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Financial Innovation and Economic Growth: Evidence from IFC Islands

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Abstract

Purpose: International Financial Centre (IFC) Islands offer a plethora of financial services to international clients with primary purpose of expanding their foreign direct investment and growing their economy, both at a micro and macro level. Over the years, IFCs have been implementing innovative products and services to build their stance including IFC islands such as Mauritius, Singapore, Seychelles, Antigua & Barbuda and Bahamas. Financial innovation has been the theme of these islands with creative instruments surfacing their financial markets including Crowd-funding, Sustainable Bonds, Variable Capital Companies and many more. Hence, this paper demonstrates the impact of Financial Innovation on the Economic Growth of IFC islands.

Design/Methodology/Approach: A quantitative approach has been used for this study. The Auto Regressive Distributed Lag (ARDL) model have been implemented to assess the influence of financial innovation on economic growth of IFC Islands. There have been over 200 observations made from a sample of 5 IFC islands over 40 years. The variables proxying financial innovation adopted are Domestic-credit-to-private sector (DCP), Broad money (BM) and Trade Openness (TO) where the former two were adopted by () and the latter by (). Furthermore, the Non-linear ARDL model has been used to reveal the asymmetries in data, while analysing how truly variables impact GDP per capita, which is the variable proxying Economic Growth.

Findings: Results suggests that although in the short-run, only broad money has noteworthy impact on economic growth as the circulation and volume of money is a constant financial innovation to be present in the short-run. DCP and BM have greater influence than TO in the longer run. The NARDL also supports the conclusion that long-run relationship does exist between Financial-Innovation and Economic-growth. It can be inferred that there is asymmetric relationship between them and that financial innovation is directly linked to GDP per capita, implying that its positive change will bring greater economic growth and negative change bring adverse effects on the latter.

Limitation of the study: Few data were missing when compiling data for the study. Missing values have been interpolated. Interpolated data is not as accurate as the rest which could have brought a different Descriptive statistic.

Practical Implications: The outcomes of the study suggest that innovation in finance does impact the growth of economy for IFC islands.

Originality: This is the first known study to explore how financial innovation impacts economic growth of IFC islands.

Keywords: ARDL-model, NARDL-model, Financial Innovation, Economic Growth, Relationship, IFC islands

1. Introduction

Global digitalisation entails evolution in almost every aspect of daily life, including finance, which is seen through the unceasing innovation it brings. Infact, instantaneous innovation, particularly financial revolution in the financial system, both in terms of number and value, has significant impact on the dynamic economic environment (Blach, 2011). Hence, to bring financial efficiency and economic growth together, the financial system is essential (Saqib 2015). This leads to growing competitiveness amongst financial centres across the global, causing the emergence of International Financial Centre (IFC) Islands. As they thrive to remain investment-attractive, their financial innovation becomes the epicentre of their activities, and the impact it has on their economic growth is substantial.

Background of study

This study's purpose is to analyse financial innovation's consequences on economic growth of IFC Islands. The chosen sample are the following five islands: Mauritius, Singapore, Seychelles, Antigua & Barbuda and Bahamas. The sample spans over 40 years (1980-2020) with interest variable, GDP per capital (annual growth) as the indicator of Economic growth. Proxies for financial innovation are Domestic credit to private sector (DCP), Broad money (BM) and Trade openness (TO), all as a percentage of GDP.

Financial Innovation (FI)

Financial innovation, if classified by its nature, can be a financial system, product or process.

Financial system innovation is the change in business structures, supervisory and regulatory frameworks and establishing new types of financial intermediaries. It also includes institutional innovations which is the creation of new category of financial firms.

Product innovation is when new hire-purchase, credit, deposit, insurance, and other financial products are being introduced to boost the financial system's effectiveness.

Process innovation is innovative business methods with aim to boost productivity and market growth, such as data management.

Economic Growth (EG)

No economy stays the same and as it evolves and adapts to the changing demand and supply compositions amidst different economic weather, it experiences fluctuations. The positive expansionary move in the economy is called economic growth. Economic Growth is the rise in aggregate productivity, which is having the capacity to augment output of products and services overtime (Lolldharry, 2020) and is thus measured by Gross Domestic Product. Other variations of GDP accounts for different indicators, but for financial innovation, GDP per capita (annual growth) is more relevant.

Research Objectives
The main objectives of this research are:

- To investigate such relationship in the case of IFC Islands through data collection and statistical analysis,
- To provide recommendations – policies and their implementation – based on the outcome of statistical analysis.

2. Literature Review and Research Framework

2.1 Innovation in Finance and the Economy

Merton-Miller (1986) regard the period from the middle of the 1960s until the middle of the 1980s as an "extraordinary period in the history of financial innovation." Such conclusion was based on the idea that during Miller's time, there was an emanation for new financial products – various forms of derivatives – "alternative risk transfer products, exchange traded funds, and variants of tax-deductible equity but the bigger picture advocates that"– according to the Schumpeterian process – a profit-maximizing economy regularly and continuously incorporates financial innovation (Tufano, 2003). In an attempt to understand the term "financial innovation", Tufano breaks down the meaning of "innovate" as being a broad approach to describing economic shocks and responses to these shocks. When brought in the financial context, it "refers to the act of creating and then popularising new financial instruments, technologies, institutions and markets."

