





Article

Effects of Financial Inclusion on Economic Growth, Poverty, Sustainability, and Financial Efficiency: Evidence from the G20 Countries

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Abstract: The main purpose of this study is to scrutinize the effect of financial inclusion on financial sustainability, financial efficiency, gross domestic product, and human development in the context of G20 nations. This study has employed annual data of 15 developed and emerging economies during the period from 2004 to 2017. The current study has utilized a single index for financial inclusion, financial sustainability, and financial efficiency by employing principal composite analysis (PCA). The outcomes of the panel stationarity test confirmed the ARDL model for both the long and short runs. Equally, the findings of the ARDL Model 1 showed no association between financial inclusion and financial sustainability in the short run, however, in the long run, inclusive finance showed a significant impact on sustainability. Likewise, the ARDL Model 2 showed that financial inclusion has no effect on efficiency in the short run, while it positively influenced financial efficiency in the long run. The results of the ARDL Model 3 are also similar to Models 1 and 2 where inclusive finance showed no effect on poverty in the short run, but a significant effect in long run. Similarly, the ARDL Model 4 also presented no association between GDP and inclusive finance in the short run, while it showed significant relationships in the long run. Moreover, the outcomes of the GMM Model 1 showed a significant impact of inclusive finance on financial stability, and these results were similar to the GMM Model 2 between financial inclusion and financial efficiency. Additionally, GMM Models 3 and 4 have shown that inclusive finance has a statistically significant impact on poverty and economic expansion, respectively. The outcomes of this article are essential for policymakers, academics, regulators, and practitioners with valuable and convincing debate over financial inclusion, economic growth, poverty, sustainability, and financial efficiency.

Keywords: financial Inclusion; sustainability; financial efficiency; economic growth; poverty; ARDL; fixed and random effect; GMM; G20 nations



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1. Introduction

Financial inclusion refers to the availability to both individuals and companies of relevant and cost-effective financial goods and services that satisfy their wants for purchases, payments, deposits, lending, and coverage that are provided sustainably and responsibly [1]. Financial inclusion helps develop services that help the development of financial efficiency. Financial inclusion means equal access to financial services arranged by society to all adult members at affordable costs. Moreover, in the advanced stage of financial inclusion, people take financial risks without any hesitation because of the availability of insurance [2]. Financial inclusion is a critical and integral part of economic growth and is becoming a burning issue in recent years. Inclusive finance is a part of financial development and it received more attention in research when it is related to resolving the problem

of poverty and economic growth [3]. Financial inclusion is considered the ninth pillar of the global development agenda when it was discussed at the G20 summit in South Korea and Seoul in November 2010. Inclusive finance is a vital indicator of the whole financial system as it helps households and entrepreneurs access financial services and products at low prices, which is why it contributes to fostering and deepening the financial system. Furthermore, it also helps to attain seven goals at the same time as sustainable development goals (SDGs). Since endogenous growth theory has gained significant attention, more focus is on financial development to accelerate economic growth. Whereas, financial inclusion helps to enhance savings, which lead to an increase in household spending and agriculture output as well. Therefore, financial inclusion helps those countries that are living under the poverty line. The activity that improves the performance and number of financial products, which sustains thriving nations, is known as financial inclusion.

This study investigates the (1) influence of inclusive finance on economic expansion; (2) influence of financial inclusion on poverty; (3) influence of financial inclusion on sustainability; and (4) influence of financial inclusion on financial efficiency. The definition of financial efficiency is “the degree to which the financial sector performs its duties” [4]. For financial stability to prevail, shocks must not result in the collapse of banking firms, money markets, or payment services [5]. Further, a strong financial system is important even though financial efficiency and sustainability have been less prioritized in Pakistan. Asia is considered the fastest growing region in the world because of its annual increasing growth rate. However, there is still a need to fill the gap which exists because of the lack of access to financial services. In South Africa, more than one billion people still exist who are living their lives without getting any financial services, having no bank accounts, and getting payments through bank accounts [6]. Statistically, only 27% of individuals, whereas 33% of firms are registered in formal financial institutions where they can apply for loans or credit [7]. To increase the economic expansion of the country, inclusive finance is considered one of the main ingredients. However, its impact may vary according to different income groups and ability to bring either stability or instability. Financial inclusion has an association with financial stability because instability occurs when financial inclusion reduces its credit standards, unattended policies of microfinance, or a bank’s reputation are damaged. To achieve the desired economic growth level, many countries use financial inclusion as a tool [8]. Financial inclusion has been the part of the millennium development goal 2015 (MDG) to attain sustainability, economic growth, and equality [9]. Many policymakers are prioritizing the importance of financial inclusion because it is helping countries achieve economic growth at their desired level. To build a strong foundation of the financial infrastructure of any country, financial inclusion is considered an important factor, especially for economic growth and development [10]. Inclusive finance can be improved through diverse methods, e.g., Indonesia increased its financial inclusion through microfinance and business loans. Whereas, Thailand and India increased their financial inclusion through their customized banking system [11]. Financial inclusion has been also perceived as a tool that helps to attain multidimensional macroeconomic stability, by reducing poverty in the countries. Financial inclusion facilitates underprivileged people, and low-income groups, by providing different financial services, e.g., saving and insurance [12]. Underprivileged people remain distant from a financial system, which creates problems for saving at the national level. Financial inclusion helps to reduce these gaps and provides a platform where these types of economic activities are generated and contribute to poverty reduction. Sustainable development goals 2030 discuss poverty to reduce as an agenda number because it is considered the major threat to the economic progress of the country. However, financial inclusion is considered a powerful tool that has this much potential to disrupt the malicious sphere of poverty in the countries. The United Nations affiliate nations have encompassed inclusive finance as their objective to achieve development goals.

