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An Empirical Study on the Finance-Growth Nexus in Brunei Darussalam – A Target for Economic Diversification

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Abstract

This study investigates the long-run relationship between financial development and economic growth in Brunei and its direction of causality using data from 1975 to 2013. The single equation estimation model used is as follows: $lngdp = \alpha_0 + \alpha_1 lnInflation + \alpha_2 lnAccess + \alpha_3 lnDepth + \alpha_4 lnEfficiency + \alpha_5 lnStability + \varepsilon_t$. Several econometric techniques have been applied: unit root tests, co-integration tests and Granger Causality pairwise testing based on the vector autoregressive (VAR) and the vector error correction method (VECM) frameworks. Results from Granger Causality tests show that there is no bi-directional causality between economic growth (represented by real GDP) and three of the financial variables used in this study (represented by inflation, domestic credit to the private sector and bank overhead costs to total assets in %). Altogether, financial development does not have an effect on economic growth. However, this study found significance at 0.1% level in the long-run relationship between inflation and financial depth (domestic credit to private sector).

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1. Introduction

1.1. Overview of the Macroeconomic Structure and Complications in Brunei

Brunei Darussalam (Brunei) is located in the northern part of Borneo Island in Southeast Asia. With a land area of 5,765 km^2, it is a small country with a population of 417,200 as of 2015 (Brunei Darussalam Key Indicators, 2015). The country ceased being a protectorate of the United Kingdom and regained full political independence in February 1984. In 'The Constitution of Brunei', the country declared itself as a Malay-Islamic-Monarchy with an administration and governance observing the Islamic and Malay values. The economy of Brunei is critically dependent on oil and gas exports: the sector is estimated to have contributed an average of 80.0% to the total gross domestic product (GDP) from 1971 to 1990 and 55.2% from 1991 to 2001. However, the figures have decreased in recent years: current prices of the oil and gas sector (% share) in 2013, 2014 and 2015 are 64.8%, 63.3% and 55.9% respectively (Brunei Darussalam Statistical Yearbook, 2002; Brunei Darussalam Key Indicators, 2015).

Liquefied natural gas (LNG) production contributes to the economy through export earnings, the GDP and government revenue. Export earnings from LNG account for about 48% of the economy of Brunei: daily production amounted to 970,065 million Btu and daily exports reached 957,647 million Btu in 2012 (Odano and Islam, 2013). The production of LNG contributed 11% (i.e. B$2,331 million) to Brunei's total GDP of B$21,185 million in 2012, though activities related to the oil and gas sector are responsible for two-thirds of Brunei's GDP (Odano and Islam, 2013). As for the government revenue, the LNG industry paid royalties and taxes with the value of B$12,020 million in the fiscal year 2011-12 to the Government of Brunei, which equates to 93% of the total revenue (Brunei Darussalam Statistical Yearbook, 2011).

The value of oil exports, and indirectly the country's income, depend on world oil prices and output, which has been declining in recent years. In a study analysing the dynamic relationships of three factors (government revenue, expenditure and GDP), the global oil market is shown to be a large source of variation in GDP (Obben, 1998). Further, positive growth rates from 1971 to 1980 coincided with world oil price shocks in two periods, i.e. 1974-1977 and 1980-1985, therefore, fluctuations in the rates of real GDP are based on changes in the world oil price (Anaman and Duraman, 2003).

Brunei's reliance on commodities places it at risk of economic dislocations or the paradoxical "resource curse" phenomenon (Odano and Islam, 2013). The "Dutch Disease" is

a related concept which describes an economy of inert growth in other sectors except the energy sector (Gylfason, 1999; World Economic Forum, 2012). A seminal paper theorised that a boom in the energy sector will cause a rise in the labour movement from the manufacturing and non-tradable sectors to the energy sector (the marginal product of labour) (Corden and Neary, 1982). Lastly, the rentier predatory state hypothesis may explain the ensuing struggle of economic diversification of oil-abundant countries such as Brunei: the negative impact of natural resources on growth stems from political repression which is indicated by the level of non-democracy (Alkhater, 2012). The significance of positive growth, observed in the same study upon holding constant the interaction with repression, mirrors the democratic status or political structure of the country.

A review has detailed several characteristics exhibited in the "Dutch Disease": (1) having substantial share of oil and gas revenues in the total GDP, (2) highly-skilled workers having a preference towards the resource sector and compromising other industries (especially the manufacturing sector), (3) the rise in government investment in economic and social programmes and (4) high wages without resorting to taxation (Odano and Islam, 2013). Empirical work of Parvin and Dezhbakhsh (1988) presented a variant (or extension) of the "Dutch Disease", the "Hyper-Dutch Disease", which theorises the expansion in the non-traded (oil) sector and the concurrent squeeze in the non-oil traded sector due to technology imports caused by the oil boom. The "Dutch Disease" is argued to be prevalent in Brunei because of the inhibitory effects of the oil sector on the non-oil sector: the production of non-oil exports in a given year were lowered if oil exports (as share of GDP) increased in the previous year (Anaman and Mahmod, 2003; Othman, 2012). This thus forms the context and motivation of the present study.

1.2. Theory and Models of Growth

The finance-growth nexus, defined as the relationship between financial development and economic growth, is used as a theoretical framework in this dissertation. Major contributors to the theory include Goldsmith (1969), King and Levine (1993b), McKinnon (1973), Schumpeter (1912) and Shaw (1973), all of whom regard the financial services as important for economic agents, such as entrepreneurs and savers, and the long-term growth of a country. Levine (1997) emphasised that financial services bridge savings and investment. This agrees with an earlier study stating that investing in financial development aids the role of financial institutions in evaluating future entrepreneurs and funding the most promising ones which ensures maximum productivity (King and Levine, 1993b). Mankiw (1999) presented the idea of a "classical dichotomy" which discerns the financial sector from the 'real' sector. Levine

(1997) asserted that the financial sector is a 'real' sector because it researches firms and managers, exerts corporate control and facilitates risk management as well as the allocation and exchange of resources. Bernanke (1983, 1995) further proved that economic variables measured with real GDP are affected by the efficiency of bank credit intermediation or lack thereof.

Other economic theorists had contradicting views. Joan Robinson (1952) stated that financial institutions are not so important for growth, arguing the latter is a mere reflection of the entrepreneurial activities taking place. In other words, it is a natural product of financial intermediation having to meet the demands of market participants. There are other theorists such as Lucas (1988) which take a neutral stand-point. This dissertation shares the line of thinking of Robinson and challenges that of Goldsmith, King and Levine, and others.

The finance-growth relationship model has different versions embedded within the literature. In the first model, Levine depicts the development of the financial sector as being facilitated by economic growth via unique services which are deemed necessary for market participants in order to be able to engage in a mutually beneficial exchange (Baltensperger, 1980; Bhattacharya and Thakor, 1993; Levine, 1997; Santomero, 1984). The services involve evaluating prospective entrepreneurs and selecting those which show the most promise. This way, the financial sector will channel savers' funds to the most productive investment projects, mitigating the problem of information asymmetry and transaction costs. This linkage is underscored in a 1996 McKinsey Global Institute report which compares the capital productivity in Germany, Japan and the United States (U.S.). The capital productivity determines the differences in physical capital or wealth accumulation and is itself influenced by the performance of the financial sector; the capital productivity of Germany, Japan and the U.S. are $21,900, $20,900 and $26,500 respectively (based on 1993 prices) (McKinsey Global Institute report, 1996). The U.S. excelled because it funded the most productive investments and provided incentive-driven management upon making the investment. This led to higher financial returns and thus the accrual of substantial amounts of household wealth.

The second growth model, i.e. the 'endogenous growth model' presented by King and Levine as early as 1993, is reminiscent of that of Grossman and Helpman (1990, 1991) and Romer (1990): all three models share the assumption that new production methods and products continue to emerge with the advancement of human knowledge which requires a long process (King and Levine, 1993b). What sets the 'endogenous growth model' apart is the permeating Schumpeter-ian elements: financial sectors that identify and fund entrepreneurs with the most successful innovations will spur technological innovation fostering economic growth (Schumpeter, 1912). This model is much better at portraying the permanent growth

with a more efficient financial sector because it takes into consideration the sources of technological change and their effects on permanent economic growth.

