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A Cross-Country Analysis of the Influence of Financial Technology in the Business Economics and Management

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Abstract:
This research evaluates the effect on economic development in the province of Index financial inclusion and human capital. This essay also examines the influence of financial inclusion on both developed and emerging economies. Financial planning for small businesses must adhere to the following essential principles: scientific nature, goal orientation, consistency, and adherence to the rules. Stability and adaptability, coordination, and synchronization of thought sources of money for their projects, as well as liquid resources and long-term financial viability The discovery that the emergence of challenges with small-business financial strategies, such as meeting the needs of a minimal accounting team, inadequate management accounting skills; a lack of funds for the development of proper accounting and reporting system of analysis. The new financial inclusion index is used to determine every country's degree of financial inclusion. The impact of financial inclusion on economic growth is then assessed using a cross-sectional threshold regression approach. An examination of the long-term linkage between financial inclusion and economic development makes use of a panel co-integration test, while a panel causality test determines the causal direction. This means that financial inclusion seems to have a non-monotonic positive economic impact. A higher financial inclusion index has a far greater positive impact than a reduced level. Our findings should spur policymakers as well as the banking system to expand financial inclusion as a way of encouraging long-term economic growth. Our research observations must encourage policymakers and also the banking industry within every country to work harder to increase financial inclusion as a means of promoting long-term growth in the economy.

Keywords: *Small business, development, management, financial inclusion, economic growth, financial inclusion index, cross country, panel co-integration test, panel causality test*

1. Introduction

The business economy relies heavily on small businesses. Despite their many difficulties, small businesses have a major advantage in creating employment and curb the crises in our country's economic system. The agricultural sector is given a lot of attention in the current state of affairs, and small growth companies have a direct influence on the economic expansion of the surrounding area, communities and the general population. I am not exaggerating when I say that the economic benefits of a small company have a positive effect on the stability and security of our state. In the backdrop of our economy's development, we are seeing an increase in the competitiveness of the European Union's efficiency. Financial inclusion has garnered a lot of attention in recent decades from scholars, lawmakers, and other financial players. This is because worldwide research has shown a relationship between the extent of financial exclusion and the stage of economic expansion and poverty (ERULGEN, A, et al 2023). Accessibility and availability of all participants in an economy to official financial services like bank deposits, credit, insurance, etc., is what this research is concerned with. To put it another way, a financial society with a high degree of inclusiveness is one in which the majority of its members use formal financial institutions to profit from financial services and maintain their financial security.

Due to a lack of financial services in nations with minimum levels of financial inclusion, many individuals find themselves in financial distress. An estimated 30 percent of the globe's people are either financially expelled or experiencing financial instability, as shown by the fact that over 2.5 billion individuals lack admittance to financial services (GPFI, 2011). Many nations' authorities are very concerned about financial inclusion. In a larger sense, financial inclusion refers to the process of bringing individuals of various socio-economic backgrounds, including the poor, the disadvantaged, and migrants, under the same roof of the financial system and providing them with access to the most basic financial services. In addition to traditional banking services, low-cost insurance, pensions, and remittances are also available.

The increasing emphasis on financial inclusion has two major factors. As a start, a lack of financial infrastructure due to the need for financial inclusion may put a crimp on economic development. Second, policymakers have discovered that reducing poverty is a powerful way to boost economic development. To fully understand how financial inclusion affects growth, it is necessary to understand how it is linked to issues like joblessness, poverty, and income inequality.

Individuals' production and employment choices may be changed, and poverty may be reduced as early theoretical literature highlights their ability to obtain financial services. People are more likely to keep their money with a bank if they have access to banking services. This raises GDP per capita as a consequence of the multiplier effect. Recent empirical investigations have demonstrated that access to formal financial services is adversely linked with both poverty and inequality. Universal access to financial goods like insurance and savings would help the poor become less vulnerable (Sethi, D. and Acharya, D., 2018). It will raise their incomes, which will improve their quality of life.

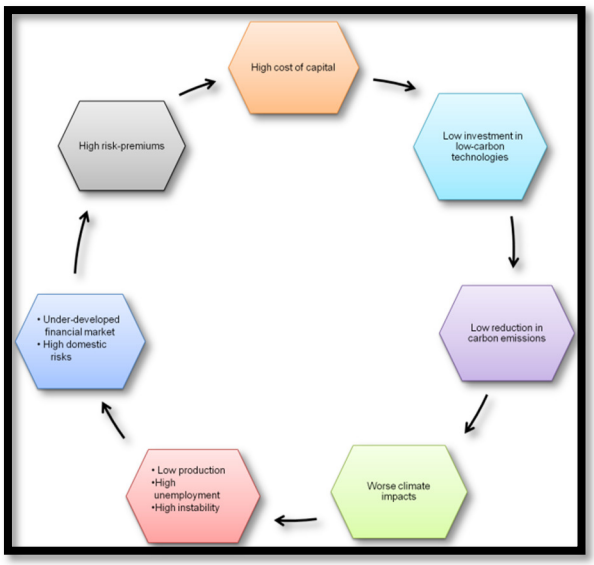

Figure 1: Financial and Economic Level

In approximately the last several years, over two billion people have been left out of the economic mainstream. Financial services should be available to low-income earners, rural residents who are illiterate, and those who are financially disadvantaged. Consumers' access to financial goods and services is among the qualitative characteristics of financial development that have an impact on the economy of a nation. According to several empirical studies, economic development is strongly linked to the amount of financial inclusion. Many developing countries have made financial inclusion one of their top priorities, and many studies have shown how critical it is to eliminating family poverty. The theoretical significance of financial inclusiveness has been recognized. Empirical studies conducted over the previous two decades have shown a strong link between financial sector development and economic development. The reverse causality issue tainted the investigation since financial depth alone was unable to appropriately quantify financial progress. It is impossible to discern if an economy is on a sustainable path based just on its financial progress. Researchers have found that there must be a limit on the amount of money that may be created. According to these data, the link between financial improvement and economic expansion is both linear and non-linear. However, this shows that the interaction with other financial development components has to be revisited. As a result, this investigation will observe the effect of financial technology on the economy, as shown in figure 1.

This research adds to previous growth empirical studies in the following ways. This research is required to find the ideal degree or minimal turning point of financial inclusion that benefits growth in the economy. This means that policymakers must establish a good approach to promote financial inclusion by strengthening the index and determining the appropriate degree of financial inclusion to foster economic growth. Policymakers can concentrate on all other development methods by understanding the contingent impact and the optimal financial inclusion threshold level. So, initially, the datasets are gathered across certain countries for the design of the financial inclusion model, which is assessed through a cross-sectional threshold regression approach. To examine the long-term relationship between financial inclusion and economic progress, the panel co-integration test is employed. And, to assess the causal direction, a panel causality test is used. Then, the performance of this work is assessed and compared with other existing approaches to accomplish our work with the greatest rate of effectiveness.

The following is a breakdown of the structure of this publication. Section 2 delves into an evaluation of earlier literature regarding financial inclusion and development. The data, the experimental framework, and also the econometric approach are all demonstrated in Section 3. The report's research outcomes and validity are examined in Section 4. Section 5 concludes with the overall work.

