Do FinTech, Financial Inclusion, and Institutional Quality Reduce Income Inequality? Panel Data Evidence from Asian Countries

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Abstract

Asia is one of the fastest-growing economies in the world, but it consistently lags behind the global average in terms of FinTech penetration and financial inclusion. Improved financial inclusion and enhanced FinTech are expected to reduce income inequality. In this study, we utilize data from four rounds of the Global Findex survey conducted in 2011, 2014, 2017, and 2021, covering 39 countries in Asia with 143 observations. We applied various models, including unbalanced pooled, fixed/random, with different sets of variables such as institutional quality, schooling, GDP, population, government expenditure, trade, and inflation, to assess the relationships across FinTech, financial inclusion, and income inequality. Our findings suggest a reciprocal relationship between FinTech and financial inclusion. FinTech enhances financial inclusion, which, in turn, positively affects the development of FinTech. Moreover, our analysis reveals that financial inclusion significantly reduces income inequality, but we could not confirm the direct effect of FinTech on income inequality reduction in the Asian regions. Institutional quality emerged as a powerful measure in reducing income inequality. Similarly, mediating variables such as GDP and trade also reduce income inequality significantly. Therefore, the government may emphasize investing in Fintech infrastructure, launching financial inclusion programs through public-private partnerships, promoting institutional quality, and expanding trade activities to support employment opportunities, particularly in developing economies in Asia. These joint efforts to reduce income inequality help in poverty reduction.

Keywords: FinTech, financial inclusion, income inequality, institutional quality, panel regression

JEL Classification: D63, O16, O33

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Introduction

Income inequality is a significant global concern, particularly in developing countries, where widening disparities in income and wealth have left large portions of the population in severe poverty, especially across regions in Asia and Africa. The growing wealth gap poses a serious threat to achieving the Sustainable Development Goals (Sugiawan et al., 2023). Various factors contribute to income disparity, ranging from political and institutional dynamics to social structures and economic infrastructures.

Wealth disparity is not a new issue; it exists in both developed and developing countries. However, it is not entirely problematic, as no society or country is completely equal, despite numerous policies attempt to create a more equitable and just society. Inequality within countries has become increasingly critical in recent times. Even high-income nations, such as the United States, have exhibited a growing tendency toward wealth inequality between rich and poor (Hubmer et al., 2021). Some argue that capitalism can reduce inequality by providing increased access to finance and resources through innovation and investment. This is evident in capitalism's role in enhancing profits and wealth for individuals, firms, and governments, which in turn drives increased aggregate demand (De Soysa & Vadlamannati, 2023). However, another school of thought attributes the growing wealth gap to modern capitalism, accusing it of enriching the well-off group while driving the poor into deeper poverty (Bukowski & Novokmet, 2021).

Experts broadly agree that economic policy and financial administration are essential for ensuring a fair allocation of resources, key to reducing wealth inequality and promoting economic equality. Nevertheless, as discussed by Wan et al. (2022), the situation remains critical in least-developed countries (LDCs) and by Castelló-Climent and Doménech (2021) among low-income groups, where income inequality continues to expand, and access to essential resources is narrowing. Although indicators such as the Human Development Index (HDI) and the Multidimensional Poverty Index (MPI) show some improvement due to intervention programs and policy adjustments, income inequality remains central to global debates. The greatest vulnerability lies in third-world nations, where wealth inequality exacerbates social instability and limits opportunities for broad-based growth and development. While some countries have made strides in poverty reduction, inequality persists due to systemic issues, such as limited access to education (Bapuji & Chrispal, 2020), financial access (Tchamyou, 2021), and employment (Haini et al., 2023), particularly for marginalized groups. Economists and development researchers emphasize the need for comprehensive economic policies, inclusive growth strategies, and effective financial management to ensure equitable resource distribution and a more just global economy.

In identifying the various factors that influence income inequality, it is crucial to consider the impact of financial aspects. These financial factors, such as access to credit, savings, investments, and financial services, significantly shape economic opportunities and outcomes, affecting income distribution (Ratnawati, 2020). While there is no universal definition of financial inclusion, it refers to the systematic provision of financial services, instruments, and rights, ensuring that they are accessible, affordable, and available to economically vulnerable and marginalized groups. Addressing various forms of socioeconomic inequality requires considering financial inequality, as financial inclusion is intrinsically linked to broader societal disparities. Financial resources play a pivotal role in shaping the economic stability of individuals and governments, influencing key aspects such as living standards, economic growth, and long-term prosperity. A higher degree of financial inclusion facilitates the efficient circulation of financial assets, spanning savings, borrowing, and investment opportunities across diverse sectors. This fosters equitable access to opportunities and promotes inclusive, distributive economic growth.