The ‘Solow growth model’ extends from the endogenous growth model and describes the medium-run economic growth emerging from a more efficient financial sector. It agrees that permanent economic growth is borne from a highly effective financial sector, however, the ‘Solow growth model’ contends that the financial system only has a small effect on the growth in per capita output regardless of improved identification and funding of the best investments (assuming constant technology and savings rate). This logic receives support from Levine who outlines five key functions of financial systems (Levine, 1997). The reallocation of savings to the highly-valued, capital-producing technologies entails efficient intermediation because the portfolio is now shifted towards investment with higher expected returns. The improved real value of production allows for both an immediate short-run gain in per capita output and a further gain in per capita output from medium-run growth as the economy assumes a higher level of steady state equilibria – a shift which is elucidated in the neoclassical model. The neoclassical model analyses the changes which accompany the varying efficiency of capital allocation but does not explain changes in technological progress over time.

Schumpeter’s theory of innovation in an entrepreneurial system will be the last point of discourse. The factors in this model include (a) research and development (R&D) expenditures of entrepreneurial firms and (b) a financial sector which evaluates and disburses financing to these entrepreneurs; it models the intentional efforts of entrepreneurs to innovate new production techniques through costly R&D expenditures and formulate superior products which will supply monopoly profits (Schumpeter, 1912). Similar entrepreneurs function as rival firms attempting to survive in this competitive marketplace. Schumpeter outlined this technological progress model as one in which leading entrepreneurs gain monopoly power as a form of reward for innovation and competitive edge, however, other entrepreneurs will create new and better products in due course which will out-do the initial monopoly (Schumpeter, 1912). The constant and repetitive process of creation-destruction (‘creative destruction’) spawns an environment in which production costs continuously decline, the products continuously improve, and the standards of living continuously rise (Schumpeter, 1912).

Despite the depth of literature on the finance-growth nexus, conducting a detailed analysis of resource-abundant, small countries such as Brunei is difficult due to limited data. This study fills this knowledge gap and aims to address economic crises by understanding the role of financial development. This study investigates the long-run relationship between financial development and economic growth in Brunei and its direction of causality using

available data from 1975 to 2013. This study tests King and Levine's (1993a) hypothesis that development in the financial sector is important for growth. The single equation estimation model used as the basis of analysis is as follows: $lngdp = \alpha_0 + \alpha_1 lnInflation + \alpha_2 lnAccess + \alpha_3 lnDepth + \alpha_4 lnEfficiency + \alpha_5 lnStability + \varepsilon_t$. Several econometric techniques are applied to test the model: unit root tests, co-integration tests and Granger Causality pairwise testing based on the VAR and VECM frameworks. Possible occurrences of spurious regressions and non-stationarity which come with time-series analysis are dealt with accordingly.

The remainder of this paper is organised as follows: a literature review and a description of the data and methodology are provided. The empirical results are presented followed by a discussion. The paper concludes by exploring the limitations of this research and outlining some policy recommendations.

2. Literature Review

Empirical evidence on the finance-growth nexus which has made contributions to the development of the concept is reviewed in this section.

As documented in the book 'Financial Structure and Development', Goldsmith (1969) was the first to empirically analyse the parallels between financial sector development and economic performance. Data from 35 countries from the year 1860 to 1963 was extracted and their financial development was measured using the financial intermediary assets to GNP (gross national product) ratio. Periods with increasing economic growth had a simultaneous increase in financial development. However, this early study is pervaded with flaws: not only was the modelling based upon correlation analysis, many other finance-related factors and variables impacting economic growth were excluded.

King and Levine (1993a) tested the same hypothesis using 80 countries from 1960 to 1989. Their results are in agreement with the previous study but with a more meticulous approach. The authors constructed a linear regression model and incorporated new measures into the analysis for accuracy. The effects of capital accumulation and productivity improvements on economic growth were considered and, because of the positive influence of private banking institutions on growth, the size of bank-intermediated credit relative to the credit intermediated by all types of banks was included in the analysis(King and Levine, 1993a). Additionally, the same paper accommodated the difference between credit granted to private institutions and that granted to the sum of public and private institutions (King and

Levine, 1993a). Financial intermediaries appeared to have a positive impact on innovation and thereby accelerated growth.

Levine and Zervos (1998) is another example of a study which made use of cross-sectional data to study the empirical link between the different measures of financial development (specifically the stock market and the banking sector) and economic progress in the long run; their findings show a similar direction of causality in that bank services and capital markets are important factors in pushing economic growth.

When a researcher begins to characterise the finance-growth relationship across countries, the behavioural information of individual countries is mired by the differing institutional characteristics and regulations governing financial operations in each of them. For example, King and Levine (1993a) suggested that better financial services predict technological and thus economic growth in the future but did not account for any reverse causation. The methods used in the previously discussed studies failed to uncover the dual nature of the finance-growth linkage. This flaw can be overcome by time-series regression analysis – a statistical approach opted for in this dissertation.

In response to King and Levine (1993a), Demetriades and Hussein (1996) carried out a time-series analysis on 16 countries with financial development approximated by two ratios, namely bank deposit liabilities to nominal GDP ratio and bank claims to nominal GDP ratio: reverse causation was found in that financial deepening also contributed to general economic growth. This finding is important for the following reasons: firstly, it highlights the bi-directional nature of the finance-growth relationship and challenges the notion of the financial sector being the leading force. Secondly, it challenges the incorrect assumption of economies being homogenous entities.

A similar approach was used to analyse the finance-growth causality in Germany and the United States using stock market indicators, given the positive association between measures of equity market activity and real activity across different countries (Arestis and Demetriades, 1997). Unidirectional causality existed from financial development to real per capita GDP growth in Germany, but unlike Germany, the United States had evidence of reverse causality running from GDP growth to the development of both the capital market and the banking system (Arestis and Demetriades, 1997).

Likewise, a more recent paper, investigating the finance-growth nexus in 15 Asian countries from 1961 to 2011 using Granger Causality testing, showed the coexistence of relationships running from financial development to economic growth and vice versa (Pradhan et al., 2013). The same study also discovered a secondary bidirectional link between financial and social development although the results showed variation from country to country.

Despite views supporting the finance-growth causality, there are other studies which claim otherwise. Iheanacho (2000) used financial and macroeconomic data on Nigeria from 1981 to 2011 in order to examine the finance-growth relationship. The author used the auto-regressive distributed lag (ARDL) approach to co-integration analysis, controlling for seven specifications, namely oil price, trade openness, gross fixed capital formation and government spending.

The core of Iheanacho's paper describes the finance-growth relationship between Nigeria and other oil-dependent economies as not being significantly different: all specifications have negative coefficients and some (trade openness, government expenditure and gross fixed capital formation) are not statistically significant which implies that financial development does not stimulate economic growth. All seven short-run coefficients are negative at 5% significance level, therefore, the relationship between financial intermediary development and growth in Nigeria is found to be insignificantly negative in the long run but significantly negative in the short run (Iheanacho, 2000). The latter highlights the inefficient resource mobilisation and allocation in the Nigerian financial intermediary sector. An interesting observation is the dominant role of the oil sector in the Nigerian economy: a 1%-increase in the oil price leads to about 0.12% increase in the level of economic growth in the short-run and over 0.40% in the long-run (Iheanacho, 2000).

A study on the financial deepening and economic growth in Bosnia and Herzegovina implied negative or no causality, specifically when the financial intermediation ratio and Financial Development Indicator-3 were used respectively (Ganić et al., 2016). On the other hand, regression models showed positive results when Financial Development Indicator-1 (M2 to GDP ratio) was used, which highlights the need to standardise the choice of both the approach and indicators used, especially when making comparative studies.

The studies discussed thus far involve the use of cross-sectional data. Demetriades and Hussein (1996) noted the oversimplifications which accompany cross-sectional studies. Firstly, having a number of cases (i.e. countries) will automatically include biased estimated coefficients. Secondly, factors which are already present could be inaccurate, hence raising the concern of omitted variable bias. Thirdly, important differences within institutional structures of countries imply that the direction of causality between financial intermediation and economic growth will vary across countries; this is because it does not allow for accurate representation of the circumstances of a single country – a problem described as sample selection bias. Time-series analysis of single country case studies may yield a better insight and thus informs this dissertation's choice of methodology.

Adu et al. (2013) have undertaken a similar study using financial development data for Ghana. They used principal component analysis in order to narrow the dimensions of the financial development indicators to four sub-component indices. They found that different indicators bring about different effects on growth: the credit to the private sector (as ratios to GDP) and the total domestic credit variables were both growth-inducing but broad money stock to GDP ratio had opposing effects. From the ARDL-based co-integration analysis, the private sector to GDP ratio (or the private sector credit as a ratio to total credit) had a significantly positive coefficient on economic growth, however, when broad money supply to GDP ratio was used as a financial variable the effects were significantly negative. The authors therefore proposed that growth effects are sensitive to the choice of variables used to represent financial development, echoing the sentiment shared by Ganić et al. (2016).

