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Application of VECM to Analyze the Determinants of Multidimensional Financial Inclusion Index in Bangladesh

Tasneema Afrin
Assistant Professor
Institute of Business Administration
University of Dhaka
Dhaka, Bangladesh

Mashrur Navid
Associate Manager
Agent Banking Department, Alternate Banking Channels Division
BRAC Bank Limited
Dhaka, Bangladesh

Abstract
Bangladesh is turning out to be one of the rapidly growingcountries in terms of GDP, trade business and local and foreign business ventures. With the economy's growth, it is also essential to build up a robust financial system, which has been developing in Bangladesh since the early 2010s. In earlier 2010, there was the inception of Mobile Financial Services (MFS) and Agent Banking Operations, which are mostly the triggering point for a rapid financial inclusion activity.Previously, the informal financial activities were quite popular, which were not highly regulated. With introduction of MFS and Agent Banking initiatives by Bangladesh Bank, formal banking service in limited but updated form were introduced. Due to the ease of use, acceptability rose higher than ever. In this study, the impact of the financial service evolution through more financial service points, different financial accounts, various deposit and loan accounts were addressed to establish a Financial Inclusion Index (FII). This FII is a crucial part of this study, as there is limited work on such measurement. Afterwards, using the FII determinants, a correlation between the determinants of Financial Inclusion was established. As determinants, GDP, Remittance, FDI, Employment and Mobile Subscription were considered as there is a positive relation among them and Financial Inclusion was previously established by some authors. Apart from these, Financial Inclusion would never be possible without promoting financial literacy and awareness to the rural customers. To properly serve the underserved, underprivilege and hard to reach people, it is a must.The purpose of the study is to analyze the determinants of financial inclusions, which is mostly determined by establishing an empirical equation by using Vector Error Correction Model (VECM), which showsthe impact of these macroeconomic factors on Financial Inclusion.

Keywords: *Financial Inclusion, Financial Inclusion Index, Vector Error Correlation Model, Determinants, Financial Institutions.*

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I. Introduction

Financial Inclusion has become a very important agenda to ensure the economic growth of Bangladesh. To promote financial inclusion, numerous initiatives are already taken by the Government of Bangladesh as well as Bangladesh Bank, the regulatory body of financial institutions.In August 2021, Finance Institutions Division under Ministry of Finance and Bangladesh Bank jointly published "National Financial Inclusion Strategy". Financial inclusion has been recognized as enablers of 7 Sustainable Development Goals out of 17 and guides towards the national's goal to become a middle-income country that is free from poverty with inclusive and equitable society. (Islam et. al., 2021).

In recent times, Bangladesh has seen a significant growth in Financial Inclusion with the entrance of multiple new FinTech as well as maturation of Banks, Non-Banking Financial Institutions (NBFI), Mobile Financial Services (MFS), and Micro Finance Institutions (MFI) has boosted the growth of Financial Inclusion as a whole. During the COVID-19 pandemic, the importance of adapting digitization with ensuring coverage to the hard-to-reach areas were a high priority. During that time, we have seen significant adoption of Internet Banking, MFS, Agent Banking and other mediums which enabled financial inclusion. This study emphasized on

all of these institutions while calculating the Financial Inclusion Index (FII) and uses the determined result for analyzing the determinants of Financial Inclusion as a whole.

II. Literature Review

2.1 Overview on Financial Inclusion

Financial Inclusion has become one of the key factors for social development and poverty reduction (Beck et. al, 2000, 2004; Demirgüc-Kunt et. al, 2008;Islam, 2015; King and Levine, 1993; and Levine, 2005). Financial Inclusion has also shown a positive relationship with economic growth (Iqbal & Sami, 2017; Kim, Yu & Hasan, 2018; Sharma, 2016). Onaolapo (2015) analyzes data spanning three decades (1982 - 2012) to examine the impact of financial inclusion on economic growth of Nigeria and found that inclusive financial activities influencepoverty reduction very positively, resulting in 74%. Financial inclusion through an enhanced branch banking network, providing credit to rural areas, small scale loans yielded about 50% to variables of the equation he stated.

Financial inclusion boosts the economy by increasing money flow through transactions (Damodaran, 2013). Mobile financial service has played a huge role in this area and increased the usage, which helped both the government and MFS providers (Ashraf, 2021; Ozili, 2018).

Financial Inclusion initiates by the first major needs of its user, the deposit or savings of money. Khalily (2016) found around 66% of the households have savings in formal financial institutions, such as commercial banks, microfinance institutions (MFI), mobile financial services (MFS), or informal institutions. Out of these households, 13% had multiple accounts on different institutions. Another study found that access to loan positively impacts average labor productivity as well as total factor productivity positively (Khalily and Khaleque, 2013).

Khalily (2016) showed that financial service accessibility and adoption increased in Bangladesh due to high user penetration of MFS in rural areas. His study also emphasized on importance of financial literacy for access to financial services.

To ensure financial inclusion, awareness on financial services and financial literacy is very important. A study conducted in two districts of Maharastra, India by Kumbhare and Kumar (2016) showed that the National Financial Inclusion Programme (NFIP) by India failed in those areas due to lack of awareness of financial services. They stated that without financial awareness, the vulnerable people remain excluded from financial services.

Yadav et al. (2016) focused on reducing exclusion by describing the necessity to bring out low-cost instruments for the financial institutions to minimize the transactional cost as well as increase availability of financial institutions at the doorsteps of rural India. With low-cost financial services, the coverage can be high and the banks can seek new business opportunities and effectively perform the corporate social responsibility.

Han and Melecky (2013) correlated financial inclusion with financial resilience by analyzing data from 90 countries. They described how accessibility and usage of deposits can improve deposit base of banks and enable economy to absorb the financial shock during times of crisis. Hannig and Jansen (2010) found how inclusion of low-income, underserved, underprivileged people in the financial system leads to increment of deposit and loan base, which improves the local economic activities.

In the recent few years in Bangladesh, we have seen significant growth in usage of ATM machines, debit and credit card subscribers, MFS accounts, Agent Banking accounts and different non-frill accounts such as Ten Taka account, student account and so on. With this development, the users don't have to be involved in traditional banking services. To the underprivileged, underserved persons in the rural area, such traditional banking set up can be hard to conduct and they seek personal touch with assisted mode to their nearby places. So, this has given them convenience, resulting a significant increaseof mobile financial service penetrationin Bangladesh.

