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Role of Financial Development in Economic Growth in the Light of Asymmetric Effects and Financial Efficiency

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Abstract: The growth effects of financial development might be asymmetric and nonlinear according to the level of financialisation of countries. As a corollary to this notion, in the subject study, we developed a three-regime Threshold Autoregressive Distributed Lags (TARDL) model, which allows us to accommodate the asymmetric effect of financial development on economic growth in top ten financially-developed countries. We augmented the TARDL model by including trade openness, capital formation and labour as potential determinants of economic growth. The empirical findings revealed the existence of threshold asymmetric cointegration between variables. In particular, in the upper regime, financial development boosts economic growth in Singapore while it exerts a negative impact on economic growth in Finland. In the middle regime, financial development increases economic growth in Australia and Singapore. However, in the lower regime, financial development hampers economic growth in the US, Malaysia and Singapore. Trade openness has a positive long-run influence on economic growth in Canada, South Africa, Australia, Malaysia, New Zealand, Singapore, Finland and Norway. Capital formation strengthens economic growth in the US and Malaysia in the long-run. Labour is found to sustain economic growth in the long-run for Malaysia and Singapore. The dynamic multipliers which depict the response path of economic growth to a one-unit shock of financial development in the three regimes highlight the discrepancies in the reaction of economic growth to financial development shocks occurring in different regimes. Important policy implications can be instigated from the empirical results.

Keywords: Financial Efficiency, Economic Growth, Financial Development, Asymmetries, TARDL Model
JEL Classification: F41, F65, G21, O16

I. Introduction

Financial stability and development play an important role in the economic growth and prosperity of a nation. Financial development implies the growth and evolution of the financial sector, which is symbolized by increased monetization of the economy, growing scale of the financial sector and financial innovations (Sawyer, 2015). The significance of the financial sector and its stability for real economy and society has been recognised for centuries (See seminal work by Bagehot, 1873). The importance of the financial sector is manifested in the crucial function it performs. Its financial markets and intuitions act as intermediaries which redistribute resources from the savers, such as, households or institutional investors, to firms. The former is intended to invest profitably while the latter requires the financial resources for further economic development. Financial development affects a firm's ability to invest (Zhang and Hou, 2014). The importance of the financial sector and its stability has been repeatedly emphasised through financial crises, from the Tulip mania in the 1630s to the Global Financial Crisis (GFC) in 2008-09[1]. Each episode of financial turmoil reminded us of the financial sector's importance to the real economy. In this regard, the GFC differed little from its predecessors; however, due to its magnitude, it was named a "*once in a century crisis*" (IMF, 2009; Nasir and Du, 2017). The prima facie significance of the financial sector for the real economy implies that "financial and economic stability are two sides of the same coin" (Borio, 2011; Nasir et al., 2015)[2]. Nonetheless, it also led prominent figures to argue for more active macroeconomic and prudential policy responses (see Mishkin, 2011; Williams, 2012; Nasir and Soliman, 2014). On the other hand, a number of studies emphasize the appropriate institutional design and frameworks (see, Beck et al., 2003; Lu and In, 2006; Semiromi and Reza, 2010; Nasir et al., 2017; Law et al., 2018). While studies suggested different remedies and policies to address the challenges of financial instability, one common focus they stress is the importance of the financial sector for the real economy and existence of crucial interlinkages.

In the Post-GFC era, a number of studies have investigated the role of financial development in defining the dynamics of economic growth (see, Keen, 2011; Admat and Martin Hellwig,

[1] Note, to some financial historians, the date of first financial crisis is even older, the Financial Crisis of 33 AD faced by the Roman Empire, which led Emperor Tiberius to use Quantitative Easing to calm the financial markets (Taylor, 2013).

[2] In the wake of GFC 2008, a number of recent studies have re-emphasised the significance of macro-financial linkages (e.g. see Blanchard et al., 2010; Gros; 2010, Borio, 2011; Mishkin, 2011; Nasir et al., 2015). For detailed insight into the events that led to GFC, policy response and the incomplete business of financial stability, see Blinder (2016).

2014; Kay, 2016). However, the nexus between financial development and economic growth was empirically investigated and analysed well before the GFC crisis. For instance, seminal work by Gurley and Shaw (1960), Goldsmith (1969), McKinnon (1973) and Shaw (1973) expanded our understanding of the role of finance in growth and development of an economy. In rather recent studies, Nasir et al. (2015) analysed the impact of financial markets (stock, bond, money and exchange rate) on economic growth and reported significant impact. Although the importance of the financial sector for economic growth and development is broadly recognized, further insight into the factors which moderate this relationship should be investigated. For instance, a country's stage of development may reflect the influence of certain aspects of the financial system. When a country is at the developing stage, the banking sector might be more influential than capital markets, which may need more time effectively intermediate between savers and borrowers (see, Levine and Zervos, 1998; Allen and Gale, 2000). Some studies, for instance, Rioja and Valev (2004), reported positive effects of the financial sector (banking and stock markets) on economic growth in middle and high-income economies with a negative impact on lower income countries. However, Shen and Lee (2006) reported negative effects of financial sector development on economic growth (also see Cecchetti and Kharroubi, 2012; Law and Singh, 2014). A recent study by Nguyen et al. (2017) reported that the economic development matters in the nexus between financial development and economic growth. However, various aspects of financial sectors (bank, stock insurance etc.) impact countries' economic growth differently. Financial crises and shocks also play an important role in shaping the relationship between finance and economy (Beck, 2012; Nguyen et al., 2017). The heterogeneity and conflicting evidence on the finance-growth nexus imply that crucial factors moderate this relationship, and the ability of finance to harbour growth is contingent upon other important factors. We already reflected on studies focused on the level of development of a country and reported on the heterogeneity in the impact of finance due to the level of development. However, there are two important aspects which also require consideration in this study. First, a logical point to argue is *that the performance of any sector shall be associated with the efficiency of that sector rather than the overall level of the development of the economy*. Intuitively, an efficient financial sector shall contribute better to economic development than an under-developed financial sector. The second aspect of the finance-growth nexus is the *consideration of non-linearity in the association* between the variables. The earlier acknowledged studies investigating the relationship between finance and growth predominantly employed the linear framework of analysis but did not account for the nonlinearity.

It is intuitive to argue that the association between finance and growth shall not be perpetually linear. Perhaps, a number of empirical studies reported on the nonlinearities between finance and growth nexus (for instance, Shen and Lee, 2006; Ergungor, 2008; Hung, 2009; Cecchetti and Kharroubi, 2012). This also implies that this relationship can be moderated by a number of factors, e.g. legal framework (Beck et al., 2003), institutional quality (Law et al., 2013; Law et al., 2018), level of countries development (Nguyen et al., 2017), etc. It is also logical to argue that the relationship between finance and growth may change at different levels of financial development and its factors. Putting it simply, there could be threshold effects between finance-growth nexus which are important to take into account, and the existing empirical evidence has often condoned this aspect. Reflecting on this caveat in the existing body of knowledge on the subject, Law et al. (2013) argued that most of the studies have been based on the proposition "*more finance, more growth*". On the contrary, it is important to consider the nonlinearities and threshold effects in the growth-finance nexus.

Keeping these ideas in context and the notion that the impact of financial development on economic growth might be asymmetric and nonlinear, according to the level of financialisation of countries, we developed a three-regime Threshold Autoregressive Distributed Lags (TARDL) model which allows the accommodation of the asymmetric effect of financial development on economic growth in the top-ten financially developed and competitive countries[3]. In so doing, the obtained lower, middle and upper regimes are defined by the level of financial development rather than the threshold of one standard deviation. We also augmented the TARDL model by including trade openness, capital formation and labour as potential determinants of economic growth. Our key findings suggest the existence of important threshold asymmetric cointegration between variables. The long-run association between economic growth and financial development can be summarised as follows. First, financial development enhances economic growth in Singapore and Finland in the upper and middle regimes respectively. Second, financial development has a harmful effect on economic growth in the lower regime in the US, Malaysia and Singapore. Findings also reveal a regime-dependent short-run growth effect of financial development. Indeed, financial development boosts economic growth in the upper regime in the US, South Africa, Australia and Finland,

[3] The choice of top ten is based on supporting economic competitiveness and growth. As part of its overall competitiveness ranking, the World Economic Forum's Global Competiveness Report evaluates the level of development of 144 of the world's financial systems, based on their efficiency and levels of trustworthiness and confidence, available at http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf.

while it reduces economic growth in New Zealand and Hong Kong in the short-run. In the middle regime, financial development has a negative cumulative effect on economic growth in the US, Singapore and Canada and a positive cumulative effect on economic growth in South Africa, Australia, New Zealand and Hong Kong. In contrast, growth effect of financial development is recorded in the lower regime, i.e. at the beginning of the Financialisation of economies in the US, South Africa, Australia, New Zealand, Singapore and Hong Kong, but the opposite conclusion is drawn in Canada.

The paper proceeds as follows: in Section II, we will critically discuss the finance-growth nexus to reflect on the caveats of the existing body of knowledge and to contextualize the subject treatise in the debate on the subject. Section III briefly describes the layout of the empirical framework. Section IV provides the results of analysis and presentation of findings. Section V concludes the argument and discusses policy implications.

II. Literature Review

Financialisation is described by Moosa (2017, p.1) as '*the increasing importance of financial markets, financial motives, financial institutions, and financial elites in the operation of the economy and its governing institutions, both at the national and international levels'*. Though the size and influence of the financial sector have varied through time and history, the importance of the financial sector for the real economy has always kept the finance-growth nexus as one of the most attractive relationships in the field of economics. Concomitantly, there have been a number of studies which explored this nexus and provided a theoretical or empirical explanation of the underlying phenomenon. The results are mixed and, hence, inconclusive. Perhaps, this is the reason that the efforts to understand the finance-growth nexus have been continued and different scholars examine this relationship from different dimensions. Among those who explored the causal-linkage, studies such as King and Levine (1993) and Levine et al. (2000) reported a positive impact of financial development on economic growth. On the contrary, some suggested that the financial development only brings positive effects on economic growth for the developed countries and no significant benefits for the developing countries (Deidda and Fattouh, 2002). In another remarkable study, Rioja and Valev (2004) also reported mixed results and suggested that the financial sector development does not play a significant role in economic growth for the developing countries. Contrarily, studies by Odedokun (1996) and Demetriades and Law (2006) reported positive effects of financial (banking) sector development on economic growth in developing

countries. Similarly, Zhang and Hou, (2014) showed that the financial development positively affects a firm's ability to invest, whereas, Favara (2003) found weak positive effects of finance on economic growth in middle-income countries.

Financial development is important to developing and transitioning economies (Perotti and Vesnaver, 2004; Tasic´ and Valev, 2010). In evidence from developing economies, India and China, Kandil et al. (2017) reported positive effects of financial development on growth. Lin et al. (2016) argued that financial development and reforms are vital for the continuous and high economic growth in China although Guariglia and Poncet (2008) reported mixed results from provinces. In particular, they reported that state-level financial intervention had negative effects while the market driving financial developments had positive effects on economic growth. In a contrary study, Zhang et al. (2012) reported that financial development has a mostly positive effect on provincial economic growth, citing Chinese city-level data. Nonetheless, they refuted the claims that the state-led financial development has negative effects on economic growth. Similarly, using evidence from Russia, Berglof and Lehmann (2014) argued that financial sector development and reports are important for sustainable economic growth. A study by Shahbaz (2009) also reported a positive impact of financial development on per capita GDP in Pakistan. A later study by Shahabz (2012) also reported that trade openness strengthens the relationship between financial development and economic growth although financial development is positively linked with economic growth. On the other hand, studies by Cecchetti and Kharoubi (2012) and Law and Singh (2014) reported the negative effect of financial sector development on economic growth. These mixed results led to the notion that there are limits to which finance can harbour economic growth (see Beck and Feyen, 2013; Law and Singh, 2014; Arcand et al., 2015). In this context, a study by Samargandi et al. (2015) reported rather a U-shaped relationship, which implies that finance can only lead to economic growth to a certain level before it leads to negative effects. Similarly, a recent study by Moosa (2017) reported that the Financialisation (credit to GDP and publically traded shares to GDP) has a negative impact on economic growth. Furthermore, Moosa (2017b) suggests there is a U-shaped relationship between financial development and economic growth, i.e. Financial Kuznets curve.

It is important to account for the country-level heterogeneities in the nexus between finance and growth. On this aspect, an empirical study by Durusu-Ciftci et al. (2017) which was based on a panel data analysis of forty countries showed that the financial development (stock and

credit markets) has positive effects on the economic growth. However, they also reported that there were significant country-level heterogeneities. In addition to the country-level heterogeneities, it is important to account for the nonlinearities in the relationship between financial development and economic growth. In this regard, a Pre-GFC study by Stengos et al. (2007), using non-parametric estimation techniques reported that the relationship between financial development and economic growth is linear but positive. Aside from the GFC, there is no reason to argue the possibility of a linear relationship between financial development and economic growth. The events of the GFC are prima facie evidence of huge nonlinearities and complexities surrounding finance-growth nexus. The later empirical evidence also supports this argument. For instance, Hung (2009) reported that there are important nonlinearities in the relationship between financial development and economic growth. It was argued that investment loans benefit while consumption loans hamper economic growth, but the level of financial development plays an important role in determining which channel is more appropriate and effective. Similarly, a contemporary study by Huang and Lin (2009) also supported the findings by Hung (2009). They reported that there is a positive association between financial development and economic growth, though the positive effects were more pronounced in the developing countries than developed countries. More recently, Soedarmono et al. (2017) reported that the financial development is found to have an inverted U-shaped relationship with economic growth. Contrary to Hung (2009), their results suggested that investment and consumption were the cause of non-linearity and both types of excessive credit creations have negative effects. Concomitantly, considering the overwhelming evidence in favour of nonlinear relationships, we will employ a framework of analysis which accounts for this aspect. One important aspect of this line of argument is that the level of financial development shall also influence the finance-growth nexus.

