

RESEARCH ARTICLE

Going Digital: Financial Inclusion in Asia Pacific Economies

Hira Idrees ^a Ammara Mubashar ^b Afkar Majeed ^c

Abstract: Even though financial inclusion (FI) is being paid increasing consideration from policy makers and academics, the impact that digital finance (DF) has on FI did not receive enough attention. Hence the aim of this study is to inspect association between FI and DF in a panel study that includes ten Asia-Pacific economies. To measure FI, an amalgamated index comprised of three sub-indices is used: availability, access, and use of financial services. To measure Digital finance, the no. of ATMs per one hundred thousand adults is used. By Using annual statistics for ten Asia Pacific nations from 2013-2024, (Sys-GMM) the system generalized method of moments panel method is employed. This study uses nearly five control factors in addition to the primary variables. The results of the study, showed that DF had substantial impact on the quantity of commercial bank payment accounts per one hundred thousand individuals, implying Digital Finance and financial services valuation are associated. The findings of this study are used by policymakers and digital financial service providers in these economies to raise FI standards.

Keywords: Digital Inclusive Finance, Innovation, Financial Inclusion, Asia Pacific

Introduction

The world has gradually moved into advanced space. Digital change began before, during and after Corona and is continuing. Digitization is transforming and opening up unparalleled prospects for dealings in almost every business, especially small businesses, by implementing infrastructure and digital Information and Communication Technology (ICT) technologies. However, as digital revolution transforms business environments changing the nature of business structures and markets, are raising concerns about skills, jobs, security as well as social and economic interaction, therefore bringing challenges (Dubea & Telukdarie, 2022).

Because of its usefulness with entrepreneurs and small medium enterprise, digital financial innovation is now considered the fourth revolution because of its rapid global spread. Due to fintech, financial inclusion can significantly affect productivity. Nonetheless, the debate over how financial technology impacts financial inclusion remains central. Digital financial innovation can influence productivity across the manufacturing process by reallocating resources. However, traditional intermediation of financial processes may be more common and aid expanding business by allocating reserves efficiently.

As information technology advances, digital inclusive finance is shifting the conventional framework for economic development to reduce information asymmetry and cut costs (Jian, 2020). In the context of 'Fourth Industrial Revolution', digital inclusive finance is based on the physical information system, which conveys the reality of new monetary advancements through integrated networks of computer software, hardware and interactive phases. As COVID-19 spreads internationally, digital inclusive finance has

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accelerated global economy's digitization and led to the creation of "non-contact" financial alternatives (Xia, 2022).

It is observed that digital finance is a response to the financial industry's technological breakthroughs. Examples of electronic financial services and products that are accessible via digital channels include: investment, finance, insurance, payment, and financial data (Gomber, 2017; Ozili, 2018). On the one hand, it provides number of advantageous to the economy, business, individuals, and government. First of all, when financial transaction increase, it provides the government with a platform to boost overall spending and tax income as financial transactions increase. Secondly, it stimulates GDP development by boosting credit facilities access for business enterprise as well as for individuals. It is projected that use of digital finance will boost GDP by \$3.7 trillion across all economies by the end of 2025 (Malady, 2016). Thirdly, it increases significance of financial organizations. At least, it creates new avenues for offering those who are financially disadvantaged a wider variety of financial services (Al-Smadi, 2023).

Conversely, digital Finance entails extra risks, such as those pertaining to contractual risks, and cybersecurity that arise from a financial institute's interaction with third parties (Al-Smadi, 2023). To protect users, proper technology infrastructure, regulatory regulations, and stringent processes are required (Ozili, 2018).

Financial inclusion aims to guarantee that all societal sectors can access and use financial services and products within the financial system (Al-Smadi, 2023). In addition, it promotes financial steadiness and growth of economies (Neaime, 2018), which aids in achieving United Nation's Sustainable Development Goals (UN SDG) (Ma'ruf, 2019). Despite, it is worldwide endeavor to improve Financial Inclusion, there is significant discrepancy among emerging regions (Al-Smadi, 2023). However, Digital Finance might improve Financial Inclusion by allowing financial transactions via mobile phones, boosting contact to financing for ventures, enterprises and individuals, therefore making it easier for small businesses and rural beneficiaries to access social security funds (Gomber, 2017).

There has been long debate on the insinuations of financial inclusion for both macro and microeconomics (Patnaik, 2016; 2021). Prior research has found that reduced account expenses are linked to financial inclusion. As per political stability suggests, financial inclusion provides ways to promote fair growth and the fight against poverty. However, not much of the research has been done to study how digital inclusion affects Co2 emissions and the aspects that influence it. According to previous research, financial expansion is significantly tied to carbon discharges and environmental consequences (Li, 2022). Since digital inclusivity is an essential part of financial development, this study contends that increasing it reduces Co2 emissions.