Based on the above debate, this study is going to answer the query of what is the effect of inclusive finance on financial sustainability, financial efficiency, economic expansion, and human development in the context of G20 economies. The foremost purpose of this

research is to check the effect of inclusive finance on financial sustainability, financial efficiency, economic expansion, and human development index in G20 nations. This study fills the research gap in the present literature and adds several contributions to the existing research. First, the main contribution is that this research has been carried out in the case of G20 nations, and to the extent of the researcher's knowledge, there is no accumulative study to check the long-run inclusive finance on financial sustainability, financial efficiency, economic expansion, and poverty in the case of G20 economies. Second, multiple studies have utilized single or improper measurements for financial inclusion, while our research has accumulated three distinct proxies and made a complete index using PCA. Third, most of the prior studies have used cross-sectional data and even a single country for analysis, but our study used panel data for 15 G20 nations, namely, USA, Japan, France, Italy, Australia, Brazil, India, Indonesia, Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, and Spain and also utilized proper econometrics methods. Last, many of the past studies, for instance, refs. [13–16] have focused on inclusive finance and economic expansion and poverty, while this research has introduced two new variables, namely financial stability and financial efficiency, into the model, enriching the existing literature.

The findings of our article would provide policymakers, academics, and regulators with accurate information about financial inclusion and other variables. Based on the empirical findings of the study, the present study suggests the following policy implications. First, this study suggests that the government of G7 countries should promote equal opportunities for financial inclusion to bring financial stability to the country. If opportunities are equally accessible for a loan to all citizens, then financial stability will occur. Second, the government should expand the information on insurance products that can be availed by the general public, then there will be economic growth in countries. Third, the study suggests government authorities should impose higher interest rates on loans to avoid damage to financial efficiency. Fourth, the study suggests that the governments of the G7 should start renewable projects on equity for human development. Finally, the study also suggests that government authorities should design policies for banks to stimulate financial stability and economic growth. Lastly, the outcomes of this article would be essential to access leads to financial services, which can ultimately increase economic growth, reduce poverty, and improve financial stability and financial efficiency, which in turn, can achieve sustainable development.

The article is structured as follows: Section 2 contains a literature review and theoretical lens, Section 3 contains the methodology, Section 4 has the results and discussion, Section 5 contains the conclusion and recommendations.

2. Literature and Theoretical Framework

2.1. Financial Inclusion and Economic Growth

Theoretically, there are two types of economic growth models, i.e., the exogenous growth model and the endogenous growth model. The exogenous growth model is associated with technology, capital formation, and labor productivity with economic growth in addition to the enhancement of human capital. Many economic growth models have emphasized the latest technology, where new technology means financial technology with digitalization, ATMs, and online banking [17].

Access to finance has been a heated topic on the international policy platform since the early 2000s. Many countries employ financial inclusion as a way to promote more evenly distributed economic expansion [14,18]. Financial inclusion is vital for constructing a solid foundation for a world's financial infrastructure, which will promote economic development and prosperity [19]. Plentiful pieces of literature are available on the connection between inclusive finance and economic expansion in different developed and developing countries left with limited literature in this field and inclusive finance in developed and emerging economies is still in the infant stage [13,20].

However, there are still contradictory results based on the previous literature, some researchers have found a positive association between inclusive finance and economic

expansion. For example, ref. [19] investigated the association between inclusive finance and the economic development of the emerging economy of India from 2004 to 2013. The Granger test and the VAR technique's findings revealed a strong and favorable correlation between inclusive finance and growth. Additionally, ref. [15] for 31 developing and developed countries for the period from 2004 to 2010, scrutinized the association between inclusive finance and economic expansion by employing the fixed, random effect, and panel co-integration on the panel dataset. The outcomes revealed the positive and significant connection and bidirectional causality between inclusive finance and economic expansion. Likewise, ref. [21] for 55 (OIC) nations from 1990 to 2013, scrutinized the link between inclusive finance and economic expansion. Based on the outcomes of VAR, inclusive finance has a positive connection with economic expansion. Another study by, ref. [16] analyzed the emerging markets data to scrutinize the link between inclusive finance and economic expansion. The article utilized a panel data econometric approach, and the results showed that inclusive finance has a favorable impact on economic expansion, with the influence being larger in low-income nations. Surprisingly, over the past several years, the spread of digital financial inclusion drastically boosted the availability and affordability of finance in China. To assess the connection between digital inclusive finance and province economic development from the years 2011 to 2018, a study was carried out in China. The fixed-effect model demonstrated that digital inclusive finance boosted the Chinese province's economic expansion and that the Chinese government should establish supportive systems to expand digital financial inclusion [22]. The financial sectors in the MENA region dominate the bank-based financial institution. Similarly, ref. [23] explored the association between inclusive finance and economic expansion for 44 emerging markets and MENA countries from 1990 to 2018. The system (GMM) and dynamic panel regression model were utilized to scrutinize the yearly data. The overall findings disclosed that inclusive finance favorably affected the GDP per capita in nominated nations.

Even though inclusive finance appears to be a positive predictor of economic expansion, various studies have found a negative relationship between them. Additionally, ref. [24] scrutinized the effect of inclusive finance on economic expansion in Kenya by utilizing secondary data from 2002 to 2013. The results supported that economic growth has a weak negative association with financial inclusion measured by Automated Teller Machines and a strong negative connection with bank lending interest rates. Similarly, ref. [25] revealed a negative association between inclusive finance and economic expansion and inclusive finance can diminish loan standards. Regarding this, ref. [26] for 11 MENA nations, also looked at the relationship between economic expansion and financialization. The findings indicated that financialization had a detrimental effect on economic expansion. The link between inclusive finance and economic expansion has to be further investigated in light of the contradictions in the aforementioned arguments.

2.2. Financial Inclusion and Poverty

The systems theory of financial inclusion explains that financial inclusion has a positive relationship with the existing system. System financial inclusion affects its expected outcome. For instance, economic agents and suppliers of financial services can align their interest in basic financial services to offer quality financial services that protect users of financial services from price discrimination and exploitation. In this theory, poor communities can be added in financial with financial regulators [27].

Inclusive finance has been viewed as a dynamic instrument for both developed and developing nations to reduce poverty and achieve sustainable and equitable economic expansion [28]. Limited studies showed that financial inclusion has promoted economic growth. However, ref. [29] argued that financial inclusion increased economic expansion, but this does not always indicate that poverty decreased [30]. Although, financial inclusion can be utilized as a tool for mitigating poverty [31].

