth series:

$$\mathbf{y} = \mathbf{s}_\Lambda + \sum_{\lambda=1}^{\Lambda} \mathbf{d}_\lambda \qquad (2)$$

[5] Multiresolution analysis of the DWTs was introduced by Mallat(1989). The terminology *smooth series* and *detail series* was first used by Percival and Mjofeld (1997).

[6] See Hacker, Karlsson and Månsson (2012) for a more detailed discussion of the use of multiresolution analysis for MODWT using a Haar wavelet.

The variable's long-term trend at the scale level of Λ is given by $\mathbf{s}_\Lambda$, which contains the non-stationary components of the original series if any exist. The original series' decomposition at various time scales is given by the detail series $\mathbf{d}_1$ to $\mathbf{d}_\Lambda$.

3.2. Data description

The sample consists of 10 Asian economies with annual data during the period 1969-2013 (the data of South Korea starts 1971 and that of Myanmar starts 1980 due to data availability). Although data set includes more economies in the Asian region, only 10 economies were selected due to limited data availability especially for developing economies. The economic growth is measured by the natural logarithm of the real GDP per capita which is from United States Department of Agriculture (USDA) Economic Research Service and financial development is measured by the natural logarithm of liquid liabilities to GDP in percent which is from the Financial Development and Structure Database of the World Bank.[7] Liquid liabilities to GDP is a traditional indicator of financial depth, and the broadest available indicator of financial intermediation since it includes interest-bearing liabilities of banks and other financial intermediaries (bank-like and non-bank financial institutions) in construction (Beck et al., 200). King and Levine (1993) and Levine, Loayza, and Beck (2000) interpreted a positive effects of liquid liabilities on per capita GDP growth as the growth enhancing effect of financial development.

4. Estimation and testing methodologies

For each country pair and at each wavelet scale we test for Granger causality in the vector autoregressive framework (VAR) in both directions between the Liquid liabilities to GDP (%) and the real GDP per capita. In this section we present the estimation of the VAR model and the subsequent Granger causality testing. For our analysis we use for a pair of countries the detail series at the same scale for the log of both variables, the time t values of which are d_t^{Fin} and d_t^{GDP} respectively. Letting

$$y_t \equiv \begin{bmatrix} d_t^{Fin} \\ d_t^{GDP} \end{bmatrix}$$

we proceed to estimate the vector autoregressive model of order K, VAR(K), as shown below:

[7] The database includes different measures on financial development on the size, activity, efficiency and stability of banks, nonbanks, equity markets and bond markets. Further details on the data are available at http://econ.worldbank.org/programs/finance. As a robustness check, we have repeated all empirical tests presented in this paper using bank deposit to GDP (%), which is another measure on the size of the financial system from the liquidity side and private credit by deposit money banks and other financial institutions to GDP, which measures size of the financial system from an asset side. Since the results are analogous to ones that are presented in the following section, results using other measures on financial development are not included in this paper. Results are however available upon request.

$$\begin{bmatrix} d_t^{Fin} \\ d_t^{GDP} \end{bmatrix} = \begin{bmatrix} \beta_{01} \\ \beta_{02} \end{bmatrix} + \begin{bmatrix} \beta_{11}^{(1)} & \beta_{12}^{(1)} \\ \beta_{21}^{(1)} & \beta_{22}^{(1)} \end{bmatrix} \begin{bmatrix} d_{t-1}^{Fin} \\ d_{t-1}^{GDP} \end{bmatrix} + \begin{bmatrix} \beta_{11}^{(2)} & \beta_{12}^{(2)} \\ \beta_{21}^{(2)} & \beta_{22}^{(2)} \end{bmatrix} \begin{bmatrix} d_{t-2}^{Fin} \\ d_{t-2}^{GDP} \end{bmatrix} + \mathrm{L} + \begin{bmatrix} \beta_{11}^{(K)} & \beta_{12}^{(K)} \\ \beta_{21}^{(K)} & \beta_{22}^{(K)} \end{bmatrix} \begin{bmatrix} d_{t-k}^{Fin} \\ d_{t-k}^{GDP} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix}$$

where the various β parameters are constants and $[u_{1t}\ u_{2t}]'$ is the error vector at time t. The number of lags of the regression models, K, is decided by using the Schwarz (1978) information criteria (SIC). If significant autocorrelation is found then we continue to add lags until the autocorrelation is not present anymore.

