

The Mechanism of DIF's Effect on Economic Growth: Evidence from Seven Countries

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Abstract. Digital Financial Inclusion (DIF) gains growing momentum as digitalization accelerates and financial technologies burgeon in recent years. This study finds some causes of DIF's impact on economic growth with multiple linear regression analyses under mediating variables. Based on data from seven global countries from 2011-2021, the empirical result finds that innovation, coverage, literacy, and attitude play essential roles in driving economic growth in DIF, respectively, and cooperatively. Future implications derived from the results are that policymakers should incentivize investments in R&D, network infrastructure, financial education programs, and financial awareness campaigns, enhance consumer protection against malpractice and fraud, and foster trust by strengthening regulations on corporate responsibility.

Keywords: DIF; Economic Growth; Technological Innovation; Financial Literacy; Financial Coverage.

1. Introduction

To complete its transformation from a developing to a developed country, China has paid tremendous effort and gone through fast growth in the past decades. The concept of financial inclusion was proposed at Pittsburg G20 Summit in 2009 and yet again appeared in the agenda the following year at Seoul Summit with higher relevance and regard. G20 claimed a "strong commitment to financial inclusion and recognized the benefits of universal access to financial services" and launched Global Partnership for Financial Inclusion (GPFI) to execute and enforce G20 Financial Inclusion Action Plan.[30]

Inclusive finance is no new term for China. Like many developing countries, it endorsed and acknowledged that inclusive finance has societal implications and great potential for the joint economic development, particularly through achieving sustainable development goals (SDG).[14] As the era of digitization rise to its prime, China swiftly works to combine technology and inclusive finance to exploit benefits for the greater public, aiming to level up the state of the economy.

The topic of digital inclusive finance (DIF) became a common topic in committee conferences and gained growing concerns starting from the early 20th century. In 2019, the Fourth Plenary Session of the 19th Central Committee of the Communist Party of China formally treated data "as a new factor of production and vigorously developed digital inclusive finance in rural tertiary industries." Again, the same topic was brought up in the "14th Five-Year Plan Outline" in 2021, pressing the importance of DIF and crediting its help in "promoting the integrated development of the primary, secondary, and tertiary industries in rural areas." [10]

The mounting discussions on DIF and its relevance in political settings prove its significance as scholars discuss the real-life benefits it brought to people in the academic realm; the most common public interacts with it daily and enjoy its favor. DIF-related discussions are highly relatable and tangible; however, this relatively novel notion still carries a lot of mystery, and many things are unclear: How and to what extent has DIF helped economic growth? Is there an uneven impact, and why? Does DIF have a negative effect at all? Is it realizing its full potential, and if not, what are the challenges? What can we learn from cases across the world of this novel idea with little historical reference as a guide?

Inclusive finance, first introduced by Wei at the Asian Microfinance Forum in Beijing in 2006, was the idea of making financial services accessible and available for all. More precisely, as Miao and Yang put it: "Financial services extended to less developed regions and low-income people at an affordable cost by improving financial infrastructure, providing them with reasonable and convenient

financial services with an affordable price." [6] Some of these financial services include "investment and financing, operation and risk management, payment and settlement, information security and user experience" [6] and more.

In the increasingly digitalized world and empowered by big data, inclusive finance can deliver financial services to poor groups with high efficiency. This is a solution to the spatial challenge for the poorer demographic, who tend to live in more remote regions [33], are distant from major cities, and are often disadvantaged by "backward development." [35] Digitization also leads to large-scale innovations, and as the country promotes and spreads the use of new technologies, they get embedded into the social infrastructure, which in turn change every individual's life; one example is DIF. As evidence suggests, digital inclusive finance has made an influential and long-lasting social impact because it self-sustains a cycle that advances sustainable technology as the system optimizes the use of resources and diverts money to other areas of improvement.[6] Our discussion of DIF has been based on China's context; nonetheless, DIF is widely adopted globally, especially in developing countries.

2. Literature review

All recent studies agreed that DIF imposes a positive impact on the economy and generally have arrived at the conclusion that DIF facilitates economic growth. This is supported by evidence across countries globally as studies based on G20 countries: "...conclusively, it means that a significant relationship subsists between financial inclusion, financial sustainability, and financial efficiency." [14] In Sub-Saharan Africa, scholars found that "there is a complimentary association (correlation) between the present degree of inclusiveness of finance and economic advancement in SSA." [3] Indian studies also identified similar results of "a positive association between economic growth and various dimensions of financial inclusion." [27] However, most works of literature are China-based studies and are categorized into three main themes: rural revitalization and sustainable economic growth in the form of a green economy and promoting small and micro enterprises (SMEs).