Studies on the association between financial inclusion and poverty are still inconclusive. For instance, ref. [32] for 42 African countries from 1995 to 2017, scrutinized the

connection between inclusive finance and poverty mitigation. The outcomes of system GMM revealed that financial inclusion has a favorable influence, which means an increase in financial inclusion increased poverty reduction. Likewise, ref. [33] for cooperative banks of India, scrutinized the connection between financial inclusion and poverty by employing SEM, and ANOVA for the analysis of the 540 primary datasets. The results indicated that inclusive finance had a significant impact on poverty alleviation. Similarly, ref. [12] utilized Turkish household survey data and investigated the link between inclusive finance and poverty mitigation. The study employed a Logit regression model, and outcomes revealed that poverty has decreased due to financial inclusion. Similarly, ref. [34] mentioned in their work that the vital factor for diminishing sustainable poverty eradication is access to finance and scrutinized the link between digital inclusive finance and farmers' vulnerability to poverty in 1900 households. Overall, the findings showed that digital financial inclusion has a positive association with the vulnerability of farmers. In addition to this, ref. [35] for 13 Latin American nations, also checked the connection between inclusive finance and poverty. The outcomes of the panel data showed that the use of mobile and inclusive finance decreased poverty.

Contrary to this, some studies have found a negative association between inclusive finance and poverty mitigation. For instance, ref. [36] utilized the data from 12 Eastern provinces of Indonesia to show the connection between inclusive finance and poverty. Regression and VAR results showed that inclusive finance has an unfavorable relationship with poverty. Another study by, ref. [37] scrutinized the link between inclusive finance and poverty in India. The study employed GMM on panel data from 1973 to 2004. The outcomes indicated a detrimental correlation between poverty and inclusive finance. However, ref. [38] unveiled that inclusive finance does not influence poverty in the MENA region.

2.3. Financial Inclusion and Sustainability

Theoretically, ref. [39] also explained that economic development helps to improve living standards and self-esteem regarding freedom and oppression. The human development index builds through literacy rate and life expectancy that can impact economic development in the long run. The human development index opens new horizons for education, employment, and the healthcare environment. It helps to increase the income of citizens individually. Moreover, economic development transformed into sustainability when human development is the key factor of development. The link between inclusive finance and sustainability has been the target of numerous types of research. Inclusive finance may, however, have an impact on sustainability both favorably and adversely.

Several kinds of research have revealed a favorable association between inclusive finance and financial stability. For instance, ref. [40] utilized the data from 2004 to 2016 for 31 Asian countries, to show the impact of inclusive finance on sustainability. Inclusive finance has a favorable and significant impact on sustainability, according to the results of the feasible generalized least squares (FGLS) approach. Likewise, ref. [41] also investigated the association between inclusive finance and sustainability in the context of Jordan. The fully modified least squares (FMOLS) technique was utilized in this research, which used time-series data from 2006 to 2017. The outcomes showed a weak significant but favorable connection between inclusive finance and financial sustainability.

In addition to this, ref. [38] employed GMM and GLS on the data set of eight MENA countries to scrutinize the link between inclusive finance on sustainability. The findings supported the previous literature that inclusive finance positively contributed to financial stability. In accordance with, ref. [42] also scrutinized the connection between inclusive finance and financial sustainability by utilizing the data set of Kenya. The study employed multivariate regression by using SEM, and findings indicated that inclusive finance enhanced sustainability in Kenya. Similarly, ref. [43] examined the connection between inclusive finance and sustainability. The study utilized 3071 Asian banks using the period from 2008 to 2017, and employed the GMM method. The results showed that a higher level of inclusive finance provided better access to the banks and hence contributed positively

and significantly to the stability of banking sectors. Moreover, refs. [14,44,45] also exposed that inclusive finance has a favorable connection with sustainability.

Contrary to the positive association, some studies have also shown a negative link between inclusive finance and sustainability. According to, refs. [46,47] both indicated that inclusive finance harmed financial sustainability. Similarly, refs. [25,48] also exposed that inclusive finance negatively influences financial sustainability. The inconsistencies in the results provide a path to further explore the connection between inclusive finance and sustainability.

2.4. Financial Inclusion and Financial Efficiency

Theoretically, ref. [49] described that the financial literacy theory of inclusive finance increases the consent of people to invest more in the financial sector, which helps to increase financial efficiency. It helps to educate people to invest more and excel in this field. It means when people get conscious of financial inclusion, then they focus to get more services that help to work efficiently. People go for their formal bank accounts and work for welfare, investment, and mortgage products that bring stability to personal finance. It also helps people know the difference between need and want and helps them to manage their retirement plan. So, it helps to increase the financial efficiency of the country.

During the survey of the literature, we found that there is no good study on the link between inclusive finance and financial efficiency. This may be due to the shortage and freshness of statistics on efficiency. Recent research done in this area by [40] investigated the influence of inclusive finance on financial efficiency in the context of Asia. The study took 31 Asian countries and employed the FGLS procedure. The findings exposed that inclusive finance negatively affects financial efficiency in all selected countries.

Similarly, ref. [50] for Asian and Middle Eastern countries, investigated the association between inclusive finance and Islamic banks efficiency. The study employed data from 2011 to 2017 and used the Simar–Wilson bootstrapping model. The outcomes showed that inclusive finance had a favorable association with Islamic banks' efficiency. Financial inclusion is also pivotal for green economic efficiency, as [51] disclosed the association between inclusive and green economic efficiency in the context of China based on the city-level data from 2011 to 2015. The consequences showed that inclusive finance enhanced green economic efficiency.

The aforementioned literature analysis made it abundantly evident that many researchers have observed the relationships between financial inclusion, economic development, poverty, sustainability, and financial efficiency in many economies. However, the G20 nations received no attention in earlier literature. Similarly, financial sustainability and financial efficiency have not gained much attention in past studies. The cumulative influence of inclusive finance on economic expansion, poverty, financial stability, and financial efficiency has not been studied in the context of G20 nations, hence the current study is going to work on it and fills this literature gap.