Authors like Finnerty (1988, 1992, 2001) branches out this term to a list of taxonomies of innovations with over 60 securities innovations that have functions of "reallocating risk, increasing liquidity, reducing agency costs, reducing transactions costs, reducing taxes or circumventing regulatory constraints." The functions of financial innovation were categorised by Merton (1993, 1995) into six: moving funds over time and place, pooling reserves, controlling risks, getting data for decisions, dealing with moral hazard and asymmetric information issues, and finally easing the sale or purchase of products and services via payment schemes.

Innovation goes beyond creating new products, but also "the process of diffusion or adoption of the inventions", starting as early as Automatic-teller machineries [Hannan and McDowell (1984,1987)] to "small business credit scoring" (Akhavein, Frame and White, 2001), "patents" (Lerner, 2002), "off-balance sheet activities of banks" (Molyneux and Shamroukh, 1996) and "to corporate security innovations" (Tufano, 1989). All to suggest that financial innovation's impacts are multi-fold and as Merton (1992) puts it: the "engine" that propels the financial system toward its objective of enhancing the performance of what economists refer to as the "real economy", is thought to be financial innovation. Perhaps the seed to the idea of Financial Innovation being an inv"sible "and behind Economic Growth.

Traditionally, neo-classical economists believed that the financial-system seldom influences economic expansion, Goldsmith (1969), McKinnon (1973) and Shaw (1973) discovered financial progress is essential for economic extension. As they believed – similar to Schumpeter – that the number and quality of a country's financial services directly affect its pace of growth (Hao, 2006). Greenwood and Jovanovic (1990)'s paradigm showed that the amount of financial intermediation and the rate of economic expansion are governed endogenously. Followed by King and Levine (1993) showing that financial systems leading to facilitated rational investment decisions, could channel funds to the most fruitful sectors to realise a higher expected rate of return on capital.

A plethora of empirical evidences point to a persistent rapport between financial innovation and economic growth, whilst considering a country's dynamics and demographics. While there is a divergence in methods used to assess the said link, inconclusiveness remains on the results obtained from the various financial innovation variables.

2.2 Financial innovation: Perspectives and variables

It is not unbeknownst that financial innovation is not only new financial tools being available but includes financial reporting's ability to track changes in the financial system, advancement in data processing and enhancing credit rationing (Michalopouloset al., 2001). This leads to a discrepancy in the way financial innovation is interpreted and applied in each country or sample used by authors, and thus a number of variables that accounts for one or more specific characteristic to

financial innovation. Consequently, the financial system should be represented by a diverse range of proxies in the variable selection process for financial innovation. (Qamruzzaman and Jianguo, 2018).

Many empirical literatures measure financial innovation based on availability of funds to allow financial sector growth and these financial resources made available to businesses and households by financial corporations is identified as DCP. Nazir et al. (2021) studied the impact of "Financial Innovation on Economic Growth in China, India and Pakistan" by employing DCP during the period of 1970 to 2016. A similar approach is seen in Satia and Okle's (2020) paper on financial innovation and economic progress in Cameroon. In both cases, the variable had a direct connection to growth. DCP include loans, securities, and other receivables, that is the percentage of credit services to the private region for investment. While the capital adequacy is assessing a bank's financial health using its capital-to-assets ratio (Tan & Floros, 2013), the higher it is, the more safe and likely it is to fulfil financial commitments which positively impacts DCP and therefore economic growth (Werner, 2016). Infact, Growth economic theory foresees that enough capital will have a favourable impact on economic growth, and so Qamruzzaman and Jianguo (2017) gave the coefficient of this variable a positive sign. Mollaahmetoğlu et al. (2019) uses DCP as one of the proxies for Financial Innovation in his article – "The Missing link between Financial Development and Economic Growth: Financial Innovation" – with similar outcomes to prior studies, suggesting that the higher the financial innovation the more is economic growth.

Another prominent variable for financial innovation undertook by several authors is the Broad-to-Narrow Money (M1M2), which is the medium in which monetary transactions take place (bank notes, coins among others). Qamruzzaman et al. (2017, 2018) adopted the approach found in Bakang (2016) of defining financial innovation through Broad-to-Narrow money. On the same path, Nazir et al. (2021) chose this variable as it determines how demand for actual cash balances, income, and interest elasticity of demand are affected (Bara et al., 2016; Ansong et al., 2011)

The above two variables focus more on the monetary aspect of financial innovation, but many researchers argue that it is not limited to it. Infact, financial innovation brings about trade openness (TO), growth in capital formation (GCF), mobile banking, financial efficiency, financial stability and financial developments. Mohammed et al. (2021) even considered financial transactions, online payments in their paper "Financial Innovation and Economic Growth: Empirical Evidence from Nigeria", basing itself on the financial-growth theory. Satia and Okle (2020) used mobile banking accompanied with DCP and Broad-to-Narrow money as a measure of innovation in finance, although its existence is quite recent. Bara et al. (2016) also used mobile banking in the case of SADC. While trying to prove FI as a "missing-link between" Financial Development and EG, Mollaahmetoğlu et al. (2019) used financial access, financial depth (DCP), financial effectiveness – bank-overhead cost to total assets – and financial security – stock price volatility – to assess financial evolution by accounting for different sectors; banks and securities market. Md. Qamruzzaman & Wei Jianguo (2018) explored the economic side of financial innovation by implementing Trade Openness and Capital formation in their analysis, as both have a two-way relationship with financial evolution. Didier (2019) generalised financial innovation as a variable on its own, along with financial innovation in his investigation effort the impact of Innovation and Financial Development on Economic Growth in some Asian and Latin American countries.