2.2 Determinants of Financial Inclusion

Numerous research on determinants of financial inclusion has been conducted across multiple countries with different economic scenarios. For this study, the major emphasis was given to previous works on Asia and Africa, as the socio-economic conditions of these countries are similar and can be assumed that the determinants will also act as the same. In these studies, different sets of determinants have been taken into consideration.

Park and Mercado (2015) had a cross-country analysis on developing countries of Asia where they emphasized on poverty, inequality, and financial inclusion found from per capita income, implication of law in society, literacy, age dependency ratio etc., which had a significant effect on financial inclusion. Honohan (2007) used different financial indicators from the IMF published database as well as household surveys and did a cross-country investigation of 160 economies. He found that gross national income (GNI), population density, andage dependency ratio inversely affects access to finance, whereas mobile phone subscription and quality of financial institutions increase the financial inclusion significantly. Mihasonirina and Kangni (2011) found that

the banking sector backed by a strong IT development has positively impacted financial inclusion while conducting a study on South African region. Toxopeus and Lensink (2007) conducted cross-country research with remittance inflow as a determinant and found a positive relationship between remittance inflow and financial inclusion. Soumaré et al. (2016) conducted study on countries of Central and West Africa and found age, gender, residence area, household size, education, income, employment status, marital status, and degree of trust in financial institutions determines the financial inclusion.Cámara and David (2015) studied at the country level in Peru and found vulnerable groups like women and people living in rural areas are more excluded from financial services. Their study also found influence of age, gender, education, and income level towards financial inclusion.

Implication of dynamic GMM method has been adopted by several authors while analyzing the determinant of financial inclusion. Kumar (2013) found that the level of branch network, geographical region, ease of access to financial inclusion has significantly impacted financial inclusion in India. Uddin et al. (2017) used data from 2005-2014 and took inflation and GDP as macroeconomic indicators and total volume of deposit, total volume of loans and advances, size of bank based on customer and distribution network, cost-to-income ratio, interest rate, GNI as variables for calculating financial inclusion.

To determine the macroeconomic factors affecting Financial Inclusion, variables are picked up based onthese literature review and consideration of financial institutions contributing to the financial inclusion. When a set of integrated variables jointly shows same stochastic trend, cointegrating relationships can be imposed by reparametrizing the Vector Auto Regression(VAR) model as Vector Error Correlation Model (VECM). It is an effective tool to determine the relationship between various macroeconomic factors with a known or unknown variable.

A determined Financial Inclusion Index (FII) has never been compared with the macroeconomic factors by VECM approach before this study, but similar approach is taken by multiple authors such as Uddin and Chowdhury (2020), Mishra and Palit (2020), Rizvi and Nishat (2009), Morshed and Hossain (2022) and so on who used variables such as FDI, GDP, Employment; which shows positive relationship with the determined FII in this study.

III. Research Methods

3.1 Data Source and Analysis Tool

The data used in this study are collected from multiple open data sources. To establish the Financial Inclusion Index and other relevant macroeconomic factors considered as determinants, data are sourced mostly from World Development Indicators, data archive of the World Bank containing data from 1960 - 2021 and Financial Access Survey, data archive of the IMF containing data from 2004 - 2021. Our study is limited to Bangladesh data of 17 years, from 2004 - 2020 to maintain consistency while preparing the model. VECM Approach. To do this, E-Views 12 Student Edition software is used, which is an open-sourced student edition software to perform various econometric calculations.

3.2 Variables and their Justification

3.2.1 Dependent Variable

Financial Inclusion Index (FII) is considered as dependent variable by adapting an approach tof Sarma and Pais (2011). In this approach, the Financial Inclusion Index is estimated by considering multipleratios. Previously different authors used different variables, such as Mhlanga and Denhere (2020) used bank account ownership, Maity and Sahu (2020) used number of deposit and loan accounts per thousand of total population, Uddin et al. (2017) used natural log of total deposit and total loans, Gebrehiwot and Makina (2019) used branches of commercial banks per 100,000 adult population, customer with deposit accounts with commercial banks per 1000 adult population and domestic loan to the private sector as percentage of GDP. For this study Service points ratio, customer ratio, deposit account ratio, and loan account ratio are taken.

Following the Sarma and Pais (2011), the financial inclusion index computed fromfour dimensions should lie between 0 and 1, where 0 indicates complete financial exclusion and 1 indicates complete financial inclusion. Accordingly, the yearly index is calculated using the following formula:

$$FII = \frac{1}{2}\left[\frac{\sqrt{(I_a^2+I_b^2+I_c^2+I_d^2)}}{\sqrt{n}} + \left(1 - \frac{\sqrt{(1-I_a)^2+(1-I_b)^2+(1-I_c)^2+(1-I_d)^2}}{\sqrt{n}}\right)\right]$$

Where, FII = Financial Inclusion Index (Dependent Variable)

I_a = Service points ratio (including branches of banks, MFIs,outlets of agent banking, MFS and ATMs)

I_b = Customers ratio (including customers of banks, MFIs, MFS)

I_c = Deposit accounts ratio (including accounts of banks, MFIs)

I_d = Loan accounts ratio (including accounts of banks, MFIs).

There is no weighted average approach taken, as no significance of weight can be found upon the four parameters. The ratio is determined by dividing the values with adult population. All the data are sources from World Development Indicators.The details of these parameters aredescribed in Section4.1.

3.2.2 Independent Variable

Dependent Variables of Financial Inclusion are picked up after going through the literature review and running some statistical analysis. Only those values are picked up which showed significant positive relationship with the Financial Inclusion Index (FII). The following Table 3.1 explains the independent variable's definition and relation with dependent variable FII.