In the pre-GFC period, the importance of financial sector development in economic growth was almost universally accepted, however, the GFC led to a major shift in the perception of the financial sector's impact on the real economy. In the post-GFC wisdom, the financial sector, particularly when it is too large and influential, can rather put a drag on economic growth, leading to a phenomenon termed "*Finance Curse*" (See Shaxson and Christensen, 2013; Moosa 2017). There are some studies which endeavoured to explain the channels via financial sector development that exert a negative effect on economic growth. For instance, Crotty (1990, 2009) also cautioned that rapid financialisation can lead to financial instability and distortion of economic growth. Later, Cushen (2013) and Black (2011) also reported

negative effects of financialisation on the economy via adverse workplace and political consequences, while Lavoie (2012) suggested that financialisation leads to increase in debt, which has negative consequences in the long-term. A study by Bartlett (2013) suggests that financialisation leads to increase in income inequality which as a result, slows down economic growth. According to OECD (2015) the long-term increase in the indebtedness caused by credit weighs on economic growth via five channels, including (i) excessive financial deregulation, (ii) a more pronounced increase in bank lending than bond financing, (iii) too-big-to-fail guarantees, (iv) a lower quality of credit and (v) a disproportionate increase in household credit compared with business credit (also see Moosa, 2017). While these factors are important to consider when accounting for the negative consequences of the financialisation for the economy, the importance of net effects undoubtedly cannot be overlooked. Policy setting and the social welfare of a society would be the net effects of financialisation. Interestingly, a study by Hook and Singh (2014) argued that the level of financial development is beneficial to economic growth only up to a certain threshold, and beyond the threshold level, further development of finance tends to affect growth negatively.

In addition to the banking sector, there are a number of studies which focused on the particular segment of the financial sector, for instance, stock market (Acemoglu and Zilibottie, 1997; Levine and Zervos, 1998; Shen and Lee 2006), bonds markets (Levine and Zervos, 1998, Herring and Chatusripitak, 2006; Haiss and Fink, 2006; Gruic and Shrimpf, 2014), insurance sector (Webb et al., 2002; Arena, 2008) and have reported varying and contrasting results. A comprehensive study by Nguyen et al. (2017) analysed the impact of financial sector development on economic growth in the World Bank's designated high, middle and low-income countries, considering the banking, stock, bond and insurance markets. Their empirical findings led them to conclude that '*economic development matters in financial development-economic growth nexus'*. Specifically, their findings suggested that the banking sector development has a negative effect on economic growth for all levels of development but more so for developed economies. Although stock market development showed a positive effect only for the middle-income countries, bond markets had positive effects on economic growth in the middle and high-income countries. Lastly, they found that the insurance sector had overall positive effects. There are few limitations regarding the empirical framework and the theoretical and logical reasoning of their studies which require consideration. The development level of a country in terms of income level does not imply that the financial sector of that economy can also be categorised as developed. Perhaps, the financial sector

could still be going through the development phase. Nonetheless, it is also important to consider how efficient the financial sector is in performing its role of intermediation. Furthermore, it is intuitive to consider that there could be country-wide differences in the finance-growth nexus; hence a suitable framework for the analysis is the one which takes into account the country-level heterogeneity. Lastly, it is also vital to consider that the countries reach different levels of financial development over a period of time; hence a framework of analysis shall also take into account the regime-switching aspect between financial development and economic growth. In the next section, we will elaborate on this phenomenon and the employed empirical framework.

III. Methodology and Data

In order to investigate the growth effect of financial development, trade openness, capital and labour, we adopt the following general form of production function:

$$Y_t = f(F_t, O_t, K_t, L_t) \qquad (1)$$

where Y_t, F_t, O_t, K_t and L_t refer to the gross domestic product, financial development, trade openness, capital and labour, respectively. The autoregressive distributed lags (ARDL) model is considered the best model to account for the long-run and short-run relationship between financial development and economic growth along with trade openness, capital and labour. The advantages of the ARDL model as compared to traditional and conventional error correction models are fourfold. First, the ARDL model offers the opportunity to test long-run cointegration between I(0) and I(1) time series data using the Bounds test of Pesaran and Shin (1999) and Pesaran et al. (2001). It thus relaxes the condition that all of the time series should be integrated of order 1 as required in the Johansen (1988, 1991) and Engle-Granger (1987) cointegration tests. Second, the ARDL model tests for cointegration in one single equation and, hence, reduces the dimensionality of the cointegrating system as in Johansen (1988, 1991). Third, endogeneity is no more an issue in the ARDL model since it is free of residual correlation, as all variables are assumed to be endogenous. Fourth, according to Pesaran et al. (2001), the ARDL approach is able to discriminate between dependent and explanatory variables in the presence of a single long-run relationship through a single reduced form equation. Formally, the linear ARDL model has the following form:

$$\Delta Y_t = \mu + \rho_Y Y_{t-1} + \rho_F F_{t-1} + \rho_O O_{t-1} + \rho_K K_{t-1} + \rho_L L_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta Y_{t-i}$$

$$+ \sum_{i=1}^{q-1} \delta_i \Delta F_{t-i} + \sum_{i=1}^{m-1} \theta_i \Delta O_{t-i} + \sum_{i=1}^{n-1} \alpha_i \Delta K_{t-i} + \sum_{i=1}^{o-1} \varphi_i \Delta L_{t-i} + \varepsilon_t \quad (2)$$

where p, q, m, n and o are lag orders of the variables selected by the Schwarz Information Criterion (SIC). However, the ARDL model in Equation 2 becomes too restrictive if the relationship between considered variables is nonlinear due to the complex nature of economic systems and occurrence of abrupt changes in the dynamic of economic and financial time series possibly caused by crises (Asian crisis, GFC, European debt crisis), political turmoil, terrorist attacks, macroeconomic announcements and government interventions, among others. Shin et al. (2014) introduced an asymmetric cointegration model as follows:

$$Y_t = \beta_0 + \beta_1 F_t^+ + \beta_2 F_t^- + \beta_3 O_t + \beta_4 K_t + \beta_5 L_t + \mu_t \quad (3)$$

In Equation 3, financial development (FD_t) is decomposed into its positive (F_t^+) and negative (F_t^-) partial sums having the following respective representations:

$$F_t = F_0 + F_t^+ + F_t^- \quad (4)$$

$$F_t^+ = \sum_{i=1}^{t} \Delta F_t^+ = \sum_{i=1}^{t} \max(0, \Delta F_i) \quad (5)$$

$$F_t^- = \sum_{i=1}^{t} \Delta F_t^- = \sum_{i=1}^{t} \min(0, \Delta F_i) \quad (6)$$

where Δ is the difference operator, and the subscripts '+' and '-' denote positive and negative partial sums, respectively. Shin et al. (2014) introduced the previous partial sums into the linear ARDL model and suggested the following error-correction nonlinear ARDL (NARDL) model:

$$\Delta Y_t = \mu + \rho_Y Y_{t-1} + \rho_F^+ F_{t-1}^+ + \rho_F^- F_{t-1}^- + \rho_O O_{t-1} + \rho_K K_{t-1} + \rho_L L_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta Y_{t-i}$$

$$+ \sum_{i=1}^{q-1} (\delta_i^+ \Delta F_{t-i}^+ + \delta_i^- \Delta F_{t-i}^-) + \sum_{i=1}^{m-1} \theta_i \Delta O_{t-i} + \sum_{i=1}^{n-1} \alpha_i \Delta K_{t-i} + \sum_{i=1}^{o-1} \varphi_i \Delta L_{t-i} + \varepsilon_t \quad (7)$$

Since Model 7 is linear in all the parameters, it is estimated by Ordinary Least Squares (OLS). The null hypothesis of a no long-run relationship between the variables $H_0 : \rho_Y = \rho_{F^+} = \rho_{F^-} = \rho_O = \rho_K = \rho_L = 0$ against the alternative of the existence of a long-run relationship between the variables is tested by the $F - test$. The associated critical values are computed following the procedure detailed in Pesaran et al. (2001), as the asymptotic distribution of the test in non-standard under the null hypothesis. The test rejects the null hypothesis of a no long-run relationship between the variables if the computed $F - statistic$ is above the upper bound critical value.

The short-run relationship between economic growth and its past values are measured by $\gamma_i, i = 1,2, \dots, p-1$, while the current and past effects of financial development, trade openness, capital and labour on economic growth are measured by δ_i^+ and δ_i^-, θ_i, α_i and φ_i $i = 0,1,2, \dots$, respectively. The long-run asymmetric impact of financial development on economic growth is tested by using a Wald test of null hypothesis $\rho_{F^+} = \rho_{F^-}$ while the short-run asymmetric reaction of economic growth to financial development is tested using a Wald test of null hypothesis $\delta_i^+ = \delta_i^-, i = 0,1,2, \dots, q-1$. The long-run asymmetric coefficients of positive and negative shocks of financial development are calculated as $\beta_{F^+} = -\frac{\rho_F^+}{\rho_Y}$ and $\beta_{F^+} = -\frac{\rho_F^-}{\rho_Y}$.

Although the NARDL model allows capturing several features of time series dynamics and their relationship, it presents the drawback of imposing a zero threshold to account for nonlinearity and define regimes. The nonlinearity in the NARDL model is driven by positive and negative regimes, i.e. positive and negative variations of explanatory variables. However, due to the complexity of economic system driving the relationship between variables, it is more likely that financial development influences economic growth differently when it reaches different levels within a country. It is thus unlikely that economic growth would be impacted by average change of financial development. The ARDL model would provide inconsistent and unreliable results. We rather suspect that financial development impacts economic growth when the level of financial development is considerable, which we specify as threshold level. The latter is not necessary at zero-level, as imposed in the NARDL model of shin et al. (2014). We thus develop a three-regime threshold autoregressive distributed lags

(TARDL) model, which represents a more flexible framework than the NARDL model of Shin et al. (2014). The three-regime model is adopted to capture the different influence of financial development on economic growth not only when the level of financialisation is substantial (upper regime) or very low (lower regime), but also for a moderate level of financialisation (middle regime). This is the case when a country has achieved a halfway financialisation process. Indeed, the TARDL contains two thresholds defined as the average value of financial development $\pm$ one standard deviation. Consequently, we decompose financial development into three partial sums, i.e. F_t^+, F_t^0 and F_t^-, as follows:

$$F_t = F_t^+ + F_t^0 + F_t^- \tag{8}$$

$$F_t^- = \sum_{i=1}^{t} \Delta F_t^- = \sum_{i=1}^{t} \Delta F_t * I_{\{F_i < d_1\}} \tag{9}$$

$$F_t^0 = \sum_{i=1}^{t} \Delta F_t^0 = \sum_{i=1}^{t} \Delta F_t * I_{\{d_1 \le F_i < d_2\}} \tag{10}$$

$$F_t^+ = \sum_{i=1}^{t} \Delta F_t^+ = \sum_{i=1}^{t} \Delta F_t * I_{\{F_i \ge d_2\}} \tag{11}$$

where $d_1 = \overline{F} - \sigma_F$ and $d_2 = \overline{F} + \sigma_F$ are the lower and upper thresholds, with $\overline{F}$ and σ_F denoting average and standard deviation of financial development, respectively. I is a dummy variable that takes the value 1, if the condition in curly brackets is true, and 0 otherwise. We introduce the previous decomposition of financial development in the ARDL and obtain the following representation of the three-regime TARDL model:

$$\Delta Y_t = \mu + \rho_Y Y_{t-1} + \rho_F^+ F_{t-1}^+ + \rho_F^0 F_{t-1}^0 + \rho_F^- F_{t-1}^- + \rho_O O_{t-1} + \rho_K K_{t-1} + \rho_L L_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta Y_{t-i} + \sum_{i=1}^{q-1} (\delta_i^+ \Delta F_{t-i}^+ + \delta_i^0 \Delta F_{t-i}^0 + \delta_i^- \Delta F_{t-i}^-) + \sum_{i=1}^{m-1} \theta_i \Delta O_{t-i} + \sum_{i=1}^{n-1} \alpha_i \Delta K_{t-i} + \sum_{i=1}^{o-1} \varphi_i \Delta L_{t-i} + \varepsilon_t \tag{12}$$

Since the threshold parameter d is known, estimation of TARDL model could be carried out using OLS and standard inference remains valid. The model in equation-12 assumes that only loadings of financial development variable switch between the three regimes. The subsequent results can be generalized to the case where all parameters change between the regimes (Hansen, 2000).

