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IMPACT OF DIGITAL FINANCE ON FINANCIAL INCLUSION: AN EVIDENCE FROM INDIA

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Abstract
In order to better understand how digital finance affects financial inclusion, this study focuses on two independent variables: the population's internet usage rate and the number of ATMs per 100,000 persons. The overall value of internet transactions expressed in lakh crores is the dependent variable under analysis. In order to investigate the connection between digital finance and financial inclusion, a dataset spanning from time period of 2010 to 2020 is gathered. The collection includes data from secondary sources. Various tests like augmented dickey filler test, co-integration test, vector error correlation model are used to create correlations and spot patterns between the variables that are both independent and dependent. The study's findings offer insightful information on how digital finance affects financial inclusion. Results show that the total value of online payments is positively correlated with a larger proportion of the population utilising internet access and a higher density of ATMs per 100,000 adults. These findings imply that increased accessibility to digital banking services, which has been made possible by internet use and ATM accessibility, greatly increases the amount of digital transactions. The proportion of people who use the internet and ATMs as independent factors and the total amount of digital payments as the dependent variable, respectively, are used in this research paper to illuminate how digital finance affects financial inclusion. This study emphasises the significance of digital technologies in promoting financial inclusion and identifies potential paths for expanding financial accessibility and engagement in the digital era by examining the links between these factors.

Keywords: Digital Finance, Financial Inclusion, Augmented Dickey Filler Test, Co-integration test, Vector Error Model

Introduction
The term **"digital finance"** is used to describe how new technologies have affected the financial services sector. The old method of offering financial services as well as banking has been revolutionised by a number of new products, applications, procedures. The development of new technology has accelerated along with an economy's overall growth. These technological breakthroughs have also contributed to improvements in the banking, investment, and finance sectors. Old and conventional methods of communication with banks are gradually giving way to innovative methods of communication. The trend towards digitalization in the financial service industry has experienced a fast acceleration. With the aid of recent technology improvements, making payments, investments, money transfers, and other transactions related to banking and finances have become significantly faster.

Another key idea on which this study will concentrate is **financial inclusion** which refers to all of the initiatives aimed at ensuring that all members of society have access to all financial

services. It strives to eliminate all the obstacles that prevent various segments of society from taking advantage of these financial services and their advantages. Financial inclusion is becoming simpler to attain because of the developments in financial technology like digital transactions. Digital financial inclusion entails the use of cost-effective digital means to provide populations that are currently underserved and financially excluded with a variety of official financial products and services that are with integrity delivered at a cost that is affordable to beneficiaries and feasible for providers. There is still a sizable segment of the global populace that lacks access to financial services. Due to these developments, it is now simpler and more effective for a larger percentage of the public to obtain financial services. The idea of "digital financial inclusion" appears to provide the excluded group a lot of prospects and advantages which includes affordable access to a range of financial services. There are several objectives of financial inclusion which includes increasing financial knowledge and awareness and giving the impoverished people specialised services based on their circumstances, requirements, and income level. Additionally, it plans to introduce smartphone banking or the worlds of finance in order to connect with the country's poorest residents who live in exceedingly remote regions. The transition from cash to digital payments is being facilitated by financial inclusion. Customers have access to a system for electronic payments that allows them to quickly and inexpensively send money to friends, family, and business partners.

The present paper seeks to investigate how digital finance affects financial inclusion. It contributes to the scant and still-growing amount of knowledge about how financial innovation affects the financial inclusion in India.

Review of Literature

With the help of his research**, Mohammad O. Al-Smadi (2022)** has looked at the relationship between digital banking and financial inclusion in the Middle East and North Africa (MENA) area. A study demonstrates how digital finance might improve financial inclusion. The study's conclusions demonstrate how digital finance has improved the region's access to, availability of, and use of financial offerings.

In their study**, Banna, H., and Alam, MR. (2021**) looked into how electronic financial inclusion may help to sustain the stability of banking in ASEAN nations and whether there would be any implications for the post-Covid-19 period of pandemics. The complete implementation of digital financial inclusion, according to the study, accelerates ASEAN banking stability, reducing banks' default risk while simultaneously boosting the region's financial mobility. The findings also imply that ASEAN lenders are likely to maintain the stability of the financial system by minimising liquidity crises during and after COVID 19. Greater adoption by electronic payments is positively correlated with ASEAN banking stability**.**

In their study, **Achugamonu BedeUzoma, Alexander E. Omankhanlen, et al. (2020)** looked at the dynamic causality between financial inclusion and digital finance. The findings indicate a long-term relationship between financial inclusion and digital finance that is favourable. The study comes to the conclusion that the effects of digital money on inclusive finance behave in various ways in the short- and long-term. In the near term, financial enclosure is negatively impacted by digital financial technology; but, in the long term, financial enclosure is positively impacted by digital finance. The study comes to the conclusion that financial inclusion is positively impacted by digital finance over the long term. .