3. Methodology

Prior to conducting an econometric analysis, it is fundamental to make sure data is meeting the requirements of the model. Preliminary tests are performed to analyse the characteristics of the data and ensures usage of appropriate model to comply with research-questions. For the purpose of this study, five International Financial Centre islands were considered including Mauritius, Antigua and Barbuda, Singapore, Seychelles and Bahamas, over a time period of 40 years. GDP per capita represents Economic growth and variables proxying financial innovations are Domestic-credit-to-private sector (DCP), Broad Money(BM) and Trade Openness(TO).

Model Specification

As this study purposes to analyse the influence of financial innovation on the economic growths of IFC islands. The analytical model chosen for the study is the multiple linear regression and it is as follows:

$$Y_t = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon_t$$

Where,

Y_t = GDPpc, x_1 = DCP, x_2 = BM, x_3 = Trade Openness, β_0 = Constant, ε_t = Error term, β_1, β_2, β_3 = Coefficient betas

3.1 Preliminary tests

3.1.1Normality test

Jarque-Bera Test is used to measure the difference of the skewness and kurtosis of the series with those from the normal distribution. The normality test is followed by the following hypothesis:

H_o: Normally distributed data

H_1: Not normally-distributed data

The critical value is 0 which is lower than significance level of 5%, which leads to rejecting the null hypothesis. It can therefore be said that this data has its errors normally distributed and is suitable for the Autoregressive Distribution Lag model.

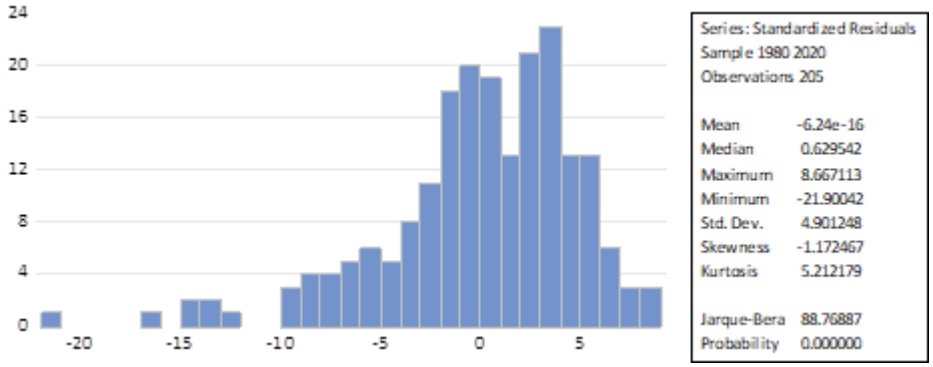

Figure 3.1: Normality Test

3.1.2Unit root Test

The ADF test is used, with Schwartz Bayesian Criterion (SBC) implemented to ascertain the optimal number of lags. The stationary test is applied to GDP per capita, DCP, BM and TO. The table 5.1 illustrates the results of the ADF test.

Table 3.1: Unit Root Results

ADF Test (Schwartz Bayesian Criterion)				
Variables	**Lags Chosen**	**Intercept & Trend**	**Probability value**	**Order of Integration**
GDPpc	0	-5.69026	0.0000	I(0)
DCP	0	-6.50239	0.0000	I(1)
BM	0	-2.81681	0.0024	I(1)
TO	0	-9.99836	0.0000	I(1)

Source: computed using Eviews 12

The results in the table above suggests that all variables other than GDP per capita, are integrated of order one, that is they are stationary after first difference I(1) and GDP per capita is stationary in level. This validates using the ARDL approach as both order of integration can be used at once under this model, deriving the long-run or short-run connection between the variables.

The following hypothesis arises when testing for unit root:

H_o: Non-stationary data

H_1: Data is stationary

Table 5.2 show that all variables have had a probability value less than 0.05, implying that unit root is present and that the null hypothesis of the data not being stationary is not rejected. It is noted that DCP, BM and TO have had stationarity at level but none at first difference, which makes ARDL model suitable for this study.

3.1.3 Homoscedasticity test

Testing for homoscedasticity not only gives an idea about the data's trend but ensures there is a constant error term across different observations.

Table 3.2: Heteroscedasticity Test

Heteroscedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoscedasticity			
F-statistic	3.086182	**Prob. F(3,201)**	0.0096
Obs* R-squared	9.026992	**Prob. Chi-Square(3)**	0.0118
Scaled explained SS	18.27697	**Prob. Chi-Square(3)**	0.0473

Source: Eviews 12

The Breusch Pagan test is employed with the hypothesis below:

H_o: No Heteroskedasticity

H_1: Heteroskedasticity present

The table above shows an F-statistic less than 5% and Prob (Chi-Square) less than 0.05, causing H_o to be rejected and suggesting that the data is not homoscedastic.