2. Literature Review

Financial inclusion and economic development are examined in associate nations of the Organization of Islamic Cooperation (OIC) (Kim, D.W. et al. 2018). Panel data for 55 OIC nations was put up and used to generate multilateral conclusions, including panel VARs, IRFs, and panel Granger causality testing for dynamic panel estimation. Based on dynamic panel estimates, we conclude that financial inclusion contributes to economic development. Focusing on only four major pillars is the ideal approach, according to (Arner, D.W. et al. 2020). For the first pillar to be successful, it must be backed by open, interoperable electronic payment systems and the development of digital identification, streamlined

account opening, and e-KYC schemes. Government services and payments may now be provided electronically utilizing the infrastructure of the first and second pillars. The fourth pillar of digital financial markets and schemes is designed to facilitate more people having access to financial resources and making investments. We look at these correlations across a variety of geographical panels. Narayan, P.K. and Narayan, S. (2013) state that bank loans have a detrimental impact on economic development despite evidence to the contrary for the whole panel of 65 nations. For Middle Eastern nations, data reveals that neither the financial industry nor the banking division adds to economic development at the regional level. Except for Asia, the financial sector's contribution to economic growth is minimal. A sample of 31 Asian nations from 2004 to 2016 is used (Le, T.H. et al. 2019). Principal component analysis (PCA) is used to create composite indicators for the 3 financial proportions based on normalized data. Across nations, we see a wide range of patterns, and no obvious pattern emerges in many of them. The results hold up regardless of the method used to normalize them. Feasible Generalized Least Squares (FGLS) are used to examine the consequence of financial inclusion on financial efficiency and sustainability (FGLS) (Salampasis, D. and Mention, A.L., 2018). In this context, financial exclusion continues to be a very essential issue that prevents developing countries throughout the globe from eliminating poverty, resulting in widespread famine and civil unrest on a huge scale. Furthermore, financial exclusion is intertwined with social reliance, resulting in communities that are financially excluded or underserved being increasingly reliant on their social networks (Abu Alrub, A., et al., 2021; Lu, W.C., 2018). A panel unit root test that accounts for cross-sectional dependency shows that Internet utilization remains unchanging. Using co-integration testing, we can determine whether or not the nexus of information and interaction stools, energy, GDP, and carbon dioxide emissions have reached long-run equilibrium. Carbon dioxide emissions are influenced by both energy usage and GDP, and both have a major effect on the growth in carbon dioxide emissions as well. Promoting ICT has emerged as one of the most essential methods to minimize carbon dioxide emissions in many countries due to its hugely negative effect on carbon dioxide emissions from ICT. It has been shown that rising energy consumption is linked to rising GDP and rising financial growth, according to the causality tests. Energy use, GDP growth, and CO2 emissions are all elements that contribute to ICT (He, G. and Shen, L., 2021). Digital financial inclusion has had an impact on the transition of regional capital from a fictitious economy into an important one. The financialization of real enterprises and the financialization of real estate are two examples of the misallocation of financial capital due to a persistent decline in the efficiency of real sector capital. Small and micro businesses benefit from digital financial inclusion since it helps boost consumer spending and improve services for agricultural, rural, and farmer-related challenges (Liu, X., et al., 2021). Using the network analysis technique and the "quadratic assignment process (QAP)" approach, we investigated the architectural and geographical characteristics of China's financial expertise inclusion system and the factors that impact them. Guan, H. and Li, Q. (2021) investigate the impacts of high-speed trains across the whole research region. HSR construction has a significantly positive spillover effect despite the region's economic difficulties at the time of the study, indicating that the economic benefits of HSR construction outweigh these difficulties, even though this region is currently experiencing general economic difficulty. Dai, W. (2021) conducts research with the help of complicated systems and clustering methods. It is initially used to select the first clustering center, develop noise and outlier handling abilities, and construct a data-mining scheme depending upon the updated approach. When all that is done, the dangers associated with using robo-advisors will be examined from three perspectives: technological, market, and legal (Zhou, L. and Wang, H., 2021). Medical, economic, and educational poverty are all reduced via digital inclusive finance (DIF) in a variety of ways. To alleviate poverty in three dimensions, a wide range of factors are involved, including coverage breadth, depth of usage, and digitalization level, among others. The effect of digital inclusive finance on reducing poverty is mediated by the amount of regional economic growth. Non-linear generalized complex systems are used in Tang, X. (2022) to analyze and research the geographical impacts of financial assistance on economic development. Further investigation of the fi and its function in contemporary financial policies is based on an in-depth knowledge of financial constraint's hypothetical meaning and policy logic. The industrial sector serves as a research object (Xie, J. & Cao, Y., 2021). Using the particle swarm optimization approach, a two-sided positioning model was built, and the best solution was obtained for the feasible area. The unknown node's location may be determined when two anchor nodes are established. Another method of determining wireless network node distance is used in this article: shadowing. In this approach, environmental issues like route loss and occlusion are taken into account to their full extent (Li, J., 2021). The grey relational degree approach is used to examine how competitive the cultural sector is concerning economic development. This is followed by a comparison and evaluation of the cultural industry's impact on the three industries. It was based on these findings that economic development was examined and evaluated further from cultural industries. On top of that, the economic expansion model is utilized to compute the effect of cultural sector investment on the economy. The Internet has had a profound impact on economic growth and financial progress. If the financial sector's penetration of the internet is to be evaluated, financial growth in China's provinces may be accelerated by increasing Internet access in rural areas, according to a study by Jiang, Q., et al (2020). Nearly a third of cities have unsustainable growth, with varying degrees of decoupling. Economic practices that have promoted rapid GDP expansion over the last four decades have left cities with major environmental issues. Li, Z. and Zhou, Z. (2020) show that urban growth and environmental preservation of Chinese resource-based cities are not on the right track. The cities with faster GDP growth will have a harder time achieving a suitable decoupling trend (Wang, C.B. and Huang, Z., 2021). A market-based finance system greatly fosters industrial innovation throughout greater levels of the economy. The importance of financial structure in innovation varies in the range between 9747 International dollars and I$17070 per capita income. As shown in this study, a financial system built on banks is required for the technology imitation approach to innovation, whereas a market-based financial structure is required for the self-initiated method. The development of the need for financial systems in the economy results from the diverse, innovative techniques used at different periods of economic growth (Chang, K., Li, Z. and Long, Y., 2022). A 3-stage super-efficiency data envelopment analysis (DEA) is used in this research to attempt to fill in major information gaps concerning the geographical spillover

influence of economic institutions on regional financial stability in 8 economies. Zeng, Q., et al. (2021) According to research, the three essential elements of regional intangible resources all have positive impacts on local economic growth, with regional structural capital making a contribution the most, accounting for over half of the sum, accompanied by human resources, and eventually, capital employed. The disparity in the growth of cities' intellectual capital has become a pressing issue that must be addressed immediately (Lenka, S.K. & Sharma, R., 2017). Loan to deposit ratio, financial deepening indicators, loans to rural regions, and branch networks were used to quantify financial inclusion in the research. Private sector credit and wide money supply ratios are used as indicators of financial deepening in the research. A measure of poverty, per capita income, was used as a proxy for economic progress across time and hence a gauge of development. Research reveals that rural loan distribution has helped reduce poverty in Nigeria, even if it has not contributed considerably to economic development in Nigeria. To account for institutional variance, we analyze this impact at the cross-country level. In terms of "access to finance," financial infrastructure and financial literacy are largely interchangeable (Grohmann, A., et al, 2018). When it comes to "using financial services," on the other hand, greater financial depth has a stronger impact when people have better financial literacy. These findings are corroborated by IV regressions, which point to a relationship between the variables. By examining the variables that influence financial inclusion and evaluating the effects of financial inclusion on poverty and income inequality in Asia and throughout the globe. Park, C.Y. and Mercado Jr, R. (2018) add to the body of knowledge on financial inclusion. Of the 176 countries, 37, which are in developing Asia, are assessed using a new financial inclusion measure incorporating a wide range of macroeconomic and country-specific criteria. They examine the impact of financial inclusion on inequality and poverty. An international comparison of financial inclusion is made in this research (Wang, X. & Guan, J., 2017). According to the findings, developed European and North American nations have greater levels of financial inclusion than the less developed countries of Africa and most Asian countries. Based on this, we may conclude that our geographical analysis supports our hypothesis and indicates the influence of nations on one another. Then, we conduct a geographic econometric study to discover those elements that have a major impact on financial access (Park, D. & Shin, K., 2017). Our primary goal in writing this study was to conduct an empirical investigation of the link between economic growth and wealth disparity. Both a positive and negative link between the two variables might theoretically be found in the context of this study. Up to a certain point, financial growth helps to reduce inequality; as this development continues; however, it causes inequality to rise. We have also found that as the proportion of children in primary school rises and the state of law and order improves, so does the ability of financial development to reduce inequality (Hajduk, S., (2018). The International Organization for Standardization (ISO) 37119 standard, which deals with sustainable community development, is the focus of this research. Cities with a higher certification score have better governance, and their citizens are more dedicated to civic engagement as a result. The World Council on City Data's Multi-dimensional Comparative Analysis was used to compile data for the evaluation of smartness (Weerasinghe, K.P.W.D.R., 2019). There is currently a paucity of research on content marketing since it is a relatively new phenomenon. The research's goal is to see how content marketing affects consumer participation in the online world. Using convenience sampling, 75 online surveys were sent. For the investigation, descriptive and bivariate analyses were employed. Shah, I.A. et al. (2019) Overconsumption of office paper is examined in this research, and the environmental and economic consequences of overconsumption are estimated. According to the survey, data were gathered from the staff of Oman's higher education institutions. Overconsumption was shown to be mostly caused by technical issues, work environment, printing preferences, and a lack of knowledge. Standard methods from the literature were used to evaluate the environmental and economic effect of paper consumption based on the actual quantity of paper used.