Md. Morshadul Hasan, Shajib Khan, and others (2020) have made an effort to research how digital financial services contribute to China's inclusive finance and the influence of these services' instruments on changing the financial industry. The study's finding suggests that Chinese should go above and beyond to give better financing options to everyone who is financially disadvantaged. Another crucial aspect is that they have been showcasing how to advance inclusive finance through the use of digital financial services as a world leader in the digital financial transformation. These inclusive finance digital transformation strategies will in particular promote the growth of inclusive finance globally.

A further research by **David Mhlanga (2020)** to look at the effect of AI on financial inclusion through digital means has found that AI has a significant influence in areas linked to risk detection, measurement, and management.

The goal of **Tabitha Durai and G. Stella's(2019)** study is to determine how digital finance—including credit and debit cards, mobile wallets (Apps), internet banking, and mobile banking—affects financial inclusion. According to the study's findings, ease of use, accessibility, accurate execution, and easy interbank trade account facilities have positive effects on mobile banking. Low service fees, accurate timing, and convenience also have a big positive impact on mobile wallets (apps). Although there are many drawbacks to digital marriage, including costs, security, adaptability, etc.

Peterson K. Ozili (2018) has made another effort to research the effects of internet-based finance on monetary inclusion and stability. Results of the study have demonstrated how digital finance has a favourable impact on financial integration in emerging nations. It also demonstrates how much more significant to them is the ease that digital money offers to people in low-income groups.

According to **Vinay Kandpal and Rajat Mehrotra's** research on the impact of fintech and internet-based financial services in India, clients are less inclined to adopt new technologies if they have faith and trust in the existing banking system. New technologies won't be successful until users are happy with security and privacy concerns.

Pengpeng Yue et al has investigated how households are affected by digital money. The study's findings indicate that the usage of digital banking has expanded the involvement in the loan market. The increased availability of credit has changed consumers' marginal propensities to consume, which has raised household consumption. However, the increased ease of access to the credit market also raises the possibility of household debt trapping**.**

Data and Methodology

1.1.Data description

This study looks at the connection between financial inclusion and digital finance in India from 2010 to 2020. The goal of this study is accomplished through the utilisation of secondary data. The World Bank database was used to get the information. ATMs per 100,000 individuals, internet use rates, and the total dollar worth of all digital transactions are used as indicators of digital finance and financial inclusion, respectively.

Methodology

1.2.1. Stationarity test

Investigating the stationarity of the data's qualities in time series data is crucial. This is crucial since the majority of time series data are non-stationary and analysis of such data may result in inaccurate conclusions. Finding the variables' stationarity qualities aids in determining the sequence of integration and the best econometric technique to use when analysing the data. In order to investigate stationarity qualities, this research applies the Augmented Dickey Fuller test.

1.2.2 Augmented Dickey Fuller Test

A statistical test called the Augmented Dickey-Fuller (ADF) test is used to assess if a time series dataset contains a unit root, which denotes that the dataset is non-stationary. A time series is said to be stationary if statistical characteristics like mean and variance don't change over the course of the data. The Dickey-Fuller test, which looks for a unit root in a time series, is extended by the ADF test. The ADF test incorporates lagged variations of the variable of interest in the formula for regression as well as the potential of serial correlation.The unit root existence in the time series is tested using the ADF test as the null hypothesis. The null hypothesis is dismissed and the time series is considered stationary if the p-value for the ADF test is less than a preset level of significance (typically 0.05). The null hypothesis cannot be disproved, however, if the p-value is above the significance level, which indicates the existence of a unit root and non-stationarity in the data. To evaluate the stationarity of economic and financial data, the ADF test is often used in econometrics and time series analysis. Researchers can use suitable statistical methods and models that presume stationarity, including the autoregressive integrated moving average (ARIMA) models, by establishing whether a time series is stationary or not.