Table 3.1: Description of Independent Variables

Variable	Relationship with FII	Description	Reason for Choosing
GDP	Positive	Gross Domestic Product or GDP is defined as the gross value added by all resident producers in the economy. Data are in USD.	With more money flow, traditional channel-based transaction increases.
Inward Foreign Remittance	Positive	Comprises of compensation of employees who are employed as non-resident and personal transfers from any individuals outside the country. Data are in USD.	Brings foreign currency that subsequently increase beneficiary accounts in the country.
FDI	Positive	Foreign Direct Investment or FDI are the inflow of equity reported in economy. Data are in USD.	Increases employment and business opportunity.
Employment	Positive	Employment is the number of employed resident individuals working in the economy. Data are in exact number.	Directly related to financial channel use as individuals join the work force.
Mobile Subscription	Positive	Mobile subscriptions are public mobile telephone subscriptionsin both prepaid or postpaid accounts. Data are in per 100 people.	A mandatory requirement for MFS accounts. Also, all financial accounts require mobile subscription.

3.3 Methodology

To conduct the research on multiple macro-economicvariables, the Vector Error Correction Model (VECM) has been taken as a standard practice and given nature of the dataset. The following model is prepared using the EViews 12 Student Edition software, an open-sourced student addition software to conduct econometric calculations. Using this software, the following steps are conducted to estimating a VECM:

Step 1: Conduct Unit Root Test to check the data are either stationary or non-stationary.
Step 2: Determine the Optimal Lag Length.
Step 3: Perform Johansen Cointegration Test with the determined lag.
Step 4: Given the cointegration of the variables, conduct VECM model.
Step 5: Establish and explain the empirical equation.

3.4 Model Specification

To determine the model, first it is assumed that Financial Inclusion Index (FII) depends on overall GDP, Inward Foreign Remittance, Foreign Direct Investment or FDI, Employment and Mobile Subscription of the country. This relation can be explained by the following functional relation:

$$FII = \int (GDP, Rem, FDI, Emp, Mob)$$

As the variables are different and the unit varies throughout the function, all the variables are taken to their logarithmic forms to find out elasticity. Ordinary Least Squares Regression (OLS) is conducted as per below equation:

$$lnFII = \beta_1 + \beta_2(lnGDP) + \beta_3(lnRem) + \beta_4(lnFDI) + \beta_5(lnEmp) + \beta_6(lnMob) + u$$

Where,
FII = Financial Inclusion Index (Dependent Variable)
GDP = GDP per capita (in USD)
Rem = Foreign Inward Remittance (in USD)
FDI = Foreign Direct Investment (in USD)
Emp = Employment (in number)
Mob = Mobile Subscription (per 100 people)
u = Error term

As a very basic tool, following equation gives a stimulated result. To make it more appropriate time series analysis, stationarity level of the variables is determined using unit root test. Both Augmented Dickey and Fuller (ADF) Test (after Dickey and Fuller, 1979) and Phillip-Perron Test (after Phillips and Perron, 1988) are done for this step.

Once the data are found stationary, Cointegration test is performed. As cointegration test, Johansen Cointegration Test (after Johansen and Juselius, 1990) is done and the following unrestricted Vector Auto Regressive (VAR) model was found.

$$Z_t = \theta_1 Z_{t-1} + \theta_2 Z_{t-2} + \cdots + \theta_p Z_{t-p} + \mu$$

Here, Z = The matrix of all endogenous variables
P = Lag order
μ = Stochastic error term.

The above equation can be regenerated as following:

$$\Delta Z_t = \sum_{i=1}^{k-1} \Gamma_i \, \Delta Z_{t-i} + \Pi Z_{t-1} + \mu_t$$

Here, Δ= Difference Operator
Γand Π = The matrices of coefficients.

There are two test statistics for the further steps, trace statistics and maximum Eigen value. Between these two, trace statistics were taken to consideration

$$\lambda_{trace}\,(r) = -T \sum_{i=r+1}^{n} \ln(1-\lambda)$$

Here, r = Rank of cointegration

The null hypothesis for this equation is there is no co-integration, resulting r = 0.

After finding out the variables are cointegrating, a short run dynamic was observed using VECM as the long run relationship is confirmed.

IV. Findings and Analysis

4.1 Financial Inclusion Index (FII)

Using the available data from World Development Indicators of World Bank and Financial Access Survey of the IMF, Financial Inclusion Index is determined and presented in the Table 4.1 with a graphical presentation Figure 4.1. According to the study, the financial inclusion rises significantly from 2011 (46%) and gained momentum on 2013 (50%), which can be explained as these years where the inception of theMFS industry and Agent Banking industryin Bangladesh, both are operated under indirect and direct governance of banks respectively. Also, during the COVID, year 2020 and 2021, the FII rose to 71%, which can be explained by various government initiatives such as disbursing social safety net, payment facilitation through these two channels and people's willingness to adopt to digital platform.

Table 4.1: Values of Indicators used to determine Financial Inclusion Index

Year	Service Points Ratio (I_a)	Customer Ratio (I_b)	Deposit A/C Ratio (I_c)	Loan A/C Ratio (I_d)	Financial Inclusion Index (FII)
2004	0.0001	0.4171	0.5129	0.2162	0.3038
2005	0.0002	0.4685	0.5678	0.2472	0.3374
2006	0.0002	0.5127	0.6182	0.2789	0.3677
2007	0.0002	0.4882	0.5993	0.2669	0.3545
2008	0.0002	0.5208	0.6431	0.2872	0.3776
2009	0.0003	0.5317	0.6585	0.2878	0.3841
2010	0.0003	0.5971	0.7489	0.2975	0.4230
2011	0.0003	0.7330	0.7973	0.2953	0.4636
2012	0.0005	0.7939	0.8127	0.2783	0.4765
2013	0.0022	0.8796	0.8485	0.2770	0.5015
2014	0.0053	0.9901	0.8771	0.2682	0.5272
2015	0.0055	1.1980	0.9337	0.2803	0.5748
2016	0.0067	1.3076	0.9915	0.2966	0.6030
2017	0.0072	1.5047	1.0498	0.3094	0.6373
2018	0.0080	1.6365	1.1220	0.3095	0.6592
2019	0.0086	1.7933	1.1979	0.3102	0.6801

2020	0.0093	2.0036	1.2674	0.3081	0.6993
2021	0.0097	2.1396	1.3217	0.3234	0.7126

Source: Author's own calculation. Details of the calculation is given in Appendix A.