3.1.4 Serial Correlation/ Autocorrelation test

The autocorrelation test helps uncover the reliability of the data by giving information about the trend of a set of historical data, since it measures links between observations at different points in time, thus seeking a pattern or trend. Here, the Breusch-Godfrey Serial Correlation Lagrange Multiplier test has been used with null hypothesis being no serial correlation at up to 2 lags.

Table 3.3: Autocorrelation test (Breusch-Godfrey)

Test	T-statistic
Durbin Watson	1.878673

The Durbin-Watson test accounts for the linear association between adjacent residuals from a regression model. Absence of serial correlation will imply a DW statistic around 2 while a positive serial correlation will take values below 2 and a negative one between 2 and 4. The result above suggests 1.878673 DW value which is below 2, implying a positive serial correlation. There is, infact, a trend existing – relative to GDPpc – which validates the use of this data for this study.

3.1.5 Optimal lags Selection

Since the dependent variable does not respond to the independent variables instantly, a lag selection must be conducted so as to select which information criterion best suits the data. Eviews suggests two criteria as in the table below:

Table 3.4: VAR Estimates (part) values

Akaike Information criterion	26.36801
Schwartz criterion	26.97226

The rule of thumb is to select the lowest value and, in this case, the AIC is selected, and for the ARDL model, Model 12 – ARDL (3,4,4,4) – gives the lowest value of 4.97 out of the different optimal lag combinations, as shown in Figure 5.2 below. Hence the optimal lags chosen for this study's ARDL model is 3 for GDP per capita and 4 for the independent variables: DCP, BM and TO.

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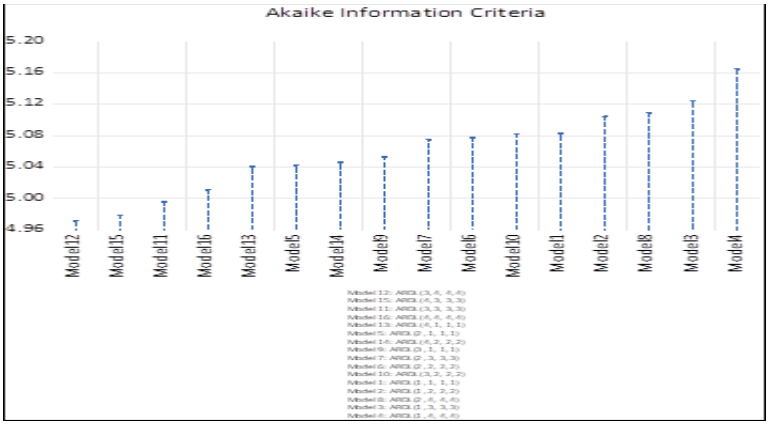

Figure 3.2: AIC Optimal Lags selection for ARDL Model

3.1.6 Multicollinearity Test

Table 3.5: Correlation Matrix

	GDPpc	DCP	BM	TO
GDPpc	1.000000	-0.005248	-0.034080	0.249290
DCP	-0.005248	1.000000	**0.715493**	**0.579222**
BM	-0.034080	**0.715493**	1.000000	0.477981
TO	0.249290	**0.579222**	0.477981	1.000000

Source: Eviews 12

Multicollinearity checks for the strength of relationship between variables. A strong connection can greatly impact data analysis and make the study bias. The test considers correlation coefficients, with values ranging -1 to +1. If the correlation coefficient takes the value +1, it indicates a perfect positive relationship between two variables and if it takes the value of -1, it shows a perfect negative relationship. The hypothesis statements for this test are:

H_o: Presence of multicollinearity

H_1: Absence of multicollinearity

The correlation matrix below gives an idea about the variables' relationship with each other and values are checked against 0.5 to reveal their strength and weakness.

All the values are below 0.5 except for the correlation between TO and DCP as well as BM and DCP. The relationship between BM and GDPpc, DCP and GDPpc, TO and GDPpc, BM and TO are weak in terms of their correlation strength. It is assumed that if any value exceeds 0.8 or 0.9, there is presence of strong multicollinearity between the independent variables. However, although the correlations of TO – DCP and BM – DCP are greater than 0.5, they are less than 0.8 suggesting that they do have a positive relationship but it is not strong enough to significantly impact data analysis. Interestingly, DCP and BM showed a negative relationship to GDPpc which may be reflected on when conducting the ARDL analysis.

3.1.7 Panel Cointegration Tests

Given that the variables are not stationary, the cointegration test will be able to perform, where it will assess the existence of long-run relationships between variables. Two panel cointegration tests is considered – Pedroni Panel Cointegration test and Kao Cointegration test – instead of the ARDL Bounds test which is applicable only on time series data.