Asia is predicted to have the fastest growing economy for many years to come, with estimated GDP to rise at approx. 6.3% yearly rate of during the following years, primarily due to the regions emerging economies (Thai-Ha Le, 2019). Asia is ideally positioned for rapid expansion, for this development to be fair and thorough, policymakers need to recognize that financial services are not widely available. It is estimated that over a billion people in the region lack former conventional financial services, including bank accounts, recognized jobs and ability to perform paid work both online and offline. Additionally, only 33% enterprises in emerging Asia have a loan or line of credit, and only 27% of individuals are expected to have a formal account with financial institutions (Bhardwaj, 2018).

Despite of several efforts to endorse financial inclusion in Asia, it continues to be a noteworthy obstacle. It is because of the fact that Asia is among the world's most diverse region, with large variances in population size and per capita GDP between states, also a wide range of religious, cultural, ethnic and linguistic diversity. As a result, there is little chance of a "magic bullet" strategy for improving financial

inclusion being a feasible alternative. (Thai-Ha Le, 2019). The goal of underlying study is to investigate the impact of DF on FI within Asia Pacific.

The goal of the underlying research is to determine how digital finance affects financial inclusion in the chosen region. The composite index used to access FI is made up of three subindices: availability, access, and utilization of financial services. On the other hand, the number of ATMs per 100,000 people is used to measure DF. Additional drivers of FI are inflation, income level GDPC, internet use, human development index, and carbondioxide emission. As per our research digital finance aims to enhance use of, and availability of, and access to monetary services in the Asia Pacific, as well as the overall FI level. Previous research has limited their content to one of the sub-indices. This study offers a thorough evaluation of the two over ten-year span. To achieve research goal, we have targeted 10 Asia Pacific countries (Bangladesh, China, Indonesia, India, Japan, Malaysia, Nepal, Pakistan, Thailand, Vietnam,) from year 2013 to 2024. Because country specific effects exist, the system generalized method of moments (sys-GMM) is the recommended methodology.

The remaining article is as follows: second portion undertakes detailed evaluation of literature review. The next unit highlights methodology and research model. The second last section explains the outcomes of model estimations. The conclusion, policy implications, future directions and some study limitations are covered in the final part.

Literature Review

Digital finance has employed substantial role in increasing inclusion. Referring to (Verhoef, 2021) digital revolution and the subsequent business model innovation have significantly affected consumer prospects and habits, put burden on existing organizations, and disturbed several sectors. Digital technology, digital customer behavior, and digital competitiveness are three key external factors that are most influencing digital innovation. Economic rounds, climatic changes, pandemics, financial sequences, and armed conflicts are all exogenous drivers of digital change (Verhoef, 2021). The major engine of digital transformation is digital technology. The way industrial workers think and behave has changed, which is one of the obstacles to the acceptance of digital transformation (Morze, 2021). Digital transformation promotes worldwide public sector service improvement as the means of creating social benefit (Loureço Andrade, 2020).

Diffusion and Innovation Theory (DIT) serve as the foundation for DF and FI due to their societal ramifications (Rogers, 2014). This theory inspects the phenomena of innovation spread, that outlines how modernization is transferred via multiple platforms across members of society. According to DIT, five variables drive the spread of any revolution: invention itself, innovation adoptive parent, social structure, time and communication channels. In contrast to the technological acceptance paradigm, organizations and groups with social networks, as well as individuals, are among the innovators. Failure to disseminate a concept does not imply that no one accepts it; rather, it has not attained complete acceptance due to insufficient innovation (Yoon, 2020), lack of awareness and competition from other inventions (Albastaki, 2022).

Digital Finance: Conceptualization

Digital finance, according to many experts, is the provision of financial services via computers, laptops, cell phones, credit cards, the internet, or e-wallets connected to a trustworthy electronic payment gateway. Similarly, DF according to research of McKinsey is "the financial services delivered via the internet, mobile phones, or cards." In spite of the lack of a single definition, it has been acknowledged that Digital Finance comprises: every financial service and product that financial institutions offer remotely (Manyika, 2016).

DF is separated into three categories by another author: technology, business functions, and institutions. The digital financial services like banking, insurance, payment and investment are made possible

by technical applications like blockchain, and that these business processes are carried out by digital service providers. (Gomber, 2017). According to another research, digital finance in developing nations delivers safe financial services to unbanked individuals at a reasonable cost, helping them to improve financial inclusion and switch from cash to digital transactions (Mufakkir & Mohammed, 2020).

Financial Inclusion: Conceptualization

According to the UN, financial inclusion is the continuous availability of reasonable financial services that allow persons in poverty to participate in the formal economy (UN report, 2016). According to another study, financial inclusion occurs when the poor utilizes these formal financial services (Beck, 2007). According to one definition, it is a procedure that, guarantees every participant in an economy have easy access to, availability of, and use of the formal financial system (Sarma, 2011).

Another study expands on former definition, that is inclusive and grounded on three separate extents: utilization, availability, and accessibility of financial services (Al-Smadi, 2023). Individual participation in the financial system, according to another scholar, increases their capacity to form enterprises, manage risks, and withstand financial crises. As a result, international institutions like the 'World Bank', consequently push pressure on governments all over the globe to pass policies and strategies to promote financial inclusion as a means of accelerating long term financial growth and poverty elimination (Demirguc-Kunt, 2015).