In line with Shin et al. (2014), we construct the long-run parameters associated with the financial development using the delta method as follows:

$$\beta_{F^+} = -\frac{\rho_F^+}{\rho_Y}, \beta_{FD^0} = -\frac{\rho_F^0}{\rho_Y} \text{ and } \beta_{F^-} = -\frac{\rho_F^-}{\rho_Y}$$

Consequently, long-run asymmetry is tested using a Wald test of the following four null hypotheses:

$$H_0^1: \beta_{F^+} = \beta_{F^0} \quad (13)$$

$$H_0^2: \beta_{F^+} = \beta_{F^-} \quad (14)$$

$$H_0^3: \beta_{F^-} = \beta_{F^0} \quad (15)$$

$$H_0^4: \beta_{F^+} = \beta_{F^0} = \beta_{F^-} \quad (16)$$

Financial development exerts an asymmetric long-run effect on economic growth if the Wald test rejects at least one of the previous hypotheses in (13)-(16). These four hypotheses could be written in matrix compact form as follows:

$$H_0: R\beta_F(d) = \text{r} \quad \text{versus} \quad H_a: R\beta_F(d) \neq \text{r where } d = (d_1, d_2), \quad (17)$$

R is a $v * 3$ matrix with v is the number of hypotheses to be tested on the 3 parameters in $(\beta_F^+, \beta_F^0, \beta_F^-)$, and $r = v * 1$ vector. Similarly, the short-run asymmetric effect of financial development on economic growth is tested using the following Wald test:

$$H_0: Q\delta_F(d) = \text{q versus } H_a: Q\beta_F(d) \neq \text{q where } d \text{ is defined above.} \quad (18)$$

with Q and q are defined in a similar manner to equation-17. Pesaran and Shin (1998) argued that, when d is known a priori, OLS estimators of short-run parameters in equation-17 are $\sqrt{T}$-consistent and have the asymptotic normal distribution while OLS estimators of long-run parameters are T-consistent and follow a mixture distribution. Consequently, Wald statistic for testing the null of long-run or short-run symmetry follows a χ^2 distribution.

Following Shin et al. (2014), we compute the asymmetric dynamic multipliers tracing the response of economic growth to a one-unit shock of financial development. For each country in our sample, dynamic multipliers are calculated in each regime as follows:

$m_h^+ = \sum_{j=0}^{h} \frac{\partial Y_{t+j}}{\partial F_t^+}$, $m_h^0 = \sum_{j=0}^{h} \frac{\partial Y_{t+j}}{\partial F_t^0}$ and $m_h^- = \sum_{j=0}^{h} \frac{\partial Y_{t+j}}{\partial F_t^-}$, $h = 0, 1, 2, \ldots$

where $m_h^+ \to \beta_F^+$, $m_h^0 \to \beta_F^0$ and $m_h^- \to \beta_F^-$ as $h \to \infty$.

Estimation of dynamic multipliers allows investigating the adjustment from an initial equilibrium to a new long-run equilibrium following a unit shock of financial development.

This study covers the period of 1971-2016 for all the countries[4]. The data on the real GDP (constant 2010 US$), trade i.e. export + imports (constant 2010 US$), gross fixed capital formation (constant 2010 US$) and the measure of capital and labour has been obtained from World Development Indicators (CD-ROM, 2018) [5]. We utilise domestic credit to the private sector (constant 2010 US$) as a measure of financial development. Total population (collected from World Development Indicators) is also used to convert data for all the variables into per capita units. We have further transformed annual frequency data into quarter frequency, following Shahbaz et al. (2017, 2018). In doing so, the quadratic match-sum method is

[4] To reiterate, the choice of top ten countries is based on supporting economic competitiveness and growth. As part of its overall competitiveness ranking, the World Economic Forum's Global Competiveness Report evaluates the level of development of 144 of the world's financial systems, based on their efficiency and levels of trustworthiness and confidence, available at http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf

[5] There are a number of different proxies used to gauge the degree of financial development in the existing literature discussed earlier. For example, a common practice adopted by a number of studies to measure the financial development has been to consider the Money Supply (M2) and/or other liquid liabilities as a share of national income (GDP). However, one issue of using such approaches to measure the financial developed has been their limited ability to fully encompass the development of the financial sector. For instance, a study by King and Levine (1993) suggested using the M2 as a proxy of financial deepening; however, it condoned the fact that the M2 which mostly contains the currency in circulation is rather a measure of monetisation than the financial deepening or development (also see Demetriades and Hussein, 1996; Jalil and Feridun, 2011). There are also studies which used the liquid liabilities as proxies for the financial development. Undoubtedly, these measures give insight into the size of the financial sector, yet their relevance to the financial development is limited (see e.g. Claessens et al., 2001; Creane et al., 2007). Contrarily, the employed approach of using domestic credit to the private sector is more inclusive. This is explicit in the fact that this proxy establishes a claim of repayment by allocating financial resource to the private sector through loans, trade credit, purchases of non-equity securities and other accounts receivable (see Boutabba, 2014 for detailed discussion). Nonetheless, the actual level of savings allocated to the productive investment ventures is also reflected and accounted for in the domestic credit to the private sector approach. Perhaps, this effectiveness of measurement was the reason that a number of recent studies have also used this approach (Sadorsky, 2011; Mehrara and Musai, 2012; Polat et al., 2015; Shahbaz et al., 2016). Lastly, an important aspect of this measure which also makes it most suitable choice for this study is its comparability and unanimous measurement in all the under-analysed countries. This implies a fair comparison when it comes the results of finance-growth nexus in the underlying economies.

applied for transforming annual data into quarter frequency. The use of quarter frequency data increases the sample size, which helps in attaining accurate empirical results (Shahbaz et al., 2017). Lastly, all the variables are converted into natural-logarithm. The use of log-linear specification may provide consistent and reliable empirical findings (Shahbaz et al., 2018).

IV. Empirical Results and Their Discussion

Recent studies regarding the growth effect of financial development largely agreed that the dynamic relationship between the two variables is driven by complex system market and several big events, such as financial crises, debt crises, wars and terrorist attacks. These events might trigger asymmetries and regime shifts in the linkage between macroeconomic and financial time-series and particularly between financial development and economic growth (Ruiz, 2018; Ibrahim and Alagidede, 2018). Prior to estimating the developed three-regime TARDL model, it is crucial to check the order of integration of our variables as the ARDL-type models require that all of the data series should be I(1) at most.

In order to examine the order of integration of the variables, we have applied augmented Dickey-Fuller (1981) i.e. ADF and Phillips and Perron (1988) i.e. PP unit root tests[6]. We find that financial development, trade openness, capital, labour and economic growth have a unit root problem at level with intercept and time trend. All the variables are found stationary after 1st difference. It implies that variables are integrated at I(1). The empirical results provided by ADF and PP unit root tests may not be reliable as ADF and PP unit root tests ignore the presence of structural breaks in the series. The presence of structural breaks in the series may be a cause of unit root in the series. This issue is solved by applying a non-linear unit root test developed by Kapetanis et al. (2003), which tests the null hypothesis of a unit root against the alternative of the globally-stationary exponential smooth transition autoregressive (ESTAR) process. This unit root test demonstrates a better accuracy than traditional linear unit root tests, i.e. ADF and PP when there are nonlinearities in the dynamic of time series. In investigating nonlinearities in the variables, we perform the BDS test on the residuals of Equation 2 that links financial development and economic growth using the linear VAR model while integrating the influences of trade openness, capital and labour. The results of the BDS non-linear test, reported in Table 1, highly reject the null hypothesis of independently and identically distributed residuals. It also indicates the existence of remaining dependence

[6] The results are available upon request from authors.

and omitted nonlinearity in the data, rendering the necessity of a nonlinear model. The empirical results of the Kapetanios et al. (2003) unit root test, reported in Table 2, show that all the level variables are non-stationary except trade openness in Malaysia, New Zealand, Singapore and Norway, and capital in Finland (at 10%). Moreover, Kapetanios et al. (2003) highly reject the null hypothesis of the unit root when applied on first-differenced log-variables. The latter finding means that all variables in hand are either I(0) or I(1) confirming that the TARDL model is the best model to accommodate this feature of time series data. In addition, the empirical results of unit root test indicate that the linear ARDL model is likely to provide a biased outcome, as it fails to capture the nonlinearity shown by the BDS test.

Table-1: The BDS Non-linearity Analysis

Variables	USA	Canada	South Africa	Australia	Malaysia	New Zealand	Singapore	Hong Kong	Finland	Norway
GDP										
$m = 2$	0.206***	0203***	0.192***	0.205***	0.205***	0.201***	0.207***	0.207***	0.205***	0.209***
$m = 3$	0.351***	0344***	0.321***	0.347***	0.349***	0.341***	0.352***	0.351***	0.348***	0.355***
$m = 4$	0.453***	0.442***	0.408***	0.446***	0.449***	0.438***	0.453***	0.453***	0.447***	0.457***
$m = 5$	0.524***	0.510***	0.466***	0.516***	0.521***	0.506***	0.524***	0.525***	0.516***	0.529***
$m = 6$	0.575***	0.558***	0.505***	0.545***	0.572***	0.554***	0.575***	0.575***	0.563***	0.579***
FD										
$m = 2$	0.199***	0.200***	0.198*	0.206***	0.207***	0.207***	0.206***	0.200***	0.206***	0.203***
$m = 3$	0.337***	0.335***	0.334***	0.349***	0.352***	0.351***	0.349***	0.337***	0.350***	0.343***
$m = 4$	0.432***	0.431***	0.427***	0.450***	0.454***	0.451***	0.450***	0.432***	0.450***	0.441***
$m = 5$	0.499***	0.496***	0.490***	0.521***	0.524***	0.521***	0.521***	0.499***	0.519***	0.510***
$m = 6$	0.546***	0.541***	0.534***	0.570***	0.574***	0.570***	0.571***	0.546***	0.568***	0.559***
TR										
$m = 2$	0.204***	0.200***	0.186***	0.201***	0.204***	0.196***	0.203***	0.205***	0.200***	0.187***
$m = 3$	0.347***	0.338***	0.309***	0.339***	0.346***	0.329***	0.344***	0.348***	0.337***	0.314***
$m = 4$	0.447***	0.432***	0.391***	0.434***	0.442***	0.419***	0.443***	0.448***	0.431***	0.399***
$m = 5$	0.517***	0.497***	0.442***	0.500***	0.508***	0.479***	0.512***	0.517***	0.496***	0.455***
$m = 6$	0.566***	0.540***	0.473***	0.546***	0.552***	0.518***	0.561***	0.566***	0.541***	0.491***
K										
$m = 2$	0.201***	0.197***	0.196***	0.199***	0.199***	0.184***	0.202***	0.201***	0.190***	0.200***
$m = 3$	0.340***	0.333***	0.330***	0.334***	0.336***	0.307***	0.343***	0.340***	0.320***	0.338***
$m = 4$	0.436***	0.426***	0.420***	0.427***	0.430***	0.387***	0.440***	0.436***	0.408***	0.432***
$m = 5$	0.501***	0.491***	0.478***	0.490***	0495***	0.440***	0.508***	0.501***	0.467***	0.496***
$m = 6$	0.545***	0.536***	0.514***	0.533***	0.539***	0.474***	0.555***	0.546***	0.504***	0.539***
L										
$m = 2$	0.208***	0.205***	0.207***	0.208***	0.205***	0.209***	0.209***	0.208***	0.193***	0.207***
$m = 3$	0.354***	0.348***	0.350***	0.355***	0349***	0.356***	0.356***	0.354***	0.327***	0.352***
$m = 4$	0.457***	0.448***	0.449***	0.459***	0.449***	0.459***	0.460***	0.457***	0.410***	0.455***
$m = 5$	0.528***	0.518***	0.519***	0.531***	0.521***	0.530***	0.532***	0.528***	0.469***	0.526***

$m = 6$	0.577***	0.566***	0.568***	0.580***	0.573***	0.581***	0.582***	0.577***	0.509***	0.577***
Note: *** and * shows significance at 1% and 10% levels of significance.										

Table-2: Non-linear Unit Root Analysis

Variable	USA	Canada	South Africa	Australia	Malaysia	New Zealand	Singapore	Hong Kong	Finland	Norway
Panel-A										
Y_t	-1.654 [0.544]	-1.837 [0.437]	-0.474 [0.909]	-0.147 [0.941]	-1.276 [0.737]	-0.586 [0.895]	-1.539 [0.610]	-1.957 [0.374]	-1.809 [0.453]	-1.368 [0.697]
F_t	-0.759 [0.870]	-1.688 [0.524]	-0.222 [0.935]	-0.579 [0.896]	-2.502 [0.136]	-1.617 [0.566]	-1.979 [0.357]	-0.555 [0.903]	-1.035 [0.815]	-0.483 [0.908]
O_t	1.122 [0.994]	-2.565 [0.119]	-1.828 [0.442]	-1.945 [0.376]	-3.332** [0.016]	-3.254** [0.020]	-3.176** [0.025]	-1.366 [0.698]	-2.432 [0.158]	-3.347** [0.015]
K_t	-2.219 [0.239]	-1.009 [0.822]	-2.556 [0.121]	-0.583 [0.896]	-2.395 [0.170]	-1.518 [0.621]	-2.227 [0.236]	-1.891 [0.406]	-2.820* [0.065]	-1.974 [0.360]
L_t	-1.452 [0.656]	-1.013 [0.821]	-1.306 [0.725]	-1.535 [0.612]	-1.889 [0.401]	-1.953 [0.371]	-1.667 [0.531]	-2.334 [0.192]	-1.765 [0.479]	-1.539 [0.610]
Panel-B										
Y_t	-7.349*** [0.000]	-5.959*** [0.000]	-9.183*** [0.000]	-5.257*** [0.000]	-5.334*** [0.000]	-4.675*** [0.000]	-7.643*** [0.000]	-6.251*** [0.000]	-6.674*** [0.000]	-5.049*** [0.000]
F_t	-5.673*** [0.000]	-6.113*** [0.000]	-5.051*** [0.000]	-6.772*** [0.000]	-7.091*** [0.000]	-5.250*** [0.000]	-7.853*** [0.000]	-5.810*** [0.000]	-7.995*** [0.000]	-5.568*** [0.000]
O_t	-7.662*** [0.000]	-6.283*** [0.000]	-5.236*** [0.000]	-6.252*** [0.000]	-7.224*** [0.000]	-5.749*** [0.000]	-6.401*** [0.000]	-8.320*** [0.000]	-5.359*** [0.000]	-5.571*** [0.000]
K_t	-5.888*** [0.000]	-5.580*** [0.000]	-8.713*** [0.000]	-6.616*** [0.000]	-4.404*** [0.000]	-5.976*** [0.000]	-5.204*** [0.000]	-6.464*** [0.000]	-6.026*** [0.000]	-8.221*** [0.000]
L_t	-4.779*** [0.000]	-5.293*** [0.000]	-6.700*** [0.000]	-3.647*** [0.006]	-5.261*** [0.000]	-3.469** [0.010]	-4.097*** [0.001]	-5.051*** [0.000]	-2.953** [0.049]	-3.869*** [0.001]
Note: *** and ** show significant at 1% and 5% levels, respectively.										