According to Granger and Newbold (1986) one can test for Granger causality by evaluating a zero restriction in each of the single linear equations in the VAR model:

$$d_t^{GDP} = \beta_{01} + \sum_{k=1}^{K} \beta_{11}^{(k)} d_{t-i}^{GDP} + \sum_{k=1}^{K} \beta_{12}^{(k)} d_{t-k}^{Fin} + u_{1t} \quad (3)$$

$$d_t^{Fin} = \beta_{02} + \sum_{k=1}^{K} \beta_{21}^{(k)} d_{t-k}^{GDP} + \sum_{k=1}^{K} \beta_{22}^{(k)} d_{t-k}^{Fin} + u_{2t} \quad (4)$$

To investigate whether the financial development Granger causes the GDP per capita we test whether the hypothesis that all of the $\beta_{12}^{(k)}$ parameters are zero can be statistically rejected, and to investigate whether GDP per capita Granger causes financial development we test whether the hypothesis that all of the $\beta_{21}^{(k)}$ parameters are zero can be statistically rejected. This is done using Wald test.

5. Empirical findings

In this section, Granger causality test results and signs of the relationship between financial development and economic growth are reported for the various time scales. Considering the limitations of the sample size, only the wavelet details at scale levels 1-3 are analyzed. Before presenting results using wavelet details, Table 1 reports the results of the Johansen cointegration test using raw data. Using cointegration techniques we may find cointegration relationship only for developed economies, implying that causal relationships between financial development and economic growth cannot be further examined for the developing economies unless the data are first-differenced, which results in losing long-run information. However, using wavelet analysis enables us to find important empirical findings that were not documented using raw data and traditional methodology in previous studies. Therefore, the wavelet analysis provides new insights and may discover relationships between finance and growth for developing well as developed economies. Empirical findings using wavelet analysis follows in the subsections as below.

Table 1. Johansen cointegration test

	Low-income economies	Lower-middle income economies			Low-middle-income economies	Upper-middle-income economies		High-income economies		
	Nepal	Sri Lanka	India	Philippines	Indonesia	Malaysia	Thailand	Japan	Korea	Singapore
r1	11.8801	9.7923	23.1141	4.9186	16.2802	4.3628	11.0782	45.5714	13.2149	22.6462
r2	0.7722	1.15142	5.2164	0.3731	1.3889	0.7404	2.8434	10.1917	3.4927	3.0303

Note: Shaded cell indicates significant results and therefore cointegration between the variables at the 5 % level of significance.

5.1.Does financial development precede economic growth?

Granger-causality test results based on the representation in Equation (3) are presented in table 2 for different Asian economies with different development stages.[8] The relationship from financial development to growth is significant only at the time scales of D2 and D3 that are corresponding to a two-period movement frequency (changes occurring every two periods) and a four-period movement frequency, respectively. This causal relationship from financial development to growth is significant regardless stages of economic development. Two exceptions to this significant causal relationship are observed for Philippines (D2) and Malaysia (D3).

The causal direction from financial development to economic growth was asserted by supply-leading hypothesis and the supply-leading role of financial services on economic activity is expected to play a more role for the developing economies according to the development hypothesis. Our findings support the supply-leading role of the financial services, which, however, applies for all the stages of economic development covering low-middle, lower-middle, upper-middle and high-income economies.

Table 2. Granger causality from LIQUID LIABILITIES to GDP (%) to GDP per capita

	Low-income economies	Lower-middle income economies			Low-middle-income economies	Upper-middle-income economies		High-income economies		
	Nepal	Sri Lanka	India	Philippines	Indonesia	Malaysia	Thailand	Japan	Korea	Singapore
D1	0.706	0.917	0.133	0.564	0.122	0.289	0.115	0.161	0.102	0.162
D2	0.020	0.000	0.016	0.134	0.015	0.045	0.066	0.000	0.024	0.000
D3	0.978	0.406	0.758	0.002	0.008	0.619	0.000	0.000	0.000	0.000

Note: This is p-values for different Granger causality test for different countries and a panel test. Shaded cell indicates significant results at the 10 % level of significance.

5.2. Does economic growth precede financial development?

The Granger causality results of the other direction of the causal relationship, i.e. the effects of economic growth on financial development, are presented in table 3. The significant causal

[8] The classification of the economies based on income levels are from World Bank Classification. Further information on classification is accessible at http://data.worldbank.org/about/country-and-lending-groups

relationship in this direction is dominantly observed for upper middle-income economies and high-income economies, with an exception of Philippines which is a lower middle-income economy, which supports the demand following hypothesis that explains better for the economies at the later development stages.