3. Data and Methods

This study analyzes the relationship between financial inclusion and the development of human capital. To further understand how financial inclusion affects economic growth, a cross-country sample was gathered. Research in this study used an entirely new financial inclusion index to quantify the degrees of financial inclusion in six nations. The impact of financial inclusion on economic growth may be quantified using cross-sectional threshold regression. To analyze the long-term link between financial inclusion and economic development, we use panel co-integration and panel causality tests. Digital financial inclusion and human capital development have been proven to have a significant influence on provincial economic growth. Financial inclusion and economic growth have a positive and long-term relationship in the countries investigated, as seen in figure 2.

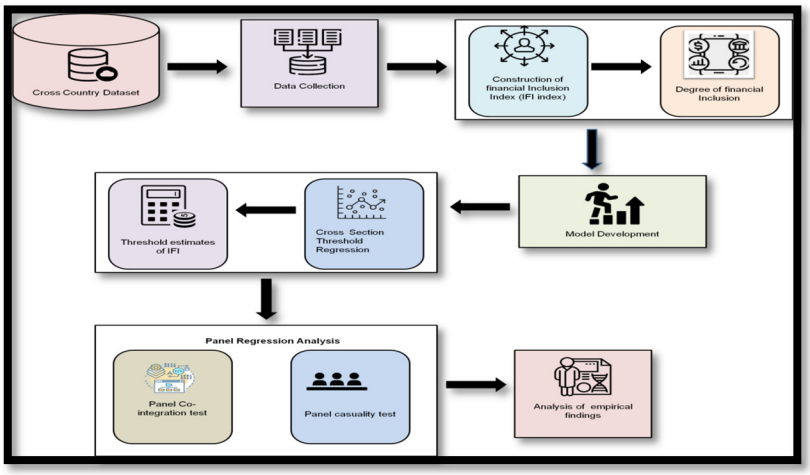

Figure 2: Schematic Representation for Overall Flow

3.1. Data Collection

For the years 2016 and 2021, this research used cross-country estimates and macro data from four developed and emerging nations: Korea, Malaysia, Thailand, and China. The availability and trustworthiness of data were the primary determinants in selecting the nations to be studied. The real GDP per capita is employed as a proxy for economic expansion in this research as the dependent variable. To calculate the real GDP per capita (GDPPC), data are transformed onto a logarithmic scale and represented in US dollars at constant current exchange rates. Indicators from the World Databank were used to compile this information. The financial inclusion index, on the other hand, is a separate variable. Based on four dimensions, demand and supply-side data are combined to create this index. An international monetary fund's Financial Access Survey (FAS) database and the Global Findex database each provided statistics on one of the four aspects of financial inclusion: banking penetration, accessibility of financial products, use of monetary policy instruments (fintech), etc.

3.2. Construction of Financial Inclusion Index (IFI Index)

Multi-dimensional financial inclusion indexes are often used by academics to assess the financial inclusion levels of different countries since they include a large number of different data points into a single total. With the use of a multi-dimensional index, researchers may more easily compare the financial inclusion levels of various countries. To arrive at the IFI Index, an algorithm with seven indicators is used. This new index has three benefits over a different financial inclusion indicator. With this new index, we can minimize issues with weight assignment that were previously caused by prejudice, a lack of scientific rigor, or multicollinearity. PCA is the most often used approach for obtaining weight endogenously. In contrast, the researcher's gut instinct determines the weight. Since the selection of financial components and the weight of the index are critical since indexes are sensitive to subjective weighting, tiny changes in weighting may have a significant impact on the index value. For this reason, an index of financial inclusion across nations is generated using a mix of parametric and non-parametric techniques. For the second time, the new index incorporates data from both the supply and demand sides, with demand-side data being included in the formulation of the index. This index provides academics and policymakers with the ability to draw significant comparisons between economies by aggregating information on many elements of financial access for each nation. For the third time, this indicator may be used to analyze how financial inclusion and other macroeconomic factors are linked. There are, thus, four aspects to consider while creating the new IFI Index. As dm1 stands for banking penetration, the number of deposit bank accounts per 1010 adults in the population is used to calculate this metric. The availability of financial services, represented as dm2, is the second dimension. This was determined by counting the number of ATMs and bank branches per 100,010 inhabitants. As a percentage of a country's GDP, the use of financial services, symbolized by the symbol dm3, was calculated using two of a banking system's most fundamental services: credit and deposit. Since 85 percent of financial inclusion data is collected from commercial banks, these datasets are used to make comparisons throughout the country. Digital financial technology (Fintech), often known as dm4, is the last dimension. How many people have paid their energy bills or purchased something online using a mobile phone, as well as how many people have made digital payments or received digital payments in the last year, were utilized as indications. A dimension index for every dimension is computed via equation (1) to begin the computation of the IFI Index:

$$dm_j = we_j \frac{r_j - min_j}{max_j - min_j} \quad (1)$$

Here, we_j is denoted as the connected weight to the indication j, $0 < we_j < 1$, r_j is denoted as the real value indication j, min_j is denoted as the minimum possible value for indicator j, max_j is denoted as the maximum possible value for indicator j,

The j-dimension of financial inclusion is measured by the dm_j dimension index. Endogenously using PCA analysis, each dimension's weight (we_j) is computed and assigned to the dimension j, which indicates how important that dimension is to financial inclusion overall. Using a two-stage PCA approach is recommended to minimize the issue of weighting indicators that are strongly linked. Four-Dimension Index are:

- Banking penetration,
- Availability,
- Usage, and
- Fintech

The first phase entails estimating the parameters or weights of each of these dimensions, while phase two involves estimating weights for all dimensions and an overall financial inclusion index. The following equation linearly calculates FI as a latent variable.

$$Financial\ Inclusion_j = we_1 X_j^a + we_2 X_j^b + we_3 X_j^c + we_4 X_j^d + t_j \quad (2)$$

Here, j represents country

X_j^a denotes Banking penetration

X_j^b denotes Availability

X_j^c denotes Usage level

X_j^d denotes Dimension of fintech

t_j = The entire variance in financial inclusion may be broken down into two orthogonal parts: variation attributable to causative factors and error.