Therefore, we apply the TARDL model to examine long-run and short-run asymmetric associations between financial development and economic growth while controlling for the respective effects of trade openness, capital and labour in the domestic production function. The empirical results of the TARDL estimation are reported in Table 3. The speed of adjustment parameter is significantly negative for all the top-ten financially-developed countries, except for Norway, thus meeting the necessary condition for the stability of ECM-TARDL model. The empirical results of the goodness-of-fit statistics in Table 3 show that the models' residuals have the expected desired features. Indeed, the residuals are normally distributed as χ^2_{NORM} , which fails to reject the null hypothesis of normality. Furthermore, the residuals show the absence of serial correlation and heteroscedasticity, as respectively indicated by χ^2_{SC} and χ^2_{HET} tests. In addition, the cumulative sum (CUSUM) of recursive residuals and CUSUM of squared residuals depicted in Figure 1 show that TARDL is stable and hence is a suitable fit for our data. The empirical results of the Wald test for long-run asymmetry presented in Table 4 shows significant differences of the effects of financial development on economic growth between the middle and lower regimes in the US, Malaysia and Singapore; between the upper and middle regime in South Africa and Finland, and between the lower and upper regimes in Singapore and Finland.

The previous results indicate that the association between economic growth and financial development in US, Malaysia and Singapore adjusted after financial development went above a low threshold value, but in South Africa, this association remained unchanged as the level of financial development is below a high threshold. Additionally, in Finland, economic growth is more sensitive to financial development as the level of financialisation impacts economic growth according to whether financial development is at its beginning, moderate or substantial stage. This could be explained by the endeavour and achievement realized by each country in term of financialisation of its economy. Indeed, Singapore and Malaysia occupy first positions in the ranking (2^{nd} and 4^{th}), South Africa took the 7^{th} position while Finland is in the middle of the ranking and, consequently, is more sensitive to low and high levels of financialisation.

Contrarily, Wald test fails to reject the null hypothesis of long-run symmetric growth effect of financial development in Canada, New Zealand and Norway. This result is not surprising and may be due to the fact that Canada and Norway are ranked in the tail of the top-ten financially developed countries which means that these countries have not yet reached the level of

financialisation that would trigger a change in the link between economic growth and financial development. However, the linear association between the two variables in New Zealand (3rd rank) is somewhat surprising, as the country achieved different stages of financial development over time. One possible explanation is that New Zealand undertook a smooth financialisation of its economy, which either caused a linear trend in the influence of financial development on economic growth or caused a nonlinear association of the two variables of different nature than the threshold nonlinearity. More specifically, in the upper regime, financial development sustains economic growth in Singapore but hampers economic growth in Finland. However, in the middle regime, the growth effect of financial development is positive in Australia and Singapore with a higher extent in the latter. In the lower regime, financial development significantly hinders economic growth in the US, Malaysia and Singapore.

However, trade openness has a significant positive impact on economic growth in all countries except the US and Hong Kong, where trade openness has no growth effect. Trade openness has the highest growth effect in Malaysia and New Zealand. Indeed, a 1% increase of trade openness leads economic growth to move up by 0.184% $\left(\beta_O = -\frac{0.028}{-0.152}\right)$ in Malaysia and by 0.8% $\left(\beta_O = -\frac{0.020}{-0.025}\right)$ in New Zealand. Similarly, capital positively impacts economic growth in the US and Malaysia with a higher impact in the US $\left(\beta_K^{US} = -\frac{0.012}{-0.010} = 1.2 > \beta_K^{MALAYSIA} = -\frac{0.023}{-0.152} = 0.151\right)$. The empirical results in Table 3 also highlight that labour sustains economic growth in Malaysia and Singapore. In Malaysia, the labour market attracts a large number of high- and low-skilled migrants who all generate a positive effect in manufacturing Malaysian industries. Moreover, low-skilled foreign workers are employed in assembling intensive modern industries, which leads to competitiveness gains at the international level and, consequently, Malaysian exports play an important role in the development and growth of the Malaysian economy (Jordaan, 2017).

Table-3: Threshold NARDL Empirical Analysis

	USA	Canada	South Africa	Australia	Malaysia	New Zealand	Singapore	Hong Kong	Finland	Norway
Dependent Variable ΔY_t										
μ	0.107* (0.063)	0.103* (0.053)	0.143 (0.114)	0.310** (0.142)	-0.755*** (0.132)	0.217* (0.113)	-0.267* (0.158)	-0.062*** (0.013)	0.081 (0.084)	0.040 (0.090)
Y_{t-1}	-0.010** (0.005)	-0.018** (0.008)	-0.046*** (0.015)	-0.037** (0.016)	-0.152*** (0.025)	-0.025* (0.014)	-0.081*** (0.019)	-0.017* (0.010)	-0.013* (0.007)	-0.009 (0.006)
F_{t-1}^{+}	0.005 (0.006)	0.0004 (0.002)	0.012 (0.009)	0.005 (0.007)	0.027 (0.018)	-0.004 (0.009)	0.020** (0.008)	0.000 (0.005)	-0.162*** (0.039)	-0.023 (0.035)
F_{t-1}^{0}	0.000 (0.001)	-0.001 (0.001)	-0.008 (0.008)	0.004** (0.002)	0.004 (0.003)	-0.0003 (0.001)	0.025** (0.010)	-0.001 (0.007)	0.001 (0.012)	-0.0001 (0.010)
F_{t-1}^{-}	-0.004 (0.003)	0.003 (0.002)	-0.002 (0.012)	0.010 (0.009)	-0.010*** (0.003)	0.001 (0.005)	-0.031** (0.014)	-0.006 (0.019)	-0.021 (0.017)	0.009 (0.027)
O_{t-1}	-0.001 (0.002)	0.008*** (0.003)	0.010** (0.005)	0.011** (0.005)	0.028*** (0.005)	0.020*** (0.005)	0.031*** (0.009)	0.006 (0.005)	0.007** (0.003)	0.011** (0.005)
K_{t-1}	0.012*** (0.003)	0.002 (0.003)	-0.001 (0.005)	0.005 (0.005)	0.023*** (0.005)	0.005 (0.004)	0.007 (0.008)	0.001 (0.003)	-0.002 (0.003)	-0.003 (0.002)
L_{t-1}	-0.034 (0.026)	-0.006 (0.016)	0.050 (0.048)	-0.035 (0.046)	0.555*** (0.094)	-0.075 (0.058)	0.217*** (0.053)	0.050 (0.048)	-0.002 (0.027)	-0.010 (0.039)
ΔY_{t-1}	0.534*** (0.072)	0.765*** (0.049)	0.541*** (0.076)	0.544*** (0.072)	0.475*** (0.070)	0.503*** (0.071)	0.434*** (0.071)	0.608*** (0.063)	0.614*** (0.059)	0.703*** (0.056)
ΔY_{t-2}	0.121* (0.068)		0.141* (0.074)	0.041 (0.058)	0.237*** (0.074)		0.136* (0.075)			
ΔY_{t-3}	-0.059** (0.030)			-0.085 (0.055)			-0.070 (0.056)			
ΔF_t^{+}	0.086*** (0.021)	0.005 (0.009)	0.088*** (0.033)	0.229*** (0.064)	-0.181 (0.128)	-0.176** (0.080)	-0.079 (0.070)	0.044 (0.032)	0.418*** (0.074)	0.036 (0.034)
ΔF_{t-1}^{+}	-0.082*** (0.021)	-0.004 (0.009)	-0.042 (0.034)	-0.164** (0.066)		0.061 (0.081)		-0.060* (0.033)		-0.049 (0.062)
ΔF_t^{0}	-0.047*** (0.014)	-0.009* (0.005)	0.033* (0.019)	- 0.055***	0.021 (0.014)	0.025*** (0.006)	-0.062* (0.035)	0.159*** (0.031)	0.036 (0.024)	0.008 (0.010)

				(0.021)						
ΔF_{t-1}^{0}	0.043*** (0.015)	0.006 (0.004)	-0.011 (0.019)	0.059*** (0.021)		-0.008 (0.007)		-0.129*** (0.032)		-0.002 (0.018)
ΔF_{t}^{-}	0.122*** (0.037)	-0.076*** (0.017)	0.132*** (0.046)	-0.031 (0.031)	0.056 (0.042)	0.083** (0.036)	0.168*** (0.043)	0.588*** (0.068)	0.015 (0.021)	0.001 (0.027)
ΔF_{t-1}^{-}	-0.054 (0.040)	0.051*** (0.016)	-0.067 (0.045)	0.057* (0.029)		-0.075** (0.032)		-0.407*** (0.078)		0.023 (0.047)
ΔO_{t}	-0.009** (0.004)	0.181*** (0.013)	0.147*** (0.014)	0.089*** (0.014)	0.236*** (0.024)	0.044*** (0.016)	0.260*** (0.024)	0.189*** (0.019)	0.113*** (0.014)	0.008 (0.013)
ΔO_{t-1}	0.008** (0.004)	-0.142*** (0.015)	-0.078*** (0.016)	- 0.066*** (0.015)	-0.109*** (0.029)	-0.017 (0.016)	-0.092*** (0.026)	-0.099*** (0.022)	-0.081*** (0.014)	-0.008 (0.015)
ΔO_{t-2}			-0.026* (0.014)		-0.066** (0.027)	-0.011 (0.015)	-0.032 (0.025)			0.003 (0.014)
ΔO_{t-3}						-0.019 (0.014)				0.006 (0.012)
ΔK_{t}	0.444*** (0.016)	0.159*** (0.015)	-0.003 (0.016)	0.202*** (0.016)	0.140*** (0.016)	0.019*** (0.017)	0.054 (0.035)	0.129*** (0.021)	0.142*** (0.020)	0.114*** (0.016)
ΔK_{t-1}	-0.264*** (0.035)	-0.123*** (0.018)		- 0.122*** (0.021)	-0.081*** (0.019)	-0.101*** (0.022)	-1.431* (0.844)	-0.080*** (0.023)	-0.070*** (0.023)	-0.068*** (0.018)
ΔK_{t-2}	-0.071** (0.033)				-0.047** (0.019)					-0.006 (0.016)
ΔL_{t}	-0.320 (0.828)	-0.699*** (0.112)	-3.814*** (1.315)	-0.179 (0.632)	-0.047 (1.169)	-5.082*** (1.251)		-0.734 (0.497)	2.723* (1.393)	-0.540 (2.254)
ΔL_{t-1}	-0.232 (0.818)	0.634*** (0.113)	1.857 (1.332)			2.796** (1.266)			-2.766* (1.440)	-0.172 (2.229)
Long-run estimates										
$L_{F^{+}}$	0.457 (0.652)	0.022 (0.143)	0.270 (0.177)	0.138 (0.175)	0.180 (0.116)	-0.151 (0.448)	0.244*** (0.074)	-0.010 (0.274)	-12.585* (6.954)	-2.542 (3.940)
$L_{F^{0}}$	0.009 (0.085)	-0.055 (0.047)	-0.174 (0.161)	0.114** (0.047)	0.025 (0.019)	0.0002 (0.0007)	0.303*** (0.085)	-0.080 (0.443)	0.049 (0.931)	-0.019 (1.056)

L_{F-}	-0.442* (0.244)	0.141 (0.125)	-0.051 (0.260)	0.273 (0.236)	-0.066*** (0.021)	0.062 (0.242)	-0.381** (0.171)	-0.334 (1.214)	-1.649 (1.397)	1.015 (3.059)
Model diagnostic										
$Adj.R^2$	0.937	0.924	0.799	0.738	0.809	0.737	0.726	0.908	0.903	0.813
AIC	-9.829	-9.618	-8.449	-8.946	-7.497	-8.520	-7.083	-8.090	-8.669	-9.070
SIC	-9.403	-9.469	-8.061	-8.556	-7.143	-8.112	-6.746	-7.738	-8.351	-8.644
χ^2_{SC}	0.918 [0.513]	0.404 [0.817]	2.044 [0.218]	0.249 [0.882]	2.391 [0.183]	1.526 [0.466]	1.835 [0.399]	1.691 [0.429]	2.950 [0.127]	2.298 [0.191]
χ^2_{HET}	0.997 [0.443]	0.943 [0.504]	0.580 [0.858]	0.507 [0.910]	1.057 [0.397]	1.155 [0.316]	1.365 [0.182]	0.719 [0.732]	1.247 [0.265]	0.602 [0.852]
χ^2_{NORM}	0.226 [0.893]	0.389 [0.967]	0.680 [0.770]	0.597 [0.844]	1.025 [0.425]	0.550 [0.880]	0.895 [0.553]	0.829 [0.620]	0.712 [0.746]	0.218 [0.898]
$CUSUM$	stable	stable	Stable	stable	stable	stable	stable	stable	stable	stable
$CUSUM^2$	stable	stable	Stable	stable	stable	stable	stable	stable	stable	Stable
Note: ***, ** and * show significance at 1%, 5% and 10% levels respectively.										