Similarly, FinTech refers to the use of mobile or computer technology to facilitate financial transactions, such as making or receiving payments. Broadly, FinTech encompasses a range of digital technologies, including mobile wallets, ATMs, credit and debit cards, smart cards (e.g., Visa), mobile banking, and QR code-based payment systems. By simplifying and streamlining the complexities associated with traditional transaction methods, FinTech offers more convenient, efficient, and technologically advanced payment solutions, improving the overall efficiency of financial systems. The rapid development of FinTech has been driven by advancements in computer technology, the digital revolution, urbanization, economic growth, and the increasing complexity of global financial systems. These factors have contributed to greater financial inclusion, providing access to financial resources and opportunities regardless of region or gender. While high-income countries have made significant strides in adopting FinTech due to strong economic foundations and supportive policies, low-income and upper-middle-income countries face challenges in adapting to these technologies, leaving them excluded from the potential benefits FinTech offers.

According to Global Findex, between 2011 and 2021, financial inclusion improved significantly worldwide, though disparities across regions and income levels persisted. Despite recent progress, the World Bank estimates that over 1.7 billion adults globally cannot access formal financial services. Globally, account ownership increased from 51% to 74%, with substantial growth in digital payment usage and credit/debit card ownership, reflecting broader financial access. However, digital and FinTech access and financial inclusion in the Asian region is below the global average. In East Asia & Pacific, account ownership rose to 82%, and digital payment usage reached 77%, demonstrating rapid adoption of financial technologies. South Asia also saw notable gains, with

account ownership doubling to 66%, but credit/debit card ownership remained low at 23%, indicating structural barriers. High-income countries achieved near-universal inclusion, with account ownership at 96% and digital payment usage at 94%. Meanwhile, developing countries saw improvements in account ownership (42% to 69%) and digital finance adoption, yet significant gaps in financial equity remain (World Bank, 2022).

The central focus of this paper is income inequality, a topic that, due to its broad, multi-dimensional nature, resists confinement to a specific study or narrow research framework. To address this complexity, we introduce FinTech and financial inclusion as key explanatory variables in our model, alongside control variables such as GDP, institutional quality, population, trade, schooling, government expenditure, and inflation in Asia. This approach enables a more comprehensive analysis of income inequality within the context of contemporary economic dynamics.

Additionally, we explore the relationship between FinTech and financial inclusion by posing critical research questions: Does FinTech improve financial inclusion? Does financial inclusion, in turn, enhance the use of FinTech? What mechanisms link these two factors? And importantly, how do FinTech and financial inclusion together influence income inequality? Azmeh and Al-Raeei (2024) suggested reciprocal relationship, where FinTech promotes financial inclusion and is, in turn, enhanced by it. By investigating these interconnections, this paper aims to provide deeper insights into the role of FinTech and financial inclusion in shaping income inequality in Asian regions.

This paper is systematically organized into five sections. The first section provides an introduction, followed by a comprehensive literature review in the second section. The third section outlines the research methodology, detailing the research design, the formulation of the econometric model, and the nature and sources of data. The fourth section presents the results and discussion, while the fifth section concludes with key findings and policy implications.

Literature Review

In this section, we provide a comprehensive review of recent studies on FinTech, financial inclusion, and income inequality worldwide. The literature review is structured into three distinct sub-sections. The first explores the relationship between FinTech and financial inclusion, the second investigates the interconnections between FinTech, financial inclusion, and income inequality, and the third explores the specific context in the Asian regions.