3. Materials and Methods

This paper uses fourteen years of (2004–2017) data for fifteen countries. The choice of these countries stems from data availability among developed and emerging economies. Data sources are mentioned in Table 1. For Financial Inclusion Index (FII), which is the independent variable. The research utilizes three proxies for measurement of the financial inclusion index, i.e., No. of ATMs per 100,000 adults, bank branches per 100,000 adults, and outstanding loans with commercial banks (% of GDP). These proxies have been utilized in some recent studies [14,40,52]. Others are dependent variables, i.e., the Financial Stability Index (FSI), which has been measured by using three proxies, i.e., bank Z-score, bank credit to bank deposits, liquid assets to deposits, and short-term funding. These proxies were utilized by [40]. Likewise, ref. [53] also constructed the Financial Stability Index for the financial sector of Pakistan only. Similarly, another is the Financial Efficiency Index (FEI), which has been measured by employing bank net interest margins, bank return on assets,

and bank return on equity, all these proxies have been taken based on a recent study by [40]. Based on the studies of [28,52] the study also considers economic expansion and poverty as the dependent variables. Some control variables, for instance, inflation consumer price index (annual %), population growth (annual %), and trade openness (import plus export GDP %) based on recent literature of [52,54]. All the variables' descriptions and sources are given in Table 1.

Table 1. Description of variables.

Variables	Description	Sources
Independent Variables		
1. Financial Inclusion Index	1. No. of ATMs/100,000 adult	WDI/IMF
	2. Bank Branches per 100,000 adults	WDI/IMF
	3. Loans with commercial banks	WDI/IMF
Dependent Variables		
1. Financial Sustainability Index	1. Bank Z-Score	FRED database
	2. Bank Credit to Bank Deposits (%)	FRED database
	3. Liquid assets to deposits and short-term Funding (%)	FRED database
2. Financial Efficiency Index	1. Bank net interest margin (%)	FRED database
	2. Bank return on assets (% after tax)	FRED database
	3. Bank return on equity (% after tax)	FRED database
3. Economic Expansion	(GDP constant 2015 US\$)	WDI
4. Human Development	Human Development Index	UNDP statistics
5. Control Variables		
1. Inflation	Consumer Price Index (annual %)	WDI
2. Population growth	Population Growth (%)	WDI
3. Trade Openness	Import plus Export (% of GDP)	WDI

Sources: World Development Bank (WDI), International Monetary Funds (IMF), Federal Reserve Economic Data (FRED database), United Nations Development Program (UNDP statistics).

This study must employ principal component analysis (PCA) through STATA 16 software, for the construction of a single index for financial inclusion, sustainability, and efficiency. The PCA allows us to build a single and aggregate index to achieve the main objective of the research. For instance, refs. [40,55,56] also constructed single indexes through PCA mentioned in Table 1.

Similarly, following the study of [40] we constructed a single composite index for financial stability and financial efficiency in our research. Based on the number of dependent variables, four models are specified. Likewise, because of the nature of the data collected, the panel estimation is specified. However, before the panel estimation, the visual trend of the variables is plotted. Additionally, the pre-test descriptive statistics-mean, median, and standard deviation are also checked. Similarly, panel stationarity using the Levine, Lin & Chu t^* (LLC t^*), Augmented-Dickey Fuller (ADF), and Phillip Perron (PP) Fisher Chi-square stationarity test is examined. The outcome of the stationarity test informed the estimation of the Autoregressive Distributed Lag (ARDL) regression path as expressed in [57,58]. Further, the study examined the panel fixed effect (PFE), and random effect (PRE).

Models

The study applied panel data to scrutinize the effect of inclusive finance on financial sustainability, financial efficiency, poverty, and economic expansion. Following, ref. [59], compared to time series and cross-sectional, panel data have certain advantages. The study

adopted both fixed and random effects to show the association between inclusive finance and sustainability, financial efficiency, poverty, and economic expansion in the context of G20 nations. Moreover, the study also adopted the GMM model for the analysis of the endogeneity issues. The models are in line with [22,52]. Similarly, Y = financial sustainability index, financial efficiency index, economic expansion, and human development index; and χ = financial inclusion index, we specify the following four equations below:

$$FSI_{it} = \alpha + \beta_1 FII_{it} + \beta_2 CPI_{it} + \beta_3 POPG_{it} + \beta_4 TOP_{it} + \epsilon_{it} \quad (1)$$

$$FEI_{it} = \alpha + \beta_1 FII_{it} + \beta_2 CPI_{it} + \beta_3 POPG_{it} + \beta_4 TOP_{it} + \epsilon_{it} \quad (2)$$

$$GDP_{it} = \alpha + \beta_1 FII_{it} + \beta_2 CPI_{it} + \beta_3 POPG_{it} + \beta_4 TOP_{it} + \epsilon_{it} \quad (3)$$

$$HDI_{it} = \alpha + \beta_1 FII_{it} + \beta_2 CPI_{it} + \beta_3 POPG_{it} + \beta_4 TOP_{it} + \epsilon_{it} \quad (4)$$

where i and t are country and time, respectively. FSI = financial stability index; FEI = financial efficiency index; HDI = human development indicator; GDP = gross domestic product; FII = financial inclusion index; CPI = consumer price index; POPG = population growth; and TOP = trade openness, and ϵ is the random error term.

Panel Unit Root

In determining the order of integration of the individual series, the variables undergo the stationarity characteristics check. Beneath is the estimated equation:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum \alpha_i \Delta Y_{t-1} + \epsilon_t \quad (5)$$

where: ϵ_t = is a residual time; Y_t = is the relevant time series; ϵ_t = random error term.

Ref. [60] provided two auxiliary regression estimations to determine appropriate unit root selection—the Levine Lin and Chu t^* (LLC t^*), ADF-Fisher, and PP-Fisher test. Here, ΔY_{it} is estimated on ΔY_{it} , where χ_{nt} is included to obtain the residual [ϵ_{it}]. Thereafter, the regression Y_{it-1} is estimated on ΔY_{it} and χ_{nt} to arrive at the residual. Likewise, $Y_{it} = \beta_i + \delta_i \Delta Y_{it} + \epsilon_{it}$. This implies the computation of the average unit root statistic over the various models [60].