Table-4: Long-run and Short-run Asymmetry

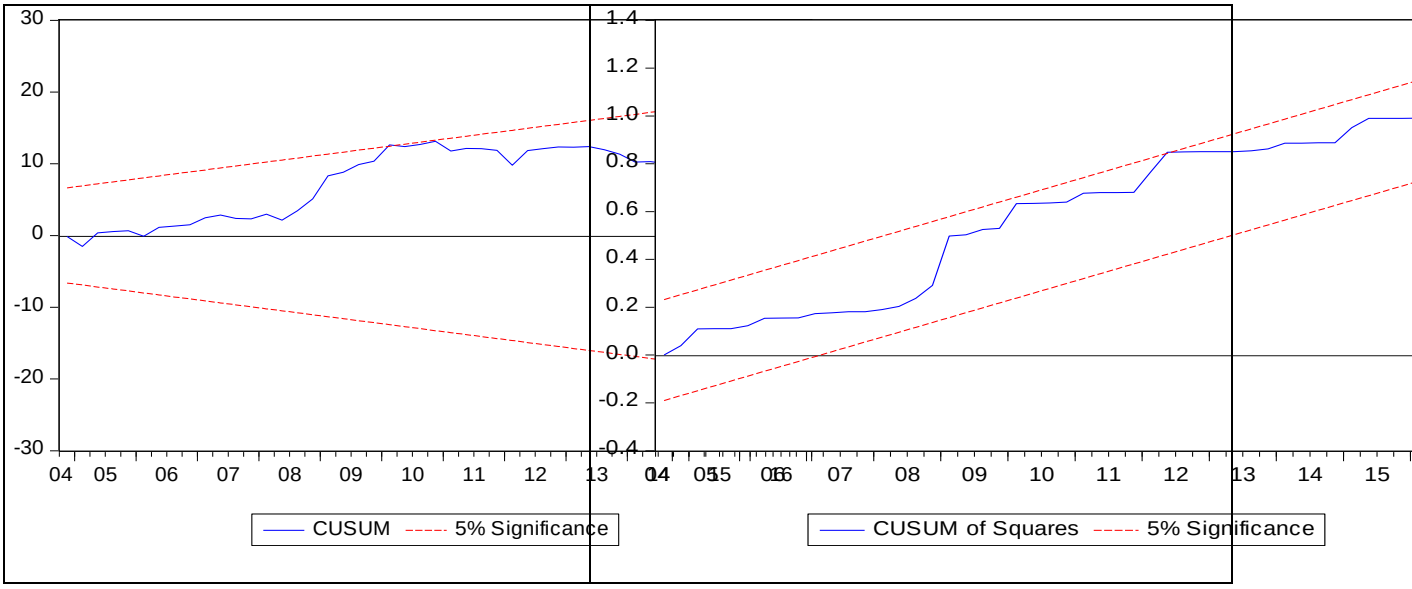
	USA	Canada	South Africa	Australia	Malaysia	New Zealand	Singapore	Hong-Kong	Finland	Norway
Long-run asymmetry										
$L_{F^+} = L_{F^0}$	0.581 [0.446]	0.307 [0.580]	3.488* [0.062]	0.026 [0.872]	1.767 [0.184]	0.117 [0.733]	0.456 [0.499]	0.014 [0.905]	3.469* [0.062]	0.407 [0.524]
$L_{F^+} = L_{F^-}$	1.490 [0.222]	0.467 [0.494]	0.894 [0.344]	0.173 [0.677]	0.860 [0.354]	0.118 [0.731]	13.858*** [0.000]	0.057 [0.811]	2.812* [0.094]	0.463 [0.496]
$L_{F^0} = L_{F^-}$	2.904* [0.088]	2.226 [0.136]	0.159 [0.690]	0.457 [0.499]	20.189*** [0.000]	0.083 [0.773]	29.179*** [0.000]	0.065 [0.799]	2.416 [0.120]	0.109 [0.740]
$L_{F^+} = L_{F^0} = L_{F^-}$	3.710 [0.294]	2.309 [0.315]	3.491 [0.175]	0.647 [0.724]	25.772*** [0.000]	0.120 [0.942]	32.763*** [0.000]	0.065 [0.968]	4.508 [0.105]	0.486 [0.784]
Short-run asymmetry										
$\Delta F_t^+ = \Delta F_t^0$	27.242*** [0.000]	2.180 [0.140]	2.068 [0.150]	17.840*** [0.000]	2.475 [0.116]	6.178** [0.013]	0.058 [0.810]	8.815*** [0.004]	27.397*** [0.000]	0.677 [0.411]
$\Delta F_{t-1}^+ = \Delta F_{t-1}^0$	22.854*** [0.000]	1.026 [0.311]	0.741 [0.389]	10.159*** [0.001]		0.695 [0.404]		2.862* [0.091]		0.560 [0.454]
$\Delta F_t^+ = \Delta F_t^-$	0.719 [0.396]	16.257*** [0.000]	0.618 [0.432]	13.230*** [0.000]	3.056* [0.080]	8.992*** [0.003]	8.885*** [0.003]	59.244*** [0.000]	28.209*** [0.000]	0.636 [0.425]
$\Delta F_{t-1}^+ = \Delta F_{t-1}^-$	0.399 [0.528]	8.136*** [0.004]	0.194 [0.659]	9.500*** [0.002]		2.412 [0.120]		18.427*** [0.000]		0.856 [0.355]
$\Delta F_t^0 = \Delta F_t^-$	18.491*** [0.000]	13.903*** [0.000]	4.149** [0.042]	0.458 [0.498]	0.655 [0.418]	2.473 [0.116]	17.757*** [0.000]	40.589*** [0.000]	0.611 [0.434]	0.054 [0.816]
$\Delta F_{t-1}^0 = \Delta F_{t-1}^-$	4.891** [0.027]	7.117*** [0.008]	1.396 [0.237]	0.004 [0.950]		4.104** [0.043]		14.481*** [0.000]		0.268 [0.604]
$\Delta F_t^+ = \Delta F_t^0 = \Delta F_t^-$	39.306*** [0.000]	16.397*** [0.000]	11.704*** [0.003]	17.846*** [0.000]	3.126 [0.209]	9.276*** [0.009]	18.795*** [0.000]	59.253*** [0.000]	28.800*** [0.000]	0.743 [0.690]
$\Delta F_{t-1}^+ = \Delta F_{t-1}^0 = \Delta F_{t-1}^-$	23.554*** [0.000]	8.281** [0.016]	1.885 [0.389]	10.411*** [0.005]		4.995* [0.082]		18.460*** [0.000]		0.858 [0.651]
Note: ***, ** and * show significance at 1%, 5% and 10% levels, respectively.										

In the short-run, considering significant parameters only, financial development has a cumulative positive effect on economic growth in the US, South Africa, Australia and Finland. However, results show that financial development paralyzes economic growth in New Zealand and Hong Kong. In the middle regime, financial development has a cumulative positive effect on economic growth in South Africa, Australia, New Zealand and Hong Kong and a negative effect in US, Canada and Singapore. In the lower regime, results highlight a cumulative positive influence of financial development on economic growth in the US, South Africa, Australia, New Zealand, Singapore and Hong Kong but a cumulative negative impact in Canada.

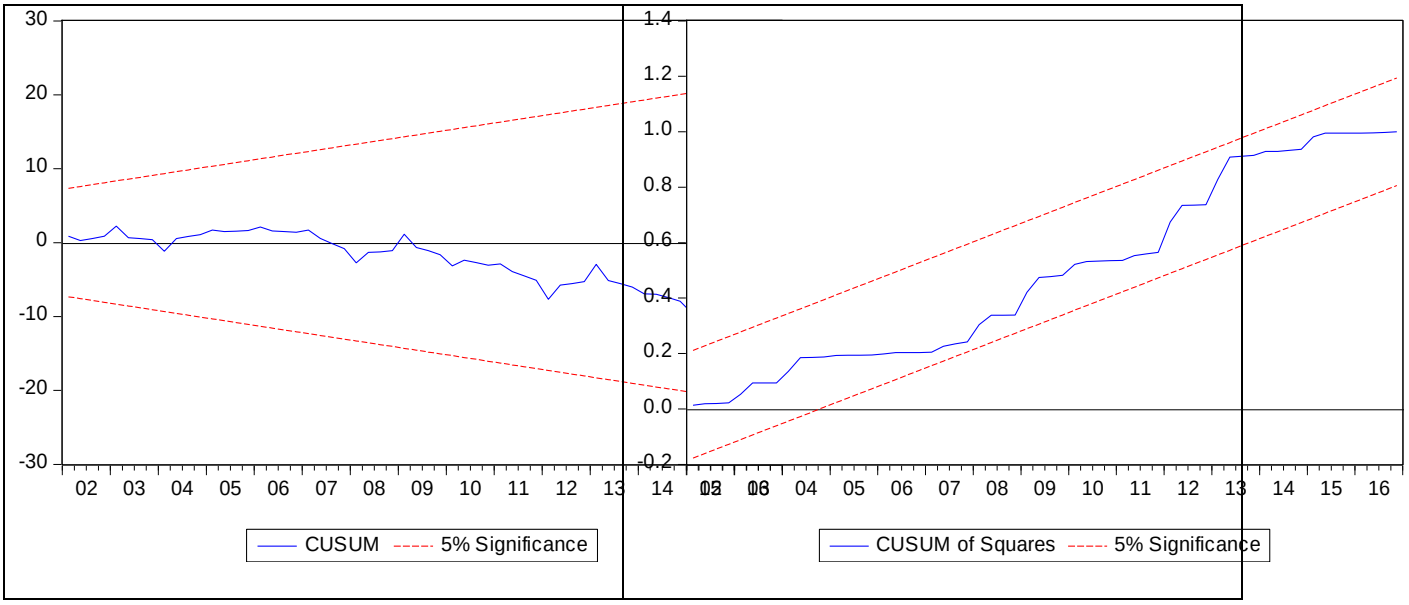
The short-run asymmetry found in the association between financial development and economic growth is confirmed by the Wald test, which highly rejects the null hypothesis of the short-run symmetric growth effect of financial development in all countries except Norway. In particular, the Wald test rejects the symmetry between the responses of economic growth to financial development in the upper and middle regime in the US, Australia, New Zealand, Hong Kong and Finland, in the upper and lower regimes Canada, Australia, Malaysian New Zealand, Singapore, Hong Kong and Finland, and in the middle and lower regimes in the US, Canada, South Africa, New Zealand, Singapore and Hong Kong. Moreover, the Wald test highly rejects the null hypothesis of the symmetric effect of financial development on economic growth in the three regimes in all countries except Malaysia and Norway. For the latter, the linear ARDL seems the best-suited specification, as the Wald test fails to reject the null hypotheses of long-run and short-run symmetries. The latter finding for the Norwich economy could be explained by the fact that, as an oil-rich country, it is highly dependent on oil export and gas production. Although Norway has planned to lessen its dependence on oil, its financial development is still in its infancy (Giannopoulos, 2006).