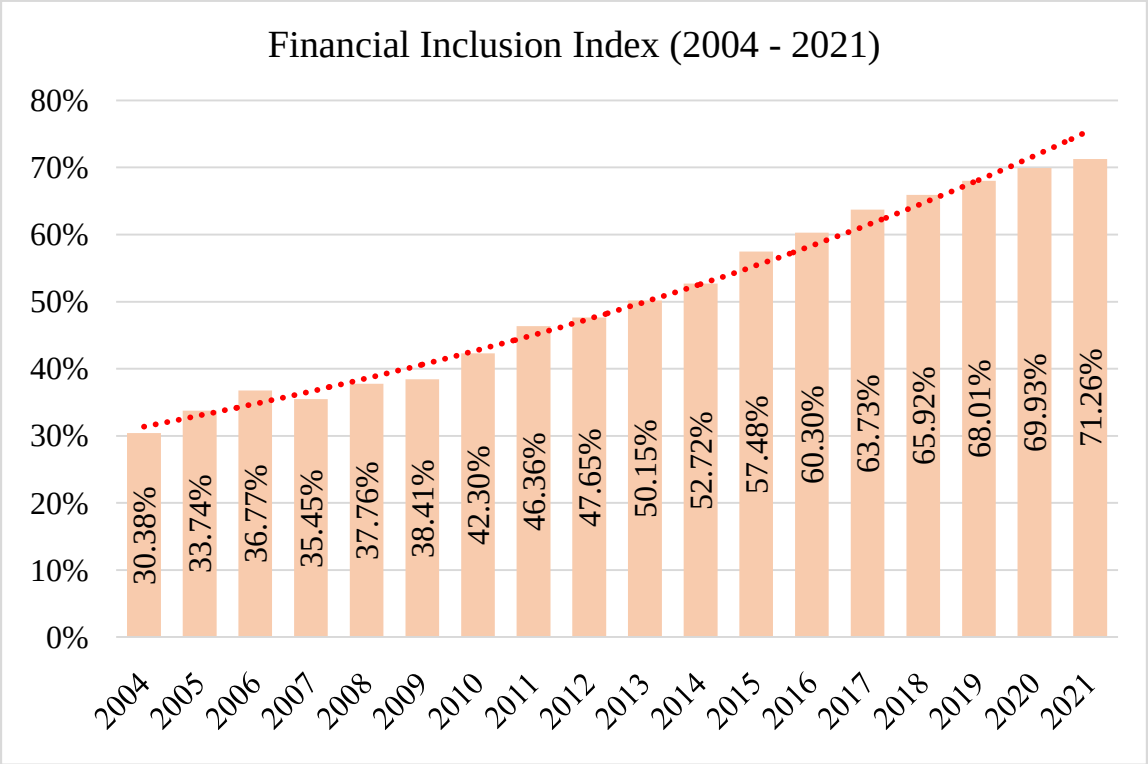

Figure 4.1: Financial Inclusion Index Trend: 2004 to 2021

4.2 Summary Statistics

A basic descriptive analysis is conducted in the six variables to understand the time series trend and determine some basic values such as mean, maximum and minimum value, standard deviation, skewness and Kurtosis and so on. The Table 4.2describes the descriptive statistics of the given dataset, which is given in Appendix B.

Table 4.2: Descriptive statistics for the yearly values of different variables (2004 – 2020)

Description	GDP (in USD)	Remittance (in USD)	FDI (in USD)	Employ-ment	Mobile Subscription (in %)	FII
Mean	161,536,014,210	11,958,724,513	1,545,303,835	60,081,292	59.48%	0.4924
St. Dev.	85,262,528,484	4,976,954,388	785,592,364	5,558,629	35.46%	0.1304
Maximum	323,056,957,972	21,751,646,479	2,831,152,765	69,229,775	107.04%	0.6993
Minimum	65,108,544,250	3,583,817,228	448,905,401	51,987,835	2.03%	0.3038
Count	17	17	17	17	17	17
Skewness	0.6545	-0.0936	0.2056	0.3488	-0.2805	0.2228
Kurtosis	-0.8625	-0.3329	-1.2779	-1.0563	-1.3777	-1.3694
JB	11.7810	7.8932	13.0827	11.9993	13.7973	13.6641
Probability	0.0028	0.0193	0.0014	0.0025	0.0010	0.0011

Jarque-Bera test is performed using the following equation:

$$JB = \frac{n}{6}\,(S^2 + \frac{1}{4}(K-3)^2)$$

Here, n = Number of observations, 17
S = Skewness
K = Kurtosis

It is always a positive number and the further the value from zero, the more it indicates the data does not contain any normal distribution. The studied data ranges from 7.89 to 13.80.

Probability test is conducted by determining the chi-square distribution with 2 degrees of freedom. The value should be less than 0.05, indicating the null hypothesis can be rejected. As for the variables are between 0.0010 to 0.0193, we canreject the null hypothesis and claim that the dataset is normally distributed.

4.3 Model Analysis

The correlation analysis determines the simple linear relationship or linear interdependence between two variables. It is a straight through relationship analysis with always two variables in consideration. Whereas, for the six variables testing, cointegration analysis is used, which checks the existence of a long-run relationship between two or more variables.

4.3.1 Correlation Matrix

Firstly, Correlation matrix table (Table 4.3) is prepared to see the correlation between each of the variations for an overall understanding.

Table 4.3: Correlation Matrix

	GDP	Rem	FDI	Emp	Mob	FII
GDP	1.0000					
Rem	0.8941	1.0000				
FDI	0.5761	0.6593	1.0000			
Emp	0.9854	0.9090	0.6411	1.0000		
Mob	0.9349	0.9510	0.7729	0.9643	1.0000	
FII	0.9841	0.9142	0.6771	0.9892	0.9735	1.0000

Based on the correlation matrix, it can be said that all of the independent variables have strong correlation with Financial Inclusion Index (FII), with value maximum 99% for correlation between FII and Employment and minimum 68% for correlation between FII and FDI. FDI has the least correlation with other variables and the determined dependent variable FII has the highest correlation.