FinTech and Financial Inclusion

As discussed by Arner et al. (2020), Fintech is the key driver of financial inclusion. They suggest that the best strategy for promoting financial inclusion

involves focusing on four primary pillars: the first pillar is building a digital identity, simplified account opening, and e-KYC systems; the second pillar supports this with open interoperable electronic payment systems; the third pillar is the electronic provision of government services and payments; and the fourth pillar, the design of digital financial markets and systems that fosters broader access to finance and investment. Similarly, Morgan (2022) investigates the developments of financial inclusion and Fintech in the ASEAN member countries and India. He identifies that Fintech is contributing and can potentially contribute to increased financial inclusion in these regions and also examines potential risks arising from the use of Fintech, including issues related to cybersecurity, regulatory challenges, and the digital divide. Meanwhile, Beck (2020) discussed the roles of innovation in Fintech and financial service sectors to enhance financial inclusion in ADB member countries based on the Global Findex survey of 2011, 2014, and 2017. Notably, he found a positive and statistically significant association of Fintech with financial inclusion, particularly fueled by mobile money account penetration across the region. Across almost all ADB countries, account penetration increased between 2014 and 2017, and surprisingly, countries like Mongolia and Bangladesh have notable account penetration driven by mobile accounts. He also added that big tech companies can collect and analyze big data and have network externalities that can further improve financial services and attract more clients. And, Mushtaq and Bruneau (2019) unveiled a positive relationship between microfinance, financial inclusion, and ICT in poverty reduction and income inequality.

Furthermore, Ediagbonya and Tioluwani (2023) have highlighted the effectiveness of FinTech innovations in promoting financial inclusion in developing and emerging markets, with Nigeria serving as a key case study. Despite efforts by governments, regulators, and financial institutions to bridge the inclusion gap through digital platforms like mobile payments, ATMs, and mobile money, several challenges persist, including illiteracy, inadequate infrastructure, poor mobile reception, and data privacy concerns. Nevertheless, FinTech plays a critical role in advancing financial inclusion, particularly in poverty alleviation, by offering innovative solutions to overcome these barriers. FinTech also promotes financial inclusion because FinTech and financial inclusion have bidirectional relationships. As mentioned by Yang (2019), FinTech promotes financial inclusion. Similarly, Asif et al. (2023) used a structural equation model to explore the impact of fintech and financial services on financial inclusion in India and found that fintech businesses have significantly aided financial inclusion in this nation, especially for the middle class. He highlighted those customers, who are meant to participate in financial inclusion through FinTech services, consistently engage with these mobile platforms, have no plans to stop using them, and believe that their use has led to increased profitability and savings due to the services' user-friendly nature. Furthermore, Baber (2020),

Kabir (2021), and Yang and Zhang (2022) further explored the positive roles of FinTech devices in enhancing financial inclusion across different regions.

In the context of Asia, Parvez et al. (2023) discussed the role of fintech and financial inclusion in inclusive growth in Asia, analyzing panel data from 2014, 2017, and 2021 of selected 25 countries. FinTech was statistically significant and positive in the model highlighting that Fintech, along with other factors like financial development, financial account, and use of bank or credit card improves inclusive growth. This paper didn't examine fintech and financial inclusion directly, but based on the study of Alekhina and Ganelli (2023), it is justifiable to use inclusive growth as a measure of inequality. Similarly, Seo and Yoo (2020) concluded that with financial inclusion indicators like holding accounts and loans, ATMs, and bank branches, the Asian region has achieved similar or superior performance to other regions. The young population using ICT has fueled expanding financial services and products, making Asian regions a new model for inclusive finance. Despite Fintech's success, a financing gap remains for the poor, the old, women, rural residents, and other underserved communities. It means that there is more work to be done to improve financial inclusion for these people who remain financially excluded. Furthermore, Imam et al. (2022) studied opportunities and barriers of FinTech in ASEAN and SAARC and noted that FinTech services have potential opportunities for expansion in the ASEAN regions, but less so in the SAARC regions. Services such as crowdfunding, neobanks, and InsurTech have potential in the ASEAN regions, especially with a positive attitude towards entrepreneurship and asset investments. In the SAARC regions, InsurTechs linked to health care have potential, along with LendTechs and neobanks. These findings are supported by Fernandez and Rakotomalala (2020) in ASEAN, Goswami et al. (2022) in rural India, and Banna et al. (2021) in OIC countries.