However, Ozili believes that financial services should be offered to all members of society in accordance with the public good premise of inclusion. To do this, a number of organizations must collaborate to bring the economically disadvantaged into the official financial channels and institutions (Ozili, 2018).

Financial Inclusion and Digital Finance: Theoretical perspective

The primary goal of financial services provided via digital inclusive platforms is to support emerging countries financial inclusion objectives and contributes towards poverty elimination (UN report, 2016). Three primary components of digital financial services are: retail agents, digital and a transactional medium. Through these online platform, agents and consumers use a device, usually a cell phone to perform transactions (CGAP, 2015). In order to access digital financial services (DFS), user have a current account with bank (or other third party authorized accounts), enough money (or bank overdraft facility), and an ability to withdraw cash or receive income flow via digital means such as: internet, mobile network devices, or network computers (Ozili, 2018).

There are certain benefits of adopting digital finance. Since nearly 50% of the individuals in emerging countries currently owns smartphone. The online banking holds promise for enhancing financial inclusion extending financial services to non-financial businesses, thus enabling customers to access basic services (Ozili P. K., 2018). Moreover, it provides the best chance of providing low-income communities in emerging states with safe, low-priced, and accessible financial services. Almost millions of small businesses can benefit from the current global advancements in the affordability and usability of electronic financial services, that can assist individuals in moving from traditional cash-based transactions to more formal digital financial transactions on secure digital channels (Babilla, 2023).

Additionally, digital finance has the probability to boost GDP levels and cumulative monetary expenses in these prestigious economies by providing individual small, medium and large size entities with an easy admittance to wide range of financial products and services including loan facilities. Digital finance might contribute towards improved economic stability and financial intermediation, which would benefit clients and the community in which they and their family reside (Marinko Skare, 2022).

On contrary, Financial Inclusion, deal with provisioning of numerous benefits to low-income individuals and enterprises. It stimulates the use of deposits in banks, which helps them uphold a more stable base of deposits during bad times, and it permits poor-income people to save, therefore encouraging

avenues of own monetary stability. The increase in financial inclusion can also provide potential prospects for underprivileged people and companies to save, capitalize, and borrow.

It also permits number of individuals to cope up with unanticipated expenses such as illness or job loss. Furthermore, it reduces procyclicality risk, increases the number of small investors thus expanding the size and firmness of bank deposit base, and lessens banks dependance on "non-core" funding, which is erratic throughout disasters, all of which contribute to improved financial stability (Thai-Ha Le, 2019).

Moreover, integrating small and medium-sized businesses into the financial sector will strengthen the steadiness of the lending and deposit bases of the system because these businesses are comparatively resilient to economic cycle fluctuations. According to another study, a lack of sufficient financing for small-scale businesses and entrepreneur has unfavorable influence on general employability, since the operations of such transactions require a lot more labor. Furthermore, greater economic inclusion could encourage more varied financial sectors to contribute to the proper financial schemes. As the official financial scheme's participation increases, argument for interest rates as crucial program tool for macroeconomic steadiness gets stronger, which eventually spurs financial growth.

The inclusion may be regarded as both a profitable chance and communal duty, as soon as self-sufficient organizations and small microfinance foundations contribute to schemes, since these two players are crucial for achieving financial inclusivity (Dev, 2006). Several statements have been made in previous studies concerning the relationship between both inclusion and digitalization. According to some authors, it offers safe spaces for financial transactions in developing nations where most people have admittance to the mobile phones and internet, letting them to contribute to the official digital monetary system. (Senou, 2019).

Additionally, financial service providers create simple digital platforms that make daily transactions easier in rural areas, where individuals cannot access traditional bank offices due to insufficient and expensive transportations. Financial inclusion is thereby improved, as a result impoverished and financially excluded individuals are gaining more trust in institutions of the proper financial system and encouraging their nobles to custom digital financial services (Bede Uzoma, 2020).

Though, because there are fewer resources available, people in disadvantaged societies decline to use digital services, weakening this beneficial link. There are several reasons for this refusal: high costs, counting economic illiteracy, spiritual anxieties, and unreasonable anti-innovation opinions (Ozili, 2018). Since they believe that low-income consumers cannot afford them, they concentrate a large portion of their marketing efforts on upper- and middle-class clientele. However, in poor cultures, this beneficial link is lessened because their citizens refuse to use digital services. (Al-Smadi, 2023).

Furthermore, in emerging countries where consumer protection is mostly absent or at minimum level, small and medium-sized businesses avoid accepting e-finance due to their lack of trust in e-channels, services and continuous worry about security of confidential information. According to the cost of protecting client data may exceed the revenue from delivering digital services, making digital finance unsustainable for service providers. Another poll found that consumers must be financially informed in order to use electronic gateways, which are complicated and riskier than traditional financial facilities. Financial inclusion suffers because of consumers, who do not possess financial literacy and limit their use of digital services. A lot of cooperation between the financial institutions and government is encouraged, in order to increase admittance to the financial capitals and lessen hinderances that obstruct financial service providers and users from using technology channels.