4.3.2 Unit Root Test

The unit root test checks whether the datasets are stationary or non-stationary in the time series. The data is said to be stationary if the values are less than or equal to 0.05, indicating the null hypothesis is rejected. Stationary time series has all the statistical properties, such as mean, variance, and covariance of the distribution are constant over time. Only when the data is stationary, regression analysis can be carried out. For determining stationarity of the data, both Augmented Dickey-Fuller (ADF) test and Phillips-Perron test had been conducted for all values at level and at 1st difference, with once at intercept and another time at trend and intercept. In the Table 5.4, only trend and intercept data are shown as they are much accurate and widely accepted. The null hypothesis of unit root test is that there exists unit root in a series, or the series is non-stationary. This table is constructed by analyzing the data on EViews 12.

Table 4.4: Unit Root Test

Variables	ADF Test		Phillips-Perron Test		Result
	Level	1stDifference	Level	1stDifference	
ln(GDP)	0.0355*	0.3201	0.0997	0.5308	Stationary at Level, Non-Stationary at 1stDifference
ln(Rem)	0.3069	0.5723	0.5356	0.5935	Non-Stationary at both Level and 1st Difference
ln(FDI)	0.8194	0.0043*	0.8594	0.0016*	Non-Stationary at Level, Stationary at 1st Difference
ln(Emp)	0.1179	0.0955	0.5291	0.2540	Non-Stationary at both Level and 1st Difference
ln(Mob)	0.2741	0.1711	0.0000*	0.0000*	Stationary at both Level and 1st Difference
ln(FII)	0.2809	0.0219*	0.2809	0.0196*	Non-Stationary at Level, Stationary at 1st Difference

4.3.3 Lag Length Selection

The lag selection is important tool in order to minimize the prediction error of the proposed model. In the analysis, first Vector Autoregression Estimates is determined using FII as dependent variable (Appendix C) and based on the result lag 0 – 3 is conducted (details in Table 4.5) and lag length is 1 is selected, as it held to maximum lowest values. According to Johansen and Juselius (1990), well organized results for small samples (such as the studied data) the lag should be either 1 or 2, so the data seems fit to conduct cointegration tests.

Table 4.5: Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	79.10103	NA	4.34e-12	-9.137628	-8.847907	-9.122792
1	203.4602	139.9040*	1.01e-16*	-20.18252*	-18.15448*	-20.07867*

Here, * indicates lag order selected by the criterion
LR: Sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan/Quinn information criterion

4.3.4 Johansen Cointegration Test

Johansen Cointegration Test is performed to identify whether three or more time series are cointegrated or not. It is based on two maximum likelihood ratio called maximal eigenvalue test and trace test (Johansen, 1988, 1991). The hypothesis states there is no cointegrating equation and rejects the hypothesis if $p \leq 0.05$
If there is a cointegration, the series can be said to be related and can be combined into a linear function. That is, even there are no patterns found in the short run, which may affect the anomaly in the series, the variables would converge with time in longer run.
To determine the cointegration test, a summary table is prepared based on applying all the assumptions and lag interval ranges from 0 to 4 from different deterministic trend assumptions. The trend assumptions are summarized in Table 4.6.

Table 4.6: Deterministic Trend Assumption

Assumption	Deterministic Trend Type	CE		Test VAR
		Intercept	Trend	Intercept
1	No Trend	X	X	X
2		✓	X	X
3	Linear Trend	✓	X	✓
4		✓	✓	X
5	Quadratic Trend	✓	X	✓

Applying these assumptions, in the alkaline information criteria by rank (row) and model (column), the lowest value present in the 2nd row (indicating Lag 1) at 5th column, indicating 5th assumption, a quadratic deterministic trend. After re-running the model based on the given value, both trace and maximum eigenvalue was determined by EViews 12, but for our study purpose and best practice, trace value is taken. The detailed value is given in Table 4.7.

Table 4.7: Johansen Cointegration Test: Unrestricted Cointegration Rant Test (Trace)

Hypothesized No of CE(s)	Null Hypothesis	Eigen-value	Trace Statistics	0.05 Critical Value	Prob*
None*	r = 0	0.991544	168.5511	107.3466	0.0000
At most 1*	r ≤ 1	0.879400	92.18496	79.34145	0.0039
At most 2*	r ≤ 2	0.801384	58.34050	55.24578	0.0261
At most 3	r ≤ 3	0.612064	32.47838	35.01090	0.0911
At most 4	r ≤ 4	0.511475	17.32774	18.39771	0.0701
At most 5*	r ≤ 5	0.306927	5.865914	3.841465	0.0154

* p-values, after MacKinnon et al. (1999)

From the Table 4.7, atr = 0 the trace statistics is within the 5% critical value, indicating the null hypothesis is rejected, i.e., there is no cointegration equation. So, there exists one co-integrating equation and a long run relationship.

5.3.5 Estimated Vector Error Correction Model (VECM)

After confirming that there is a long run relationship between the studied variables, the VECM analysis is conducted. Vector Error Correction Model (VECM) is chosen as it can interpret long-term and short-term

equations. Due to the lack of variable inputs in FII, the short run dynamic test with empirical equation cannot be determined, so only long-term empirical equation is established.

After conducting the analysis on EViews 12 based on the Johansen Cointegration Test, the following Normalized Cointegrating Equation is established:

$$lnFII = 0.26(lnGDP) - 0.25(lnRem) + 0.06(lnFDI) - 0.89(lnEmp) + 0.17(lnMob)$$

(0.06699) (0.01582) (0.00702) (0.17836) (0.00671)

**Note: Values under each variable shows the standard error in parentheses.*

In the equation, the standard error is also very negligible, ranging from 0.18 for Employment to 0.006 for Mobile Subscription, indicating the model seems to be a good fit.

From the equation, it is determined that in long run GDP, FDI and Mobile Subscription has impacted on financial inclusion index (FII) positively. From the equation coefficients, it can be concluded that with 1% increase in GDP, FDI, and Mobile Subscription, the FIIincreases by 0.26%, 0.06%; and 0.17% respectively.