There is general agreement that DIF has helped economic growth in rural areas. Studies focus on analogous contexts with different dictions like "rural," "regional," and "agricultural" —these studies all center around low-income subjects. Rural revitalization is manifested in infrastructure enhancement and poverty alleviation, [32][34][35] and both of these factors are, to some extent, the result of financial resource (re)allocation by digital finance inclusion and innovative technology. Thus, more money is invested in infrastructure building or upgrading to increase industrial efficiency, which also paves the path to a greener economy as a matter of course; as Ge et al. explain, "DIF has promoted the improvement of rural tertiary industry integration efficiency by promoting technological innovation, improving agricultural modernization, and building a risk-sharing mechanism." [10] Financial resource reallocation also means greater accessibility to loans or more loan flexibility, which leads to sustainable growth as it "eases small and micro enterprises (SMEs) financing constraints and increases the quantity and quality of consumption by increasing residents' disposable capital." [29]

To gauge DIF's effect in detail, Zhou and Wang further break down poverty into three dimensions: medical poverty, income poverty, and education poverty, and found that "the coverage breadth (of DIF) significantly affects the alleviation of medical poverty, the use depth significantly affects the alleviation of income poverty and education poverty, and the digitization level affects the alleviation of poverty in three dimensions." [35] Ge et al. studied on rural income and found "wage income, operating income, and transfer income among the income types undergo a certain degree of promotion" due to DIF. [11]

But these gains are not immediate; many studies found that there is a threshold effect from DIF in the form of a "U-shape"—DIF's benefits only show accelerated impact on growth after an inflection point before which DIF acts inhibitory. [30] Li et al. further found that the effect of DIF on green total factor productivity "shows a trend in the middle, followed by the east, and later in the west," and

the study also implied that "improving the agglomeration degree of producer services and optimizing the upgrading of the industrial structure" could help promote a green economy. [15] Moreover, multiple studies point out that DIF's impact is biased—it is "more significant in the eastern coastal and central inland provinces, and insignificant in the remote western areas. [30]

Parts of relevant literature emphasized sustainable growth and green economy, toward which scholars pose varying attitudes and where we see diverse findings and conclusions, which also reveals some impediments DIF faces. Hong et al. found that DIF can "significantly increase China's agricultural green total factor productivity," which is confirmed by industrial structure improvement results from the previous findings.^[12] In China, DIF initiated technological innovation that facilitates the "upgrading of industrial infrastructure," which "can directly reduce carbon intensity,"[16] setting the foundation for green technology and sustainable economic growth. Nevertheless, this entails talent attrition to more prosperous cities, leading to a "negative spatial spillover effect," and this discounts DIF's advantage brought on the local economy. One piece of evidence suggests that the central and "more remote western regions" [30] see a "significantly negative influence" [34] from DIF.

To mediate this, scholars have proposed to enforce environmental regulations synchronously with DIF advancements and believe this can help achieve a "synergistic effect on regional economic growth." [29] Globally, some scholars believe that economic development progress is being hampered by institutional quality. Latif et al. analyzed 48 Asian countries and disapproved of financial inclusion's role. They point out the negative environmental externality as a result of financial inclusion and advocate for institutional quality improvement to counter the effect: "Even with the negative effects of financial inclusion on environmental performance, environmental performance still rises with financial inclusion since there is a substantial positive association between institutional quality and environmental performance." [15]

The existing literature provided a good theoretical base and empirical results of coherent themes. However, there are some limitations. Admittedly, most of the studies in China are based on data that span over about ten years, and researchers often face practical data collection difficulties or a lack of reliable data. Multiple studies admit their work presents a partial picture and have room for deeper analysis, like extending the existing study to other regions and expanding on heterogeneity problems. There is also a lack of a unified definition of terms. For example, there may be "deviations in the standard for determining the level of integration of the three industries in rural areas" [10]; this signifies DIF's novelty and informs that our current society remains at a preliminary stage under DIF's impact. While most studies praised DIF's positive impacts, few elaborated on the existing challenges of DIF and whether they have inhibited growth potential. Lastly, there are few cross-country works of literature that give global views on DIF's impact.