1.2.3. Co-integration Test

A statistical concept known as cointegration describes a long-term association between more than one non-stationary time series variables. In other words, two variables are considered to be cointegrated if they display short-term variations but tend to move jointly over time. In the study of econometrics, cointegration is frequently employed, particularly when examining connections between economic indicators. Even if the variables may individually display random or non-stationary behaviour, it aids in determining whether or not there is an established equilibrium or long-term link between them. Numerous statistical methods are used by econometricians to check for cointegration. We employed the Johansen test in this investigation. By analysing the behaviour of the indicators' residuals (i.e., the discrepancies between what is actually happening and the values expected by the model), this test determines if there is a cointegrating connection.If the test results show that cointegration exists, it implies that the variables have a long-term link and that changes in one variable result in predictable long-term changes in the other(s). Macroeconomics, financial modelling, and other disciplines where it is critical to comprehend the long-range balance between variables can all benefit from cointegration analysis.

1.2.4. Vector Error Correction Model

A statistical model called a VECM, which stands for vector error correction model, is used to examine the short-term dynamics and long-term relationships between various time series data.

It incorporates a set of variables into the error correction model, also known as the ECM idea. In VECM, the concepts of cointegration (the long-term connection) and error correction (the short-term dynamics) are combined. When factors are non-stationary and show a long-run equilibrium connection, it is very helpful. The study of long-term stability adjustments and immediate dynamics may be done concurrently using VECM, which calculates the variables of both the integration connection and the short-term dynamics. The model is useful in econometrics and time series analysis because it sheds light on both the equilibrium state over the long run and the short-term relationships among the variables.

Empirical findings

1.1.Unit root test

To examine the stationarity characteristics of the parameters in the data set, the enhanced Dickey Fuller test is used. The findings (table 1) demonstrate that every variable is stationary at the first difference but non-stationary at the level.

Table 1: Augmented dickey Fuller Test

Variables	P-value at level	P-value at first difference
Total digital transactions	0.8769	0.0021
ATM per 100000 adults	0.2750	0.0002
internet use rates	0.2475	0.0403

Co-integration test

Variables that are steady at the initial difference could be related by co-integration. All of the study's variables, including the percentage of internet users and the number of ATMs per 100,000 adults, are constant from the outset. Total digital transactions are the dependent variable in this case, whereas the independent variables are the proportion of people who use the internet and the number of ATMs per 100,000 adults. The co-integration test result is displayed in Table

Table 2: Co-integration test

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.891869	42.01561	29.79707	0.0002
At most 1	0.604093	13.09826	15.49471	0.1182
At most 2	0.077789	1.052757	3.841466	0.5649

Trace test indicates 1 co integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.891869	28.91735	21.13162	0.0003
At most 1	0.604093	12.04550	14.26460	0.1769
At most 2	0.077789	1.052757	3.841466	0.3659

Max-eigen value test indicates 1 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Vector Error Correction Model

The underlying long- and short-run connection between the variables is examined using a vector error correction model after co-integration testing. The output of the vector error correction model is displayed in Table 3.

Table 3: Result of vector correction model

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.698911	0.514025	-1.359683	0.2110
C(2)	0.023663	0.462532	0.051159	0.9605
C(3)	3.876334	10.54686	0.367534	0.7228
C(4)	-2.026815	2.234048	-0.907239	0.3908
C(5)	-1.043704	1.294726	-0.806120	0.4435
R-squared	0.261091	Mean dependent var		-0.837953
Adjusted R-squared	-0.108363	S.D. dependent var		4.355992
S.E. of regression	4.585937	Akaike info criterion		6.167589
Sum squared resid	168.2466	Schwarz criterion		6.384877
Log likelihood	-35.08933	Hannan-Quinn criter.		6.122926
F-statistic	0.706695	Durbin-Watson stat		1.954090
Prob(F-statistic)	0.609427			

The outcome of the vector error correction model indicates that there is neither a long-term nor a short-term causal link between the proportion of internet users, the number of ATMs per 100,000 adults, and the total value of digital transactions. In both the long- and short-term, the impact of ATMs per 100,000 individuals and the percentage of the population that uses the internet is negligible.

Conclusion

This research looked at the link between the effects of being financially included on India's economic development from 2015 to 2020. In order to first study the long-term link between digital finance and inclusion in the economy, a co-integration test was employed. The outcome demonstrates that there is a long-term association between the total value for digital transactions, the number of ATMs per 100,000 adults, and the percentage of people who use the internet. Using a vector error correction model, we later looked at the long- and short-term causal relationships between online banking and financial inclusion. The results showed that neither the number of ATMs per 100,000 adults nor the percentage of people who use the internet has any effect on the overall worth of digital transactions over the long- or short-term.

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