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3.1.7.1 Pedroni Residual Cointegration test

Table 3.6 Pedroni Residual Cointegration test

Null Hypothesis: No cointegration Alternative Hypothesis: common AR coefs. (within-dimension)				
	Statistic	Prob.	Weighted Statistic	Prob
Panel v-Statistic	2.732540	0.0031	1.979216	0.0239
Panel rho-Statistic	-3.204789	0.0007	-2.440579	0.0073
Panel PP-Statistic	-7.001254	0.0000	-6.613023	0.0000
Panel ADF-Statistic	-5.905597	0.0000	-6.147662	0.0000
Alternative Hypothesis: individual AR coefs (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	-3.476086	0.0003		
Group PP-Statistic	-9.026481	0.0000		
Group ADF-Statistic	-6.467890	0.0000		

The table below assess presence of cointegration between the independent variables: DCP, broad money and trade-openness. The hypothesis statements that follow this cointegration test are:

H_o: No co-integration

H_1: Co-integration

The null hypothesis – no cointegration present – is to be rejected if values are less than or equal to 5% significance level. All the probabilities in the above table are less than the significance level, suggesting that there is infact cointegration between variables. The Kao test is to be perform to have a better idea on the existence of long-run connections among variables.

3.1.7.2 Kao Cointegration Test

Again here, the null hypothesis stipulates absence of cointegration and upon applying automatic lag length selection based on AIC with a maximum lag of 9, the following ADF values are derived:

Table 3.7 Kao Cointegration Test

	t-Statistic	Prob
ADF	-5.867835	0.0000

Since the ADF value is less than 0.05, the null hypothesis is rejected, validating the Pedroni Cointegration Test above that there is infact cointegration present between variables in the long-run.

3.1.8 Granger Causality Test

The Granger Causality test investigates the causal relationship between variables. It is imperative that variables do not granger cause each other, that is the past value of one variable should not be able to predict future values of other variables, as it may make the study's analysis bias. The hypothesis for the Granger causality test is:

H_o: Causal relationship exists between concerned pair of variables

H_1: Causal relationship does not exist between concerned pair of variables

For causal relationship not to exist, values must exceed 5% significance level.

Table 3.8: Pairwise Granger Causality Test

Pairwise Granger Causality Test			
Null Hypothesis:	Obs	F-Statistic	Prob.
DOMESTIC CREDIT TO PRIVATE SECTOR does not Granger Cause GDP PER CAPITA	195	0.23476	0.7910
GDP PER CAPITA does not Granger Cause DOMESTIC CREDIT TO PRIVATE SECTOR		0.27383	0.7608
BROAD MONEY does not Granger Cause GDP PER CAPITA	195	5.768404	**0.0037**
GDP PER CAPITA does not Granger Cause BROAD MONEY		0.26144	0.7702
TRADE OPENNESS does not Granger Cause GDP PER CAPITA	195	1.70458	0.1846
GDP PER CAPITA does not Granger Cause TRADE OPENNESS		3.58481	**0.0296**
BROAD MONEY does not Granger Cause DOMESTIC CREDIT TO PRIVATE SECTOR	195	2.63931	0.0740
DOMESTIC CREDIT TO PRIVATE SECTOR does not Granger Cause BROAD MONEY		**0.00911**	0.9909
TRADE OPENNESS does not Granger Cause DOMESTIC CREDIT TO PRIVATE SECTOR	195	1.19714	0.3043
DOMESTIC CREDIT TO PRIVATE SECTOR does not Granger Cause TRADE OPENNESS		1.61005	0.2026
TRADE OPENNESS does not Granger Cause BROAD MONEY	195	0.32794	0.7208
BROAD MONEY does not Granger Cause TRADE OPENNESS		0.69660	0.4995

Generated from: Eviews 12

From the first sequence, the probability of DCP to granger cause GDPpc is 79.10% and the inverse is 76.08, which are above the 5% significance level. This suggests that there is no causality between these two variables. All pairs of variables showed this characteristic except for BM causing GDPpc, GDPpc causing TO and DCP causing BM as they show probabilities less than 0.05. The null hypothesis cannot be vetoed for these pairs. However, GDPpc is seen not to have causality for BM, implying a unidirectional relationship between these two, that is, only the past values of GDPpc can predict or cause the current values of BM and not vice-versa. The same situation is applicable to the other two pairs: GDPpc – TO and DCP – BM. Hence, as a general interpretation of Table 5.6, no major causality can be said to occur that might hamper data analysis significantly.

3.1.9 Stability Test

To conduct the stability test, the Cumulative Sum of Recursive Residuals (CUSUM) test and the Cumulative Sum of Squares of Recursive Residuals test (CUSUMQ) is employed. This test assesses the goodness of fit of data for the ARDL model, where short-run and long-run parameters are measured for their stability. The CUSUM equation is as follows:

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$CUSUM_t = W_t = \sum_{y=k+1}^{t} \frac{W_r}{S_r}$ **(Equation 5.1)**

Where,

W = Recursive residual

S =Standard error to the size of the sample, T and t = k+1 to T.