Based on these pre-existing works, this paper aims to enrich academia by examining DIF's impact on economic growth by suggesting causes in its mechanism: innovation, coverage, literacy, and financial attitude using global data. This paper exploits new perspectives on DIF's impact on literacy and attitude, in addition to the more extensively discussed themes of innovation and coverage. With respect to data, we synthesize the macro-level objective measures from the World Bank with localized-level subjective measures from the European Value Survey and the World Value Survey; together, they reveal insights into the effect of financial attitude in the overall picture.

3. Hypothesis

Innovation drives economic growth. This is an important lesson learned from history. When Ford invented the automobile, it consequently led to the creation assembly line and accompanied many new technologies that greatly enhanced efficiency for mass production, leading up to the industrial revolution. Innovation relies on skills, knowledge, ideas, and funds, which all come along as DIF advances. Many studies found that DIF reallocates money to "alleviate the financing constraints and financial mismatches faced by enterprises and promote enterprise innovation through R&D

investment." [31] As Ren et al. point out, R&D investment ultimately effectuates innovation indirectly through the interaction among different agents: "Venture capital influenced enterprise innovation mainly through introducing R&D talents and providing industry experience and resources to increase the number of patents and further stimulate innovation." [25] When money is invested in R&D talents, it aims for innovative ideas and their realization. Furthermore, the brainchild of R&D, like innovative design and new technologies, becomes the input in infrastructure enhancement projects; in this way, DIF indirectly optimizes "agricultural industry structure," [1] facilitates "agricultural modernization" [10] and upgrades "industrial structure." [17] By efficiently reallocating financial resources in terms of its "coverage, depth, and credit, [5]" DIF also provides finance for green technology innovation, which "effectively stimulates the green innovation of heavily polluting enterprises." [31] DIF leads to the aggregated effect of sustainable growth through, including but not exclusive to, providing finance, stimulating infrastructure renovations, promoting enterprise transition to green technology, and so on, which all root from innovations and in which process regenerates innovations.

H1: Digital inclusive finance enhances economic growth through innovations.

Digitalization is the future of financial inclusion and could unlock many growth potentials as more people could take part in financial activities, and digitalization helps expand financial service coverage through the power of the Internet of Things (IoT). OECD states that DIF benefits consumers by "extending the reach and access of financial services, thereby supporting broad-based financial inclusion" (OECD). Digitalization extends financial services to any person who owns and uses a smart device in any place with network services. As Jain et al. defined that "digital financial inclusion was making financial services accessible through technology intervention, that is, via the Internet, mobile networks, cards, and digital wallets." [25]

With increased financial service coverage comes great opportunities for people in remote and poor areas, and digitalized financial service means greater efficiency and convenience, phasing out the traditional over-the-counter type of financial service. One study noted that "in Asia and Africa, the mobile phone use rate is more than 90 percent. However, the percentage of people with bank accounts remains low...Interestingly, among the approximately 1.7 billion "unbanked" people, about one billion have mobile phones." [21] If DIF is propagated rightfully, we can foresee large-scale economic growth by converting unbanked mobile users to enjoy online banking services. On the micro-level, people could make more money given higher financing flexibility and thus increase consumption and investment. Similarly, SMEs can also exploit the benefit from DIF to expand their business; as Sun and Tang explicate: "digital inclusive finance contributes to sustainable economic growth by easing small and micro enterprises (SMEs) financing constraints and increasing the quantity and quality of consumption by increasing residents' disposable capital." [29] In a way, broadening financial service coverage is an inevitable step in the quest for financial inclusion, and we believe digitalization and innovative efforts are conducive to this course. Hence, we propose here:

H2: DIF enhances economic growth through increased financial service coverage.