The index of financial intermediation is computed based on 4 dimensions after the weights have been found intrinsically (s) using the PCA approach, and the final equation for creating the IFI index for a nation is as follows:

$$IFI_k = \frac{1}{2}\left[\frac{\sqrt{a_n^2+b_n^2+c_n^2+d_n^2}}{\sqrt{y}} + \left(1 - \frac{\sqrt{(s-a_n)^2+(s-b_n)^2+(s-c_n)^2+(s-d_n)^2}}{\sqrt{y}}\right)\right] \quad (3)$$

Here,

a_n denotes Dimension weight index for Banking penetration

b_n denotes Dimension weight index for Availability

c_n denotes Dimension weight index for Usage level

d_n denotes Dimension weight index for fintech

3.3. Degree of Financial Inclusion (DFI)

Described in this section is the theoretical process through which Index financial inclusion and human capital influence economic development. With the introduction of the term DFI, financial inclusion has always been a topic of discussion in policy, society, and academics. To put it another way, DFI is not simply an acronym anymore; it is a useful tool for structuring financial services. Currently, the financial services sector is seeing fast growth. As per the Fintech Factors to Monitor 2019 research, above 1700 online exchanges totaled $40 billion. New financial products and business models have emerged due to the technological and digital financial convergence, increasing customer involvement and lowering transaction costs. Information technology in the digital money sector, share price prediction, and portfolio management with DFI's support are becoming more important as the financial services sector shifts from the finding stage to the realization stage. According to the DFI, financial inclusion is defined as the percentage of people and businesses that have access to banking and other financial services (Rjoub, H and Abu Alrub, A, 2023). Financial goods and services are made more accessible and usable by DFI, which encompasses a wide range of criteria. Financial inclusion has been measured using just a few metrics, including the amount of profitable bank branches per 100,000 adult populations, the quantity of ATMs per 1000 kilometers, and the proportion of credit & deposits as a proportion of gross domestic products (GDPs). Despite this, these financial metrics are not sufficient to assess the extent to which people have access to financial services.

3.4. Model Development

Equation 4 serves as the foundation for the empirical model, and it may be stated as follows: growth equation:

$$Real\ gross\ domestic\ product\ per\ captial_j = \varepsilon_0 + \alpha_1 IFI_{(ft)j} + \alpha_2 Y_j + \rho_j \quad (4)$$

Here,

IFI represents financial inclusion

Y_j represents economic factors influencing per capita real GDP growth

j represents country, j= 1,2,....m

ρ represents value of error

The following is the hypothesis of threshold consequence or non-linearity in this work:

$$H_0: \alpha_1 = \alpha_2 \quad (5)$$

$$H_0: \alpha_1 \neq \alpha_2 \quad (6)$$

Here $\alpha_s$denotes parameter vector. The alternative to linear regression is non-linear extrapolation, which is the favored solution in this case. There is a two-regime non-linear threshold regression when the null hypothesis is rejected. There may be contingent effects among financial intermediation and economic development, which may be tested using Equation (4). As can be seen, the threshold regression model:

$$Realgrossdomesticproductpercaptial_j = \begin{cases} \alpha_0^1 + \alpha_1^1 IFI_{(ft)j} + \alpha_2^1 Y_i + \rho_j, & IFI_{(ft)j} \leq \curlywedge \\ \alpha_0^2 + \alpha_1^2 IFI_{(ft)j} + \alpha_2^2 Y_i + \rho_j, & IFI_{(ft)j} \leq \curlywedge \end{cases} \quad (7)$$

Here, IFI_ifinancial inclusion level is employed as a threshold to divide the sample into groups or regimes and $\curlywedge$denoted unknown threshold value. Models like these allow the importance of financial inclusion to shift depending on

whether or not a country is below or over a predetermined threshold λ of some unknown value. This equation uses an index of financial inclusion as a sample-splitting or threshold factor. Real GDP per capita would be impacted by financial inclusion in countries with a low/high regime by α_1^1 and α_1^2. In contrast, the representation becomes linear and simplifies to equation 3 if the premise $\alpha_1 = \alpha_2$ is accepted.

The generic version of Equation (4) may be rewritten as follows:

$$y_i = \alpha_1' y_i M(q_i < \lambda) + \alpha_2' y_i M(q_i < \lambda) + \rho_j = \alpha_2' y_i(\alpha) + \rho_j \quad (8)$$

Where M(.) is an indicator function, $\alpha = (\alpha_1', \alpha_2')$ and $x_i(\lambda) = \begin{bmatrix} y_i M(q_i < \lambda) \\ y_i M(q_i < \lambda) \end{bmatrix}$ (9)

3.5. Cross Section Threshold Regression

Using cross-section threshold regression, the non-monotonic impact of financial inclusion on economic growth was examined. Financial inclusion and economic development are dynamic concerns, and this technique might be utilized to better understand the process of change and adaptation in these areas. Recovery of reliable estimates of additional parameters may depend on allowing for changes in the underlying process.

Estimation begins by testing against Equation's threshold model for linearity's null hypothesis, H0:$\alpha_1 = \alpha_2$. Statistical proof of maximum threshold extrapolation with two systems and a non-linear model may be found if the rejection of the null hypothesis Samples is considered to be $IFI_{(ft)j} \leq \lambda$during the first regime and $IFI_{(ft)j} > \lambda$ in the second regime if they meet a criterion. Statistically, the two regimes provide distinct results.

A Lagrange Multiplier (LM) bootstrap technique compatible with heteroscedasticity is used to reject the research hypothesis of linear formulations versus a threshold regression alternative. In order to test the hypothesis of the no-threshold effect, the threshold parameter p is not discovered; hence, the p values are calculated using a fixed bootstrap approach. The results of this approach are asymptotically accurate p values. Following the rejection of the null hypothesis $\alpha_1 = \alpha_2$and identification of a threshold level, we must check the threshold regression representation against a linear specification once again, this time after splitting the actual sample as per the threshold level determined. This technique is repeated till the null of $\alpha_1 = \alpha_2$ can no longer be discarded as a valid result.

3.6. Panel Co-Integration Test

In the empirical literature, a number of different types of econometric tests are offered to test for the co-integration of the two variables. In conjunction with the development of panel data analysis, various common approaches for estimating co-integration among the variables have been created. A panel co-integration technique was suggested to assess the long-term connection between variables, and it has been the most used test since then. Because it incorporates variation at the individual country level, this technique has the benefit of being more accurate. The following diagram depicts how the test is conducted:

$$A_{b,c} = \acute{g}_b + \ddot{g}_b c + \widehat{g_{1b}} z_{1b,c} + \widehat{g_{2b}} z_{2b,c} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots + \widehat{g_{Nb}} z_{Nb,c} + f_{bc} \quad (10)$$

Here c = 1, ..., C; b = 1, ... M; n = 1, ... N

Here:

C denotes the duration of time

M refers to the specific nation represented in the panel.

a $\widehat{g_{1b}}$, $\widehat{g_{2b}}$, ...$\widehat{g_{Nb}}$, are variables that are used in regression analysis.

$\acute{g}_b$ is an identifier for each individual member.

$\ddot{g}_b c$ is a specific country's deterministic time trend.

Lastly, this test generates 7 statistics to test the null hypothesis of no co-integration versus the alternative hypothesis of co-integration. The first four of the seven test statistics demonstrate co-integration "inside" the dimension, whereas the final three show co-integration "between."

If $\widehat{g_i}$ =1, then there is no co-integration, and if $\widehat{g_i}$=$\widehat{g}$ < 1, then there is. Alternate hypotheses for group statistics include $\widehat{g_i}$< 1.

However, it is suggested that the "OLS" co-integration technique is biased and inconsistent. The co-integration study used a technique called "FMOLS", which is a fully modified "OLS". It takes into consideration the simultaneity issue that arises from variability in panel data when estimating long-term relationships between variables. When it comes to making accurate predictions, "FMOLS" is a better option than "OLS" since it is more powerful.

The co-integrating "FMOLS" equation is as follows:

$$A_{b,c} = d_b + \beta_b z_{b,c} + \tau_{b,c} \quad (11)$$

Here, cointegrating parameters $A_{b,c}$ and $z_{b,c}$ are monitored via β_b.