Table 3: Granger causality from GDP per capita to LIQUID LIABILITIES to GDP (%)

	Low-income economies	Lower-middle-income economies			Low-middle	Upper-middle-income economies		High-income economies		
	Nepal	Sri Lanka	India	Philippines	Indonesia	Malaysia	Thailand	Japan	Korea	Singapore
D1	0.094	0.976	0.355	0.547	0.889	0.617	0.257	0.018	0.418	0.247
D2	0.001	0.376	0.035	0.088	0.170	0.602	0.003	0.000	0.235	0.000
D3	0.842	0.791	0.799	0.000	0.208	0.877	0.047	0.000	0.090	0.103

Note: This is p-values for different Granger causality test for different countries and a panel test. Shaded cell indicates significant results at the 10 % level of significance.

5.3.Impulse Response Results

We now resort to impulse response functions to examine what sign is likely associated with any Granger causality found, since Granger causality tests do not indicate anything about the sign of causal relationship found, and since such a sign cannot be determined using only one lag. To investigate the sign of the relationships between financial development and economic growth, impulse response functions are generated using our unconstrained estimated VAR models with orthogonalized covariance matrix using the Cholesky decomposition. When the impulse response function is estimated we report the sign of the response of the investigated causal variable to the investigated caused variable at the lag matching the wavelet scale.
By examining the impulse response functions in Table 4 we can see that negative signs are dominating at the D1 (one-year wavelet scale) and D2 (two-year wavelet scale). This is consistent with the short-run negative causal relationship between the financial development and economic growth according to the literature on banking and currency crisis. A shift of the sign starts to be dominantly observed from D3 (the four-year wavelet scale where positive signs for all the economies are detected. As a whole, we see that there is an obvious pattern of a shift of the impulse response sign as time scale changes, and the positive signs are dominant at the longer wavelet scales of four years, evidence which is in concert with the theoretical frameworks of banking crisis in the short-run and growth theory in the long-run.

Table 4: Impulse respons from LIQUID LIABILITIES to GDP (%) to GDP per capita

	Low-income economies	Lower-middle-income economies			Low-middle	Upper-middle-income economies		High	High	High
	Nepal	Sri Lanka	India	Philippines	Indonesia	Malaysia	Thailand	Japan	Korea	Singapore
D1	-	-	-	+	-	-	-	+	+	-
D2	-	-	-	-	-	-	-	+	+	+
D3	+	+	+	+	+	+	+	+	+	+

Impulse responses from economic growth to financial development, however, show mixed results on signs on the causal relationship at different time scales and at different development stages. Overall, however, we see that positive effects of economic growth on financial development are more dominant for high-income and upper-middle-income economies, with an exception of Indonesia which is low-middle income economy. As the demand-following hypothesis and economic development hypothesis discussed earlier suggest, we see that financial development responds to the economic development for economies with high and moderate level of economic development.

Table 5: Impulse response from GDP per capita to LIQUID LIABILITIES to GDP (%)

	Low-income economies	Lower-middle-income economies			Low-middle	Upper-middle-income economies		High-income economies		
	Nepal	Sri Lanka	India	Philippines	Indonesia	Malaysia	Thailand	Japan	Korea	Singapore
D1	-	-	+	-	+	-	+	+	+	+
D2	+	+	-	-	+	-	+	-	+	+
D3	+	-	-	-	+	+	+	-	+	+

6. Conclusions

We could find that there is a cointegration relationship between financial development and economic growth using traditional method, which, however, could be implemented only for developed economies. The empirical results of the paper using Granger causality test and impulse response functions based on wavelet decomposition provide new insights and enables to discover relationships between finance and growth for developing well as developed economies. The major findings can be summarized as: 1) financial development in general leads to economic growth for both developing and developed economies in the region; (2) there is bidirectional causality between financial development and economic growth, which nonetheless applies generally only for high-income economies; (3) the positive effects of the financial development on economic growth, however, holds for the long-run; while (4) negative effects of the financial development on the economic activity is observed in the short-run, as the banking crisis literature asserts regarding the association of increasing size of lending in the economy and higher probability of banking crisis. This short-run negative effect of financial development on real sector applies especially for the low- and lower-middle income economies.

The principal conclusions that emerge from the analysis are informative for policy dialogues on economic growth. Our results show that financial development through financial deepening, that may follow liberalization process, can bring about short-run negative effects for developed economies at a rather early development stage with financial fragility. This short-run negative effect of financial development through liberalization is in line with the literature on financial crisis. The short-run negative effects, however, can turn to positive effects in the long-run as the economic theories, endogenous growth theory, for example,

suggests. In these regards, financial policy measures of a certain group of developing economies should consider that liberalization process can dip the economic activity due to financial crises. Therefore, policies on liberalization attempting financial development through financial deepening lead to the main implication of the paper that it is important to differentiate the short- and long-run effects of the financial development. The short-run positive gains through financial deepening and liberalization are expected only when the economy is at a certain level of economy development with mature institutions, for example, among others.

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