Financial Inclusion and Digital Finance: Empirical Evidence

Although relatively new, the research on measuring financial inclusion is growing rapidly. The authors used econometrics to determine financial inclusion by figuring out how many adults and households in an economy had bank accounts (Demirguc-Kunt A. K., 2018). Thus, the study provides an evaluation of financial presence

across nations for up to approx. 160 economies valid for one time. Such estimates might be correct for financial penetration, which constitute just one aspect of financial inclusion (Sarma, 2015). However, in our review of literature we recommend two lines of inquiry. Primarily it examines the association between technology use and inclusion.

Another study examined the association among technology and financial inclusion by means of data from 186 countries, observed two elements of inclusion: financial service access as indicated by the bank accounts per 1000 people and use as indicated by electronic fund transfers. They report a beneficial influence of internet technologies and ATMs for access and use of financial services, indicating that digitalization has substantial impact on financial and economic inclusion (Fanta, 2019).

In order to investigate the relationship between digital technologies and financial inclusion, the other study understudied data from forty-three Sub Saharan African nations. They estimate digital technology by using four information communication indicators, whereas financial establishments are evaluated by means of an indicator, the number of bank accounts per 100,000 people, bank branches, and ATM users per 100,000 adults. They found that all digital technology indicators have a positive impact (Kouladoun, 2022).

A Nigerian based study is being done to analyze the impact of e-banking on financial inclusion. Using the number of ATMs and point of sale (POS) devices used annually as proxy for electronic banking, they calculated financial inclusion as percentage of the bankable population with access to the formal financial system. There is significant positive relationship between the two as per findings of this study, meaning that e-banking augments it. The percentage of persons that use ATMs represents digital finance, whereas utilization and quality of services represent inclusion. They measure the depositor-to-borrower ratio and actual financial service consumption by using payment accounts in commercial bank for each 1000 people. The findings show a correlation between the two (Ene, 2019). This finding is substantiated by the results of another study, that analyzed data from 189 economies for 12 years till 2016, examined the impact of digital banking on financial inclusion (Siddik, 2020).

Another research on digital finance product usage and internet use on enhancing financial inclusion in China, examined the influence of financial literacy on inclusion (Shen, 2020). They suggest that financial inclusion benefits directly from the adoption of digital products and financial literacy. However, they found that there is an undirect relationship between internet use and financial inclusion, indicating that using the internet increase inclusion since it provides digital banking products.

Furthermore, digital banking has associated green properties in future, and such green fiscal policies serve to foster the fast and stable growth of industry (Cao et al. 2021). It can help in regulating risks and cutting the financial industry's energy consumption and make it more environmentally friendly, also it can be better source to distribute financial resources. Digital finance underwrites the growth of financial green goods, the evolution of carbon trading market, the lessening of carbon trading costs, the enhancement of carbon trading effectiveness, and therefore the upgrading of environmental quality. According to our examination of the literature, previous work has not examined the association among financial inclusion and digital finance with specific context of Asia Pacific. As a result, in order to meet the study's goal, we offer the subsequent hypothesis: Digital Finance has a significant impact on Financial Inclusion in the Asia Pacific region.

Methodology

The current study focuses on 10 ASIA PACIFIC countries: Bangladesh, Malaysia, China, Japan, Indonesia, India, Nepal, Pakistan, Thailand, and Vietnam. This is based on datasets that are available for assessing the variables between 2013 and 2024. The data used to gauge digital finance and financial inclusion comes from the International Monetary Fund's Financial Access Survey (FAS) database, this comprises 121 time series on financial service admissions and practices covering approximately 189 countries. Additionally, the control

variables are measured using data United Nations development reports and from World Development Indicators (WDI) database.

This study looks at the association between DF and FI for enterprises, FI is therefore endogenous variable. The three dimensions of financial inclusion: availability, access and use of financial services are evaluated by the Financial Inclusion Index (FII). A subindex is used to measure each dimension, and it looks like this: the number of ATMs per 100,000 Sq Kms determines the Availability Subindex (AVI), the number of commercial bank deposit accounts per 1000 individual determines the Access Subindex (ACI), and the relationship between outstanding commercial bank loans and GDP determines the Use Subindex (USI) (Al-Smadi, 2023). To calculate these subindices, we utilize the following equation:

$$SI_i = \frac{V_i - \text{Mini}}{\text{Maxi} - \text{Mini}}$$

where Mini is dimension I's minimum value, Vi is dimension I's actual value, and SIi is dimensions subindex. The following formula is then used to calculate the FII for each nation:

$$FII_i = \frac{1 - \sqrt{(1 - AVI_i)^2 + (1 - ACI_i)^2 + (1 - USI_i)^2}}{\sqrt{3}}$$

and where Country's I's financial inclusion index is denoted by FIIi, its availability index by AVIi, its access index by ACIi, and its use subindex by USIi. FIIi has a value between -1 and +3, with below 0 indicating low financial inclusion and above 1 indicating great financial inclusion. Furthermore, the index was cross-checked in Stata using principal component analysis. The independent variable is digital finance, which is assessed by the no. of ATMs per 100,000 people. This metric is also used by (Siddik, 2020) (Bede Uzoma A. O., 2020).