Figure-1: CUSUM and CUSUMSQ Stability Analysis

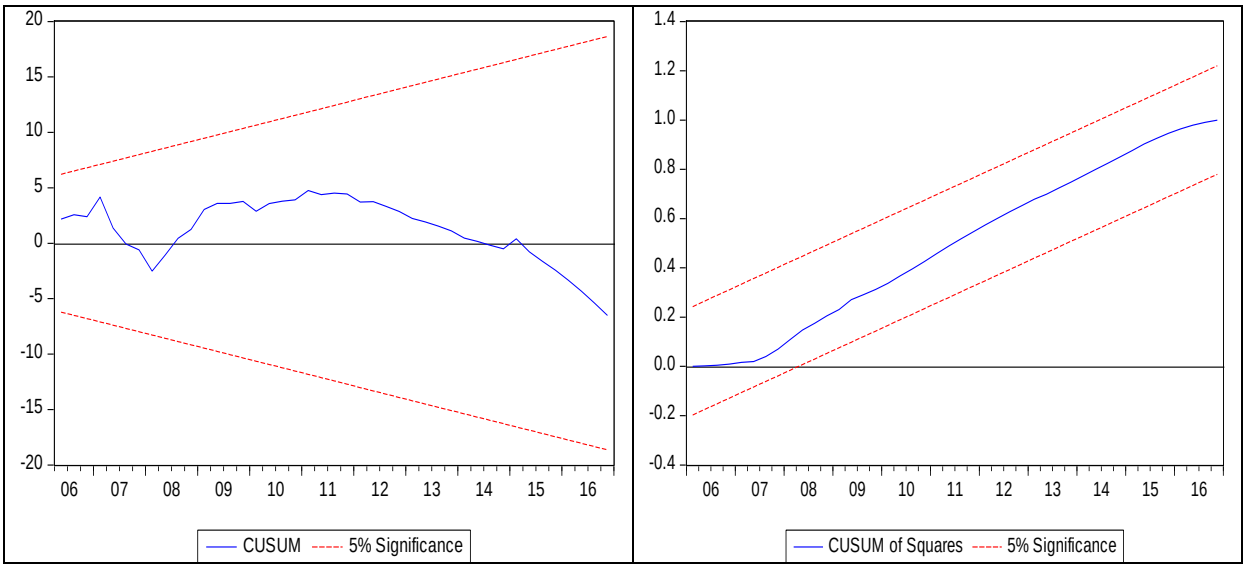
USA



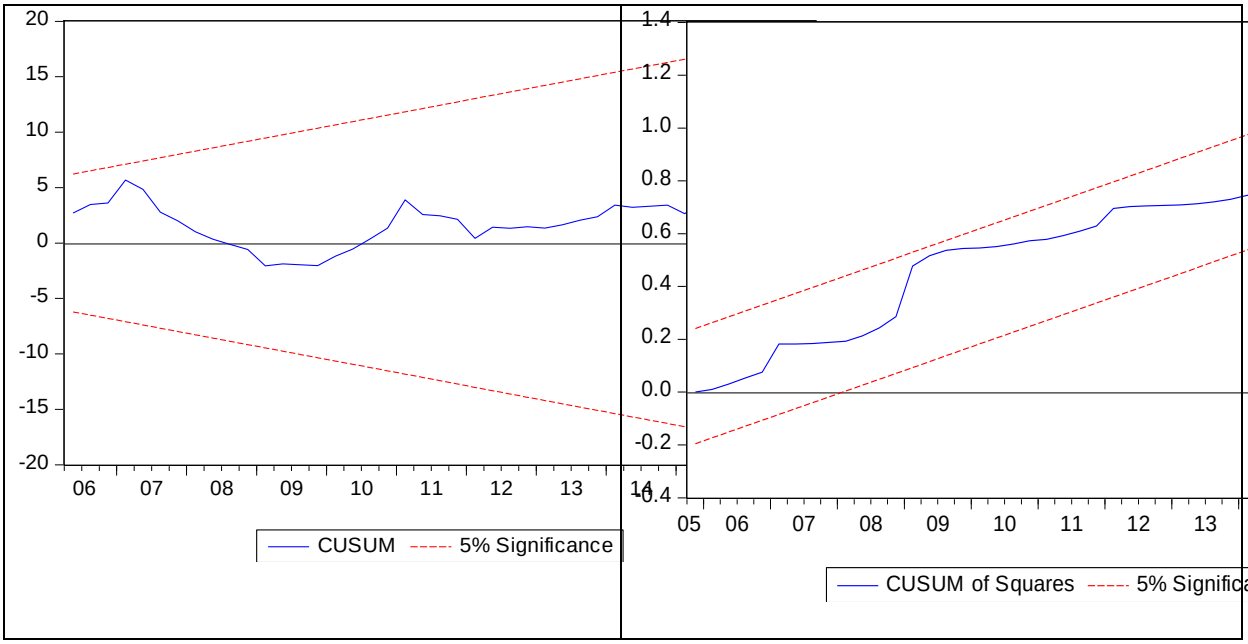
Canada



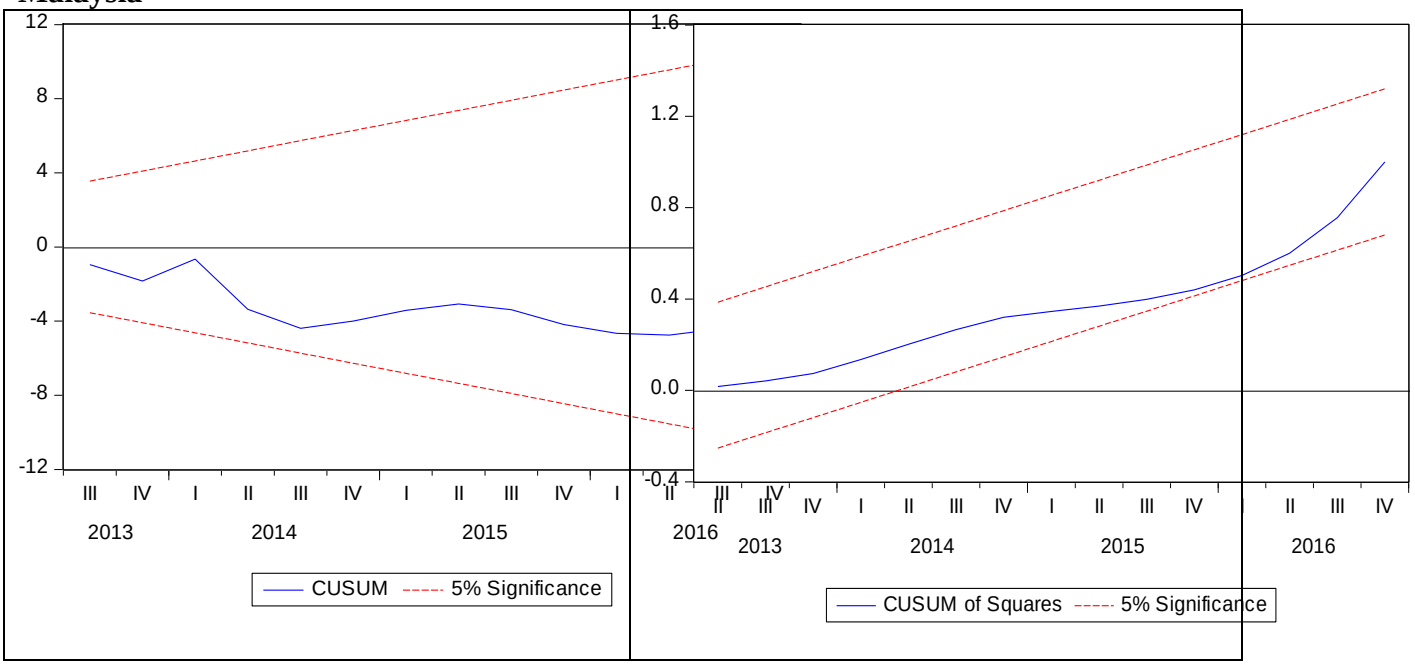
South Africa



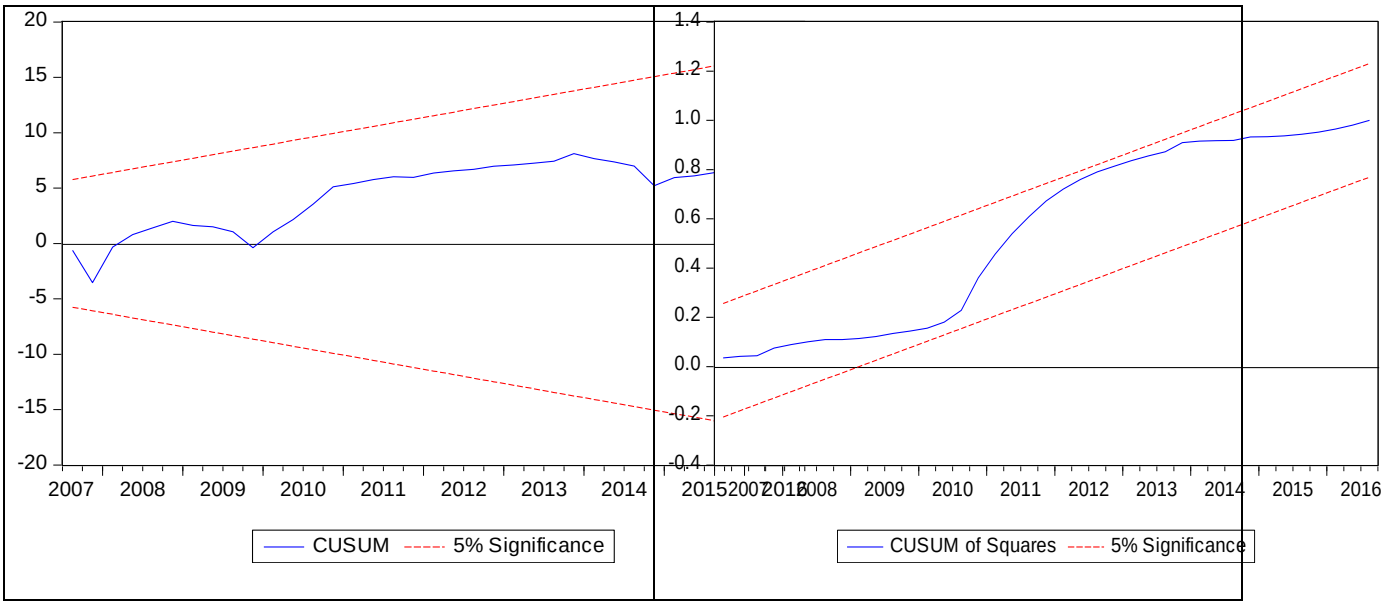
Australia



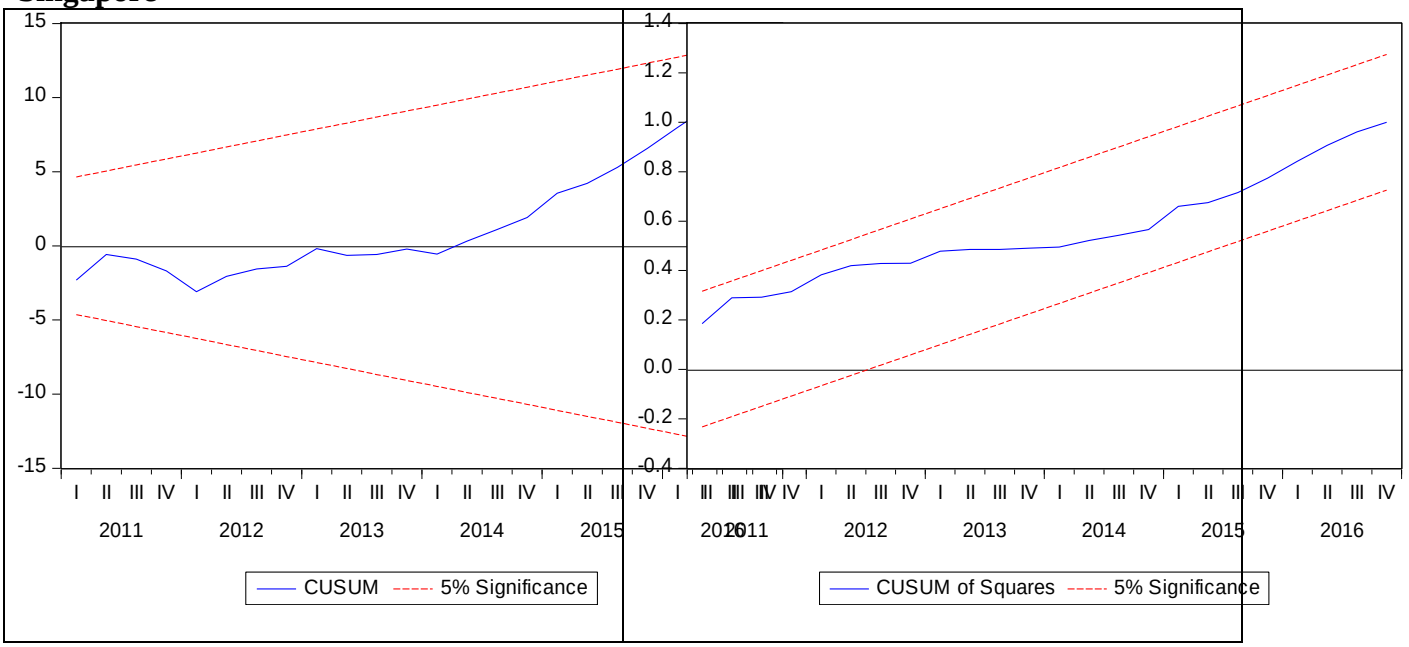
Malaysia



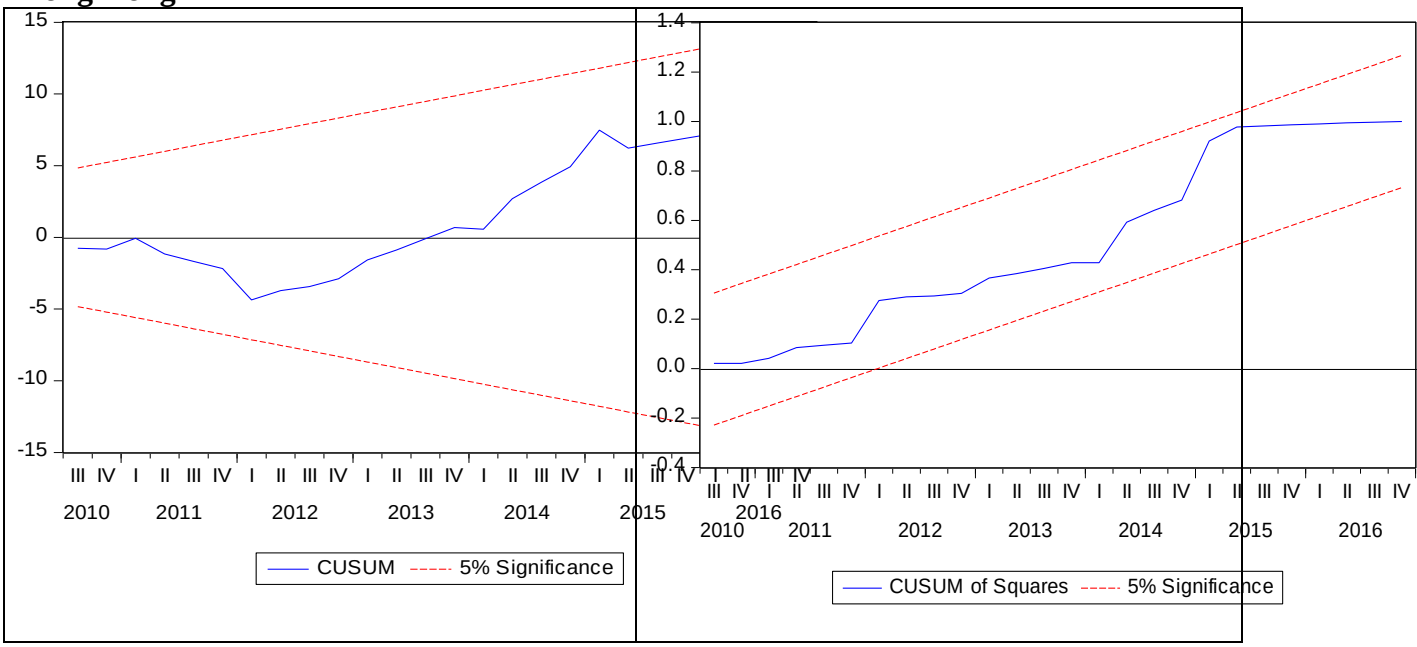
New Zealand



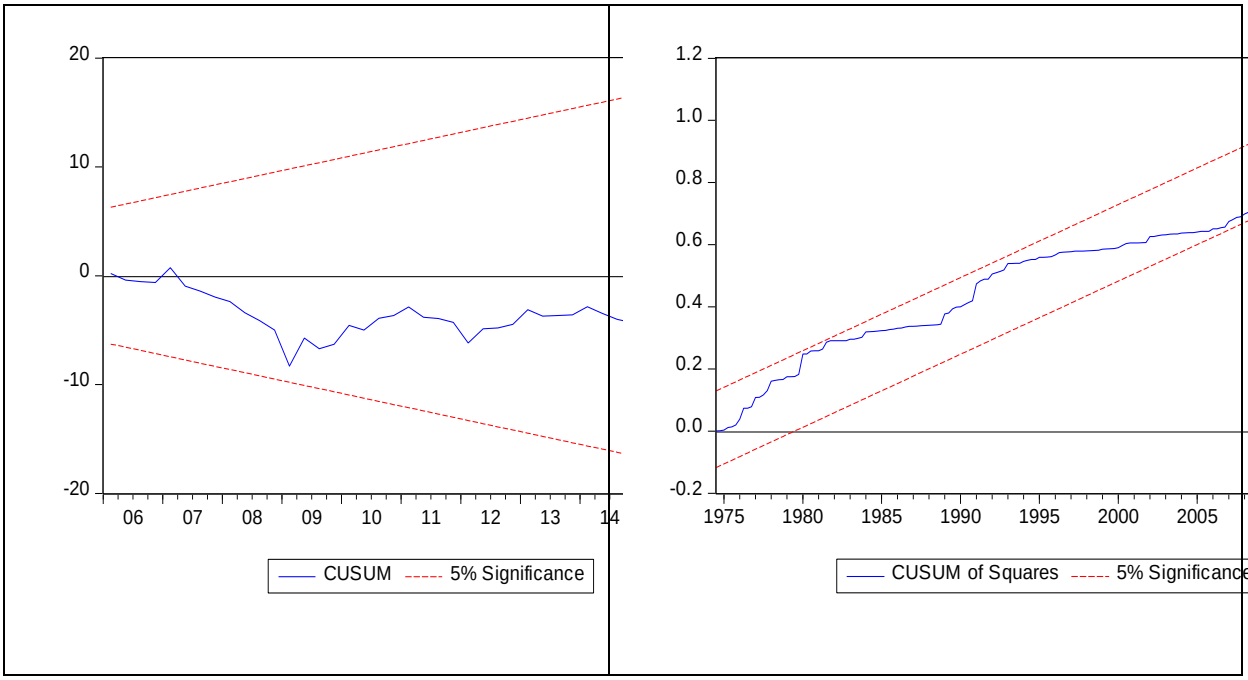
Singapore



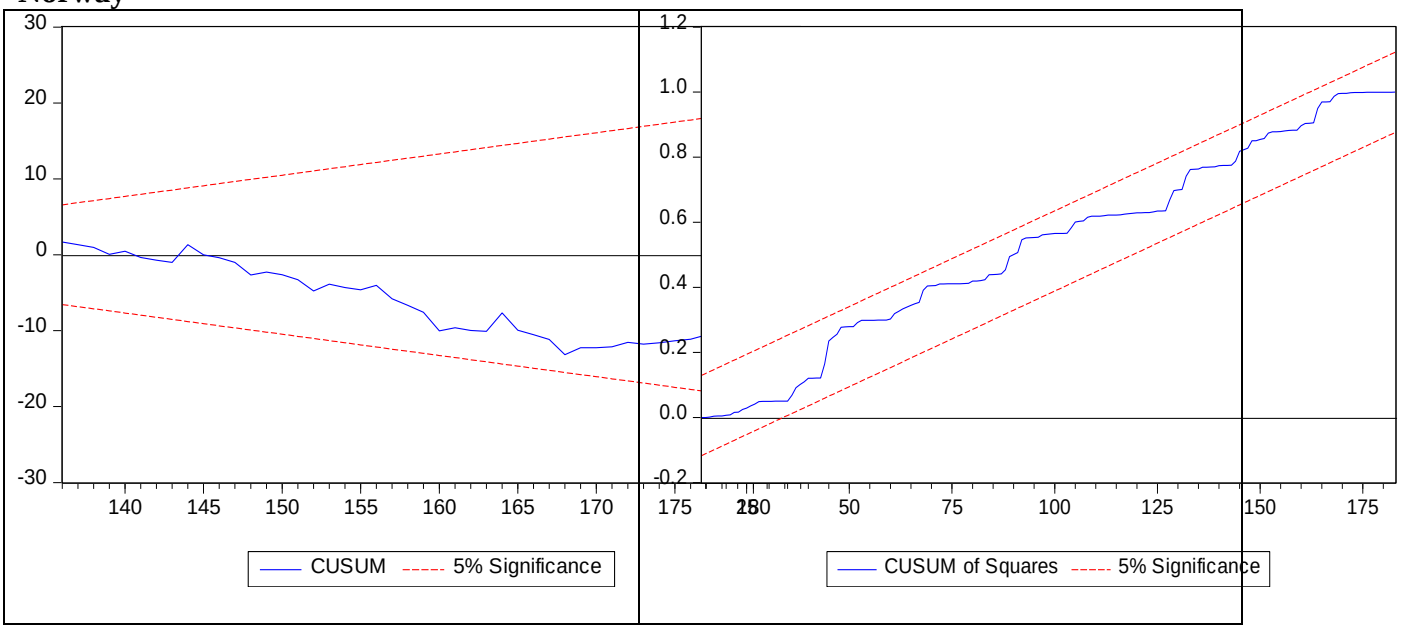
Hong Kong



Finland



Norway



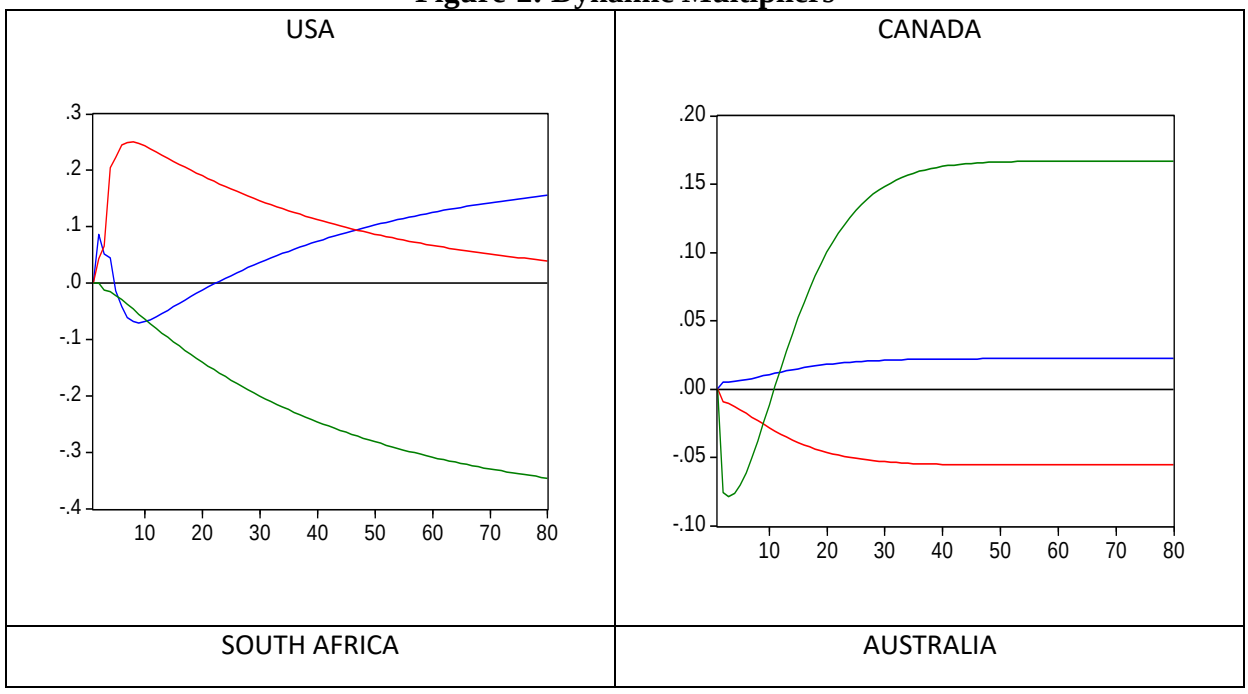
Regarding the short-run effect of financial development, trade openness, capital and labour on economic growth, empirical findings show that trade openness exerts a significant positive influence on economic growth in all countries except the US, where it negatively impacts economic growth. The latter results may be due to the negative trade balance of the US. Indeed, in 2016, the US exported $1.42T and imported $2.21T. In contrast, trade openness does not impact economic growth in Norway, possibly due to its dependency on oil exports and gas production. Also, Norway's trade is tied to the EU. Capital displays a positive

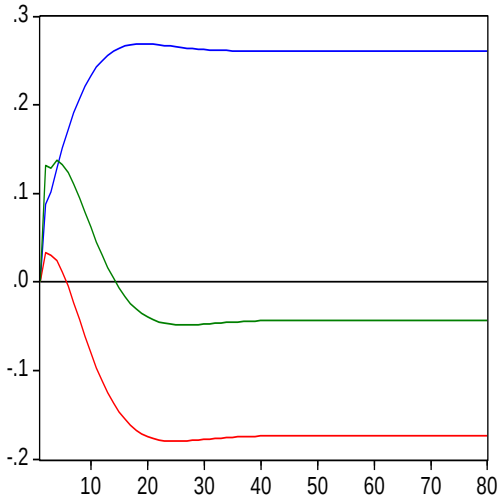
contemporaneous effect on economic growth, and a negative lagged effect, its cumulative short-run impact remains significantly positive. In the short-run, capital sustains economic growth in top-ten financially developed countries. The cumulative short-run effect of labour on economic growth is negative in all countries and is significant in Canada, South Africa, New Zealand and Finland. This result could be explained by the wrong allocation of workers' skills with jobs skills requirements; the learning time required by workers to adapt to their jobs results in a growth retarding effect of labour in the short-run but a positive growth effect in the long-run.

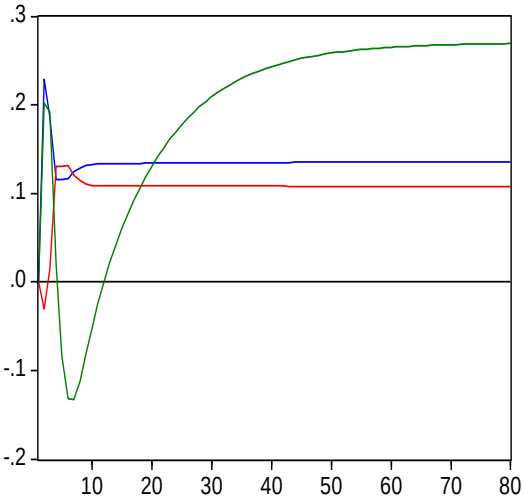