The CUSUM's mean will diverge if the α vector does not stay constant and if the latter is fixed, the former takes the value of 0. Hence the CUSUMQ test statistic is as follows:

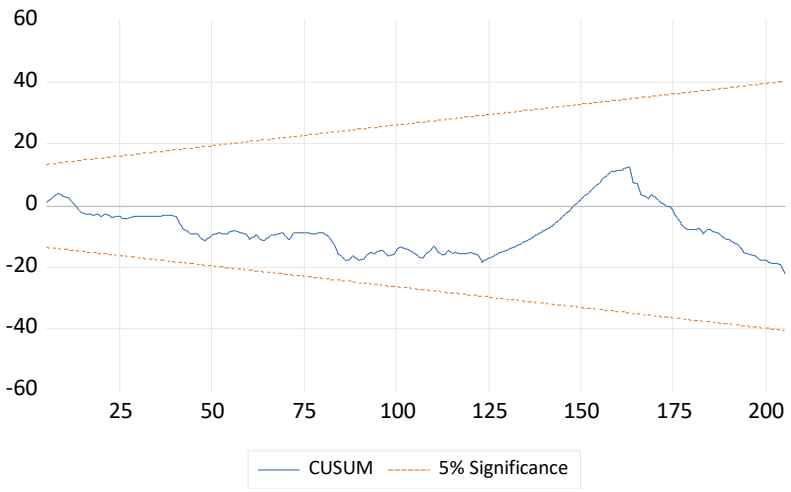
$$CUSUM_t = S_t = \frac{\sum_{r=k+1}^{t} W_r^2}{\sum_{r=k+1}^{T} W_r^2} \quad \textbf{(Equation 5.2)}$$

Given that the parameters remain fixed, the mean of S is given by:

$E(St) = \frac{t-k}{T-k}$ where at 0, t = k and at 1, t =T.

The graphs of CUSUM and CUSUMQ is measured at 5% significance level that is indictive of the stableness of the variance and parameter as shown in figure 5.2 and 5.3 below.

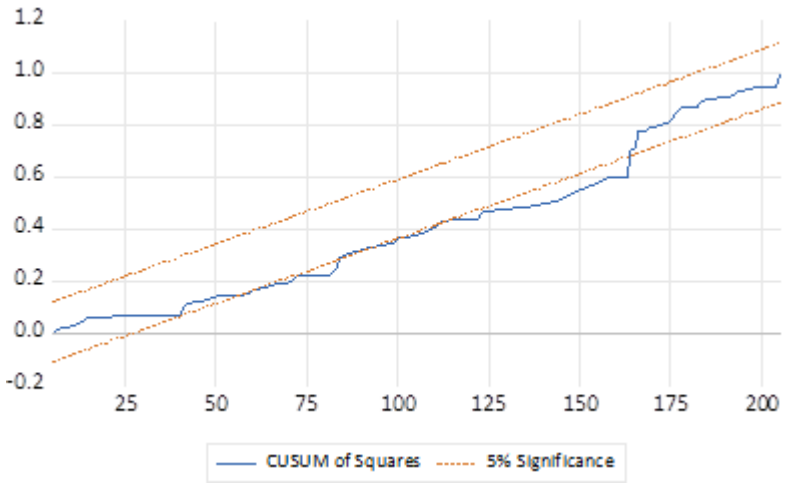
Figure 3.3: Plot of CUSUM test



Source: Eviews 12

In Figure 5.2, it is seen that the blue line is lying within the red critical lines proves that the residual variances are stable.

Figure 3.4: Plot of CUSUMQ test



At 5% significance level, the blue line does fluctuate a bit outside the critical bounds, however the majority lies within the bounds. The instability in data could be explained by the disturbances faced by the pandemic that did affect GDP and all the independent variables. Overall, the model is structurally stable enough for the ARDL analysis.

3.2 The Autoregressive Distribution Lag (ARDL) Model

Although the ARDL model has been present for decades, it recently proved to be more useful when it came to deriving long-term results in econometric series. From the table below, it is seen that DCP and BM have probabilities less than 5% significance level, implying that they are very significant variables in this model; they indeed have direct impact on GDP per capita. Trade Openness on the other hand has a probability greater than the significance level but its T-statistic is above 2 which shows that it does affect GDP per capita.

This brings the long run ARDL equation to:

$$\textbf{\textit{GDP per capita}}_{\,t} = \beta_0 + 0.058625\ \textbf{\textit{DCP}} - 0.129234\ \textbf{\textit{BM}} + 0.001646\ \textbf{\textit{TO}} + \mathcal{E}_t \qquad \textbf{(Equation 5.3)}$$

This implies that, given a change in DCP, there is a positive change of 0.058625% in GDP per capita. Similarly, a 1% change in BM will bring to a negative change of 0.129234% in the dependent variable. Lastly, given a change in TO will bring a positive change of 0.001646% to GDP per capita. Hence the model proves that, there is indeed a strong relationship between the Financial Innovation and the Economic Growth of IFC Islands in the long run.

Table 3.9: The ARDL Results

Long Run Equation				
Variable	**Coefficient**	**Std. Error**	**T-Statistic**	**Prob.**
DCP	0.058625	0.022043	2.659580	0.0089
BM	-0.129234	0.027152	-4.759593	0.0000
TO	0.001646	0.006926	0.237659	0.8125
Short Run Equation				
D(DCP)	0.057157	0.072636	0.786905	0.4329
D(BM)	-0.407745	0.170011	-2.398348	0.0180
D(TO)	0.078907	0.055646	1.418009	0.1587
Root MSE	1.835693		**Mean dependent var**	-0.445334
S.D dependent var	4.987548		**S.E. of regression**	2.379562
Akaike info criterion	4.485310		**Sum squared resid**	690.8027
Schwarz criterion	5.830724		**Log likelihood**	-376.7443
Hannan-Quinn criter.	5.029497			

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However, in the short run, DCP and TO have high probabilities against the 5% significance level, making them less significant variables in the model. BM, on the other hand, is less than the 0.05, suggesting that even in the short run BM impacts economic growth of IFC islands. In the short run, the ARDL equation is as follow:

$$\textbf{\textit{GDP per capita}}_{\,t} = 0.057157\ \textbf{\textit{DCP}} - 0.407745\ \textbf{\textit{BM}} + 0.078907\ \textbf{\textit{TO}} \qquad \textbf{(Equation 5.4)}$$

In the short-term, a change in DCP, BM and TO will bring 0.057157%, -0.407745% and 0.078907% change respectively to GDP per capita. Although the independent variables might not be as significant as in the long-run, they still prove that financial innovation does influence the economic growth of IFC Islands.