Based on previous research, we include five control parameters to investigate their impact on finance in the Asia Pacific region for SMEs. GDP per capita (GDPC) is an income metric. People with high incomes are more likely to be incorporated into the financial system, which will enhance financial inclusion. . The change in the consumer price index (CPI) is used to calculate inflation (INF). High inflation is accompanied by uncertainty, which has a negative impact on the economy's supply and demand levels, threatening financial inclusion.

Table 1

Variables

Variables	Proxy	Data Base
Financial Inclusion	FII, (Access, Availability & Use)	FAS a
Digital Innovation	No. of ATMs per 100,000 adults	FAS
Income Level	Log natural of GDP per capita	WDI b
Inflation	Delta consumer price index	WDI
Use of Internet	%age of population using Internet	WDI
Socio-Economic Environment	Human development index	Dev. Reports UN
Green Finance	CO2 Emission	WDI

a: Financial Access Survey (IMF)

b: World Development Indicators (World Bank)

We also include an internet use (INU) variable, that calculates the proportion of people that use e-services. The development of internet accessibility facilitates the availability and ease of many financial services, which

in turn helps to integrate those who are financially excluded into the official banking system, thus promoting financial inclusion (Sha'ban, 2020). To indicate impact of socioeconomic environment, the human development index (HDI) is included. The HDI is determined by United Nations and it takes into account three factors: standard of living, health and education. People with higher level educations are more knowledgeable and inclined to use financial services, which leads to greater financial inclusion. Furthermore, a growth in living standards allows people to raise their deposits with banks, which encourages banks to provide financial facilities to a larger percentage of clients, hence extending financial inclusion (Datta & Singh, 2019).

Lastly, digital inclusive finance is a crucial component of financial development, its growth supports the reduction of carbon emissions. This link might be explained by one of two fundamental processes. First, research have demonstrated that financial development aids in energy usage reduction. Using digital finance as a part of financial development may assist reduce carbon emissions. Second, inclusion of e-finance raises GDP per capita, which reduces carbon emissions. On the one hand, available evidence indicates that embracing digital finance contributes to higher GDP per capita. Carbon emissions, on the other hand, have been found in studies to drop when per capita GDP rises. (Babilla, 2023).

All variables of underling study are defined in Table 1. In consistent to the study of (Bahrini, 2019) and (Al-Smadi, 2023), the variable coefficients are calculated using sys-GMM in this study. Unlike traditional methodologies, under consideration methodology can address the country specific issues using a sample consisting of multiple economies. The sys-GMM estimator integrates moment conditions for the models in levels and moment conditions for the model in first differences for dynamic panel data models. It has been demonstrated that the first differenced model outperforms the GMM estimator in terms of bias and root mean squared error. (Arellano, 1991). Therefore, we created the following models.

$$FII_{i,t} = \beta$$

$$ACI_{i,t} = \beta_0 + \beta_1 ACI_{i,t-1} + \beta_2 DFI_{i,t} + \beta_3 Z_{i,t} + \delta_i + \epsilon_{i,t} \quad (1)$$

$$AVI_{i,t} = \beta_0 + \beta_1 AVI_{i,t-1} + \beta_2 DFI_{i,t} + \beta_3 Z_{i,t} + \delta_i + \epsilon_{i,t} \quad (2)$$

$$USI_{i,t} = \beta_0 + \beta_1 USI_{i,t-1} + \beta_2 DFI_{i,t} + \beta_3 Z_{i,t} + \delta_i + \epsilon_{i,t} \quad (3)$$

$$FII_{i,t} = \beta_0 + \beta_1 FII_{i,t-1} + \beta_2 DFI_{i,t} + \beta_3 Z_{i,t} + \delta_i + \epsilon_{i,t} \quad (4)$$

Where, $AVI_{i,t}$, $ACI_{i,t}$, and $USI_{i,t}$ signifies financial service availability, access, and usage in nation i at time t . $FII_{i,t}$ represents the level of inclusion in nation i at time t . $DFI_{i,t}$ is a digital finance vector in nation i at time t . $Z_{i,t}$ represents nation i 's control variables at time t , i represents overlooked country-specific things, and i,t is the error term. β_1 is the coefficient to be assess possible impact of the delayed $AVI_{i,t-1}$, $ACI_{i,t-1}$, $USI_{i,t-1}$ and $FII_{i,t-1}$ on their current level. β_2 is the coefficient to be calculated to examine any significant influence of DF on ACI, AVI, USI, and FI across the study period, and Beta 3 is the coefficient to be estimated for each control variable.