To better understand the adjustment from an initial long-run equilibrium to a new long-run equilibrium following a one unit shock of financial development occurring in the upper, middle or lower regime at a given forecasting horizon, we plot the asymmetric dynamic multipliers in the three previous regimes. For each country, the graph in Figure 2 depicts the dynamic response of economic growth to a unitary shock of financial development in the upper regime (blue curve), middle regime (red curve) and the lower regime (green curve). Overall, Figure 2 shows that although there are some differences at the small horizon, a financial development shock in the upper regime has a positive long-run impact on economic growth in the US, Canada, South Africa, Australia, Malaysia and Singapore. The latter long-run impact is negative in Finland and Norway, while it vanishes in Hong Kong after around 40 quarters. Similarly, in the lower regime, a financial development shock causes economic growth to move up in the long-run in Canada, Australia, New Zealand and Norway, while it reduces economic growth in the US, South Africa, Malaysia, Singapore, Hong Kong and Finland. However, in the middle regime, a financial development shock increases economic growth in the long-run in the US, Australia, Malaysia and Singapore, while it reduces economic growth in Canada, South Africa, New Zealand and Hong Kong. Moreover, a shock of financial development in the middle regime does not impact economic growth in Finland and Norway. Ruiz (2018) performed a dynamic threshold model estimation on a panel of 116 countries and found that countries below the finance threshold grow less, and those above the threshold grow more. Also, Ibrahim and Alagided (2018) argue that the association between financial development and economic growth is tributary to a threshold point above which financial development significantly influences economic growth in a set of 29 Sub-Saharan countries. However, we polish the previous findings and argue that for a level of financial development within the band defined by the two thresholds, we consider economic growth insensitive to financial development in some countries, namely Norway and Finland.