The findings of Ali et al. (2014) are in line with that of Adu et al. (2013) but in the context of Pakistan, with all of the three financial variables used (credit of the banking sector to private sector, bank deposits and domestic savings to GDP). However, more importantly, applying the Granger Causality test revealed the bidirectional causalities between (1) inflation and growth, (2) bank deposits and growth, and (3) domestic savings and growth unlike foreign direct investment (FDI) (unidirectional causality) and credit (no causality). Likewise, in an attempt to test the 'supply-leading' and 'demand-following' hypotheses in Laos, Kyophilavong et al. (2014) found the existence of a long-run trivariate relationship whereby financial development has a positive association with the capital stock development via economic growth.

Appendix A provides an overview of recent empirical evidence on the finance-growth nexus in studies based on an individual country.

With regards to this literature review, the consensus of opinion indicates that the financial sector is important to promote economic growth and vice versa. Similarly, this dissertation aims to test the hypotheses of the finance-growth nexus i.e. the bidirectional nature of the relationship in Brunei using methods detailed in the following section.

3. Research Design and Method

3.1. Case Study and Method

This study uses data from the year 1975 to 2013, including the periods before and after the introduction of the country's structural adjustment programme, i.e. the 'National Vision 2035' (or *'Wawasan 2035'*). Appendix B shows the data containing the variables used in this study.

Real GDP is used as a traditional proxy of economic growth ('lngdp') (King and Levine, 1993; Gries et al., 2009; Rahman, 2004). Banking sector development is one of the three broad categories of financial development, including stock market development and others, and may be indicated by two measures, namely the domestic bank credit to the private sector (as % of GDP) and the amount of domestic credit provided by banks (as % of GDP); this study uses the latter ('lndepth'). Other indicators of financial development used in this study include inflation ('lninflation') and bank overhead costs to total assets ('lnefficiency') as also used in the following studies: Adu et al. (2013); Asongu (2013); Bordo and Jeanne (2002); Hendrix et al. (2009); Iheanacho (2000); Loayza and Shankar (2000); and Murari (2017). All variables are in natural log form.

Table 1 gives details on the variables used in this study. The variables are collected from multiple sources: missing GDP and population data from the World Development Indicators (WDI) are supplemented by values from the Penn World Tables in order to obtain representative results. WDI are initially reported by host governments, then cleaned and collated by the World Bank. The variables in this dataset are only a subset of the total variables available from WDI and only include those considered useful.

Table 1: A Brief Description of the Variables Used and Their Sources

Variables **(as denoted in Rstudio coding output)**	**Concept**	**Source(s)**
lngdp	Real Gross Domestic Product (constant 2005 US$) **Available data for Brunei:** 1975-2013	World Development Indicators, World Bank (2015) and Penn World Tables Coverage: 1950-2011

lninflation	Inflation based on consumer prices (annual %) **Available data for Brunei:** 1981-2013	World Development Indicators, World Bank (2015) Coverage: 1961-2013
lnaccess	**Short definition:** Number of depositors with commercial banks per 1,000 adults **Long definition:** The value for each country is calculated as 1,000 x the reported number of depositors / the adult population in the reporting country. **Available data for Brunei:** 2008-2013	Financial Access Survey (FAS), International Monetary Fund (IMF) Coverage: 2001-2013
lndepth	**Short definition:** Domestic credit to private sector **Long definition:** Financial resources provided to the private sector such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries, these claims include credit to public enterprises. **Available data for Brunei:** 1999-2013	World Development Indicators, World Bank Coverage: 1960-2013
lnefficiency	**Short definition:** Bank overhead costs to total assets (in %) **Long definition:** The operating expenses of a bank as a share of the value of all assets held. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax assets, discontinued operations and other assets. Raw data are from Bankscope. It is estimated as: data2090[t] / ((data2025[t] + data2025[t-1])/2) The numerator and denominator are first aggregated on the country level before division. Note that banks used in the calculation might differ between indicators. Values are calculated from underlying bank-by-bank unconsolidated data from Bankscope. **Available data for Brunei:** 1999-2011	Bankscope, Bureau van Diik (BvD) Coverage: 1998-2013
lnstability	**Short definition:** The Bank Z-score or probability of default of a country's commercial banking system. The Z-score compares the buffer of a country's commercial banking system (capitalisation and returns) with the volatility of those returns. **Long description:** The Bank Z-score or probability of default of a country's commercial banking system. The Z-score compares the buffer of a country's	Bankscope, Bureau van Diik (BvD) Coverage: 1998-2013

	commercial banking system (capitalisation and returns) with the volatility of those returns. It is estimated as: (ROA+(equity/assets))/sd(ROA) where sd(ROA) is the standard deviation of ROA. ROA, equity, and assets are country-level aggregate figures calculated from underlying bank-by-bank unconsolidated data from Bankscope. μt is an error term. All variables are in natural logarithm. **Available data for Brunei:** 1999-2011	

3.2. Model Specification

This study investigates the causal effects of financial development on economic growth in the long-run in Brunei. The dependent variable in the model is real GDP. The independent variables (or financial development variables) are made up of (1) the annual inflation rate based on Consumer Prices (in %), (2) the number of depositors with commercial banks per 1,000 adults, (3) the bank overhead costs to total assets (in %), (4) the domestic credit to the private sector and (5) the Bank Z-score or probability of default. Following Ali et al. (2014), the relationship is posited in the linear empirical model below:

$$lngdp = \alpha_0 + \alpha_1 lnInflation + \alpha_2 lnAccess + \alpha_3 lnDepth + \alpha_4 lnEfficiency + \alpha_5 lnStability + \varepsilon_t \quad (1)$$

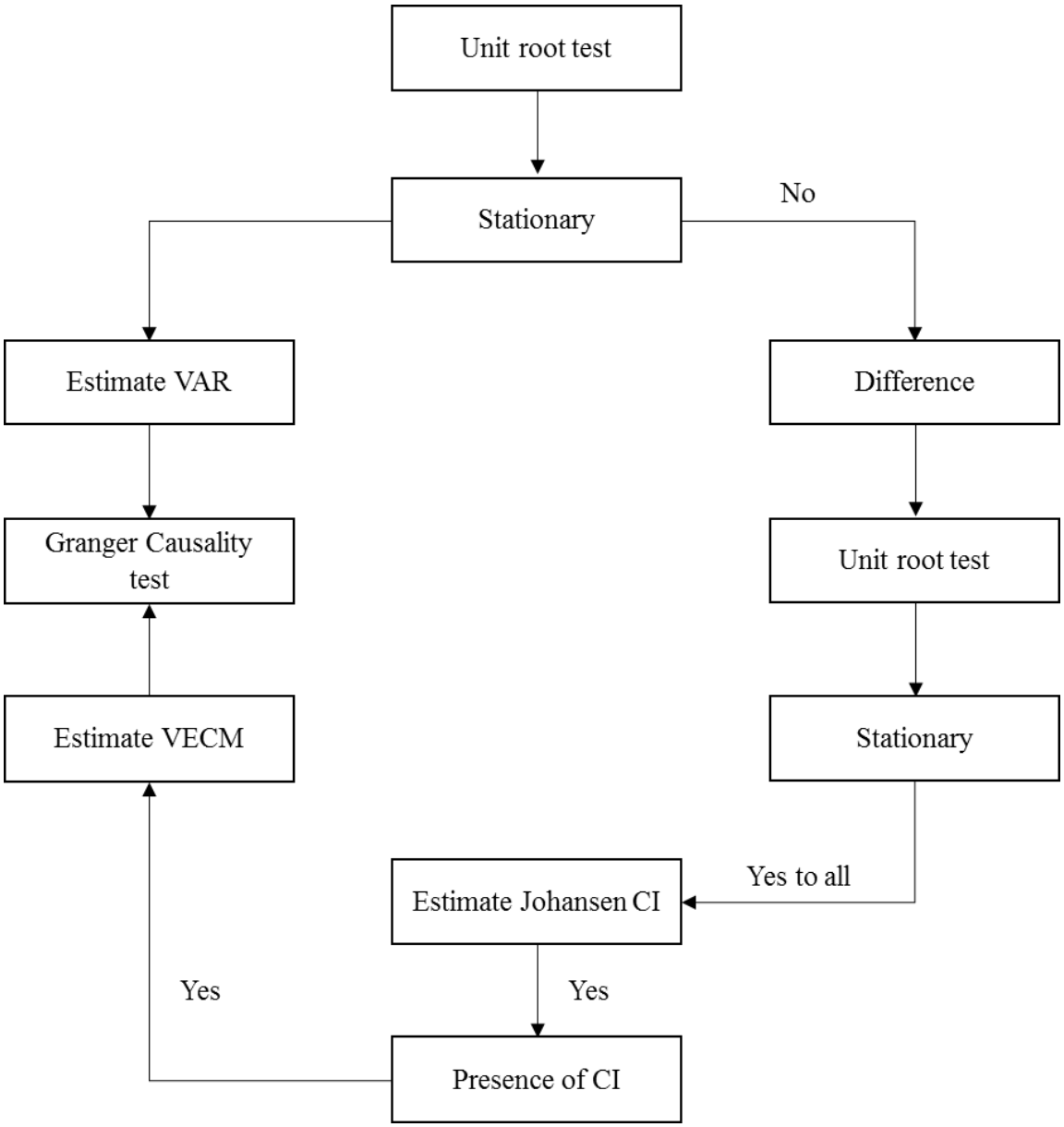
Where ln represents the natural logarithm function and ε_t is the error term.