Nazir et al. (2020) found that financial innovation had a positive impact on economic growth in China, India and Pakistan, both long and short run, suggesting that monetary management and credit flow to the private sector are vital elements to growth of their economy. As for IFC islands, it is not quite the same results since broad money seems to have a negative impact on GDP per capita and projecting financial innovation as a negative influence on economic growth when in reality, DCP and trade openness have significant positive influence, even if they cannot out-weight that of broad money. Satia and Okle (2020) had discovered that in the long run DCP and broad money were positive but in the short-run negative, implying that financial innovation adds to economic-growth of Cameroon in the longer term. Bara et al. (2016) also found positive relationship between FI and EG in SADC through the ARDL model. Qamruzzaman and Jianguo (2017, 2018) found long-run cointegration between the EG and FI in Bangladesh and South Asia respectively but used NARDL to understand impact

of each variable for South Asia. Hence this study also – given the ambiguity surrounding BM being a negative influence in both the long- and short-term – implements the NARDL Model below.

3.3 The Non-Linear ARDL (NARDL) Model

The linear model of ARDL bases itself on symmetric-assumption that the dependent variable is linearly affected by explanatory variables, where the probable impact of the explanatory stays the same. However, the reality is that movements in a variable can alter to either the positive or negative direction. The NARDL model considers the positive and negative change in the independent variable each and accounts for the asymmetries that may be present between variables, as proposed by Shin et al. (2014).

The table below sums up the data generated for the study under the NARDL model in the short-run.

Table 3.10.1: Short-run NARDL values

Short-run				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob**
C	2.779236	0.649688	4.277804	0.0000
GDPC(-1)	-0.387274	0.088982	-4.352270	0.0000
DCP P(-1)	-0.014835	0.020670	-0.717684	0.4739
DCP N(-1)	-0.116435	0.064172	-1.814440	0.0714
BM P(-1)	0.557471	0.080702	6.907734	0.0000
BM N(-1)	0.365337	0.090429	4.040023	0.0001
TO P(-1)	0.080935	0.032547	2.486707	0.0139
TO N(-1)	-0.144095	0.030520	-4.721401	0.0000

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The R-square (Appendix 9) in the model is 0.575301, that is approximately 57.5% of the variations in the dependent variable is deduced by the independent variables. To obtain the long-term values of the independent variables, their positive and negative coefficients are divided by the coefficient of the dependent variable, generating the table below:

Table 3.10.2: Long-run NARDL values

Long-run	
Variables	**Long-run coefficients (absolute values)**
DCP P(-1)	0.038306
DCP N(-1)	0.300652
BM P(-1)	1.439474
BM N(-1)	0.943355
TO P(-1)	0.208986
TO N(-1)	0.372075

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Hence, the long-run NARDL equation is:

GDP per capita = c + 0.038306 **dcp_p** + 0.300652 **dcp_n** + 1.439474 **bm_p** +0.943355 **bm_n** + 0.208986 **to_p** + 0.372075 **to_n** + μ

(Equation 5.5)

The equation states that a 1% increase in DCP of the IFC islands will increase the GDP per capita by 0.038306 units while a 1% decrease in the DCP will lead to a fall of 0.300652 units in GDP per capita. Similarly, a 1% increase in BM will increase GDPpc by 1.439474 units and a 1% decrease in BM will result in 0.943355 units decrease in GDPpc. As for Trade Openness, a 1% increase will lead GDPpc to rise by 0.208986 units and a 1% decrease in TO will bring a fall in GDPpc by 0.372075 units.

Damane and Sekantsi (2021) also implemented the NARDL model along-side their ARDL bounds testing, to understand the short-term and long-term symmetric effects of FI on EG. Short-run positive changes in financial innovation, relative to growth of the economy, were found more significant in the long-run, similar to the findings of this study, where overall

finance-relative innovation seems to be directly related to GDPpc. Qamruzzaman and Jianguo (2018)'s NARDL results for South Asia, suggest that financial innovation has a positive impact on growth in short and long term, but had "mixed behaviors in the case of positive and negative changes in financial innovation". Similar mixed behaviour is seen for IFC islands as some variables (Appendix 9) have had positive and negative impact on the GDP per capita.