The ARDL Model Estimates

Thus, transforming Equations (1) to (4) to its general form ARDL process (p, q_1, \dots, q_n), the model is re-specified as;

$$\Delta Y_t = \beta_0 + \sum_{i=1}^n \beta_i \Delta Y_{t-1} + \sum_{i=0}^n \lambda_i \Delta \chi_{t-i} + \Omega_1 Y_{t-1} + \mu_t \quad (6)$$

where: $i = 1, \dots, n$ is the short-run technique and $\Omega_1 Y_{t-1} + \Omega_n Y_{t-1}$ is the long run technique of the equation. That is, $\beta_1, \dots, \lambda_1$ is the short-run coefficients of the model; while $\Omega_1, \dots, \Omega_n$ are the ARDL long-run coefficients and μ_t is the white noise term. This is in place with the study of [57,58].

GMM Method

To address the endogeneity and unobserved country-specific effects, this study utilized a panel data procedure [61], i.e., the system GMM technique for the estimation. The model is given below:

$$Y_{it} = \delta_i + \sum_{j=1}^m \gamma_j Y_{it-1} + \sum_{j=1}^n \delta_j X_{jit} + \sum_{k=1}^p \theta_k Z_{kit} + \epsilon_{it} \quad (7)$$

Whereas t represents time frame, i represent the nation, Y_{it} represents the dependent variables, X_{jit} represents the independent variable, and Z_{kit} represents control variables, δ_i represents the nation unobserved effect, and ϵ_{it} is the error term.

4. Results and Discussion

4.1. Visual Trend

The visual trend in Figures 1–8 shows the movement in various variables used in the study across sections. In Figure 1, the financial inclusion index oscillated between high and low with Indonesia, the Republic of Korea, Russia, and Spain depicting the highest in that order than the rest of the countries. In Figure 2, Australia, Indonesia, the Republic of Korea, Russia, Turkey, and Spain ranked in the same order in the financial stability index chart. The financially efficient country includes Japan, Italy, Australia, Saudi Arabia, and South Africa according to the chart movement. In human development indicators, Australia appears to lead. This is closely followed by the United States of America, Japan, Republic of Korea, France, Italy Spain, Saudi Arabia, and Russia in that order, respectively. Similarly, in terms of gross domestic product, Australia leads. Additionally, in the leading position are Indonesia, the Republic of Korea, Mexico, and Turkey. Further, Brazil, India, Indonesia, Mexico, Russia, South Africa, and Turkey occupy the center stage in the consumer price index. Additionally, in the area of population growth, Saudi Arabia and South Africa occupy the center stage in the chart. Others with visible population growth impacts are Australia, Indian, Mexico, and Spain. For the TOP, the Republic of Korea and Saudi Arabia occupy the top spot as indicated in the chart.

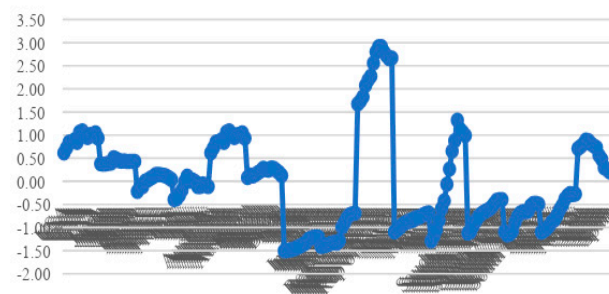


Figure 1. FII.

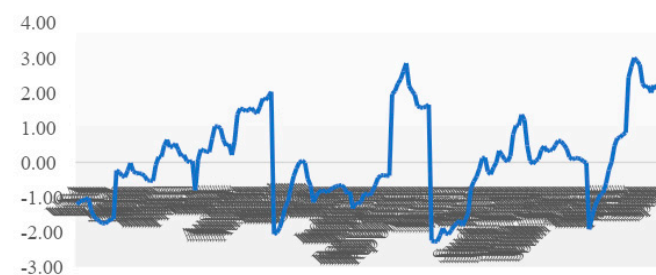


Figure 2. FSI.

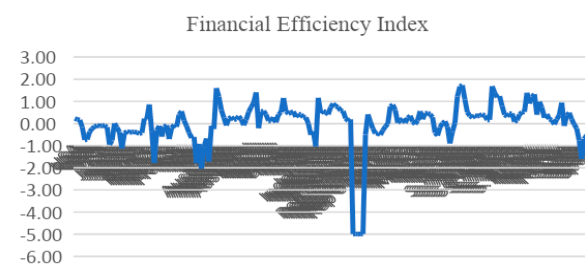


Figure 3. FEI.

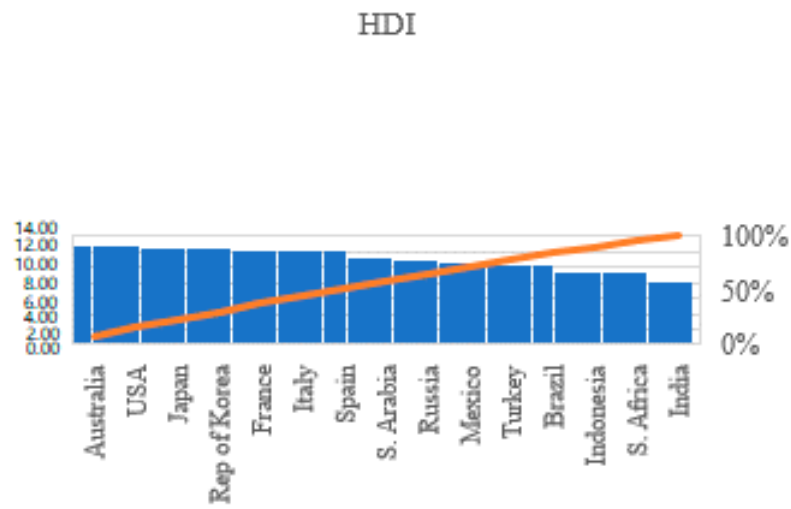


Figure 4. HDI.