This study tests the hypothesis of King and Levine (1993a) stating a positive relationship between the financial and economic variables. A limitation of this study is the exclusion of several control variables which shape the macroeconomic environment and this may affect the output value. Examples of controls used in other studies are as follows: Ali et al. (2014) have included the consumers' price index (measuring the impact of annual inflation rate), FDI and domestic savings (percentage of GDP). Iheanacho (2000) compounded seven financial development indicators (*lnFDindex1*, *lnFDindex2*, *lnFDindex3*, *lnCPS*, *lnLIQ*, *lnBA* and *lnBD*) into one variable (*FD*) and this permits a longer linear empirical model. A study on the oil-rich Nigeria included the international crude oil price, therefore, we expect reduced accuracy with the exclusion of this variable (Iheanacho, 2000). More variables could also be controlled in this study such as trade openness, investment and government consumption.

3.3. Methodology

The approach taken by this study consists of a series of sequential steps: the model is first estimated followed by unit root testing to investigate the properties of the individual time series. The next step involves testing for the presence of any co-integrating variables. This is done by using the Augmented Dicky-Fuller (ADF) test. The flow chart below shows the sequence of the methodology used, followed by a brief clarification of each procedure.

Figure 1: Flow Chart of Statistical Methods



3.3.1. Unit Root Test

It is important to understand the properties of our time series as they determine which methodology is valid for the analysis. The unit root test is first done to check for the presence of co-integrating vectors and examine the order of integration of the variables. The order of integration in turn helps characterise the stationarity of the data. The correct order of integration ensures no spurious regression in the data which may lead to useless analysis.

The stationarity of the time series is tested using the ADF test. It is a modified version of the Dickey-Fuller (DF) test but one of the most common methods in the literature (Dickey and Fuller, 1979). The ADF test is done first in levels and then in first difference to check for the presence of unit roots and the order of integration of all variables (Dickey and Fuller, 1979; 1981). The following regression for the estimation of the ADF test statistic is used:

$$\Delta y_t = \mu + \theta y_{t-1} + \delta t + \sum_{i=1}^{p} \theta_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

Where δt is the time trend (Adam, 2009).

In this study, the ADF test is run with a trend and/or constant and tested at 5% significance level. The null hypothesis (H_0) states that the data is non-stationary ($\theta = 0$) and tested against the alternative hypothesis ($H_1 : \theta < 0$). If p-value is less than 0.05, we reject the H_0 and accept that there is no unit root and the variables are stationary. If p-value is greater than the 5% threshold, we reject the H_0, infer it as a unit root being present in our data and proceed with differencing. When variables are stationary at first difference, they are described as co-integrated; when they are not stationary at first lag but become stationary at first difference, the variables are said to be integrated of the order 1. Macroeconomic processes have integral unit roots, therefore, the finance-growth time series used in this study is assumed to have unit roots, and be non-stationary (Nelson and Plosser, 1982).

The next stage involves VAR modelling and the selection of the appropriate lag length. Two of the widely used indicators for VAR lag selection are the Schwartz Bayesian Criterion (SBC) and the Akaike Information Criterion (AIC). SBC chooses fewer lag, yet any additional regressor is penalised with greater loss of degrees of freedom. On the other hand, AIC gives a very large model. The varying lag lengths offered by the two test criteria give rise to a procedural weakness. It is better to choose a model with too many lags than too few to ensure autocorrelation is addressed, thus, AIC is chosen in the present study (Adam, 2009).

The critical values are derived from simulation in RStudio (Version 1.0.153). Table 2 shows the results of the ADF stationarity test: the variables appear to be integrated at different orders at level but are stationary at their first difference with both constant and trend in the

equation, except ‘lnaccess’ and ‘lnstability’. The variables have to be integrated at the order of one i.e. I(1) in order to proceed with co-integration tests. This informed the choice of this study to exclude the ‘lnaccess’ and ‘lnstability’ variables from the model.

Table 2: ADF Test Results

Level			
Variables	**None**	**Constant**	**Constant & trend**
lngdp	1.7119	-2.4633*	-3.3308**
lninflation	-3.8660***	-4.0635***	-4.8146***
lnaccess	0.0541	-0.3342	-1.3553
lndepth	-0.2303	-0.9449	-2.1471*
lnefficiency	-1.3141	-1.5742	-1.5459
lnstability	-1.3619	-1.6715	-1.6911
First difference			
lngdp	0.9513	-1.4889	-3.1925**
lninflation	-2.6007*	-2.7544**	-3.6511***
lnaccess	0.0438	-0.3039	-1.2781
lndepth	-0.1654	-0.8844	-2.0903*
lnefficiency	-1.6991	-2.0900*	-2.9999**
lnstability	-1.3758	-1.7268	-2.0162
Critical values			
1% level	-2.62	-3.58	-4.15
5% level	-1.95	-2.93	-3.50

Note:

1. * indicates significance at 0.01%
2. ** indicates significance at 0.05% level
3. *** indicates significance at 0.10% level

The statistical implications are as follows: stationary variables experiencing shocks will 'reverse to the mean', i.e. they will not be permanently affected or deviated by shocks. The relationship will also hold in the long-run. Stationarity implies the possibility of spurious results produced by the ordinary least squares estimator is mitigated – except in rare cases where the series is co-integrated and regressors are exogenous.

This statistical procedure of the study may be improved. This study did not carry out the Phillips-Perron tests as done in other papers: conducting two different stationarity tests gives certainty of non-explosive variables in the time series model and deals with the issue of tests with small power, the statistical inference of this study may therefore be restrained (Rahman, 2004). Another route this study could have taken is the Autoregressive Distributed Lag (ARDL) approach for estimation because it does not impose strict exogeneity assumptions and allows for both stationary and non-stationary regressors (Samargandi et al., 2014). This study uses the Johansen maximum likelihood test of estimating co-integration vectors (Johansen, 1990).

3.3.2. Johansen Co-integration Test and Trace and Max-Eigen Statistics

The Johansen co-integration test is a standard assessment for the presence of co-integrating vectors and the long-run relationship between economic time series. This multivariate test is expressed as (Adam, 2009):

$$\Delta X_t = \varphi + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-1} + \Pi X_{t-p} + \varepsilon_t \quad (3)$$

Johansen test estimates the rank of a given matrix of time series with a level of confidence. The third order matrix (r=3) tells us the association between three variables in the long-run and the rank of this matrix equals the number of co-integrating vectors. The procedure is executed in the ca.jo function in RStudio (Version 1.0.153). The optimal lag length based on the AIC (i.e. 6) is determined by the VARselect package. The Trace and Max-Eigen statistics are two different likelihood ratio tests developed by Johansen to test for the number of co-integration vectors (*r*) (Johansen, 1990).

The trace test is given by (Adam, 2009):

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1 - \lambda_i) \quad (4)$$

The maximum Eigenvalue test statistics is given by (Adam, 2009):

$$\lambda_{\max}(r, r+1) = -Tln(1-\lambda_{i+1}) \quad (5)$$

The two test statistics have different definitions of their null hypotheses. The trace statistics test defines it as $H_0 : r = 0$ against the alternative hypothesis $H_1 : r > 0$. In contrast, the maximum Eigenvalue statistics defines its null hypothesis as $H_0 : r$ number of co-integrating vectors and its alternative hypothesis as $H_1 : r + 1$ number of co-integrating vectors.