The importance of financial literacy is recognized by OECD in introspection of the financial crisis. The underlying problem is asymmetric information between consumers and financial service providers. Hence, OECD calls for building better "protection regulatory framework and financial education tools" to "help individuals understand financial risks and products and thus take decisions to adapt to their personal circumstances." [6] Financial services and products come in many different forms, but they are highly technical and can seem daunting for laymen. Those who willingly use or learn about finance benefit from better financial well-being because due to their financial literacy, which the OECD defines as "a range of skills, information, beliefs, and practices that assist people to make wise financial decisions and achieve personal financial well-being." [18] Knowledge of finance has a positive correlation with individual savings behavior, as a study in Laos finds that "individuals with higher financial literacy scores are more likely to hold savings in both formal and informal forms than those who have lower financial literacy scores, even when we control for income and education." [20] An Indonesian study result found that DIF and digital financial literacy have "positive

influence also a significant effect on the performance of MSMEs (Micro, Small and Medium Enterprises)."[22]

In addition, financial literacy's importance is emphasized in an Indian research study, in which authors urge to act and propose a GETU model to promote financial literacy through a concerted effort by Government, Education, Training at Home, and Upskilling in College. They also raised that digitalization is producing far more complicated and technical financial products than people's ability to make sense of, that "where all transactions are digitized, individuals all over the world are still lagging behind in this race, where understanding finance and financial concepts is still a concern." [18] Improving financial literacy helps people make more prudent and justified financial decisions. Along with "popularized internet usage" under the prevalence of DIF, people and SMEs are motivated to take advantage of new digital financial products to exploit profit opportunities.[1] All these findings find benefits of strengthening and enhancing overall financial knowledge, thus pointing to the need to prompt financial education. Thus, we claim the following hypothesis:

H3: DIF can improve social well-being through increased financial literacy.

It is not hard to conceive that after DIF has been popularized and promoted, more people engage in financial services. However, a major practical challenge touches on the tricky psychological aspect—people find it hard to balance their financial attitude. Indeed, financial activities tend to be associated with high expertise and long, rigid procedure, and many people find this bar too high and evade them in the first place. Instead, they would turn to alternative informal agencies instead of official institutions due to accessibility. A Pakistan-based study illustrates the bilateral mindset in the formal financial setting. It claims that SME owners' attitude is crucial to their financial decisions, and most "prefer informal finance to fulfill their business needs." [24] Two factors that influence SME owners' attitudes are a lack of awareness of available financial products and concerns about risk. While the former falls onto SME owners' own responsibility, the latter is a dilemma for both the lender and the borrower, due to the reason that "banks and other financial institutions feel the risk of loss in providing financing facilities to SMEs because of their unstructured business setups and documentation. In the same manner, SME owner-managers' lower financial knowledge halts them from investment and adopt those financing options which are risky for them." [24]

Professionals in the finance sector might hold bad attitudes toward the expanded low-income client groups due to prejudice and distrust, which in turn reduces the amount of formal financial services. A study in India shows that bank staff's "negative attitudes towards poor clients, expressed through disdain and contempt, entail a cost for clients nonetheless." [13] Financial service providers' attitudes might be an important factor that stops poor people from getting service from official banks, and it poses a big obstruction to realizing full financial inclusion. The result of the Indian project "demonstrated that attitudinal and customized training in banks produces results that can impact positively on financial exclusion and poverty alleviation." [13]

To achieve inclusive finance, institutions are compelled to address such bilateral distrust attitudes. For example, OECD's initiative on New Approaches to Economic Challenges (NAEC) learns from past financial crises about "the behavior of economic agents and to risks, paying greater attention to psychological bias, perceived versus objective risks, as well as the nonlinearity in risk perception" to make stronger analytical framework. OECD also applies behavioral economics to formulate more effective public policies.[1] In essence, behavioral economics suggests that financial firms should offer consumer protection, bridge the information gap, and gain trust from consumers so they can intervene in irrational decisions by consumers and make effective and optimize the outcome of financial activities. Under these observations, we propose that:

H4: Inclusive Finance enhances economic efficiency through mitigating attitudes in the finance sector.

4. Methodology

4.1 Data

The present research used data from Global Partnership for Financial Inclusion (GPII), the World Bank, European Value Survey (EVS), and World Value Survey (WVS). The WVS is conducted every five years, while EVS is conducted every nine years. We used the closest survey wave to approximate missing data in the years not covered by the waves. The data collected were for the 2011-2021 period. Since not all countries had available data record in GPII, we selected seven countries as our study sample: China, Germany, India, Japan, Mexico, USA, and South Africa, covering first, second, and third-world countries. These countries represent a diverse range of geographic regions, levels of development, and stages of adoption of digital inclusive finance.