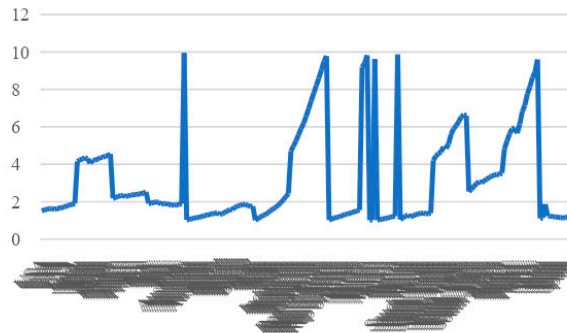


Figure 5. GDP.

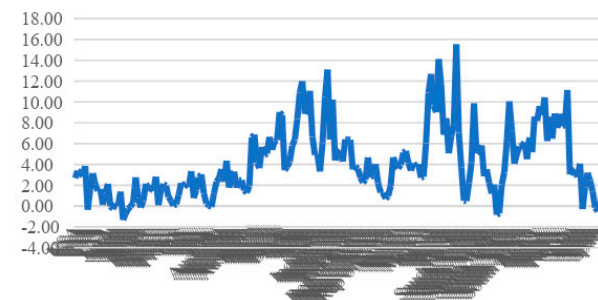


Figure 6. CPI.

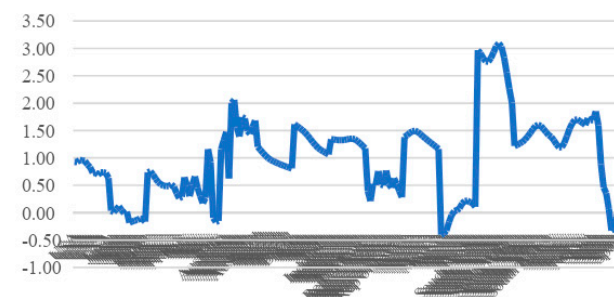


Figure 7. POPG.

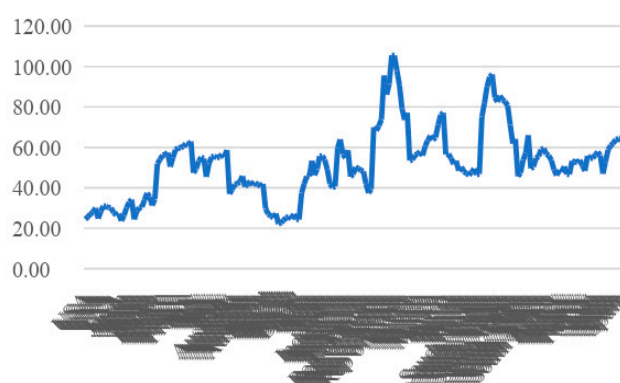


Figure 8. TOP.

The study followed the estimation path stated in the methodology of the study. First, the visual trend of the variables is checked. The essence is to determine the form of variable movement over time across sections. Next to this is the presentation of the descriptive result. The study presented the mean, median, and standard deviation of the variables. This is presented in the Table 2 below.

Table 2. Descriptive statistics.

Variables	Mean	Median	Max	Min	Std. Dev
FII	0.006935	0.054549	2.914449	−1.50512	1.011053
FSI	0.829	0.005164	3.001264	−2.27777	1.224063
FEI	0.667	0.161506	1.728015	−4.99066	1.00009
HDI	0.800	0.8215	0.94100	0.527000	0.10486
GDP	3.083	1.8700	9.9500	1.10100	2.41428
CPI	4.203257	3.525805	15.53441	1.334137	3.279603
POPG	1.026434	1.116896	3.090725	0.402681	0.741174
TOP	51.42533	51.70612	105.5663	22.10598	17.48365

The study pre-tested the summary statistics. The mean, median, maxi, mini, and standard deviation were examined. Note also that the variables are the combined variables for the four models adopted for the study. As such, the financial inclusion index (total number of bank branches per 100,000 adults, automated teller machine per 100,000 adults) serves as the study's independent variable. The financial stability index (FSI), financial efficiency index (FEI), poverty (HDI), and economic expansion (GDP) serve as the study's independent variables. However, the consumer price index (CPI), population growth (POPG), and TOP serve as the control variables of the study.

The outcomes of panel unit root tests are available in Table 3. The study affirmed the panel stationarity status of the variables using the Levine Lin and Chu t^* , ADF/PP Fisher Chi-square to ascertain estimation direction. The results show that the variables are of a different order of integration. That is, the financial inclusion index, financial stability index, financial efficiency index, human development indicator, gross domestic product, consumer price index, and population growth and trade policy all showed mixed outcomes of stationarity. That is, FII, FSI, POPG, and TOP are of order zero I (0), while FEI, HDI, GDP, and CPI are of order one I (1). This informs the autoregressive distributed lag (ARDL) estimation procedure. Accordingly, [57,58,62] posited that when series exhibit different order of integration, such series qualify to be examined under the autoregressive distributed lag process. This is to check for the presence of a short or long-run relationship among the variables.

Table 3. Panel unit root test.

Variables	Parameters	LL&C t *	ADF-Fisher-Chi-Square	PP-Fisher-Chi-Square	Order	Remark
FII	Statistic	−7.16560	97.1290	106.078	I (0)	Stationary
	Prob **	0.0000	0.0000	0.0000		
FSI	Statistic	−3.8510	59.3124	70.6660	I (0)	Stationary
	Prob **	0.0001	0.0011	0.0000		
FEI	Statistic	−8.44099	98.5079	81.9992	I (1)	Stationary
	Prob **	0.0000	0.0000	0.0000		
HDI	Statistic	−4.55080	68.4790	67.5479	I (1)	Stationary
	Prob **	0.0000	0.0001	0.0001		
GDP	Statistic	−112.989	143.795	142.324	I (1)	Stationary
	Prob **	0.0000	0.0000	0.0000		
CPI	Statistic	−16.5416	231.705	251.327	I (1)	Stationary
	Prob **	0.0000	0.0000	0.0000		
POPG	Statistic	−6.60553	89.8967	90.6235	I (0)	Stationary
	Prob **	0.0000	0.0000	0.0000		
TOP	Statistic	−13.5433	192.277	203.685	I (0)	Stationary
	Prob **	0.0000	0.0000	0.0000		
CROSS-SECTIONS		15	15	15		

Note: * $p < 0.1$, ** $p < 0.05$ represents significant level.