The coefficient values of Remittance and Employmentare negative.This means with 1% increase in Remittance and Employment, FII decreases by 0.25%, and 0.89% respectively. For both cases, two probable explanations may be applicable:

- Remittance received are mostly from the foreign workers who already have accounts in the country where their salary is credited, or they send money though remittance house or banks. But in the rural area, the remittance beneficiary, who are mostly women, does not have an account as they don't find confidence to go to a branch and open an account there. They rely on some third-party persons, who mostly get this money either from Hundi or all the money comes directly to their account and the pay the beneficiaries back with taking some commission in between. That is why despite having an increase of remittance there may not be a positive impact on financial inclusion. In real life scenario after discussion with the industry experts, some say due to inaccessibility and lack of awareness, one single dealer may take a huge commission only for withdrawing the money from the exchange house. To prevent this, financial literacy and awareness is a must.
- Employment should imply to increase in Financial Inclusion, as it creates more jobs and job holders may increase their banking products like saving account, loan account, fixed deposit accounts, etc. as they keep on using the channel. However, not all employment relies on disbursing salaries through any formal channel. The lower margin people who are outside the financial inclusion umbrella usually get their salary by cash. Although MFS is showing promise to penetrate this market.For example, some of the garments start to pay theirworkers salary is disbursed through MFS during pandemic. Still there is some barrier here as well, the cash withdrawal charge from MFS is high, ranging from 1% to 2% of the amount. In this particular case, Agent Banking can be a better alternative, as through this channel cash withdrawal and deposit from the mother agent banking outlet (where the customer has opened his/her account) is free. Financial literacy and awareness are needed here as well, and employers and employees need to have a clear vision why they should use the formal channel rather than having the salary in cash.

V. Conclusion and Recommendation

Financial Inclusion has become a major agenda by Government of Bangladesh and Bangladesh Bank, as without it a robust financial ecosystem cannot be built. Through this study, it is found that the financial inclusion rose from 30.38% back in 2004 to 71.26% in 2021, meaning almost 2.5 times growth in 18 years. Recent initiatives from central bank and government to address the rural, financially excluded population through innovative accounts and distribution channel is certainly praiseworthy, which is resulting to such growth in short period of time.

On the other hand, there are some drawbacks. Due to lack of proper financial literacy and awareness, still rural people, mostly women are outside the financial inclusion umbrella. Using their lack of touch, the middle men are taking unethical approaches such as Hundi or other fraudulent activities by the name of bank, or financial institutions such as NGO and MFI, or Cooperatives. Regulatory framework needs to be strengthened to ensure safe and secure financial services. There also lacksa proper database on financial inclusion could be found, as not all the financial accounts are tagged or opened using NID or any other social security number such as use of Aadhar Card by our neighboring country India. Furthermore, interoperability between the different service channel is needed as well.

The Financial Inclusion Index determined in the study reflects the actual scenario, however, as mentioned earlier due to lack of proper database based on single reference, no proper data can reflect the actual scenario of Financial Inclusion directly, like how many people are actually having any formal financial institution accounts for either deposit or credit. Also, statistical analysis wise, lack of such data made the study limited as the time series could not be expanded to checktheshort run dynamic equation. However, the empirical equation that was established using VECM approach is a good fit. The study reflects that opportunity persists to make a financially resilient and robust system which will ensure inclusive banking irrespective region, profession, and gender. Bangladesh will soon reach full potential economically if the leverage of rapid

digitization is properly utilized and financial literacy and awareness is properly disseminated to the underserved, underprivileged people.

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Appendix

Appendix A: Components of Financial Inclusion Index Estimation

A1 Service Points Ratio(I_a)

Year	Branches of Commercial Banks (1)	Branches of MFIs (2)	No. of Agent Banking Outlets of Commercial Banks (3)	Automated Teller Machines (ATMs) (4)	No. of MFS Outlets (5)	Total No. of Service Points (6) = (1)+(2)+(3)+(4)+(5)	Adult Population (Age 15+) (7)	Service Points Ratio(I_a) (8)=(6)/(7)
2004	6,304	6,106	NA	115	NA	12,525	89,166,840	0.0001
2005	6,404	7,733	NA	184	NA	14,321	91,256,553	0.0002
2006	6,565	12,156	NA	330	NA	19,051	93,135,245	0.0002
2007	6,727	13,507	NA	486	NA	20,720	94,956,690	0.0002
2008	6,902	13,200	NA	816	NA	20,918	96,746,413	0.0002
2009	7,244	18,185	NA	1,267	NA	26,696	98,540,562	0.0003
2010	7,641	17,726	NA	2,121	NA	27,488	100,370,567	0.0003
2011	8,009	18,068	NA	3,797	5,654	35,528	102,371,967	0.0003
2012	8,382	17,977	NA	4,217	25,988	56,564	104,382,489	0.0005
2013	8,724	14,674	NA	5,273	204,359	233,030	106,407,881	0.0022
2014	9,111	14,730	NA	6,259	544,565	574,665	108,451,805	0.0053
2015	9,458	15,358	448	7,839	573,853	606,956	110,507,467	0.0055
2016	9,747	16,284	2,579	9,036	711,194	748,840	112,553,881	0.0067
2017	10,055	17,052	4,158	9,580	787,219	828,064	114,614,869	0.0072
2018	10,375	18,196	6,934	10,406	886,880	932,791	116,665,645	0.0080
2019	10,568	18,977	11,320	11,178	971,544	1,023,587	118,674,192	0.0086
2020	10,671	20,898	15,977	12,703	1,058,897	1,119,146	120,627,494	0.0093
2021	10,939	20,955	19,247	14,031	1,123,458	1,188,630	122,547,131	0.0097

A2 Customer Ratio(I_b)

Year	Customers of commercial banks (1)	Customers of MFIs (2)	No. of Registered MFS Accounts (3)	Total No. of Customers (4) = (1)+(2)+(3)	Adult Population (Age 15+) (5)	Customer Ratio (I_b) (6)=(4)/(5)
2004	22,795,768	14,400,000	NA	37,195,768	89,166,840	0.4171
2005	23,934,903	18,820,000	NA	42,754,903	91,256,553	0.4685
2006	24,858,359	22,890,000	NA	47,748,359	93,135,245	0.5127
2007	25,787,022	20,567,490	NA	46,354,512	94,956,690	0.4882
2008	26,807,288	23,579,270	NA	50,386,558	96,746,413	0.5208