Lag and lead of the first regressions are then added to the equation as follows:

$$A_{b,c} = d_b + \beta_b z_{b,c} + \sum_{i=-i}^{i_b} \vartheta_{b.i} \Delta Z_{b,c-i+C_{b,c}} \quad (12)$$

After that, the FMOLS estimator for the panel in question has been laid out below:

$$\hat{B}_{FOMLS} = \frac{1}{L}\left[\left\{\sum_{c=1}^{C}\left(z_{b,c} - z_{\overline{b}}\right)^2\right\}^{-1}\left\{\sum_{c=1}^{C}\left(z_{b,c} - z\right)A_{bc^*} - C_{z^b}\right\}\right] \quad (13)$$

Where $A_{bc}^* = z_{b,c} - z_{\overline{b}} - \left(\frac{\Omega_{21b}}{\Omega_{22b}}\right)\Delta z_{bc}$ *and* $yz_b^{\wedge} = \Gamma_{21\mathrm{b}}^{\wedge} + \Omega_{21b}^{\wedge 0} - \left(\frac{\Omega_{21\mathrm{b}}^{\wedge}}{\Omega_{22\mathrm{b}}^{\wedge}}\right)\left(\Gamma_{21\mathrm{b}}^{\wedge} + \Omega_{21b}^{\wedge 0}\right)$ (14)

A dynamic OLS technique (sometimes referred to as a "DOLS") Panel co-endogeneity integration and serial correlation problems are captured by this approach. Adding additional terms of explanatory variables to the co-integration

equation corrects the biases. Depending on the order in which the explanatory variables are used, these additional words are referred to as lags or leads. There are several ways to describe the model specification.

$$A_{b,c} = \acute{Z}_{b,c}\beta + \sum_{k=-p_1}^{p_2} C_j \Delta z_{b.k} + u_b + \epsilon_{b,c} \quad (15)$$

$$d_{DOLS} = L^{-1} \sum_{b=0}^{n} (\sum_{c=1}^{C} \forall_{bc} \acute{\forall}_{bc})^{-1} \left(\sum_{c=1}^{C} \forall_{bc} (A_{bc} - \overline{A_b})\right) \quad (16)$$

3.7. Panel Causality Test

It is suggested that if 2 series are cointegrated after that, slightly one-way causation should exist. Because of this, it is recommended that causality in VECM be evaluated when co-integration is present. Cointegrated series are also said to have at least one-way causation. It is argued that the Granger causality exists in a bivariate system if one variable may predict another. Traditional causality, on the other hand, has a restricted use because of various drawbacks. When two series are co-integrated, the approach does not account for the delayed error correction term. Inadequate testing occurs since the lagged error correction incorporates information from the actual series' long-runs, which cannot be ignored. Our error correction approach includes a Granger causality test to prevent these issues (ECM). A VAR's VECM is described as follows:

$$\Delta A_{b,c} = Z_{0b,c} + \sum_{i=1}^{n} \gamma_{1b,c} \Delta A_{b,c-i} + \sum_{i=0}^{n} \gamma_{2b,c} \Delta A_{b,c-i} + \theta_{1b} ECM_{b,c-1} + \mu_{b,c} \quad (17)$$

$$\Delta Z_{b,c} = \delta_{1b,c} + \sum_{i=1}^{n} \delta_{1b,c} \Delta A_{b,c-i} + \sum_{i=1}^{n} \delta_{2b,c} \Delta A_{b,c-i} + \theta_{2b} ECM_{b,c-1} + \epsilon_{b,c} \quad (18)$$

In this case, the short-term causality between the variables is established when the null hypothesis $\gamma_{2b,c}$=0 or $\delta_{2b,c}$=0 is rejected. Long-term causality may be inferred by rejecting the null hypothesis for the values of θ_{1b}= 0 orθ_{2b}. A VECM framework does not yet have panel causality. Hence, the VECM is used to determine the direction of causation, whereas the fixed effect model is used for estimate. Instead of considering the whole panel as a single unit in the estimate of causality, this fixed effect model takes into account the effects of individual countries.

4. Result and Discussion

Due to the rise in the economic level, we explored financial understanding in this section. Table 1 displays the following information: The percentage of adults who can properly solve at least 4 out of 5 financial literacy problems is called financial knowledge. The 40th and 60th percentiles of the income distribution, respectively, report having the same consequence of financial knowledge. Financial inclusion is defined as the percentage of males and females who can properly answer at least four out of 5 questions on personal finance. How many people correctly answered each of the following questions: risk diversity, inflation, interest, and interest compounding? According to the population, the weighted means were weighed.

	Mean	Standard Deviation	Minimum	Maximum	Mean Weight	Standard Deviation Weight
Financial knowledge level	37.60	14.79	12	72	33	12.45
Financial knowledge level (40%)	30.72	12.15	6	66	26	11.51
Financial knowledge level (60%)	39.92	13.66	13	77	36.40	11.36
Financial knowledge level for male	38.86	13.39	14	76	34.06	11.07
Financial knowledge level for female	32.51	12.61	9	71	28	12.36
Risk	42.48	17.09	12	77	33.9	15.80
Inflation	53.62	11.45	16	79	48.95	11.71
Interest	48.75	10.77	15	78	49.10	9.46
Interest compounding	47.35	12.88	21	73	46.18	7.26
Measurement	142					

Table 1: Financial Knowledge Level

Table 2 shows that the data usage and availability of financial services, including card usage, Formal financial instruction, account ownership, debit card ownership, debit card use, and savings at the official financial institution, are specified as percentages of people who have deposited at a formal financial institution in the previous year. The people weighed in on the derived weighted mean values.

	Mean	SD	Min	Max	Weighted Mean	Weighted SD
Ownership of accounts	53.78	31.81	3	99	57.63	24.74
Ownership of a debit card	38.29	31.76	1	100	36.82	23.96
Formal financial instruction	23.46	19.81	0	77	24.33	16.17
Debit card used in the previous year's list	29.30	27.74	1	95	23.03	23.28
Measurement	143					

Table 2: Data Usage and Availability of Financial Service

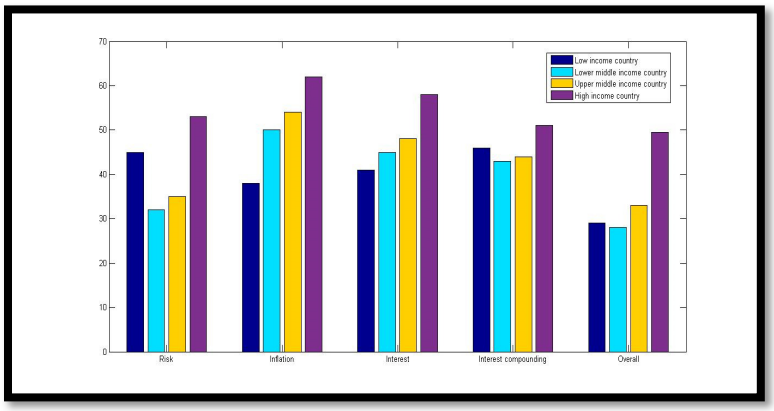

Figure 3: Variety of Levels of Financial Knowledge

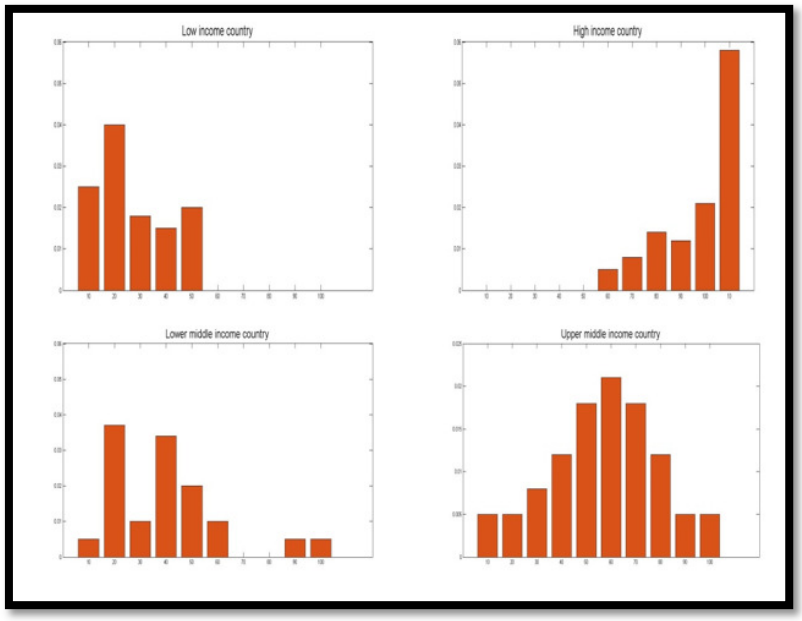

Figure 4: World Income Level

An analysis of the World Bank's categorization of nations into four income levels shows that people in wealthier countries have a greater level of financial literacy. Financial review entering groups are shown in figure 3. For lower and higher middle-income nations, the average scores on two of the questions are quite close to one another. Low-income nations have a few advantages over middle-income countries when it comes to some aspects of their lives. According to the graphs in figure 4, only nations with high incomes have a considerably higher average score. A country's income is also correlated with its level of financial literacy. On average, the wealthiest 60% of individuals have an 8% better level of financial literacy than the wealthiest 40% of persons. The difference in financial literacy between men and women is 6.4 percentage points. Figures 5 and 6 show the analysis of economic growth and financial inclusion index for different years.