In 2021 IMF stated that "countries in Africa and Asia and the Pacific regions...are found to have high degrees of digital financial inclusion compared to other regions." [26] It also stressed the role of fintech, which also reflect the extent of engagement in DIF, and interestingly, fintech is most adopted in Africa. China and India are two of the largest and fastest-growing economies in the world. They both have recognized and are devoted to the assessment and promotion of the use of digital financial services. While most DIF works of literature are China-based case studies, Indian scholars have advocated for DIF too, and there is research aimed to suggest feasible solutions to help its progression, like the use of open API in banking and the GETU model. South Africa also endorsed DIF despite having a low "mobile money penetration rate" [21] relative to other developing countries because sub-Saharan Africa-based studies also showed consistent findings about DIF on the economy. In 2022, the author of OECD's report "Expanding access to finance to boost growth and reduce inequalities in Mexico" appealed to the problem of unequal access to financial services and underlined the resultant obstruction to SMEs and the wider economy [19] and called to "strengthening financial education and digital literacy" to boost its metamorphosis.

USA, Germany, and Japan are developed countries that use DIF to different extents. Online payments and banking are widely used in the U.S., but in Japan and Germany, cash remains the dominant payment method in the country, with many businesses still preferring cash payments over digital payments. In June of 2022, IMF suggested Japan adopt digitization, believing it could help recover Japan's economy from the pandemic and bring it to the same page as its neighboring Asian countries [28]; Germany has increased digital payment and trending towards cashless payment due to Covid-19 pandemic, yet another key driver of DIF in Germany is the growth of fintech startups, which are introducing innovative digital payment and banking solutions. [7] Overall, these seven countries represent a diverse range of economic, geographic, and developmental contexts, making them a suitable sample for examining the impact of digital inclusive finance on the economy.

4.2 Variables

The dependent variable is economic growth. We used measures like Gross domestic product based on purchasing-power-parity (PPP) share of world total (percent*10-3) and GDP deflator (index*10-5). The former is "much preferred for making comparisons" in comparison to other economic growth indicators like GDP, NDP, and GNI. [2] This is because PPP measures the relative purchasing power of different currencies and adjusts for differences in the cost of living between countries. This allows for a more meaningful cross-country comparison of economic output, as it considers differences in the price levels of goods and services, which makes it a more suitable metric because this study involves economies of various economic stages. [23] The GDP deflator is a measure of inflation and is a better measure of inflation than CPI because it provides a more comprehensive measure as it measures "changes in the prices of goods and services produced in an economy," and it "closely mirrors the GDP price index." [9]

The independent variable for this research is digital inclusive finance (DIF). GPII provides an array of variables to show DIF; our analysis used "made or received digital payments (% age 15+)" and "received a digital payment, rural (% age 15+)."

These two variables directly reflect the effect of DIF as they measure the use of digital finance services.

Our four hypotheses suggest that DIF can improve economic growth through innovation, coverage, literacy, and attitude. Therefore, innovation, coverage, literacy, and attitude are treated as mediating variables. There are direct metrics that reflect innovation (e.g., number of patents, R&D spending...) and coverage (e.g., number of ATMs), but not for literacy and attitude. This research used a more general literacy indicator to represent financial literacy, supposing that there is a positive correlation between the two; specifically, we used tertiary school enrollment (%/1000) to represent country-level literacy. Attitude is highly subjective, so responses to questions indicative of personal attitude from WVS and EVS surveys are used as proxies. Selected questions include keywords like confidence, trust, and financial satisfaction. We included control variables in our regression analysis.

4.3 Model

We conducted multiple linear regressions using four interaction terms, respectively. This allows us to test whether DIF would still have a significant effect on the response variable economic growth even after adding the mediating variable, respectively. Our basic empirical equation is:

$$Y_{it} = \alpha + \alpha I + \beta X_{it} + year_t + v_i + \mu_{it} \tag{1}$$

$$Y_{it} = \alpha + \alpha C + \beta X_{it} + year_t + v_i + \mu_{it} \tag{2}$$

$$Y_{it} = \alpha + \alpha L + \beta X_{it} + year_t + v_i + \mu_{it} \tag{3}$$

$$Y_{it} = \alpha + \alpha A + \beta X_{it} + year_t + v_i + \mu_{it} \tag{4}$$

$$Y_{it} = \alpha + \alpha I + \alpha C + \alpha L + \alpha A + \beta X_{it} + year_t + v_i + \mu_{it} \tag{5}$$

where *i* and *t* represent country and time respectively; *Y* represents economic growth, *I* represents innovation; *C* represents coverage; *L* represents literacy; *A* represents attitude, and *X* represents control variables; *year* is the time fixed effect; *v_i* is individual effect; and *μ_{it}* is residual.