FinTech, Financial Inclusion, and Income Inequality

Several empirical studies on the relationship between FinTech, financial inclusion, and income inequality are available, but a comprehensive investigation by Demir et al. (2022) has profound empirical implications. The authors explored the interrelationship between FinTech, financial inclusion, and income inequality across 140 countries using Global Findex survey data from 2011, 2014, and 2017. Their findings highlighted that FinTech, directly and indirectly, reduces income inequality through financial inclusion, with the strongest effects observed in higher-income countries across all inequality quantiles. Chinoda and Mashamba (2021) analyzed the interaction between financial technology, financial inclusion, and income inequality in a panel of 25 African countries from 2011, 2014, and 2017. The results show that financial inclusion mediates the financial technology-income inequality relationship, thus fundamentally reducing income inequality in Africa. Meanwhile, Ashenafi and

Dong (2022) obtained three key findings based on waves of survey data for 2011, 2014, and 2017 across 39 African countries by using pooled OLS and 2SLS estimation methods. First, institutional factors such as political stability, control of corruption, and government effectiveness determine Fintech and financial inclusion. Second, Fintech encourages individuals to have a formal bank account, thereby promoting financial inclusion. Third, financial inclusion and Fintech exacerbate income inequality. Similarly, Cosma and Rimo (2023) highlighted that FinTech could impact financial inclusion and in turn, could help in reducing social inequality.

Another notable study was published by Kanga et al. (2022) to unveil the relationships between fintech diffusion, financial inclusion, and GDP per capita, and are estimated using a panel data set for upto 137 countries over the period 1991–2015 using both cross-section and panel techniques. A key finding was that fintech diffusion and financial inclusion have long-run effects on GDP per capita over and above their short-run impact and the effects of investment in fixed and human capital. However, a recent study by Hodula (2023) suggested that the growth of fintech and big tech credit does not necessarily reduce income inequality, particularly in countries with low financial inclusion, where the benefits tend to favor higher-income individuals. As such, innovations in digital lending may exacerbate existing disparities if targeted efforts to improve access for disadvantaged populations are not implemented alongside these advancements. Interestingly, Omar and Inaba (2020) suggested a negative relationship between financial inclusion and income inequality. The analysis was carried out using unbalanced annual panel data from 2004 to 2016 in 116 developing countries. The results provided robust evidence that financial inclusion significantly reduces poverty rates and income inequality in developing countries. Similarly, Tsouli (2022b) explored the impact of financial inclusion on poverty reduction and income inequality for 122 economies, including 32 from high-income, 38 from upper-middle income, 38 from lower-middle income, and 14 from low-income countries. The estimates revealed that rule of law significantly affects financial inclusion for the world, high, middle, and low-income countries. The findings also indicated that financial inclusion is significantly correlated with lower poverty for the full sample. The link between financial inclusion and income inequality has been found in high-income countries and lower-middle-income countries.

Similarly, Kebede et al. (2023) highlighted that financial inclusion played a significant role in reducing income inequality, with multidimensional financial inclusion demonstrating a positive impact on income distribution in Africa. These findings are supported by Huang et al. (2023) who concluded that a high level of financial inclusion and a reduction in income inequality improve human capital in Sub-Saharan African countries. Apart from this, Tsouli (2022a) invoked principal component analysis (PCA) to examine the determinants of financial

inclusion and study the impact of financial inclusion on poverty reduction and income inequality in European countries. The findings indicated that financial inclusion is significantly correlated with lower poverty for the full sample. The study supports the role of financial inclusion in reducing income inequality in European countries. Meanwhile, Polloni-Silva et al. (2021) studied 13 Latin American Countries to support the previous studies that financial inclusion is a powerful tool for tackling poverty and inequality. Additionally, the combined effects of financial inclusion and technology (i.e., mobile use) are also capable of decreasing poverty and inequality levels.

Context of Asia

Asian economies are growing as a new technology hub, especially in the ICT sector, contributing significantly to FinTech adaptation and enhancing financial inclusion in the region (Global FinDex, 2022). However, whether FinTech and financial inclusion fueled inequality in this region is a major point of debate. In this regard, Verma and Giri (2024) published a notable and comprehensive study to examine whether financial inclusion reduced income inequality in Asian economies. The study revealed that in the long run, income inequality disparity is highly influenced by financial inclusion indicators, such as the number of bank branches, deposit accounts, outstanding loans, and domestic credit to the private sector. Whereas in the short run, disparities in income are unaffected by all the indicators of financial inclusion. Furthermore, Wong et al. (2023) studied ASEAN countries by using the cross-sectionally augmented autoregressive distributed lag technique. This study found that financial inclusion plays a significant role in reducing poverty. Interestingly, when financial inclusion occurs with financial innovation, financial innovation increases income inequality. The lower-income segments are less likely to afford the smart devices and internet services required and are more likely to be financially illiterate, preventing them from receiving similar benefits as the higher-income segments. These findings further support the findings of Loo (2019) and Roongsrisoothiwong (2024) in Southeast Asian countries. Similarly, Azam Khan (2024) and Azimi (2022) revealed that financial inclusion contributes to mitigating income inequality and poverty in South Asia.