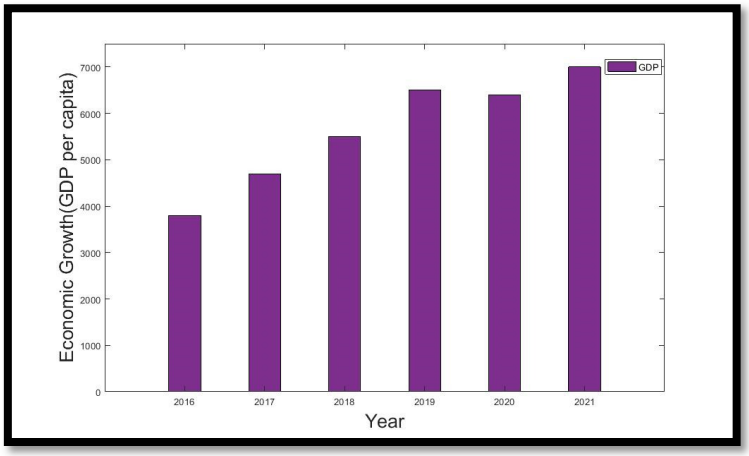

Figure 5: Analysis of Economic Growth

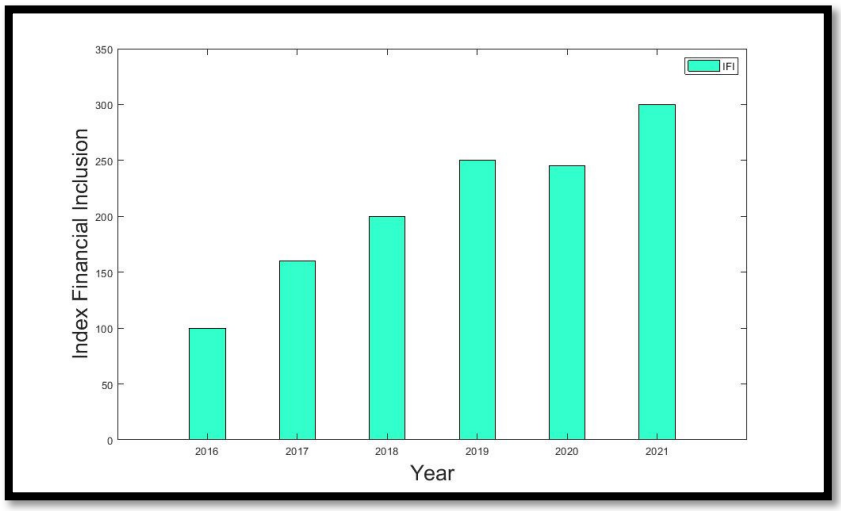

Figure 6: Analysis of Index Financial Inclusion

Variable	Mean	Standard Deviation	Lowest	Highest
L GDP per capita	5.675	0.186	3.215	4.146
L digital financial inclusion	1.200	0.296	2.210	1.576
L breadth of coverage	1.124	0.372	0.291	1.548
L depth of usage	1.192	0.282	0.831	1.602
L level of digitalization	1.343	0.320	0.879	1.657
Human capital	99.797	0.355	96.750	99.153
Government expenditure on science and technology	0.442	0.265	0.135	1.406
Inflation	101.496	2.287	99.640	105.300
Trade opens	26.004	29.860	2.684	153.816
Population growth rate	0.687	0.700	-0.786	3.311

Table 3: Analytical Stats

Data on Income per capita, IFI, and human resources are all included in table 3, which summarizes the data. To reduce skewness, IFI sub-indices are expressed as logarithms.

	2020	2021
No-threshold LM testing	14.245	13.862
Bootstrap p-value	0.0352	0.0397
Estimation of the threshold	0.592	0.669
95% confidence interval	[0.248, 0.632]	[0.501, 0.685]

Table 4: IFI Cross-Sectional Threshold Estimations during 2020 and 2021

Samples	Total countries	Min-income	Max-income	Economy	Financial Marketplace
Panel v-stat	-1.86	-3.77	-4.15	-2.16	-1.02
Panel rho-stat	-1.33	-2.26	-1.42	-1.29	-0.76
Panel pp-stat	-1.52	-2.19	-1.54	-0.98	-2.98
Panel adf	-1.04	-2.57	0.79	-1.03	0.14
Group rho-stat	0.66	0.19	1.35	0.98	-1.71
Group pp-stat	1.62	2.17	1.27	1.27	-1.27
Group adf	2.55	1.33	-1.08	0.63	-1.98

Table 5: Panel Co-integration Test's Outcomes for 2016-2021

Country	Co-efficient	Statistic	Critical-value		
			1 Percent	5 Percent	10 Percent
China	-0.012	8.523	152.362	63.221	29.531
Korea	0.048	14.336	169.221	49.896	31.523
Malaysia	-0.116	5.621	148.663	53.337	24.775
Thailand	0.146	49.685	172.451	72.652	41.653

Table 6: Causality Test's Outcomes

On the other hand, the threshold tolerating heteroskedastic errors was examined in table 4. The bootstrap approach demonstrates that the hypothesis of no threshold consequences is refuted at a fairly massive level for both decades. Since the correlation between economic growth and financial inclusion seems non-linear, imposing a priori monotonic restrictions on the interaction is similarly questionable. That financial inclusion can only lead to economic development at a specific level of such index or any other of its correlation factors is explained by the result.

Table 5 shows the outcomes of co-integration testing for 2016-2021. Subgroups of nations inside the panel are also cointegrated. The categorization of gross national income allows us to examine countries based on their revenue. We often attempt to homogenize nations in terms of financial markets or economic systems. In this case, we employ market capitalization (%) and domestic financial credit (in GDP %).

Except for Thailand, there seems to be no correlation between technology and economic expansion, as illustrated in table 6. In other terms, in emerging economies, financial technology has little effect on actual GDP. Due to the positive test statistic factor, just financial technology affects GDP favorably in Thailand. Thus, financial technology is directly related to Thailand's real GDP. This outcome backed up Thailand's growth theory. In other respects, increasing financial technology will boost the Polish economy. This result suggests that financial technology initiatives may harm Thailand's economic growth.

Figures 7 and 8 exhibit the charts of the normalized likelihood ratio LR (γ) as a measure of the threshold in the outcome. Based on figures 7 and 8, the LS estimation of γ is the value that minimizes the chart that happens around γ=0.550 in 2020 and alsoγ=0.667 in 2021. The 95 percent critical value is also represented as the horizontal line; therefore, we may read off the asymptotic 95 percent confidence range of the interval from the charts where LR (γ) passes the horizontal line. Those findings indicate that there has been substantial proof for 2 regime definitions. Amongst 4 nations with information that can be delivered beyond 0.525 and 0.654, subsequent sample divides these subsamples regarding the financial inclusion index, leading to none of the bootstrap test statistics being significant at the 1 percent or 10 percent level.