5. Empirical Analysis

This part is the regression analysis of all hypotheses. The first is the regression results of the mediation effect of innovation on the effect of DIF on economic growth.

Table1 The Results of Innovation on the Effect of DIF on Economic Growth

	GrossdomesticproductbasedonPPP (%)	GrossdomesticproductbasedonPPP (%)
difInnovation	0.1589* (1.777)	0.1576* (1.749)
Control	N	Y
Individual	Y	Y
Year	Y	Y
N	77	77

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 1 shows the result from regression (1). DIF significantly increases economic growth through innovation at a 10% level. For each unit increase in DIF and innovation, the gross domestic product based on PPP increases by 0.1576-0.1589 %, holding all else constant. The result is also significant after control variables are included. This shows that Digital inclusive finance enhances economic growth through promoting innovations; thus, H1 is justified.

As noted by many scholars, innovation is a major driver of economic growth and helped the economy trend toward a green and more sustainable economy. For example, technology innovation

in industrial infrastructure has helped improve "rural tertiary industry integration efficiency" and "agricultural modernization." [9][31] Furthermore, enterprise innovation in SMEs under DIF also contributed to economic growth in job creation, market diversification, and R&D engagement, which stimulates more technological innovations.

Second is the regression results of the mediation effect of financial coverage on the effect of DIF on economic growth.

Table2 The Results of Coverage on the Effect of DIF on Economic Growth

	Grossdomesticproductdeflator	Grossdomesticproductdeflator
difCoverage	0.091***	0.091***
	(2.778)	(2.919)
Control	N	Y
Individual	Y	Y
Year	Y	Y
N	64	64

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 2 shows the result from regression (2). DIF significantly increases economic growth at the 1% level through coverage. For each unit increase in DIF and coverage, the GDP deflator index increases by 0.091, holding all else constant. An increase in GDP deflator suggests a price increase and mild inflation is indicative of a healthy and growing economy, as it may indicate that there is rising demand for goods and services, which in turn drives economic growth. The result is also significant after control variables are included. Thus, H2 is supported: Digital inclusive finance enhances regional economic growth through increased financial service coverage, supposing an improvement in the overall economy would necessarily bring about regional economic growth.

Several research studies also have found evidence that confirm this hypothesis. Sun and Tang have found that "the breadth of digital inclusive finance coverage is most effective in promoting sustainable economic growth at this stage." [29] Zhou and Wang also found that the increased reach of digital finance services "significantly affects the alleviation of medical poverty." [35]

Third is the regression results of the mediation effect of financial literacy on the effect of DIF on economic growth.

Table3 The Results of Literacy on the Effect of DIF on Economic Growth

	Grossdomesticproductdeflator	Grossdomesticproductdeflator
difLiteracy	0.0730***	0.0389**
	(3.343)	(2.309)
Control	N	Y
Individual	Y	Y
Year	Y	Y
N	77	77

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 3 shows the result from regression (3). DIF significantly increases economic growth at the 1%-5% level through literacy. For each unit increase in DIF and literacy, the GDP deflator index increases by 0.0389-0.073, holding all else constant. The result is also significant after control variables are included, that is. This indirectly proves H3 that DIF can improve social well-being through efforts to elevate financial literacy or promote financial education, and an increase in economic growth would evidently improve living standards.

This is not surprising because generally, literacy can equip people with tools to make more informed and calculated decisions. Financial literacy should not be seen as an exclusive skill to experts, but rather, appeal to the broad public since it improves personal financial management and business performance. DIF facilitates this because it expands access to financial education by providing low-cost and convenient digital resources. Combining technical understanding with advanced technological skills is conceived to be impactful to economic growth and has appealed to many developing countries in Asia and Africa to develop fintech.

Fourth is the regression results of the mediation effect of financial attitude on the effect of DIF on economic growth.