2009	27,491,834	24,901,152	NA	52,392,986	98,540,562	0.5317
2010	33,540,746	26,388,150	NA	59,928,896	100,370,567	0.5971
2011	48,869,068	26,044,130	125,506	75,038,704	102,371,967	0.7330
2012	57,179,153	24,637,184	1,055,334	82,871,671	104,382,489	0.7939
2013	56,077,107	24,617,934	12,903,553	93,598,594	106,407,881	0.8796
2014	58,055,942	25,112,574	24,207,539	107,376,055	108,451,805	0.9901
2015	72,197,258	25,900,199	34,291,595	132,389,052	110,507,467	1.1980
2016	78,338,557	27,790,828	41,047,116	147,176,501	112,553,881	1.3076
2017	83,757,687	29,908,775	58,796,223	172,462,685	114,614,869	1.5047
2018	91,977,325	31,216,753	67,731,960	190,926,038	116,665,645	1.6365
2019	100,792,124	32,370,910	79,653,747	212,816,781	118,674,192	1.7933
2020	109,007,905	33,339,719	99,336,198	241,683,822	120,627,494	2.0036
2021	115,507,723	35,192,823	111,498,669	262,199,215	122,547,131	2.1396

A3 Deposit A/C Ratio(I_c)

Year	Deposit Accounts with Commercial Banks (1)	Deposit Accounts with MFIs (2)	Total No. of Deposit Accounts (3) = (1)+(2)	Adult Population (Age 15+) (4)	Deposit A/C Ratio (I_c) (5)=(3)/(4)
2004	31,332,685	14,400,000	45,732,685	89,166,840	0.5129
2005	32,996,923	18,820,000	51,816,923	91,256,553	0.5678
2006	34,683,049	22,890,000	57,573,049	93,135,245	0.6182
2007	36,337,158	20,567,490	56,904,648	94,956,690	0.5993
2008	38,638,909	23,579,270	62,218,179	96,746,413	0.6431
2009	39,986,516	24,901,152	64,887,668	98,540,562	0.6585
2010	48,784,254	26,388,150	75,172,404	100,370,567	0.7489
2011	55,578,265	26,044,130	81,622,395	102,371,967	0.7973
2012	60,196,294	24,637,184	84,833,478	104,382,489	0.8127
2013	65,666,487	24,617,934	90,284,421	106,407,881	0.8485
2014	70,008,283	25,112,574	95,120,857	108,451,805	0.8771
2015	77,285,412	25,900,199	103,185,611	110,507,467	0.9337
2016	83,806,878	27,790,828	111,597,706	112,553,881	0.9915
2017	90,411,690	29,908,775	120,320,465	114,614,869	1.0498
2018	99,686,694	31,216,753	130,903,447	116,665,645	1.1220
2019	109,792,030	32,370,910	142,162,940	118,674,192	1.1979
2020	119,549,170	33,339,719	152,888,889	120,627,494	1.2674
2021	126,782,257	35,192,823	161,975,080	122,547,131	1.3217

A4 Loan A/C Ratio(I_d)

Year	Loan Accounts with Commercial Banks (1)	Loan Accounts with MFIs (2)	Total No. of Loan Accounts (3) = (1)+(2)	Adult Population (Age 15+) (4)	Loan A/C Ratio (I_d) (5)=(3)/(4)
2004	8,133,876	11,140,000	19,273,876	89,166,840	0.2162
2005	8,574,401	13,980,000	22,554,401	91,256,553	0.2472
2006	8,791,275	17,180,000	25,971,275	93,135,245	0.2789
2007	8,486,138	16,857,189	25,343,327	94,956,690	0.2669

2008	8,633,490	19,153,032	27,786,522	96,746,413	0.2872
2009	8,747,950	19,608,571	28,356,521	98,540,562	0.2878
2010	9,139,579	20,724,894	29,864,473	100,370,567	0.2975
2011	9,554,406	20,673,607	30,228,013	102,371,967	0.2953
2012	9,734,484	19,312,926	29,047,410	104,382,489	0.2783
2013	10,205,034	19,271,479	29,476,513	106,407,881	0.2770
2014	9,669,536	19,421,695	29,091,231	108,451,805	0.2682
2015	9,887,179	21,087,864	30,975,043	110,507,467	0.2803
2016	10,102,494	23,286,609	33,389,103	112,553,881	0.2966
2017	10,608,826	24,849,642	35,458,468	114,614,869	0.3094
2018	10,704,156	25,398,463	36,102,619	116,665,645	0.3095
2019	11,047,067	25,760,074	36,807,141	118,674,192	0.3102
2020	11,014,197	26,153,659	37,167,856	120,627,494	0.3081
2021	11,833,509	27,804,209	39,637,718	122,547,131	0.3234

Appendix B: Yearly values of different variables (2004 – 2020)

Year	GDP (in USD)	Remittance (in USD)	FDI (in USD)	Employment	Mobile Subscription (in %)	FII
2004	65,108,544,250	3,583,817,228	448,905,401	51,987,835	2.03%	0.3038
2005	69,442,943,089	4,314,502,846	813,321,972	53,123,178	6.47%	0.3374
2006	71,819,083,684	5,427,515,429	456,523,168	54,083,636	13.58%	0.3677
2007	79,611,888,213	6,562,316,322	651,029,738	54,954,286	24.09%	0.3545
2008	91,631,278,239	8,940,611,606	1,328,422,987	55,799,460	30.93%	0.3776
2009	102,477,791,472	10,520,653,006	901,286,583	56,639,145	35.20%	0.3841
2010	115,279,077,465	10,850,211,617	1,232,258,247	57,493,263	46.03%	0.4230
2011	128,637,938,711	12,071,073,184	1,264,725,163	58,436,990	56.52%	0.4636
2012	133,355,749,482	14,119,627,034	1,584,403,460	59,377,977	64.36%	0.4765
2013	149,990,451,022	13,866,954,019	2,602,962,095	60,318,372	76.30%	0.5015
2014	172,885,454,931	14,987,531,479	2,539,190,940	61,262,254	82.10%	0.5272
2015	195,078,678,697	15,295,536,095	2,831,152,765	62,203,550	84.08%	0.5748
2016	221,415,188,000	13,574,285,886	2,332,724,781	63,131,472	86.08%	0.6030
2017	249,710,922,462	13,501,933,033	1,810,395,804	66,854,855	94.53%	0.6373
2018	274,038,973,437	15,566,241,930	2,421,626,238	68,073,235	100.24%	0.6592
2019	302,571,320,446	18,363,859,531	1,908,045,387	69,229,775	101.55%	0.6801
2020	323,056,957,972	21,751,646,479	1,143,190,460	68,412,678	107.04%	0.6993