Analysis

Descriptive Statistics

The Table 2 is presenting immediate data for the variables from 2013 to 2024 for a sample of ten countries. The results demonstrate a difference in the amount of FI among the sample countries, with a smallest value of -35966 and largest value of -50.50 in FII. AVI has the biggest standard deviation among the FI subindices, representing the no. of ATMs per 100,000 sq kms among nations in the sample, with a lowest of 9.90 and a highest of 61904.21. The average number of commercial bank deposit accounts per 1000 individuals is 1858.8, and the average loan-to-GDP ratio is 103.2. In terms of DF, the mean number of ATMs per 100,000 adults is 76.3, which is rather small when compared to the highest value of 472.38. The variation in the INU has the biggest standard deviation among the control variables, showing a considerable variance between

nations in terms of the population that uses the internet, whereas the insignificant deviation is of human rights index. The Jarque-Bera test statistic is zero, thus indicating that data sample has a normal distribution.

Figure 1

Descriptive Statistics

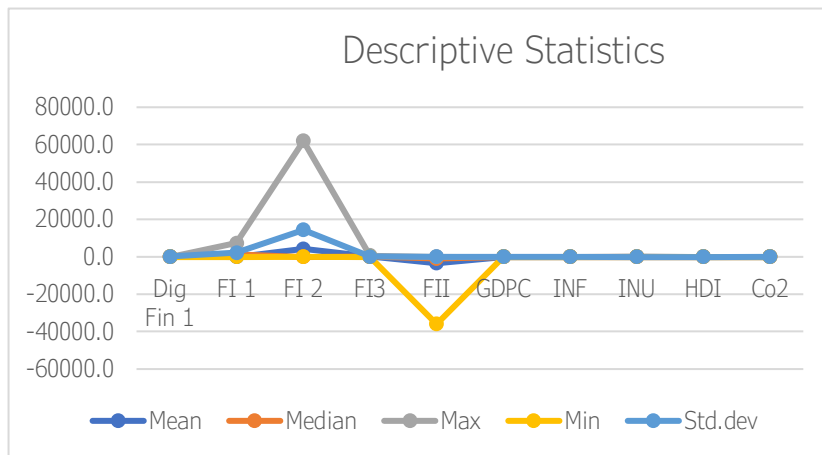


Table 2

Descriptive Stats

	Mean	Median	Max	Min	Std	Skewness	Kurtosis	JB
Dig Fin 1	76.3	34.53	472.38	4.96	107.14	2.49	8.68	0
ACI	1858.8	1334.4	7270.62	0.00	2152.73	1.74	4.82	0
AVI	4276.0	59.47	61904.21	9.90	14369.7	3.23	11.83	0
USI	103.2	71.28	587.53	15.18	131.52	2.81	9.68	0
FII	-3413.3	-888.8	-50.50	-35966	8119.11	-3.14	11.50	0
GDPC	3.50	3.77	9.73	-7.48	3.28	-1.15	5.16	0
INF	50.129	3.52	10.58	-1.14	2.63	0.39	2.63	0.25
INU	3.7	39.61	155.85	0.000	39.02	0.86	3.00	0.00
HDI	0.7	0.70	0.93	0.52	0.11	0.40	2.44	0.17
Co2	2.89	1.77	9.90	0.000	3.145	0.91	2.32	0.00

Regression Results

Table 3

VIF

Variable	VIF	1/VIF
DigFin1	3.46	0.289074
INU	4.82	0.207269
HDI	4.07	0.245943
Co2	2.93	0.341150
INF	2.27	0.440855
GDPC	1.56	0.641605

Numerous statistical tests are performed to confirm the robustness of our results. The variance inflation factor (VIF) is used to discover problems with multicollinearity. It is less than 5 in all estimations, indicating the lack of multicollinearity.

Table 4 also displays the pairwise correlation for robustness, typically abbreviated as *r*. This coefficient can be employed in a single measure to quantify the linear connection between two distributions (or features).

Financial Inclusion Index and no. of ATMs per 100,000 adults, INU-FIP, INU-DigFin1 all have a positive linear association. These couples' Pearson correlation coefficients are 0.9471, 0.8284, and 0.8472. These values suggest that the variables have a significant positive association and due to common measurement scale. (Lyons, 2021).The negative correlation coefficients exists for the following pairs: INF and FIP -0.2937, INF and DigFin1 -0.3857, INU and INF -0.5362, HDI and INF -0.7546 and Co2 and INF -0.455. A negative, or inverse correlation, between two variables may or may not imply causality, but it does depict an observable pattern. Thus, they are also significant to our observations as per the previous literature.