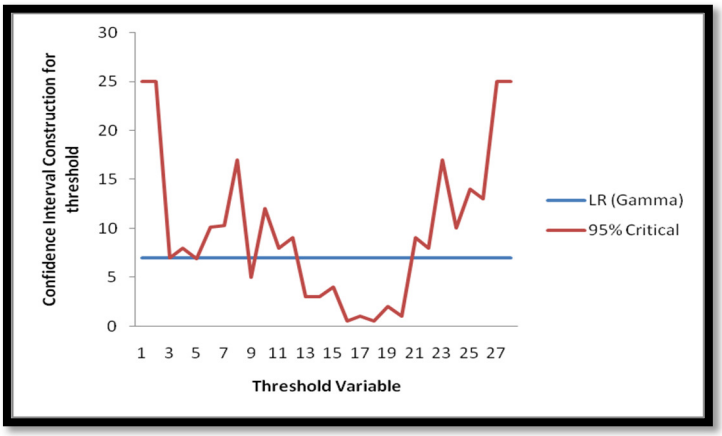

Figure 7: Confidence Interval for 2020

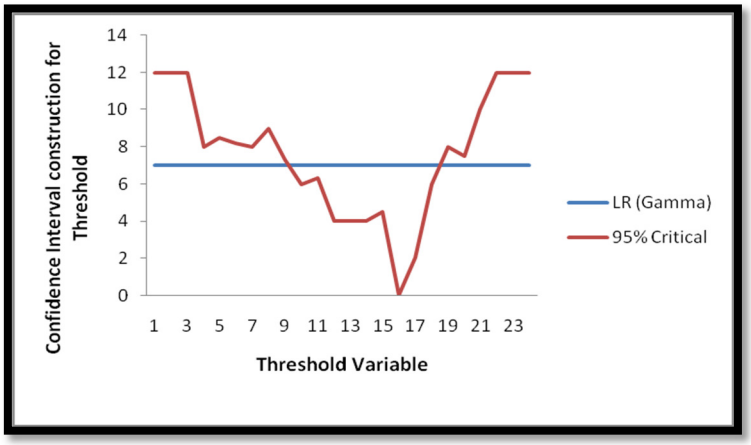

Figure 8: Confidence Interval for 2021

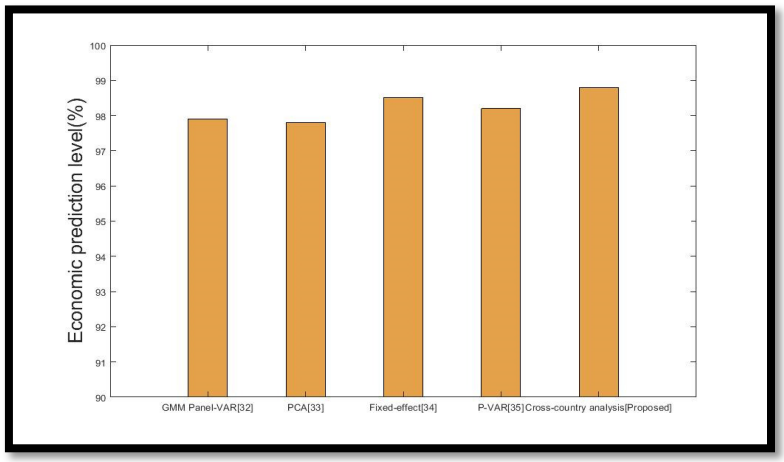

Figure 9: Comparison of Economic Prediction Level (%) with Proposed and Existing Techniques

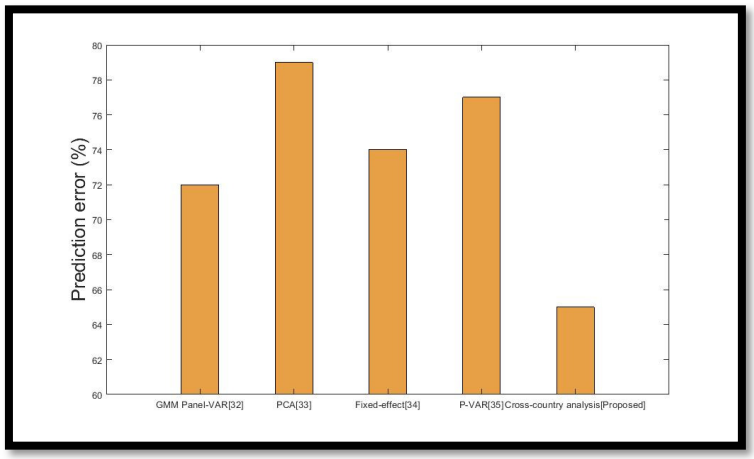

Figure 10: Comparison of Prediction Error (%) with Proposed and Existing Techniques

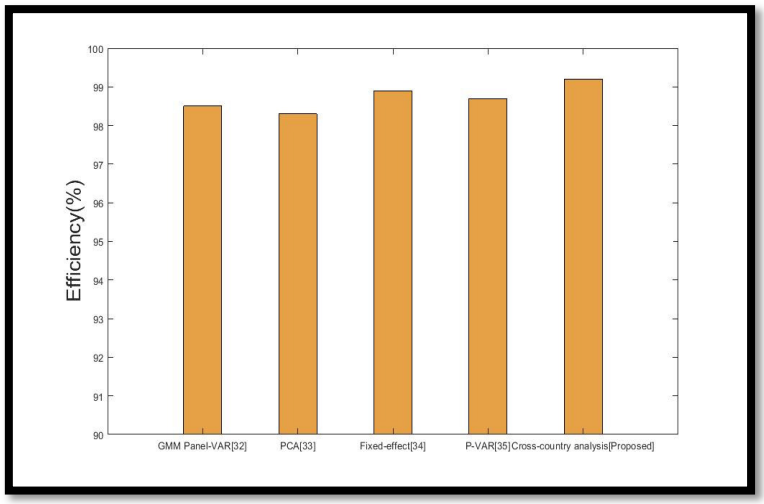

Figure 11: Comparison of Efficiency (%) with Proposed and Existing Techniques

5. Discussion of Metrics with Comparison

In this part, certain performance metrics like economic prediction level, prediction error, and efficiency are discussed regarding economic growth over given countries to analyze the proposed technique. Figure 9 depicts the comparison of economic prediction level with both the presented and existing approaches GMM panel-VAR (Ouyang, Y. & Li, P., 2018), PCA (Singh, D. & Stakic, N., 2021), Fixed-effect (Ahmad, M., et al. 2021), and P-VAR David, O.O., (2019) regarding economic growth. The definition of economic forecasting is the estimate of any aspect of economic behavior. In this figure, the x-axis indicates these existing techniques, and the y-axis indicates the prediction level. The GMM panel-VAR (Ouyang, Y. and Li, P., 2018) and the PCA (Singh, D. & Stakic, N., 2021) have a prediction rate of 97.9% and 97.8%,

respectively. Similarly, the fixed-effect (Ahmad, M., et al. 2021) and the P-VAR (David, O.O., 2019) have the prediction rate of 98.5% and 98.2%, respectively. Moreover, our proposed work has a 98.8% economic prediction level.

Figure 10 depicts the comparison of prediction error with both proposed and existing approaches. A prediction error occurs when a predicted activity does not appear. In this figure, the x-axis indicates these existing techniques, and the y-axis indicates the prediction error. The GMM panel-VAR (Ouyang, Y. and Li, P., 2018) and the PCA (Singh, D. & Stakic, N., 2021) have the prediction error of 72% and 79%, respectively. Similarly, the fixed-effect (Ahmad, M., et al. 2021) and the P-VAR (David, O.O., 2019) have the prediction error of 74% and 77%, respectively. Also, our proposed work has a 65% prediction error. Figure 11 depicts the comparison of efficiency with both proposed and existing approaches regarding economic growth. Generating the most efficient utilization of resources is what efficiency is all about. In this figure, the x-axis indicates these existing techniques, and the y-axis indicates the efficiency. The GMM panel-VAR (Ouyang, Y. and Li, P., 2018) and the PCA (Singh, D. and Stakic, N., 2021) have an efficiency of 98.5% and 98.3%, respectively. Similarly, the fixed-effect (Ahmad, M., et al. 2021) and the P-VAR (David, O.O., 2019) have an efficiency rate of 98.9% and 98.7%, respectively. In addition, our proposed work has an efficiency of 99.2%.