Research Methodology

In this section, we choose the research design and formulate the appropriate econometric model. We also deal with data, particularly defining its nature, sources, and description.

Research Design and Model Formulation

This study follows a quantitative research approach. The quantitative method invoked in this study involves the use of pooled OLS and fixed/random effect

panel regression for exploring the relationship between Fintech, financial inclusion, institutional quality, and income inequality in Asian regions. We used unbalanced panel data analysis applied to the following econometric equations.

$$ACT_{i,t} = \alpha + \beta_1 FinTech_{i,t} + \beta_2 LGDP_{i,t} + \beta_2 LPOP_{i,t} + \beta_3 Inst.Quality_{i,t}$$
$$+ \beta_4 Schooling_{i,t} + \beta_5 Govt.Exp_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (1)$$

$$BOR_{i,t} = \alpha + \beta_1 FinTech_{i,t} + \beta_2 LGDP_{i,t} + \beta_2 LPOP_{i,t} + \beta_3 Inst.Quality_{i,t}$$
$$+ \beta_4 Schooling_{i,t} + \beta_5 Govt.Exp_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (2)$$

$$SAV_{i,t} = \alpha + \beta_1 FinTech_{i,t} + \beta_2 LGDP_{i,t} + \beta_2 LPOP_{i,t} + \beta_3 Inst.Quality_{i,t}$$
$$+ \beta_4 Schooling_{i,t} + \beta_5 Govt.Exp_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (3)$$

$$FIN.INC_{i,t} = \alpha + \beta_1 FinTech_{i,t} + \beta_2 LGDP_{i,t} + \beta_2 LPOP_{i,t} + \beta_3 Inst.Quality_{i,t}$$
$$+ \beta_4 Schooling_{i,t} + \beta_5 Govt.Exp_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (4)$$

Note: FIN_INC is the composite financial inclusion obtained by the summation of ACT, BOR, and SAV. ACT, BOR, and SAV stand for account, borrowing, and saving, as mentioned in Table 1. Similarly, LGDP, LPOP, Inst.Quality and Govt.Exp is the log of GDP, the log of the adult population, and government expenditure, respectively. The sign "μ" is the error term.

In the second stage, we incorporate pooled panel regression to examine the effect of financial inclusion on Fintech development. We develop the following econometric equation.

$$FinTech_{i,t} = \alpha + \beta_1 FIN.INC_{i,t} + \beta_2 LGDP_{i,t} + \beta_3 LPOP_{i,t} + \beta_4 Inst.Quality_{i,t}$$
$$+ \beta_5 Schooling_{i,t} + \beta_6 Govt.Exp_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (5)$$

In the third stage, we examine the effect of Fintech and financial inclusion on income inequality by using pooled panel regression analysis.

$$Inequality_{i,t} = \alpha + \beta_1 FIN.INC_{i,t} + \beta_2 FinTech_{i,t} + \beta_3 LGDP_{i,t} + \beta_4 LPOP_{i,t} + \beta_5 Urb.Pop_{i,t}$$
$$+ \beta_6 Govt.Exp_{i,t} + \beta_7 Inst.Quality_{i,t} + \beta_8 Schooling_{i,t} + \beta_9 Trade_{i,t}$$
$$+ \beta_{10} Inflation_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (6)$$

Finally, we perform the unbalanced panel regression, and the Hausman test for the selection of an appropriate panel model.

$$Inequality_{i,t} = \alpha + \beta_1 FIN.INC_{i,t} + \beta_2 FinTech_{i,t} + \beta_3 LGDP_{i,t} + \beta_4 LPOP_{i,t} + \beta_5 Urb.Pop_{i,t}$$
$$+ \beta_6 Govt.Exp_{i,t} + \beta_7 Inst.Quality_{i,t} + \beta_8 Schooling_{i,t} + \beta_9 Trade_{i,t}$$
$$+ \beta_{10} Inflation_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (7)$$

Nature and Sources of Data

We used a wave of surveys of the global financial inclusion index from four rounds from 2011, 2014, 2017, and 2021 by the World Bank for key variables like FinTech and financial inclusion. The description of data incorporated in our model is illustrated in Table 1 below.