Appendix C: Vector Autoregression Estimates (Extract from EViews 12)

	LNFII	LNGDP	LNREM	LNFDI	LNEMP	LNMOB
LNFII(-1)	-0.872165	-0.249994	0.089543	-9.188689	-0.239539	-0.364276
	(0.40078)	(0.86492)	(1.77287)	(3.77683)	(0.25133)	(0.58815)
	[-2.17617]	[-0.28904]	[0.05051]	[-2.43291]	[-0.95309]	[-0.61936]
LNFII(-2)	-0.124066	0.311492	-0.031311	1.064589	-0.077238	-0.484696
	(0.25926)	(0.55950)	(1.14682)	(2.44314)	(0.16258)	(0.38046)
	[-0.47855]	[0.55673]	[-0.02730]	[0.43575]	[-0.47508]	[-1.27397]
LNGDP(-1)	0.251043	0.260122	1.287077	-4.447355	-0.129055	-1.475100
	(0.26934)	(0.58127)	(1.19145)	(2.53822)	(0.16891)	(0.39527)
	[0.93205]	[0.44751]	[1.08026]	[-1.75216]	[-0.76407]	[-3.73190]
LNGDP(-2)	0.892615	0.140491	-1.640059	8.512727	0.435768	1.680958
	(0.44465)	(0.95959)	(1.96691)	(4.19020)	(0.27884)	(0.65253)
	[2.00747]	[0.14641]	[-0.83383]	[2.03158]	[1.56281]	[2.57608]
LNREM(-1)	-0.083741	-0.420731	1.106205	-0.467076	-0.197370	-0.326409
	(0.12772)	(0.27562)	(0.56496)	(1.20355)	(0.08009)	(0.18743)
	[-0.65568]	[-1.52647]	[1.95804]	[-0.38808]	[-2.46434]	[-1.74154]
LNREM(-2)	-0.062177	0.227993	-0.160482	-1.745363	-0.005788	0.381064
	(0.13032)	(0.28125)	(0.57649)	(1.22812)	(0.08172)	(0.19125)
	[-0.47710]	[0.81065]	[-0.27838]	[-1.42117]	[-0.07083]	[1.99249]
LNFDI(-1)	0.039571	0.084305	-0.151617	0.639297	0.022735	-0.033871
	(0.02773)	(0.05985)	(0.12267)	(0.26134)	(0.01739)	(0.04070)
	[1.42692]	[1.40864]	[-1.23595]	[2.44626]	[1.30731]	[-0.83228]
LNFDI(-2)	0.066854	0.035529	-0.095434	0.756361	0.007881	0.093863
	(0.03825)	(0.08255)	(0.16920)	(0.36045)	(0.02399)	(0.05613)
	[1.74784]	[0.43041]	[-0.56404]	[2.09837]	[0.32855]	[1.67218]

	LNFII	LNGDP	LNREM	LNFDI	LNEMP	LNMOB

LNEMP(-1)	-1.366837	1.430940	1.385549	-0.557925	0.037476	0.937169
	(0.89645)	(1.93463)	(3.96549)	(8.44788)	(0.56216)	(1.31556)
	[-1.52472]	[0.73965]	[0.34940]	[-0.06604]	[0.06666]	[0.71237]
LNEMP(-2)	-0.354325	1.248535	1.350387	-11.53197	0.102301	0.290434
	(0.64939)	(1.40144)	(2.87259)	(6.11963)	(0.40723)	(0.95299)
	[-0.54563]	[0.89089]	[0.47009]	[-1.88442]	[0.25121]	[0.30476]
LNMOB(-1)	0.467022	-0.191375	0.707034	5.098018	0.012229	0.821980
	(0.19865)	(0.42870)	(0.87872)	(1.87198)	(0.12457)	(0.29152)
	[2.35103]	[-0.44641]	[0.80462]	[2.72333]	[0.09817]	[2.81967]
LNMOB(-2)	-0.273591	0.204500	-0.496267	-2.174370	0.055642	-0.091781
	(0.09992)	(0.21564)	(0.44201)	(0.94164)	(0.06266)	(0.14664)
	[-2.73802]	[0.94833]	[-1.12275]	[-2.30913]	[0.88798]	[-0.62590]
C	1.316092	-30.37279	-33.46097	151.1517	11.47314	-30.25637
	(13.5512)	(29.2448)	(59.9442)	(127.702)	(8.49792)	(19.8866)
	[0.09712]	[-1.03857]	[-0.55820]	[1.18363]	[1.35011]	[-1.52144]
R-squared	0.999383	0.999318	0.994898	0.989165	0.997989	0.999800
Adj. R-squared	0.995679	0.995228	0.964285	0.924154	0.985921	0.998603
Sum sq. resids	0.000492	0.002290	0.009622	0.043669	0.000193	0.001059
S.E. equation	0.015680	0.033839	0.069362	0.147764	0.009833	0.023011
F-statistic	269.8630	244.3277	32.49967	15.21528	82.70199	835.0655
Log likelihood	56.15814	44.61972	33.85404	22.50973	63.15792	50.40455
Akaike AIC	-5.754419	-4.215963	-2.780538	-1.267964	-6.687722	-4.987273
Schwarz SC	-5.140775	-3.602319	-2.166895	-0.654321	-6.074079	-4.373630
Mean dependent	-0.689267	25.77369	23.23326	21.11691	17.92454	-0.545773
S.D. dependent	0.238551	0.489870	0.367025	0.536540	0.082872	0.615691

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