In general, a shock of financial development occurring in the lower regime has a more profound impact on economic growth than a shock happening in the upper and middle regimes in the US, Canada, Australia, Singapore and Hong Kong. A shock of financial development in the upper regime has the most pronounced effect in South Africa, Malaysia, New Zealand, Finland and Norway. The previous observations in Figure 2 regarding the adjustment of economic growth from an initial long-run equilibrium to a new long-run equilibrium following a shock of financial development confirm the existence of a threshold asymmetry well-captured by the suggested three-regime threshold ARDL model than by any threshold model with fewer regimes, such as the nonlinear ARDL model of Shin et al. (2014) that allows for two regimes only driven by a zero threshold change point.

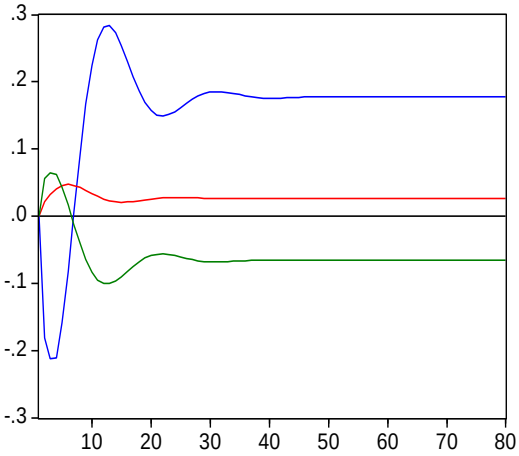
Figure-2: Dynamic Multipliers



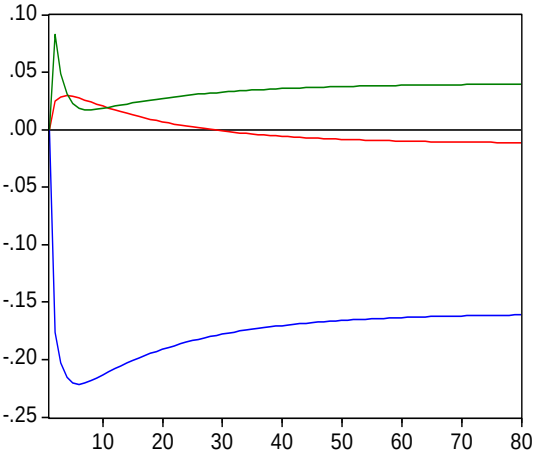




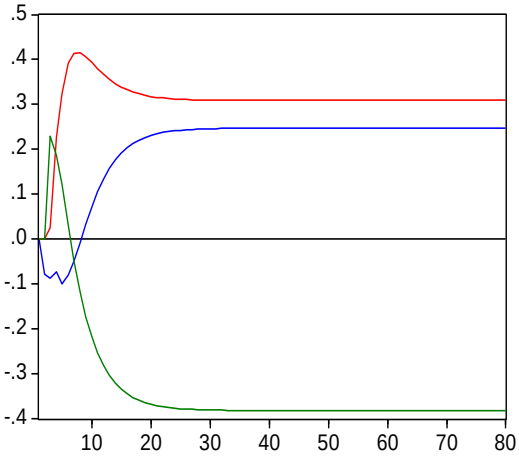
MALAYSIA



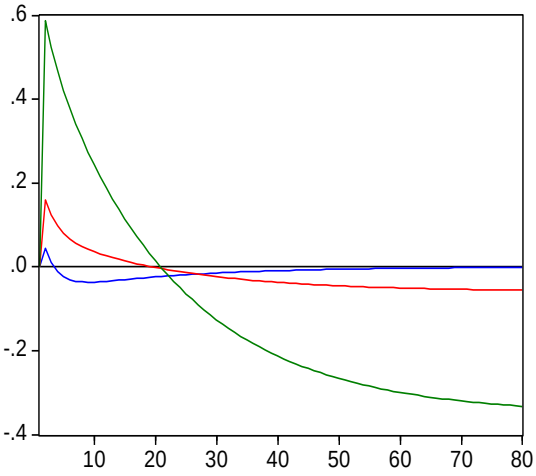
NEW ZEALAND

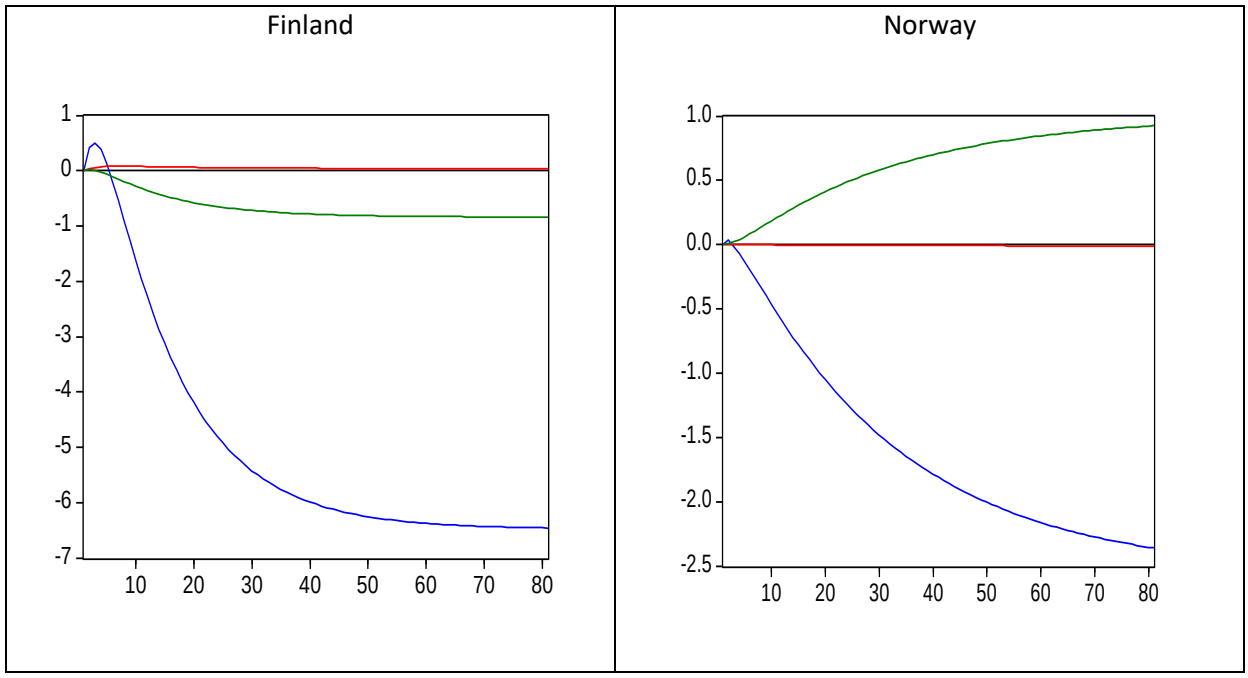


SINGAPORE



HONG KONG





V. Conclusion and Policy Implications

Financial development has profound implications for economic growth. The GFC revived and revitalised the debate on the role of finance in economic growth. There have been a number of studies which analysed the finance-growth nexus from different dimensions. However, the results have been mixed, indicating some underlying factors which moderate and influence the finance-growth nexus. The level of financial development achieved by different countries is an important factor that might explain the role financial development can play in boosting or hampering economic growth. In addition, it may clarify the heterogeneity of the extent of the influence of financial development on economic growth in different countries. Nonetheless, the growth effect of financial development might be asymmetric and nonlinear according to the level of financialization of countries. Keeping these aspects in context, in this study, we develop a three-regime Threshold Autoregressive Distributed Lags (TARDL) model, which allows for accommodating the asymmetric effect of financial development on economic growth in top-ten financially-developed countries. Specifically, we investigate the growth effect of financial development in top-ten financially developed countries. For the sake of inclusiveness, a growth function was adopted which was augmented with trade openness, capital formation and labour as additional control variables. The growth effect of financial development is examined for different levels of financial development within a newly developed three-regime threshold autoregressive distributed Lags (TARDL) cointegration model. We also defined three regimes: the lower, middle and upper regimes. The lower and upper regimes are defined by a level of financial development lower and

higher, respectively, than the threshold of one standard deviation, below or above average, whereas the middle regime is defined by a level of financial development between the lower and upper thresholds.

Our key findings suggest the existence of threshold asymmetric cointegration between variables. In the upper regime, financial development boosts economic growth in Singapore while it exerts a negative impact on economic growth in Finland. In the middle regime, financial development increases economic growth in Australia and Singapore, while in the lower regime, financial development hampers economic growth in the US, Malaysia and Singapore. Trade openness has a positive long-run influence on economic growth in Canada, South Africa, Australia, Malaysia, New Zealand, Singapore, Finland and Norway. Capital formation strengthens economic growth in the US and Malaysia in the long-run. Labour is found to sustain economic growth in the long-run in Malaysia and Singapore only; it has no growth effect in other top-ten financially developed countries. In the upper regime, financial development supports economic growth in the US, South Africa, Australia and Finland while it impedes economic growth in New Zealand and, to a lower extent, in Hong Kong. In the middle regime, financial development has a negative cumulative effect on economic growth in the US, Singapore and Canada and a positive cumulative effect on economic growth in South Africa, Australia, New Zealand and Hong Kong. In the lower regime, financial development increases economic growth in the US, South Africa, Australia, New Zealand, Singapore and Hong Kong. For low levels of financial development, the latter reduces economic growth in Canada and does not impact growth in Malaysia, Finland and Norway. Trade openness has a positive cumulative impact on economic growth in all countries except the US and Norway, while capital formation cumulatively increases economic growth in the US, Canada, Australia, Malaysia, Hong Kong, Finland and Norway. Capital reduces economic growth in New Zealand and Singapore and does not impact economic growth in South Africa. Labour has a reverse effect on economic growth in Canada, South Africa and New Zealand. It does not influence economic growth in other top-ten financially developed countries. The Wald test for parameter constancy across regimes confirms our previous findings, as it rejects the null of the long-run symmetric effect of financial development on economic growth in the US, South Africa, Malaysia, Singapore and Finland. The Wald test also rejects the null of the short-run symmetric effect of financial development on economic growth in all countries except in Norway. The dynamic multipliers which depict the response path of economic growth to a one unit shock of financial development in the three regimes

highlight the discrepancies in the reaction of economic growth to financial development shocks occurring in different regimes.

Our empirical findings have profound policy implications. It implies that the level of financial development matters for an effective and socially-beneficial financial intermediation. Nonetheless, at different thresholds, there were different directions and sizes of financial effects on economic growth as well as profound country-level differences which shall be taken in to account. Countries aiming at using financial development instrument to spur their economic growth could do so through an efficient resources allocation. Financial intermediation is useful to rise above information asymmetry, which in turn reduces transaction and capital costs and improves the allocation of resources leading to a higher availability of capital and faster economic growth through the channel of improved liquidity. Reducing information asymmetry allows firms access to finance with a lower cost of borrowing, which increases investment and productivity, leading to a lower unemployment rate in the country. Moreover, reducing regulatory constraints and tax discrepancies would increase economic growth by encouraging firms to invest further and acquire innovative technologies. Policymakers should note that strict financial regulation creates information asymmetry which may deprive firms from different sectors accessing financing possibilities offered by intermediaries. Consequently, setting up a financial system with minimum, or possibly without, information asymmetry and tax discrepancy is a priority for policymakers. Countries also should monitor the level of their financial development to keep it in the right regime in order to reduce information asymmetry and provide sufficient room to diversify and manage financial risks while mastering the effective allocation of resources for productive investments. Policymakers should be aware of the snowball effect in the association between financial development and economic growth. In fact, in countries with high income, the demand for finance increases; this, in turn, boosts economic growth. Hence, it is possible to efficiently use financial development to boost economic growth through reducing poverty. Trade openness plays an important role in the financial growth function, which implies that most of the economies benefit from openness of trade, even where there was a short run negative effect, like the US and Norway. An important implication of this finding is that in the long term economies like the US benefit from the trade openness and hence the notion of protectionism will be harmful in the long run. Similarly, capital accumulation has a positive and contributory factor to economic growth particularly in the long run, though the results also varied in the short-term and countrywide. Perhaps, in this context, the financial sector has

an important role to play in the allocation of the financial capital to the productive sector and real economy. Labour shows a positive effect only in Singapore and Malaysia in the long run, whereas in the short run it has even reverse effects on Canada, South Africa and New Zealand. This implies that the capital intensity is a very important factor to consider in these countries and perhaps the financial sector has a larger role to play. Moreover, in driving economic growth by financial development, policymakers should not ignore other potential factors that may drive growth. Trade openness, capital and labour may be employed as additional tools to boost economic growth. For example, a developed financial system coupled with a good quality of human capital, i.e. highly educated agents, would spur economic growth because those agents will have a high desire for investment and risk as they can access a well-developed financial market where a large set of hedging and financial instruments are available. Investments and production are the main sources of value-addition and, hence, there is economic growth.

Looking forward, there is potential for further research to increase our understanding of the finance-growth nexus, which could provide us further insight into this relationship and has profound social and economic implications. In this regard, our research could be extended in several directions. First, instead of considering two exogenous thresholds, one would apply a grid search over financial development variables and select all possible data-driven thresholds. Second, a sectoral analysis of the growth effect of financial development would be of great interest for policy formulation, as we believe that different sectors require different levels of financial development to positively contribute to economic growth. Last, in this study, we focused on ten of the most competitive economies; research can be furthered by including more economies. However, we leave these dimensions for our fellow future researchers to explore.

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