We begin examining the output of the function with r=0 and see whether its *H_0* (i.e. no co-integration is present) can be rejected by looking at the test statistic and the critical values reported in the output. If it can be rejected, the analysis moves up and we test the *H_0* of r=1, r=2 and so on until r=x cannot be rejected (whereby x corresponds to the number of co-integrating vectors). If all r's can be rejected, our series is presumed to be stationary. Table 3 shows results of the Johansen's unrestricted rank test and the co-integrating relationships in the data: maximum Eigenvalue statistic and trace statistic are both greater than their respective critical values for all r's.

Table 3. Results of the Johansen's Unrestricted Rank Test

H_0	**Eigenvalue (λ)**	**Maximum Eigenvalue statistic ($\lambda_{\max}$)**	**Trace statistic (χ^2)**	**Critical value of the $\lambda_{\max}$ at 5% level**	**Critical value of the trace at 5% level**
r=0	9.268778^{-01}	86.3156	181.3060	28.14	53.12
r=1	8.048796^{-01}	53.9266	94.9905	22.00	34.91
r=2	5.656341^{-01}	27.5176	41.0639	15.67	19.96
r=3	3.366764^{-01}	13.5462	13.5462	9.24	9.24

Note:

1. 'r' is the number of the hypothesised co-integrating vectors
2. The highest values generated from the AIC will determine the lag configuration of VAR

Taking r=2 as an example, the maximum Eigenvalue (27.5176) is greater than its critical value (15.67) at 5% confidence. Therefore, the three co-integrating vectors show that there is a long-run association among the finance and growth variables of Brunei, meaning that the two variables move together in the long run. We also have over 95% confidence that all the instruments, i.e. 'lngdp', 'lninflation', 'lndepth' and 'lnefficiency', are stationary by themselves. This confirms the ADF results we found above. Once a co-integration is established, Eigenvector (normalised first column) could be used as weight for a portfolio.

The normalised co-integrating coefficients are given in Table 4. The lagged error correction term (ECMt-1) values (extracted from $rlm in RStudio output) give the adjustment or speed parameters for each of the equations corresponding to each column. The beta coefficient gives the co-integrating parameters, i.e. the values used to form the ECMt-1 term. It shows that inflation in the long run has a negative impact on economic growth in Brunei. Although positive results are expected with improvements in financial depth, it is not expected that the same can be said for financial efficiency: one year lag of financial efficiency has a negative but not statistically significant impact on economic growth due to its estimate of the ECMt-1 not being significant.

Table 4. Normalised Co-Integrating Coefficients

$lngdp_t$	$lninflation_t$	$lndepth_t$	$lnefficiency_t$
1.0000 **($beta in RStudio output)**	-0.0166	0.1755	-1.8163
ECMt-1 / t-value **($rlm in RStudio output)**	-5.7023	3.6087	0.9968

3.3.3. Granger Causality Test

Since the time series data is co-integrated, its relationship can be expressed as Error Correction Model (Granger, 1988). The present study uses the Granger Causality test based on the VECM to investigate the direction of the long-run causality. The significance of the coefficients of lagged variables is tested using the χ^2 test which denotes its long-run causality. The significance of the ECMt-1 is weighed using the t-test. This study has not done any

diagnostic tests on each of the ECMt-1, which involve testing for normal distribution, serial correlation and homoscedastic stability or inverse characteristic roots test.

The direction of non-co-integrating variables in this study, i.e. between 'lngdp' and 'lninflation', is estimated using the Granger Causality based on first difference VAR. Because there is no co-integration between 'lngdp' and 'lninflation', the VAR model is used to estimate their causality. Co-integrating relationships are present between (a) 'lngdp' and 'lndepth' and (b) 'lngdp' and 'lnefficiency', thus the VECM model is the preferred framework of estimation. A VAR model could be used but the resulting 'super-consistent' estimations may forgo efficiency.

After establishing the long-run equilibrium relationship of the variables, we estimate their error correction term equations in the time series as follows:

$$\Delta Y_t = a_y + \sum_{i=1}^{n} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{1i} \Delta X_{t-i} + \varepsilon_t \quad (6)$$

$$\Delta X_t = \alpha_x + \sum_{i=1}^{n} \alpha_{2i} \Delta X_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-i} + \varepsilon_t \quad (7)$$

Where ΔY and ΔX are the first difference of the non-stationary time series variables (Adam, 2009). Alternatively, if the time series variables are integrated at the order of 1, the parameters ϕ_y and ϕ_x will have to be included in each of the error correction term equations. The terms correct for deviation from long-run equilibrium relationships. Thus, the Granger Causality pairwise test is based on the following equations (Adam, 2009):

$$\Delta Y_t = a_y + \sum_{i=1}^{n} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{1i} \Delta X_{t-i} + \phi_y ECT_{x,t-1} + \varepsilon_t \quad (8)$$

$$\Delta X_t = \alpha_x + \sum_{i=1}^{n} \alpha_{2i} \Delta X_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-i} + \phi_x ECT_{x,t-1} + \varepsilon_t \quad (9)$$

If the parameters of lag variables of X are statistically significant, this implies that changes in X cause changes in Y. In other words, we say "X Granger-causes Y". The null hypothesis, $H_0 : \beta_{1i} = 0$, which states "ΔX does not Granger-cause ΔY", is tested based on equations (6) and (8). On the other hand, equations (7) and (9) form the basis of the following hypothesis test: $H_0 : \beta_{2i} = 0$ which specifies "ΔY does not Granger-cause ΔX". F-test is used as reference for statistical significance. Rejecting both of the null hypotheses suggests that the two variables are independent.

Each of the error correction equations was estimated. The Granger Causality test was applied and results of the test are presented in Table 5.

Table 5: Pairwise Granger-Causality Test

Y / X	**Lngdp**	**Lninflation**	**Lndepth**	**Lnefficiency**
Lngdp		*H_0*: 'lngdp' does not Granger-cause 'lninflation' F = 2.3772 df1 = N/A df2 = N/A p-value = 0.1368	*H_0*: 'lngdp' does not Granger-cause 'lndepth' F-Test = 0.14641 df1 = 1 df2 = 68 p-value = 0.7032	*H_0*: 'lngdp' does not Granger-cause 'lnefficiency' F-Test = 0.11218 df1 = 2 df2 = 62 p-value = 0.8941
Lninflation	*H_0*: 'lngdp' does not Granger-cause 'lninflation' F = 0.1128 df1 = N/A df2 = N/A p-value = 0.74		*H_0*: 'lninflation' does not Granger-cause 'lndepth' F-Test = 2.7938 df1 = 3 df2 = 56 p-value = 0.04858***	*H_0*: 'lninflation' does not Granger-cause 'lnefficiency' F-Test = 0.78728 df1 = 10 df2 = 14 p-value = 0.6421
Lndepth	*H_0*: 'lndepth' does not Granger-cause 'lngdp' F-Test = 0.04864 df1 = 1 df2 = 68 p-value = 0.8261	*H_0*: 'lndepth' does not Granger-cause 'lninflation' F-Test = 1.4248 df1 = 3 df2 = 56 p-value = 0.2452		*H_0*: 'lndepth' does not Granger-cause 'lnefficiency' F-Test = 0.84423 df1 = 1 df2 = 16 p-value = 0.3718
Lnefficiency	*H_0*: 'lnefficiency' does not Granger-cause 'lngdp' F-Test = 0.20817 df1 = 2 df2 = 62 p-value = 0.8126	*H_0*: 'lnefficiency' does not Granger-cause 'lninflation' F-Test = 0.77682 df1 = 10 df2 = 14 p-value = 0.6502	*H_0*: 'lnefficiency' does not Granger-cause 'lndepth' F-Test = 2.569 df1 = 1 df2 = 16 p-value = 0.1285	

Note: *** indicates significance at 0.1% level

Values of the F-test, the two degrees of freedom and the p-value are shown in each pairwise Causality testing. The F-test is used to compare the variances of two populations to each other. It has two values of degrees of freedom, each representing the sample size of the two populations. The coefficients of the ECMt-1 show the speed of adjustment towards the long-run equilibrium, i.e. any short-run disturbance in the system is equilibrated by a certain correction magnitude (in %). Further, the significance of the ECMt-1 signifies the long-run causality from financial variables to growth variables in Brunei. This study is not able to produce the coefficients of the ECMt-1 of each of the variables.