Table 4
Pairwise Correlation

	FIP	DigFin1	GDPC	INF	INU	HDI	Co2
FIP	1.000						
DigFin1	0.9471	1.000					
GDPC	0.2784	0.2036	1.000				
INF	-0.2937	-0.3857	0.1772	1.000			
INU	0.8284	0.8472	0.0336	-0.5362	1.000		
HDI	0.2771	0.4271	-0.2255	-0.7546	0.6293	1.000	
Co2	0.5231	0.5935	0.1399	-0.4551	0.7035	0.6725	1.000

Figure 2, is showing a graph of regression analysis indicating a positive slope between two main variables financial inclusion index (FII) and digital finance (DigFin1). The t-value indicates the statistical significance of the coefficient estimate for variable digital finance. The coefficient is significantly different from zero, according to t-value 15. Thus, suggesting that two have a very strong positive relationship. The standard error (se) represents the precision of the coefficient estimate. In this case the value is very small 0.00036154, therefore suggests that the coefficient estimate for digital finance is highly reliable. Further, a low standard error value indicates that the estimated coefficient value is likely to be very close to the true population value. Lastly the coefficient value is indicating that, on average, an increase in one unit in digital finance is associated with an increase of approximately 0.00545497 in the financial index (Siddik, 2020).

Figure 2
FII and DF

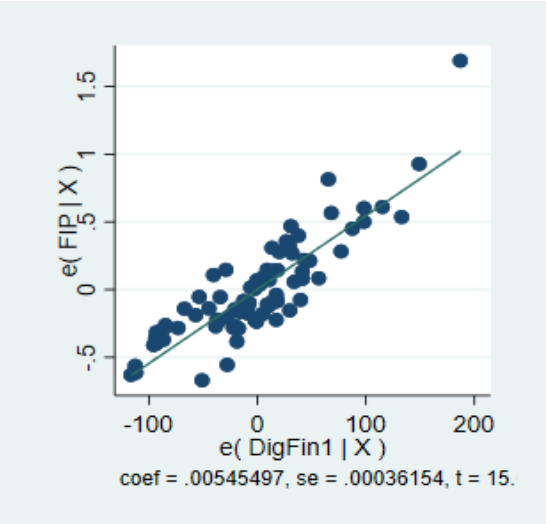


Figure 3
Financial Inclusion Index and Innovation

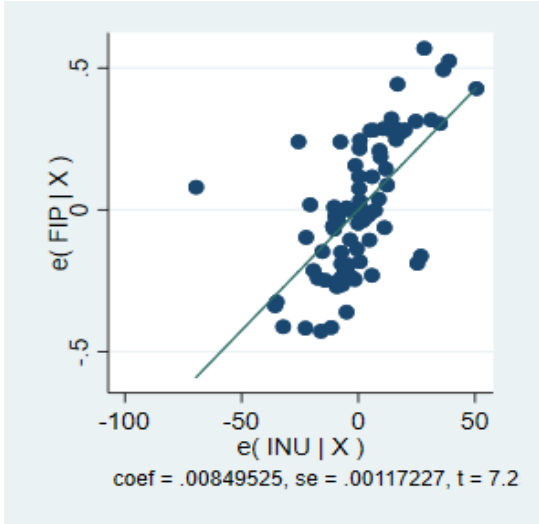


Figure 3 is showing a positive slope between financial inclusion index (FII) and one of the control variable innovations (INU). The coefficient value of 0.00849525 represents the estimated effect or impact of the variable innovation on the financial inclusion index. Therefore, depicting on average one unit rise in innovation is linked with a rise of approximately 0.00849525 in the inclusion. This positive coefficient suggests a constructive relationship between the two variables, representing those sophisticated levels of innovation are inclined towards greater financial inclusion. The t-value measures the statistical significance of estimate, value of 7.2, that is significantly different from zero. Furthermore, the graph's positive slope indicate that the financial inclusion index tends to rise in tandem with innovation. Thus, supporting conception that innovation can help advance financial inclusion (Sha'ban, 2020).

Table 5 demonstrates the model evaluations experimental results. In Model-1, the endogenous variable is access to financial services. The datum that digital inclusive finance has a substantial influence on number of commercial bank deposit account per 100,000 individuals suggests that DF is related with financial service evaluation. The endogenous variable is the financial services availability in Model-2, the findings disclose statistically positive association between no. of ATMs per one thousand sq. km. and digital finance, implying a favorable influence. This positive effect is in line with findings of (Fanta, 2019) and goes against contention (Ozili P. K., 2018). According to author, the availability of digital financial services does not always imply admissions, especially in developing countries where people would rather deal in person at banks than utilizing high-cost online platforms and services.

The outcomes of Model-3, in which the usage of financial services is the dependent variable, shows a high positive correlation between DF and the ratio of outstanding commercial loans to GDP. This finding implies that when DF rises, so does the usage of financial services. Finally in Model (4), a strong positive association between DF and FIP in the Asia Pacific Region shows that Digital Finance improves Financial Inclusion. The outcomes of underlying study are consistent with the conclusions by (Kouladoun, 2022). As a result, (Ozili, 2020a) has emphasized the importance of comprehensive economic data for supporting DF and improving FI. He contends that financially disadvantaged groups' digital bank data might be linked to financial service providers' digital payment channels and used for financial transactions. However, consumer trust, financial knowledge, and cheap prices are propelling this move to digital services.