Table4 The Results of Attitude on the Effect of DIF on Economic Growth

	Grossdomesticproductdeflator	Grossdomesticproductdeflator
difAttitude	0.1874*	0.1784 *
	(1.717)	(1.724)
Control	N	Y
Individual	Y	Y
Year	Y	Y
N	77	77

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 4 shows the result from regression (4). DIF significantly increases economic growth through attitude at a 10% level. For each unit increase in DIF and attitude, the GDP deflator increases by 0.1784-0.1874, holding all else constant, and is significant after controlling for factors. This proves the effect of attitude under DIF on economic growth; however, there are few sources that represent both financial consumer and provider attitudes before and after DIF's advent on the country level, so we could not make a comparison to verify whether DIF has "ameliorating" effect on financial service participants' attitudes. Nonetheless, the result that improving attitude (in trust for this specific case) can indirectly benefit economic growth sheds light on potential policy improvement.

DIF provides a way to fix such systemic deficiency because it allows contactless transactions. This extends financial services to reach a greater population and spares the need for in-person banking errands. This minimizes the awkward tension and miscommunication between financial service staff and customers, and since online banking apps have been intentionally made such that transaction procedures are simple and quick, it significantly enhances banking efficiency and helps economic growth.

Fifth is the regression results of the mediation effect of all the above five variables on the effect of DIF on economic growth.

Table5 The Results of All Mediation Variables on the Effect of DIF on Economic Growth

	Grossdomesticproductdeflator	Grossdomesticproductdeflator
Dif-ICLA	0.099***	0.051*
	(3.074)	(1.937)
Control	N	Y
Individual	Y	Y
Year	Y	Y
N	64	64

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 5 shows the result from full regression considering all four mediating variables' effects. DIF significantly increases economic growth through innovation, coverage, literacy, and attitude. For each unit increase in DIF and all four mediating variables, the GDP deflator increases by 0.099, holding all else constant. The result is also significant after adding all control variables, and the GDP deflator increases by 0.051 for each unit increase in DIF and all four mediating variables.

6. Conclusion and Discussion

This paper explores and finds evidence for DIF's positive impact on economic growth through the effect of innovation, coverage, literacy, and attitude. Our regression analyses are significant after incorporating each of them separately and all together, which indicates that all four variables explain some of DIF's impact on economic growth. Our result is in alignment with other scholars' findings, but here we emphasize innovation, coverage, literacy, and attitude as common factors that explain how DIF advances economic growth.

From the results, we can derive some practical implications. First, DIF facilitates economic growth through innovation. The main engine is the reciprocal force between innovation and DIF that encourages the development of each other; thus, DIF investments connote innovation. Practically this means that policymakers should support R&D, facilitate competition and collaboration among firms, and encourage investment in DIF.

For example, policymakers could provide financial incentives to companies that are developing innovative financial technologies. They can also use tax breaks, grants, or other forms of financial support that would help to spur innovation in fintech. The causality between DIF and economic growth finds a major driving force in innovation, which gives rise to new technologies that accelerate digitalization, justifying investments in R&D, a point stressed repeatedly by many scholars.[4][12][25] Fan and Chen's finding further justifies the cause; they found that "DIF and enterprise innovation could concurrently improve Financial Resource Allocation Efficiency (FRAE)," leading to the optimization of use and capacity of financial resources.[5] On the other hand, some scholars conducted studies on DIF with a more localized focus and see DIF's uneven regional impact; recall that Ding, Shi, and Hao found DIF's negative spillover effect on regional economic growth, which might be a result of talent attrition.[4] Zhou et al. claim that inclusive finance negatively affects economic growth in the central regions of China.[34] In addition, many studies take a further step to use sophisticated models to find a "U-shape" relationship between the degree of digitalization and rural revitalization.[30] Here we make a speculation about the inflection point that since DIF relies on a broad and firm digital infrastructure to take momentum and more continuing effort is needed until it makes a tangible difference in society.

Second, DIF increases financial service coverage which in turn stimulates growth. Instinctively this appeals policymakers to upgrade its digital infrastructure, such as broadband internet, mobile networks, and digital payment systems to support the growth of digital financial services. This could involve creating policies and regulations that spur digital infrastructure development or providing financial incentives for companies to invest in digital infrastructure.