The results show that the H_0 ('lninflation' does not Granger-cause 'lndepth'), is rejected at 0.1% level of significance but the H_0 ('lndepth' does not Granger-cause 'lninflation') cannot be rejected. In other words, there is a unidirectional causality running from 'lninflation' to 'lndepth' and inflation (based on annual consumer prices) does have an impact on the domestic credit to the private sector. The results also show that there is no significance in the rest of the bivariate relationships. None of the variables which measure financial development in Brunei have any effect on its economic growth. The causality therefore indicates that economic growth is independent of financial development and especially highlights that credit to the private sector significantly influences inflation.

These empirical results are in line with the thinking of Anaman (2004) who put forward two different but major determinants of economic growth in Brunei: both growth of exports and the relative size of government had a substantial impact on economic growth in the long run. The latter affected growth in the form of a cubic function; while large sizes hindered growth, moderate sizes caused improvements (Anaman, 2004). Kyophilavong et al. (2014) obtained similar results, namely causality running from their financial indicators to economic indicators. Another study reasoned that this was because the efficient use of capital is accompanied by progress in the financial sector and improvements downstream (by encouraging FDI, technological and managerial transfers, etc.), thus culminating in overall GDP growth (Shahbaz, 2012; 2013).

4. Empirical Results and Discussion

The purpose of this dissertation is to investigate the long-run relationship between financial development and economic growth in Brunei and its direction of causality using available data from 1975 to 2013.

The main finding is that financial development does not have an effect on economic growth. The Granger Causality test results show that there is no bi-directional causality between economic growth (represented by real GDP) and three of the financial variables used in this study (represented by inflation, domestic credit to the private sector and bank overhead costs to total assets in %). The economic growth in Brunei appears to be independent of the development of the financial sector. However, this study found significance at 0.1% level in the long-run relationship between inflation and financial depth (represented by domestic credit to private sector). This section discusses the findings of this study in relation to other empirical work, beginning with the lack of association between the three financial variables and GDP growth and, most importantly, the significant unidirectional causality between credit to the private sector and inflation.

4.1. Why Does Financial Development not Have an Effect on the National GDP (and Vice Versa)?

The economy in Brunei was not influenced by the financial sector as expected between 1975 and 2013. There are several possible explanations. Firstly, its economy relies heavily on oil and gas exports which contributed an estimated average of 80.0% and 55.2% to the total GDP during the periods 1971-1990 and 1991-2001 respectively (Government of Brunei Darussalam, 2003). Based on a vector autoregressive model, annual economic growth rates were influenced by world oil prices and thus oil export values: changing oil prices were the main source of fluctuations in the GDP according to an analysis of the dynamic interactions between government revenue, government expenditure and GDP (Obben, 1998). Based on annual growth data, fluctuations in the rate of real GDP (RGDP) are based on changes in the world oil price: positive growth rates from 1971 to 1980 coincided with world oil price shocks in two periods, i.e. 1974-1977 and 1980-1985 (Anaman and Duraman, 2003). The subsequent negative growth rates from 1981 to 1990 (except 1987, 1989 and 1990) were due to comparatively lower world oil prices. The same reason holds for the stagnant rates from 1991 to 2001, though another source reported a specific value, that is, the slowing down of growth with an RGDP of -0.9% (Brunei Darussalam Statistical Yearbook, 2002). The second shock was the Asian financial crisis as depicted in the recession (-14% RGDP) from 1997 to 1998 during the peak of crisis.

The government responded to these shocks by establishing a Ministerial Task Force on Economic Affairs in 1998 (Anaman, 2004). Additionally, in response to the Brunei Darussalam Economic Council (BDEC) report released in February 2000, which highlighted the unsustainable nature of the economy and foresaw social problems, the government founded the Brunei Economic Development Board in November 2001, which was given the task of attracting FDI through the execution of pro-growth policies (Anaman, 2004).

This opposes several earlier findings which uphold the 'supply-leading' and/or 'demand-leading' hypotheses, i.e. financial development resulting in GDP growth or vice versa. Calderon and Liu (2003) established the causality from financial development to economic growth by showing the 81-89% contribution in the linear dependence in the 5-year panel and the supply-leading relationship having significance only in the 10-year panel. This causality is also time-dependent because financial development had more relevance in longer sampling intervals: the 10-year panel had increased contribution (84%) when compared to the 5-year panel (61%). Araç, Aysen and Özcan (2014) have successfully established the two-way causality of the finance-growth nexus. Murari (2017) has shown that the domestic credit by banking sector/GDP, the proxy for financial development, has a significant and bi-directional association with rapid growth based on 1980-2013 panel data of South Asian countries.

Economic reforms which were implemented in the 1980s in Laos affected its financial sector (Kyophilavong, 2010). Kyophilayong (2010) presented findings which showed the important role of the financial sector in promoting economic growth by "facilitating the flow of funds and improving the allocation of resources and quality of investment", thus building a sound and efficient financial sector in Laos. Economic growth in turn created more demand for financial services and resources, forming a positive feedback loop benefiting the financial development in Laos.

Al-Tammam (2005) explored the finance-growth relationship and causality in Kuwait, Oman and Saudi Arabia. Results of Kuwait OLS regressions and co-integration testing revealed a negative finance-growth relationship and negative long-run relationship respectively, implying that financial and monetary factors do not affect GDP growth. Al-Tammam (2005) used similar econometric methods to the present study (i.e. OLS estimation, Johansen multivariate co-integration technique, and short-run and long-run VECM-based Granger Causality) but with two different models and three alternative financial development indicators. One possible explanation for the Kuwait results is the Iraqi invasion of Kuwait in 1990, culminating in regional crises which upset the financial system in Kuwait. Oman and Saudi Arabia data showed contrasting findings.

Despite the evidence supporting the presence of causality, our observation argues otherwise (that financial development does not have an effect on economic growth) and agrees with other studies – all of which asserted the minor role of the financial sector (Lucas, 1988; Mukhopadhyay et al., 2011; Robinson, 1952; Stern, 1989). Applying a time-series analysis on 20 countries, Skaden (2000) found no positive and significant association between the twelve variables of financial development and changes in the rate of economic growth. The results on the finance-growth relationship were also inconsistent.

The findings of Lakstutiene (2008) also reinforced the view of a dependency being absent between the development of the financial system and economic growth, specifically in the 'new' European Union countries, showing that a strong and dominant banking sector but low average GDP per capita in the Baltic States (a rapidly growing economy) are not shaping an environment which nurtures the formation of a market-based financial structure. This is to say that a strong financial sector cannot be the only driver or solution to economic retardation and requires various aspects to be considered. Ahmed (2010) also reported similar findings in his study on 15 Sub-Saharan African countries: the author suggested there is little evidence of financial development ("liberalisation") bolstering economic growth.

Instances of economic stagnancy in conjunction with financial growth are documented in Pradhan's (2010) analysis of the finance-growth linkage in India and Pakistan. Pradhan (2010) suggested that financial development does not have a sizeable impact on economic growth. This study uses the two measures of financial development also used by Pradhan (2010), i.e. private sector credit and inflation, which allows for comparison. Unlike this study, Pradhan protracted his to include trade openness and found reverse causality (economic growth causing financial development), thus supporting the 'demand-following response'. Altogether his study showed inconsistent results, calling for more evidence to verify the linkage. Taivan and Nene (2016) showed the dominance of the demand-following response when examining the same relationship but for the Southern African Development Community countries ('reverse causality' and 'no causality' altogether produced 60-90% response using Broad Money and Direct Credit as financial measures).

Odhiambo (2010) did not find a unidirectional causality from both financial depth and investment to economic growth after the introduction of interest rate reforms in South Africa. Although the causality running from (1) investment to the financial sector and (2) investment to economic progress in the short-run were present, the finance-growth relationship in this particular study had a tendency to take the demand-following route, i.e. from economic growth (investment) to financial development. Real sector growth was instead postulated to be the driving force behind economic development. Ali et al. (2014) did not find a causality between

financial depth (measured by credit to private sector) and economic growth (real GDP growth), however, Calderon and Liu (2003) noted the causality from financial deepening to growth having the only significance using a 10-year panel data growth. Further, financial deepening is associated with the stages of development: supply-leading contributed strongly during the early stages of development compared to later (76% versus 45% when M2/GDP is used). The significant role of financial depth (indicated by liquidity) in economic growth is also supported by Murari (2017). The contradicting results as presented in this study could be due to the modest levels of development in the Bruneian financial sector.