Only 6 bank-related factors were considered in Singh, D. and Stakic, N. (2021), and several factors were left out, leading to a shortage of available details for the sample nations. In Ahmad, M. et al. (2021), certain downsides are presented. To begin with, digital financial inclusion (DFI) statistics were only available between 2011 and 2018, and it is a very short period (i.e., inadequate statistics). Additionally, the observations are limited to a particular nation, making them inapplicable to the developing world. The burden of dimensionality is exacerbated by the minimal time-series dimension of a panel in David, O.O. (2019). In Ouyang, Y. and Li, P. (2018), the "generalized method of the moment" (GMM) does not take into account cross-sectional dependency. Therefore, we need to double-check all of our equipment. It is very common for estimates to be quashed by inaccurate instrumentation. From the above-mentioned investigation, our proposed work accomplishes more effectiveness than that of the existing techniques.

6. Conclusion

Financial inclusion has been shown in this study to have a non-linear impact on economic expansion in four nations between 2016 and 2021, using the threshold level of the financial inclusion index. Financial inclusion (IFI) and economic development have been studied in several nations using a cross-sectional approach depending on the idea of threshold consequence. The comparison between nations with low levels of financial inclusion and those with high levels examines the various implications of financial inclusion on economic development. This study's policy implications show that policy formulation regarding financial inclusion was focused on improving the financial inclusion index. This innovative index can be utilized to assess real financial inclusion across multiple economic parameters. As a result of these results, policymakers should pay close attention to the tipping point and other elements of financial inclusion if they want to guarantee that the economy performs better.

7. References

i. Abu Alrub, A., Abu Awwad, T., & Al-Saadi, E. (2021). Autoregressive neural network EURO STOXX 50 forecasting model based on principal component stock selection. *International Journal of Finance*.
ii. Ahmad, M., Majeed, A., Khan, M.A., Sohaib, M., & Shehzad, K. (2021). Digital financial inclusion and economic growth: Provincial data analysis of China. *China Economic Journal, 14*(3), 291–310.
iii. Arner, D.W., Buckley, R.P., Zetzsche, D.A., & Veidt, R. (2020). Sustainability, FinTech, and financial inclusion. *European Business Organization Law Review, 21*(1), 7–35.
iv. Chang, K., Li, Z., & Long, Y. (2022). Spatial spillover transmission effects of financial development on economic-zone financial efficiency in China. *Discrete Dynamics in Nature and Society, 2022*.
v. Dai, W. (2021). Development and supervision of robo-advisors under digital financial inclusion in complex systems. *Complexity, 2021*.
vi. David, O.O. (2019). Nexus between telecommunication infrastructures, economic growth and development in Africa: Panel vector autoregression (P-VAR) analysis. *Telecommunications Policy, 43*(8), 101816.
vii. Erulgen, A., Rjoub, H., Adalier, A., & Abualrub, A. (2022). Financial inclusion and bank profitability: Evidence from the island banking sector. *Advances in Decision Sciences, 26*(4), 78–97.
viii. Grohmann, A., Klühs, T., & Menkhoff, L. (2018). Does financial literacy improve financial inclusion? Cross-country evidence. *World Development, 111*, 84–96.
ix. Guan, H., & Li, Q. (2021). Spatial spillover effects of economic growth based on high-speed railways in Northeast China. *Complexity, 2021*.
x. Hajduk, S. (2018). The smartness profile of selected European cities in urban management–A comparison analysis. *Journal of Business Economics and Management, 19*(6), 797–812.
xi. He, G., & Shen, L. (2021). Whether digital financial inclusion can improve capital misallocation or not: A study based on the moderating effect of economic policy uncertainty. *Discrete Dynamics in Nature and Society, 2021*.
xii. Jiang, Q., Zhang, X., Lin, Q., Chen, G., Zhang, R., & Liu, S. (2020). Internet penetration and regional financial development in China: Empirical evidence based on Chinese provincial panel data. *Scientific Programming, 2020*.
xiii. Law, S.H., & Singh, N. (2014). Does too much finance harm economic growth? *Journal of Banking & Finance, 41*, 36–44.
xiv. Le, T.H., Chuc, A.T., & Taghizadeh-Hesary, F. (2019). Financial inclusion and its impact on financial efficiency and sustainability: Empirical evidence from Asia. *Borsa Istanbul Review, 19*(4), 310–322.

xv. Lenka, S.K., & Sharma, R. (2017). Does financial inclusion spur economic growth in India? *The Journal of Developing Areas, 51*(3), 215–228.

xvi. Li, J. (2021). Grey correlation analysis of economic growth and cultural industry competitiveness. *Complexity, 2021*.

xvii. Li, Z., & Zhou, Z. (2020). Fuzzy comprehensive evaluation of decoupling economic growth from environment costs in China's resource-based cities. *Mathematical Problems in Engineering, 2020*.

xviii. Liu, X., Zhu, J., Guo, J., & Cui, C. (2021). Spatial association and explanation of China's digital financial inclusion development based on the network analysis method. *Complexity, 2021*.

xix. Lu, W.C. (2018). The impacts of information and communication technology, energy consumption, financial development, and economic growth on carbon dioxide emissions in 12 Asian countries. *Mitigation and Adaptation Strategies for Global Change, 23*(8), 1351–1365.

xx. Narayan, P.K., & Narayan, S. (2013). The short-run relationship between the financial system and economic growth: New evidence from regional panels. *International Review of Financial Analysis, 29*, 70–78.

xxi. Ouyang, Y., & Li, P. (2018). On the nexus of financial development, economic growth, and energy consumption in China: New perspective from a GMM panel VAR approach. *Energy Economics, 71*, 238–252.

xxii. Park, C.Y., & Mercado Jr, R. (2018). Financial inclusion, poverty, and income inequality. *The Singapore Economic Review, 63*(01), 185–206.

xxiii. Park, D., & Shin, K. (2017). Economic growth, financial development, and income inequality. *Emerging Markets Finance and Trade, 53*(12), 2794–2825.

xxiv. Rjoub, H., & Alrub, A.A. (2023). Hybridized gradient LSTM and RNN for AI-IoT assisted financial disaster prediction in FinTech environment. *CEMJP, 31*(4), 32–44.

xxv. Salampasis, D., & Mention, A.L. (2018). FinTech: Harnessing innovation for financial inclusion. In *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 2* (pp. 451–461). Academic Press.

xxvi. Sethi, D., & Acharya, D. (2018). Financial inclusion and economic growth linkage: Some cross-country evidence. *Journal of Financial Economic Policy*.

xxvii. Shah, I.A., Amjed, S., & Alkathiri, N.A. (2019). The economics of paper consumption in offices. *Journal of Business Economics and Management, 20*(1), 43–62.

xxviii. Singh, D., & Stakic, N. (2021). Financial inclusion and economic growth nexus: Evidence from SAARC countries. *South Asia Research, 41*(2), 238–258.

xxix. Tang, X. (2022). A study of the spatial effects of financial support and economic growth under optimal control of non-linear generalized complex systems. *Discrete Dynamics in Nature and Society, 2022*.

xxx. Wang, C.B., & Huang, Z. (2021). Econometric analysis of the impact of financial structure on innovation based on the fixed effects panel model. *Mathematical Problems in Engineering, 2021*.

xxxi. Wang, X., & Guan, J. (2017). Financial inclusion: Measurement, spatial effects, and influencing factors. *Applied Economics, 49*(18), 1751–1762.

xxxii. Weerasinghe, K.P.W.D.R. (2019). Impact of content marketing towards the customer online engagement. *International Journal of Business, Economics and Management, 2*(3), 217–2018.

xxxiii. Xie, J., & Cao, Y. (2021). An empirical study of the relationship between financial development and economic growth based on intelligent algorithms based on wireless network communication. *Mobile Information Systems, 2021*.

xxxiv. Zeng, Q., Tan, Z., & Liu, C. (2021). Analysis of the contribution of intellectual capital to economic growth based on an empirical analysis of prefecture-level cities in Guangxi. *Mathematical Problems in Engineering, 2021*.

xxxv. Zhou, L., & Wang, H. (2021). An approach to study the poverty reduction effect of digital inclusive finance from a multi-dimensional perspective based on clustering algorithms. *Scientific Programming, 2021*.