Table 5

GMM Regressions

Measurement	Model 1	Model 2	Model 3	Model 4
ACI (t-1)	.367824 (0.015) **			
AVI (t-1)		0.2326 (0.000)**		
USI (t-1)			.7731748 (0.000)**	
FII (t-1)				0.75647 (0.000)**
Dig Fin1	6.827 (0.0074)*	123.81 (0.0000)**	0.879481 (0.0000)**	0.00000949 (0.01)**
GDPC	-187.75 (0.0009)**	334.95 (0.0004) **	4.520061 (0.0007)**	-111.29 (0.0043)*
INF	86.044 (0.2953)	232.90(0.0905) *	-0.008134 (0.9966)	1.9202 (0.0584)**
INU	-28.471 (0.0007)**	80.168 (0.0000)	1.369723(0.0000)**	-171.140 (0.0007)**
HDI	14041.55 (0.0000)**	47220.7 (0.0000)	291.878 (0.0000)**	18465.08 (0.0000)*
CO2	214.5633 (0.0073) *	-147.018(0.2600)	-1.579261 (0.3902)	-32.130 (0.7024)
Adjusted R Sq.	0.624536	0.97667	0.94459	0.9685
D-Watson Stat	0.517405	0.363693	0.49414	0.183864
Cross Sections	10	10	10	10
Panel Obs (unbalanced)	86	86	86	86

Note: Coefficients and p values in brackets at ***, **, and * significant at 1%, 5% & 10%, respectively

Amongst control variables, GDPC amount is noteworthy models 2 and 3, but undesirable in models 1 and 4. This finding suggests that a country's revenue level has beneficial influence on availability, access, use of financial services, and FI as a whole. Except in model (3), as anticipated, we observe a strongly positive link between FI levels and inflation. Models (2&3) also exhibit a strong positive value for use of internet, suggesting importance of cyberspace in encouraging FI. The coefficient is negative in model (1&4) result is consistent with (Shen, 2020), who indicate a negligible association between internet usage and FI in China.

Additionally, this research discovers substantial association between financial service utilization and HDI. These findings are consistent with the certainty that a customer's degree of knowledge and financial literacy is connected to their capacity to make mindful decisions in order to keep oneself against abusive financial practices. Finally, in model (1), we discovered a large positive constant for CO2, demonstrating that green fiscal policies contribute to the steady growth of the digital finance industry.

Table 6
Panels Corrected Standard Errors (PCSEs)

VARIABLES	FIP
DigFin1	0.00545*** (0.000358)
GDPC	0.0280*** (0.00651)
INF	-.0000481 (0.00871)
INU	0.00850***(0.00137)
HDI	-1.848*** (0.263)
Co2	-0.00979 (0.00652)
Constant	0.314* (0.187)
Observations	86
Number of B	10
R-squared	0.949

Note: ***, **, and * significance level of 1%, 5% & 10%, respectively

Table 6 summarizes the Beck and Katz covariance matrix estimate, which provides "Panel Corrected Standard Errors" (PCSE) for the model's robustness. We have checked robustness in our study by this. Thus, highlighting further significant positive relationship between DF and FIP. Furthermore, GDPC and INU are also statistically significant, confirming the findings. HDI, CO2, and INF are all adversely significant, confirming our findings.

Policy Implications & Conclusion

The underlying research looks at the effect of DF on FI in ten Asia Pacific nations from 2013 to 2024. Fiancial Inclusion is assessed by a composite index that includes total three subindices: availability of, usage, and access to financial facilities, whereas, digital finance is measured by the no. of ATMs per hundred thousand individuals. Additional drivers of FI were: GDPC, income level, inflation, internet use, human development index, and carbondioxide emission. The Sys-GMM approach was utilized in this work to evaluate the estimates of the variables. The results specify that Digital Finance improves overall financial inclusion level in the Asia Pacific area.

Based on our analysis, we have made several recommendations; 1) One should encourage increased financial awareness by implementing specialized financial programs aimed at students in schools, institutes of higher learning, and rural communities. 2) Promotional activities aimed at traditional financial service companies should be implemented to raise client awareness. The customers'/ client’s awareness of digital financial services and digital inclusive finance along with their many choices should increase .3) A proper policy should be devised at country level to improve the infrastructure for availability and promotion of digital

financial services. 4) National measures should be made to expand the utilization of electronic financial services and the volume of digital payments and transactions.5) A large rise in the number of bank accounts, e-banking awareness and facilitation is required for smooth inclusion.6) An environment of trust and support should be made part at organizational level and governmental level.

Our study has the following limitations: we selected nations from the Asia Pacific area at random for our sample. However, for more strong results, a sample of high-, middle-, and low-income nations should be included. By examining the risks that digital financial services pose to consumers and their impact on the financial sector, as well as taking into consideration income distribution by nation or population, future studies may expand on our findings. It is also advised to investigate the outcome of digital money on FI by employing variety of proxies and methods. It is also worthwhile to investigate the potential moderating impact of financial literacy in relationship between both. Furthermore, to better understand the relationship between the two variables, comparative studies of Asia Pacific and other regions are needed.

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