6. Conclusion

In an attempt to understand the possible influence of FI on economic expansion, this study took the context of International Financial Centre Islands, including Mauritius, Seychelles, Antigua and Barbuda, Singapore and Bahamas. To account for financial innovation, domestic credit to private sector, broad money and trade openness have been proxied and for economic growth, GDP per capita was used. Since some of the variables are integrated at I(0) and I(1), the ARDL model has been employed, assessing the short-run dynamics of this study and the long-run relationship between variables. The cointegration tests imply existence of long run link between FI and EG of IFC islands which was also seen in Lesotho (Damane and Sekantsi, 2021), Nigeria (Risikat and Auwal, 2021), China, India and Pakistan (Nazir et al., 2020) as well as in Cameroon (Satia and Okle, 2020), South Asia and Bangladesh (Qamruzzaman and Jianguo, 2017;2018) and SADC (Bara et al., 2016).

Interestingly, DCP and broad-money had "negative coefficients in the short run" for Cameroon (Satia and Okle, 2020) and for IFC islands, BM was negative in the short-run as well. Results suggests that although in the short-run, only broad money has noteworthy impact on economic growth as the circulation and volume of money is a constant financial innovation to be present in the short-run. Economic theories suggest that higher money supply leads to falling interest rate and increase in borrowing capacity and aggregate demand, positively impacting GDP per capita. In the long-run, broad money and DCP have greater influence on GDP per capita. Both are main proxies of financial innovation, as seen in various empirical evidence, and contribute in terms of the availability of funds, making it easier for industries to flourish and attract FDI. DCP is a variable more likely to be significant in the longer term as it encapsulates long-term loans/capital/equity which have longer maturity, thus impacting later on. Bara et al., (2016) discovered that similar variables "generally has a positive relationship" in the longer run for SADC, but in Bangladesh (Qamruzzaman and Jianguo, 2017) the relationship was significant in the both long and short term.

Trade Openness did not show significant influence on GDP per capita of IFC islands in both long-run and short-run but still had a positive impact. However, Nazir et al., (2020) found "trade openness and gross capital formation contribute considerably to the economic growth in China, India and Pakistan". IFC islands' exports and imports seem to have less significant influence over EG unlike bigger countries as China, India and Pakistan.

However, these findings are subject to linearity, where it is assumed that "mean values of the outcome variable (dependent variable) for each increment of the predictors (independent variables) lie along a straight line". The Non-Linear ARDL is thus implemented to dissect the impact of the variables if they increase and decrease. Indeed, results showed that all variables affect GDP per capita differently and that Trade openness can be significant in affecting the dependent variable. There is infact, non-linearity present in the data. That is, a negative and a positive change in the independent variables are going to affect the dependent variable in their own way with different intensities. The NARDL also supports the conclusion that long-run relationship does exist between Financial-Innovation and Economic-growth. It can be inferred that there is asymmetric relationship between them and that financial innovation is directly linked to GDP per capita, implying that its positive change will bring greater economic growth and negative change bring adverse effects on the latter. DCP's negative impact on GDPpc is not too significant and BM has a lasting positive impact on EG. Similarly, in Lesotho (Damane and Sekantsi, 2021), the NARDL showed "statistically insignificant impact in the short-run" of FI on EG but "negative changes in financial innovation were found to have no significant impact on Lesotho's economic growth in the short and long-run."

Infact, the NARDL model suggest relatively lower negative impact should there be a decrease in financial innovation, and the idea is supported by Qamruzzaman and Jianguo (2018), as such they were found for Bangladesh.

Overall, there had been positive changes on GDP per capita of IFC islands due to financial innovation, with DCP and BM being prominent influences. And as Risikat et al. (2021) once propounded: financial system has a "crucial role to play in the nation's economy, which validates the finance-growth theory".

7. Policy Recommendation

Interestingly, unlike previous empirical evidence, this study found broad money to be a negative influence on GDP per capita of IFC islands. K. Robert suggests that "Throughout history, there has been a strong tendency for the prices of assets–such as housing and stocks–to artificially rise following an increase in the money supply, or anything that results in a high level of liquidity entering the economy. This misallocation of capital can lead to speculative investments, which can result in the rapid escalation of asset prices followed by a contraction (an economic cycle known as a bubble) or an economic recession, a significant decline in economic activity." This could be the explanation as to why despite increasing flow on money in IFC islands, it is impacting negatively – the price rise of assets is only temporary. Hence broad money should be considered solely by policy-makers, where they can determine how exactly it is at the detriment of the economy

and resolve the issue, as it may induce hyper-inflation in the future, given the already expansionary inflationary pressures post Covid-19 pandemic and now the Ukraine-Russian War. Infact, this situation is similar to the Financial Crash where prices of housing were "artificial" leading to global recession. It is important that prices are correctly allocated and that the ideal monetary and fiscal policies are in place to channel the flow of money in a positive manner into the economy without triggering inflation.

Possible policies that may be implemented include, contractionary fiscal and monetary policies such as higher interest rate, higher taxes and buying back all government bonds. However, these may make investors wary of investing in the IFC Islands. Hence, broad money can be channelled from assets to new financial derivatives that the International Financial Centres can provide. Recently, Mauritius has launched crowdfunding where instead of loans from banks, peer-to-peer lending platforms allow for loans and other monetary facilities to take place without an intermediary. Such financial products will not only reduce inflationary pressure but enhance the financial dynamics of IFC Islands, which is an important aspect to IFCs. This will also encourage economic growth as low inflation and increasing attractiveness of financial hubs will positively impact GDP per capita.

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