The results of the ARDL for the four models are shown in Table 4. Across models, mixed results are reported. In Model 1, where the financial stability index is tested against the inclusive finance index and other control factors, the results indicate that, in the short run, no variable is statistically significant. However, in the long run, the results show that financial inclusion is significant in explaining the financial stability index. Similarly, Model 2 results report that, in the short-run, the financial inclusion index is statistically insignificant in explaining the financial efficiency index. This, however, shows that it is significant in the long run also. Likewise, the results for Model 3 followed a similar pattern. Thus, in the short-run, the connection between the human development indicator and the financial inclusion index shows that it is statistically insignificant in the short-run, but significant in the long run. By implication, financial inclusion enhances human development in countries under review. Further, the statistically significant relationship subsisting between economic expansion and financial inclusion index, in Model 4, in the short-run, is false. Conversely, this outcome shows that a long-run significant connection between economic expansion and the financial inclusion index in the long-run is true judging by the 0.05 percent value. Overall, based on the individual models specified, it is obvious that the significance of inclusive finance is common across models, hence, it presents a vital tool that the authorities can use in channeling nominated economic objectives in the long run.

The outcome of this study contributes additional findings to the issues relating to financial inclusion, financial stability, and efficiency. The outcomes of the study are inversely related to the study of [63] outcomes of seven sub-Saharan nations in Africa, but our consequences are in line with [52] findings of 54 nations of Africa.

Table 4. ARDL model results.

Dependent Variables	Model 1 (FSI)				Model 2 (FEI)				Model 3 (HDI)				Model 4 (GDP)			
	Short-Run		Long-Rn		Short-Run		Long-Rn		Short-Run		Long-Rn		Short-Run		Long-Rn	
	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05
D(FSI)	False	True	FII, POPG, TOP	CPI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D(FEI)	n/a		n/a		False	True	FII, CPI	POPG, TOP	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D(HDI)	n/a		n/a		n/a		n/a		False	True	FII, POPG, TOP	CPI	n/a	n/a	n/a	n/a
D(GDP)	n/a		n/a		n/a		n/a		n/a		n/a		False	True	FII, CPI	POPG, TOP

The findings of both fixed and random effect models are available in Table 5. To ascertain the individual country-specific effect of whether inclusive finance impacts sustainability, financial efficiency, human capital development, and gross domestic product, the panel fixed effect test was checked. The PFE allows for fixing individual cross-section intercepts and allows for time-invariant observation. With this, the examination is carried out without any particular time influences across sections. Thus, the results for PFE in the four models are mixed. In Model 1, FII is statically significant in explaining FSI. However, this is not so in Model 2. Model 2 showed that FII is statistically insignificant in explaining FEI. Model 3 also indicated that FII is statistically significant in explaining HDI. Whereas, Model 4, indicated that FII is not statistically significant in explaining GDP. However, the pitfalls inherent in PFE models, which [62,64,65] pointed out in their studies, informed taking a further examination of the significance of the variable by employing the randomization impacts using the PRE. Thus, what the PRE does is consider the heterogeneity, time-invariant, and individual country effect by allowing for the control of unseen heterogeneity through the general least squared method (GLS), where the error terms of observations are randomly distributed. With this, the individual country effect is allowed to influence the outcome randomly. In order words, the outcome of the PRE is also mixed. Though, one out of the four models, Model 4 results showed that financial inclusion is statically insignificant in explaining gross domestic product. However, Model 1 results showed that financial inclusion is statically significant at 0.000 percent in explaining financial stability. Likewise, Model 2 results also indicates that it is significant in explaining financial efficiency. In Model 3, the no existence of significant connection between inclusive finance and poverty is also rejected. This shows that the sig value is 0.000, thus it falls below the 0.05 percent level, and the null is also rejected.

Table 5. Fixed and random effect models results.

Variables	Model 1		Model 2		Model 3		Model 4	
	PFE	PRE	PFE	PRE	PFE	PRE	PFE	PRE
FII	0.0001	0.0000	0.6830	0.0002	0.0000	0.0000	0.5983	0.1027
CPI	0.0427	0.0799	0.0062	0.8825	0.8004	0.9381	0.1079	0.4213
POPG	0.1715	0.1546	0.0235	0.0000	0.0000	0.0000	0.3262	0.7882
TOP	0.8741	0.4293	0.0000	0.0815	0.5646	0.4364	0.0000	0.0013
HAUSMAN	Reject	Accept	Accept	Reject	Accept	Reject	Accept	Reject
CROSS-SECTIONAL DEPENDENCY:								
BREUSCH-PAGAN LM	0.000		0.0000		0.0000		0.0000	
PESARAN SCALED LM	0.0000		0.0000		0.0000		0.0000	
PESARAN CD	0.6013		0.0000		0.0000		0.0000	

From the results, the figures in parentheses represent the standard error of the estimation. Likewise, ***, **, * represent the significant level at 1, 5, and 10 percent. In Model 1, financial inclusion indicates that it has a significant impact on financial sustainability. This is expressed in the efforts of governments aimed at stabilizing the financial sector and the entire economy, as can be seen in the control variable of population growth and trade openness. This outcome also reflects that of [52] study. This outcome also corroborates our present results in Model 2, where financial efficiency produces a significant outcome with the financial inclusion index, population growth, and trade openness. Further, the results of Model 3 produce a similar trend. As shown, the human development index significantly impacts financial inclusion, consumer price index but not on population growth and trade openness. One possible explanation related to the latter may not be unconnected to the quality of human development as the population grows and as the top also grows. Other relevant disruptors in this regard may be attributed to the current economic situation as

a result of the global pandemic. In Model 4, financial inclusion and population growth also show that they are statistically significant in explaining the gross domestic product. This outcome corroborates that of [62], where financial inclusion was found to significantly impact economic growth, as well as that of [52].