Scholars hold similar attitudes toward the DIF coverage's impact. For example, Sun and Tang called the breadth of DIF coverage "the most effective in promoting sustainable economic growth." [29] We learned from global evidence that increased financial service coverage and "network accessibility" can increase the use of mobile money, implying broader financial access.[20][21] Other studies of specialized focus support this claim and further credit widespread DIF coverage's contribution to "poverty alleviation"[35] and "FRAE"[5] promotion through analyzing different dependent variables.

The implication of the third hypothesis is that policymakers should stress financial education and promote relevant programs. This can help individuals and businesses to understand and use digital financial services. Therefore, it is helpful to create public awareness campaigns or provide financial education programs in schools and universities. Financial literacy's importance and impact are

acknowledged in the field. From lessons learned in the financial crisis, OECD stressed concern about the information imbalance between banks and people on credit that was abused by bankers, which accumulated to the financial crisis. OECD called for "a balanced policy focus on financial education and consumer protection," which has compelled the Insurance and Private Pension Committee (IPPC) to lay down good financial practices as well as financial education endeavors to precaution against future crises.[8] Indian researchers' approach to fulfilling financial literacy conceives a Government, Education, Training at Home (GETU) model, which demands concerted efforts in Government, Education, Training at Home, and Upskilling in College. In addition, fintech is a hot, relevant topic in this field. Investment in fintech inevitably considers innovation and digitalization, sustainable growth, and education. IMF reported that developing countries most endorse fintech. In terms of its impact, Pratiwi and Rahayu found indirect evidence for "a significant influence of digital financial literacy through digital financial inclusion...on MSMEs." [22]

Finally, the significance of attitude adds another dimension of concern to DIF. Policymakers should ensure that consumers are protected from fraud and malpractice in the financial sector. This could involve creating new regulations that increase transparency and accountability in the financial sector or providing resources for consumers to report and resolve disputes with the providers of financial services. It is also important to build trust in the financial sector, which could involve promoting ethical behavior and responsible practices among financial service providers. Under digitalization, consumer data protection and privacy concerns add further complication to the "attitude" matter, and the OECD has laid principles to hold businesses accountable for consumer protection.

For example, considering ethical A.I., it raised "complementary values-based principles" that demand "transparency and responsible disclosure" in the A.I. system and hold organizations accountable for the use of A.I. systems.[6] Scholars that studied financial attitudes have a different focus.

Consistent with our finding is the conclusion of an Indian study based on the idea of amending mutual attitude between bankers and the poor to build "a more conducive and enabling environment for providing financial services to the rural poor"[13]; its result shows that attitudinal-change efforts "impact positively on financial exclusion and poverty alleviation." [13] Other scholars lay their focus on different matters. Rasheed and Siddiqui narrowed the subject to the SME context and found that "the less knowledge of financing terms, as well as dominant role of owner-managers in taking firm decisions, also increase the negative effect of the risk factor on SMEs owner-manager attitude." [24] On the other hand, Morgan and Long found that "financial attitude score is not associated with the overall financial inclusion score...but is associated with holding financial products and more specifically payment products and credit products." [20] The effect of financial attitude is interesting as much as tricky for policymakers because attuning and measuring attitude is practically difficult. Gauging this subjective matter compels one to use survey scores since attitude is a multi-faceted, abstract concept that has no single determinant metric, and what counts for attitude is at the individual researcher's discretion.

There are some limitations in this paper. First, our analysis is based on a small set of countries, and since we encountered missing or unavailable data, our sample size is small. Some of the chosen mediating variables require proxies to represent them indirectly. For example, our data for attitude is based on surveys, in which we select answers to questions that could reflect individual attitudes like How much do you agree with that 'Most people can be trusted'? and How much confidence do you have in Banks? When we see incomplete data from the world value survey, we use the most contingent data for approximation. For example, we fill in the missing values in a survey wave using the values from its closest wave. Moreover, the obtained data only spans over a decade and accounts for 2011-2021, which further constricts the efficacy of our analyses.

While we included various countries in our study with an aim to explore some global perspectives on DIF, most DIF research is based in China, and their conclusions were made specifically for China. We make some generalized claims about DIF's impact and assume their validity cross-nationally.

Lastly, This paper did not address endogeneity problems. All these provide directions for future study endeavors and improvement. We encourage scholars to explore further the interaction between attitudinal finance and DIF. Behavioral economics explains real-life phenomena and complexity, and since digitalization is slowly transforming the finance industry to become less interpersonal, whether this brings benefits or harm to the industry is a big puzzle to be solved.

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