The third conclusion of this study is that inflation specifically does not have an impact on economic growth. Some studies offer mixed conclusions with this line of thinking. Ali (2013a) stated the negative impact of inflation on poverty and economic growth but Ali (2014a) found a growth-stimulating impact of inflation in Pakistan's economy. These contrasting observations could be explained as follows: low to moderate levels of inflation may be helpful in stimulating investment and growth in the economy but any higher inflation may begin to have negative effects. This is because higher levels of general prices result in increased demand for money balances by the household. This increase in demand for the cash balances increases the interest rates in the economy and encumbers investment which affects the efficiency of the productive factors (Andres and Hernando, 1997; Ali, 2013b).

Although the present study did not confirm the causal link between inflation and growth in GDP, the financial market is postulated to be a channel for inflation to take effect. In particular, higher inflation leads to strict credit rationing and reduced chances of bank credit extension which impede investment and growth.

High inflation aggravates the endogenous friction and interferes with operations in the financial system via credit rationing (Li, 2009). Choi et al. (1996) modelled the operative mechanism with which inflation takes its effects: high inflation reduces the real return rates received by savers as well as the real interest rates paid by borrowers, increasing the appeal of becoming borrowers instead of savers. This brings to question the low-quality borrowers, who have high default risks, and their demand for credit: investors will turn to credit rationing instead of offering low-interest loans to mitigate the possibility of them getting external finance, reducing investment capital and real activity in the long run (Choi et al., 1996).

With persisting credit rationing, the endogenous volatility within the rates of return of savings will begin to emerge and reflect in the real activity and inflation rates: high inflation is accompanied by variable inflation which renders price forecasting more difficult (Choi et al., 1996). However, this model is flawed in that it does not distinguish the role of debt and equity markets when both are affected by high inflation (Boyd et al., 1995).

4.2. Why does Inflation ('lninflation') "Granger-Cause" Financial Development on the Basis of Domestic Credit to the Private Sector ('lndepth')?

The present study found significance in the long-run relationship between inflation and financial depth. Asongu (2014) also stated similar findings when studying the long-run relationship between inflation and four dynamic fundamentals namely Money (which corresponds to this study's 'lndepth'), Credit, Efficiency and Size. Results of the Engle-Granger based Pedroni testing extended the linkage backwards and found that financial size caused inflation (Asongu, 2014). Another finding which parallels this study is that financial depth and size are better instruments in keeping rising rates of inflation in check compared to efficiency: the interaction between financial intermediary and depth showed significant deflationary effects which could be a target for policy recommendations; being able to keep inflationary pressures on food prices in control could help to prevent events which debilitate economic performance (such as political crises and sustained campaigns concerning strikes, demonstrations, marches and rallies) (Asongu, 2013). The insignificance of the efficiency dimension could be explained by issues of inherent surplus liquidity as seen in African banks (Saxegaard, 2006).

According to Barugahara (2012), inflation appears to hamper the positive effect financial development has on income equality. In other words, the reduction of income inequality which comes with an improved financial sector is offset by inflation. This is due to reduced and "greater variability" of real returns leading to inefficient resource allocation. Khan et al. (2006) stated similar impeding effects of inflation upon financial deepening: disinflation (i.e. inflation below the 3-6% threshold) positively affects financial depth but has the opposite effect above said levels. Boyd et al. (2001) reported a range of 15-20%. Rousseau and Wachtel (2002) contended a different range of 13-25%, having taken a different approach of a series of rolling panel regression. In sum, the inflationary environment is an important determinant of the degree to which finance affects growth. Although Li (2009) undertook the same analysis, the author did not specify a range of values for the threshold but offered a useful explanation of the non-linear effects of inflation: when sufficiently high, inflation could hinder capital productivity by reducing the efficiency of resource allocation and the monitoring of investment projects by financial intermediaries. Altogether our findings do not accord with the standard views on the finance-growth nexus.

5. Limitations

To the best of knowledge, this is the first study to examine the finance-growth nexus at the national level in Brunei, using the real gross domestic product, consumer prices-based inflation, domestic credit to the private sector and bank overhead costs to total assets (in %) as financial indicators. This section outlines its limitations and suggests improvements.

First, each indicator has its shortcomings. The present study may be criticised for incorporating the said banking sector indicators but excluding oil and gas prices and stock market variables, for example market capitalisation and turnover ratio. The present model could be improved by adding more proxies for financial development (such as domestic credit by the banking sector and net inflows of FDI/GDP) and other control variables (such as fixed capital formation/GDP and investment/GDP) in addition to inflation. The inclusion of investment is key, especially since it is an established proxy for the availability of finance: significantly high rates of investment-based returns and investment opportunities are the by-product of enhanced financial availability (Cleary, 1999; Nazlioglu et al., 2009). Further, it is suggested that efficiency of commercial banks be measured by the net interest margin (the spread between lending and the deposit rate) which provides an additional indication of 'competitiveness' (Beck et al., 2000; Elbadawi and Mwega, 2000).

The procedure of variable selection could be followed by examining the representation or variability of information of one variable to another (Skaden, 2000). Principal component analysis could be used in cases where single equations do not allow for more than one proxy indicator for variables (financial development and economic growth) for reasons such as small sample sizes, indicators with high correlation or indicators being inadequate proxies (Jalil et al., 2010; Pradhan et al., 2013). This is done by reducing the number of dimensions (indicators) into a number of sub-component indexes which helps to extract maximum information in all of the indicators whilst mitigating the possibility of multi-collinearity, a problem which emerges during the process of including more than one proxy in a single equation.

The present study ignored structural breaks which has an effect on the outcome. Other advanced techniques could be employed, e.g. the Andrew-Zivot structural break test which is able to give the order of integration test for individual country studies such as this and predict the structural break issue in the finance-growth nexus. The ARDL approach offers some desirable statistical advantages over other techniques which test for the existence of co-integration among variables. Unlike other co-integration techniques which require all variables to be integrated of the same order, the ARDL test procedure gives a leeway for variables with a mixture of orders of integration or sample sizes and still generates consistent results (Pesaran et al., 2001).

6. Conclusion and Policy Implications

This study attempts to investigate the long-run relationship between financial development and economic growth in Brunei and its direction of causality using available data from 1975 to 2013. This study tests King and Levine's (1993a) hypothesis that development in the financial sector is important for growth. The single equation estimation model used as the basis of analysis is as follows: $lngdp = \alpha_0 + \alpha_1 lnInflation + \alpha_2 lnAccess + \alpha_3 lnDepth + \alpha_4 lnEfficiency + \alpha_5 lnStability + \varepsilon_t$. Several econometric techniques have been applied to test the model: unit root tests, co-integration tests and Granger Causality pairwise testing based on the VAR and the VECM frameworks. Possible occurrences of spurious regressions and non-stationarity which come with time-series analysis are dealt with accordingly.

The main finding is that financial development does not have an effect on economic growth. The Granger Causality test results show that there is no bi-directional causality between economic growth (measured by real GDP) and three of the financial variables used in this study (measured by inflation, domestic credit to the private sector and bank overhead costs to total assets in percentage), however, this study found significance at 0.1% level in the long-run relationship between inflation and financial depth (measured by the domestic credit to private sector). No changes in economic growth with respect to changes in the development of the financial sector suggests a financial sector which is robust to the peaks and troughs of the economy. On the other hand, high levels of economic growth implicate high levels of household income and, thus, a substantial amount of consumption and savings.

With regards to inflation rate and GDP, moderate levels would encourage investors and businesses and contribute towards economic growth while, as discussed, higher inflation rates would have the opposite effect by raising uncertainty and risks with regard to investment projects which may further reduce the confidence of investors. Further, financial depth in this study is not patently associated with economic growth; this is an empirical reflection of weaker credit disbursement in the economy, therefore, policymakers may revisit their policies with respect to strengthening the domestic credit to the private sector in terms of regulation and supervision. The positive effects of financial depth on economic growth is rendered moot if intermediaries do not function well and this necessitates more empirical work in order to understand the structure of the financial market, including financial instruments, markets and institutions, and its effects on growth (Cetorelli and Gambera, 1999).