4.2. Robustness Test

Essentially, the multifaceted problems—heteroskedasticity, autocorrelation, and a mix of endogeneity and exogeneity encountered in the panel estimation—often require a control mechanism to avoid misspelled regression and estimation bias. Refs. [53,66] observe that both heteroskedasticity and autocorrelation occur in datasets whenever series standard errors have observations in time over a period that is not constant. Likewise, ref. [67] affirm the adoption of GMM (presented in Table 6) as opined in [8] as one of the best estimation approaches to tackle either the issue of endogeneity or homogeneity in a panel study. However, for further robust estimation, both [66,67] provided that the feasible generalized least square-FGLS technique may also be employed to remove or minimize the presence of heteroskedasticity. In doing this, the FGLS technique is appropriate.

Table 6. GMM results.

Variable	Model 1 [FSI] GMM	Model 2 [FEI] GMM	Model 3 [HDI] GMM	Model 4 [GDP] GMM
FII	0.000 ** (0.076)	0.000 ** (0.067)	0.000 ** (0.005)	0.000 ** (0.183)
CPI	0.7957 ** (−0.021)	0.432 * (0.019)	0.000 ** (−0.011)	0.742 ** (0.051)
POPG	0.0373 ** (0.100)	0.000 ** (0.473)	0.226 ** (0.006)	0.0103 ** (0.232)
TOP	0.000 ** (0.003)	0.000 ** (−0.012)	0.601 ** (0.000)	0.787 * (0.009)
Constant	0.000 ** (−1.420)	0.621 ** (0.096)	0.000 ** (0.014)	0.000 ** (0.523)
AR1	0.447	0.335	0.665	0.712
AR2	0.1601	0.1495	0.1619	0.1498

Note: *, ** represents significant level at 10%, 5%, respectively.

The robustness test of the link between financial inclusion, sustainability, and financial efficiency is further confirmed when FGLS is applied. Noteworthy, Table 7 shows the coefficients of the variables in their parentheses and significant level indicated with ** at 0.05 percent level accordingly. Specifically, across the result, financial inclusion demonstrates that it is significant in explaining financial stability. Likewise, the study also indicates that this is significant in explaining financial efficiency, human development, and gross domestic product. Similarly, the study on the consumer price index also justifies the significant outcome of financial stability, financial efficiency, human development index, and gross domestic countries across the G20 countries. Further, population growth indicates that it impacts positively on financial stability and is significant as well. Additionally, it shows it is negative but influences financial efficiency and human development significantly, respectively. The relationship between POPG and GDP is also positive and significant. On the whole, TOP reports that it is significant across financial stability, human development, and gross domestic product but not on financial efficiency. The major significant outcome of these FGLS results also confirms that of [53,68].

Table 7. Robustness test.

	Model 1	Model 2	Model 3	Model 4
	FGLS	FGLS	FGLS	FGLS
	FSI	FEI	HDI	GDP
FII	(0.333) 0.000 **	(0.020) 0.026 **	(0.181) 0.010 **	(0.003) 0.338 **
CPI	(−0.567) 0.000 **	(−0.570) 0.000 **	(0.570) 0.000 **	(0.014) 0.009 **
POPG	(0.045) 0.000 **	(−0.001) 0.024 **	(−0.023) 0.000 **	(0.000) 0.003 **
TOP	(0.819) 0.000 **	(0.021) 0.167 **	(−0.294) 0.000 **	(−0.019) 0.004 **
Constant	0.0204 **	0.0002 **	0.0000 **	0.000 **

Note: ** $p < 0.05$ represents the significant level 5%.

5. Conclusions

The main purpose of this study is to examine the significant relationship subsisting between the effect of financial inclusion on financial stability and financial efficiency, with emphasis on the G20 economies. The financial inclusion index is a proxy for financial inclusion, and it represents the independent variable. Additionally, the financial stability index, financial efficiency index, human development index, and gross domestic product serve as the dependent variable of the study. The study used the consumer price index, population growth, and trade openness as its control variables. The autoregressive distributed lag, fixed effect, random effect, and the Hausman test technique are used. For robustness, the generalized methods of movement, GMM are also used. The autoregressive distributed lag estimation showed that, collectively, in the short-run, financial inclusion showed that it is statistically insignificant across models (Model 1 to Model 4). However, the result differs in the long run. In the long run, financial inclusion is statistically significant across models. This result brings to the conclusion that there is a statistically significant relationship between financial inclusion, financial stability, and financial efficiency. Again, on an individual basis, the result of the fixed and random effects concludes that, among the four models, financial inclusion is statistically significant in explaining Models 1 and 4 but insignificant in explaining Models 2 and 3. Conversely, for robustness, the GMM result showed that financial inclusion is statistically significant in explaining financial stability and financial efficiency among the G20 countries selected. Conclusively, it means that a significant relationship subsists between financial inclusion, financial sustainability, and financial efficiency. This further brings to bare the robust debate on expanding the need to strengthen financial institutions for greater economic gains.

The findings of our article would provide policymakers, academics, and regulators with accurate information about financial inclusion and other variables. Moreover, the outcomes of this article would be essential to access leads to financial services, which can ultimately increase economic growth, reduce poverty, and improve financial stability and financial efficiency, which in turn can achieve sustainable development. The present study also suggests some other policy implications. First, this study suggests that the government of G7 countries should promote equal opportunities for financial inclusion to bring financial stability to the country. If opportunities are equally accessible for a loan to all citizens, then financial stability will have occurred. Second, the government should expand the information on insurance products that can be availed by the general public, then there will be economic growth in countries. Third, the study suggests government authorities should impose higher interest rates on loans to avoid damaging financial efficiency. Fourth, the study suggests that the government of the G7 should start renewable projects on equity for human development. Finally, the study suggests that government authorities should design policies for banks to stimulate financial stability and economic growth.

Based on the above conclusion, the current has several limitations which can lead to future research direction. First, the current research has a data collection issue—the data have only been available for fourteen years, from 2004 to 2017. Future studies can come up

with fresh data and even increase the no. of years. Second, the study has only considered G20 countries for the analysis. Future research can work for G7, and OECD or even take a comparison study between developed and developing economies. Third, this study has utilized only three proxies for the measurement of financial inclusion. A lot of proxies are available in IMF and WDI for measuring financial inclusion. Future studies can thus utilize more proxies and make a single index through PCA to get different results. Last, the study argued that the mediating role of institutional quality can also create novelty, so the future researcher can also utilize this mediator to see the association.

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