The crux of this dissertation is the unidirectional causality which runs from inflation to financial depth. Monetary policy instruments have to be implemented in order to control consumer price inflation. One possible instrument could be inflation targeting: an ancillary finding suggests that central banks of greater financial depth would adopt inflation targeting

as their monetary framework in response to deflation and improve economic performance (Hu, 2006; Truman, 2003). Deflation appears as a gradation between the 'good' (supply-side) and 'bad' (demand-side); the dominance of the latter has caused the "Japanese quagmire" and might also be responsible for increasing unemployment rates and the growth slump in Brunei, all of which could be avoided by removing policy-induced rigidities of prices and wages (Maital, 2003). A study has also shown that countries which adopt inflation targeting tend to be more developed, based on the higher share of industry and services in their GDP (Carolevschi, 2011).

If allowed, financial markets could start and flourish on their own without much government involvement; there is a problem with policymakers who push for financial development as the way to jump-start economic growth and/or diversification. Nevertheless, it is maintained that Brunei should not discount the development of the financial sector. The recommendations thus far have been based on the findings of the present study. Yet, the government can afford to consider the advantageous factors financial development will bring as claimed in numerous other studies. A progressive financial sector, which involves the banking sector, can facilitate income growth by reducing market frictions such as "information and transaction costs, pooling risks and easing trade and contracts" (Levine, 1997). Because external financial resource has a form of control over firms, the launch of a stock market exchange is obliged in a developed financial system, though the government has to carefully consider which kind of stock exchange it deems appropriate (Ali et al., 2014). Finally, the government may implement feasible initiatives at the early stages, which include improving the stability of the current financial sector and the quality of financial services for economic agents, whilst being wary of the fact that the finance-growth linkage only holds up to a certain threshold with low levels proven to indirectly affect socioeconomic development (Greenwood and Jovanovic, 1990; McKinnon, 2004).

Appendix A: Recent Empirical Evidence on the Finance-Growth Nexus in Studies Based on Individual Countries

Author	Sample	Financial variables included	Research method	Causality		Key findings
				FD → EG	FD ← EG	
Anthony and Anthony 2013	Ghana (1990-2009)	Bank competition and financial innovations	• ARDL-bounds testing procedure • Granger causality	0	0	In the short-run, bank competition has a negative effect but financial innovation has a positive effect which indicates that firms experience difficulty in accessing credit in Ghana. In the long-run, bank competition has a positive effect but financial innovation has a negative effect. Bidirectional causality is present for innovation which implies that technological innovation spearheaded communication and application of information culminating in efficient mobilization and allocation of savings in Ghana.
Badeeb and Lean (2017)	Yemen		• ARDL-bounds testing procedure • VECM-based Granger test	+		Positive effects of FD on EG increases with decreasing oil dependence.
Chandio 2014	Pakistan (1982-2010)	Financial depth (broad money to	• ADF unit root test	+*		FD stimulates EG in Pakistan in the long-run through effective

		one year lagged GDP)	• Phillips-Perron test			bank-mediated allocation of resources.
Ching et al. (2010)	Malaysia (1997-2008)	Life insurance (LI) indicator (the total assets of Malaysian life insurance sector)	• ADF unit root test • Johansen co-integration test • VECM-based Granger causality test	+	+	Causality runs from LI to EG in the long-run. Investing pooled funds into the financial and real property sector could increase economic output. Causality runs from EG to LI in the short run. Making purchase of life insurance policy is easily accessible to individuals.
Coskun et al. (2017)	Turkey (2006-2016)	Capital market development (CMD): • Mutual or pension funds, • Corporate bond market, • Stock market and • Government bond market	• ARDL-bounds testing procedure • Markov switching regression • Kalman filter models	+		Unidirectional causality runs from CMD and EG. CMD is further shown to have asymmetric effects where (1) government bond market development is negatively associated with EG but (2) an aggregate of the three indexes has positive association.
Nasir and Ali (2014)	Saudi Arabia (1971-2011)	Depth (broad money as a percentage of GDP)	• ADF unit root test • Phillips-Perron test	+		FD, specifically the depth component, drives EG in the country.

			• Johansen and Jesulius multivariate cointegration method • VAR-based Granger causality test • Impulse response function • Variance decomposition method			
Odhiambo (2010)	South Africa (1969-2006)	1. Broad money stock 2. The ratio of private sector credit to GDP 3. The ratio of liquid liabilities to GDP	ARDL-bounds testing procedure		+*	Causality is shown to run from FD to EG when the financial measures broad money stock and the ratio of liquid liabilities are used. Causality is absent when the ratio of private credit to GDP is used.

Notes: FD → EG denotes unidirectional causality running from the financial development to GDP growth. FD ← EG denotes causality running in the reverse direction. +, - and 0 indicate positive, negative and an ambiguous relationship respectively. * represents significance at levels used in each study.

Appendix B: Data Associated with the Study

Year	lngdp_full	inflation_wb	lninflation	gfddai01	lnaccess	gfdddi14	lndepth	gfddei04	lnefficiency	gfddsi01	lnstability
1975	22.3531	-	-	-	-	-	-	-	-	-	-
1976	22.5367	-	-	-	-	-	-	-	-	-	-
1977	22.6403	-	-	-	-	-	-	-	-	-	-
1978	22.7059	-	-	-	-	-	-	-	-	-	-
1979	22.9093	-	-	-	-	-	-	-	-	-	-
1980	22.8368	-	-	-	-	-	-	-	-	-	-
1981	22.6158	9.1371	2.2123	-	-	-	-	-	-	-	-
1982	22.6546	6.3566	1.8495	-	-	-	-	-	-	-	-
1983	22.6596	1.1662	0.1537	-	-	-	-	-	-	-	-
1984	22.6656	3.0740	1.1230	-	-	-	-	-	-	-	-
1985	22.6506	2.3532	0.8558	-	-	-	-	-	-	-	-
1986	22.6230	1.7812	0.5773	-	-	-	-	-	-	-	-
1987	22.6429	1.2469	0.2206	-	-	-	-	-	-	-	-
1988	22.6538	1.1928	0.1763	-	-	-	-	-	-	-	-
1989	22.6430	1.3043	0.2657	-	-	-	-	-	-	-	-
1990	22.6539	2.1387	0.7602	-	-	-	-	-	-	-	-
1991	22.6848	1.6000	0.4700	-	-	-	-	-	-	-	-
1992	22.7313	1.2795	0.2465	-	-	-	-	-	-	-	-
1993	22.7344	4.2517	1.4473	-	-	-	-	-	-	-	-
1995	22.8092	5.9666	1.7862	-	-	-	-	-	-	-	-
1996	22.8375	1.9961	0.6912	-	-	-	-	-	-	-	-
1997	22.8227	1.7116	0.5374	-	-	-	-	-	-	-	-
1998	22.8171	-0.4414	-	-	-	-	-	-	-	-	-
1999	22.8472	-0.4156	-	-	-	60.1800	4.0973	1.4300	0.3577	8.5200	2.1424
2000	22.8753	1.5582	0.4435	-	-	50.2900	3.9178	1.5900	0.4637	6.7300	1.9066
2001	22.9023	0.5959	-0.5177	-	-	53.6300	3.9821	1.3800	0.3221	5.0000	1.6094
2002	22.9403	-2.3150	-	-	-	53.6800	3.9830	1.4000	0.3365	4.9600	1.6014
2003	22.9690	0.3000	-1.2040	-	-	50.8400	3.9287	1.3200	0.2776	5.3800	1.6827
2004	22.9740	0.8142	-0.2055	-	-	46.4400	3.8382	1.5800	0.4574	5.7200	1.7440
2005	22.9779	1.2444	0.2187	-	-	40.2900	3.6961	1.9500	0.6678	7.1800	1.9713
2006	23.0209	0.1599	-1.8333	-	-	34.9500	3.5539	2.0500	0.7178	6.2600	1.8342
2007	23.0224	0.9678	-0.0328	-	-	37.5100	3.6246	1.8800	0.6313	6.8000	1.9170
2008	23.0029	2.0850	0.7348	1320.8100	7.1860	35.1500	3.5596	1.8400	0.6098	7.7600	2.0490
2009	22.9851	1.0357	0.0351	1378.4500	7.2287	44.5100	3.7957	2.1000	0.7419	9.4300	2.2439
2010	23.0107	0.3569	-1.0304	1424.0600	7.2613	40.9000	3.7111	2.4200	0.8838	10.7600	2.3758
2011	23.0444	2.0159	0.7011	1432.8600	7.2674	31.2100	3.4407	1.9400	0.6627	8.3500	2.1223
2012	23.0539	0.4641	-0.7677	1856.5900	7.5265	31.4500	3.4484	-	-	-	-

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