Table 1: Description of the variables

Variables	Sources	Definition and Measurement
Income Inequality	The Standardized World Income Inequality Database (SWIDD)	Net income inequality
Account (ACT)	Global Findex, the WB	Individuals having an account at a formal financial institution (% age 15+)
Borrowing (BOR)	Global Findex, the WB	Individuals having an account at a formal financial institution (% age 15+)
Saving (SAV)	Global Findex, the WB	Individuals having an account at a formal financial institution (% age 15+)
FinTech	Global Findex, the WB	Individuals owing credit or debit cards, or mobile phones (% age 15+)
Schooling	World Development Indicators, the WB	School enrolment, secondary (% gross)
GDP	World Development Indicators, the WB	GDP (constant 2010 US$)
Population	Global Findex, the WB	Adult population
Urban Population Growth	World Development Indicators, the WB	Urban population growth rate
Trade	World Development Indicators, the WB	Trade (% of GDP)
Government Expenditure	World Development Indicators, the WB	Gross Government Expenditure
Institutional Quality	World Governance Indicators, the WB	Government effectiveness
Inflation	World Development Indicators, the WB	Annual inflation rate

Note: Datasets are obtained for four intervals: 2011, 2014, 2017, and 2021

Table 2: Summary statistics of variables

Variable	Obs.	Mean	Median	Std.dev.	Min	Max
ACT	143	55.91	55.00	29.22	3.00	99.00
BOR	143	20.55	18.00	16.22	1	79.00
SAV	143	20.76	17.00	17.13	0.00	67.00
FinTech	143	40.57	33.50	29.50	1.70	93.72
LGDP	143	25.72	25.96	1.88	21.46	30.51
LPOP	143	16.78	16.80	1.75	12.84	20.87
Urb.Pop	143	2.28	2.14	2.00	-4.17	12.30
Govt.Exp	143	13.75	13.27	4.47	2.36	25.71
Inst.Quality	143	0.00	-0.06	0.87	-1.67	2.24
Schooling	143	84.65	88.96	19.19	30.36	124.96
Trade	143	87.30	68.98	59.36	25.47	379.10
Inflation	143	6.68	4.08	13.76	-1.35	154.75
Income Inequality	143	0.56	0.56	0.06	0.35	0.69

Source: Based on the author's calculation.

Results and Discussions

This section presents an illustration and discussion of the results. First, we examine the effect of FinTech on financial inclusion. Second, we analyze the impact of financial inclusion on FinTech penetration. Third, we investigate the combined effects of FinTech, financial inclusion and institutional quality on income inequality. Finally, we assess GDP inequality using the Lorenz curve.

Effect of FinTech on Financial Inclusion

At first, we examined the effect of FinTech on financial inclusion, using pooled OLS regression including several control variables. We test the model with different variables for robust analysis, and the result of the pooled OLS regression is illustrated in Table A1, presented in the Appendix. Since the p-value was very small, we reject the null hypothesis and move to an alternative approach. The Breusch-Pagan Lagrange Multiplier Test is illustrated in Table A2, presented in the appendix. Similarly, the fixed/random effects models are presented in Table 3 below, which provides powerful evidence of the significant role that FinTech plays in advancing financial inclusion across Asia. Similarly, the Hausman test is illustrated in Table A3 in the Appendix.

Table 3: Fixed effects and random effects of Fintech on financial inclusion

Variable	Fixed Effects		Random Effects	
	FIN.INC (1)	FIN.INC (2)	FIN.INC (1)	FIN.INC (2)
FinTech	0.396*** (0.081)	0.397*** (0.082)	0.471*** (0.057)	0.473*** (0.058)
LGDP	5.198 (3.561)	5.163 (3.500)	-1.938** (0.984)	-1.864** (0.876)
LPOP	5.019 (5.067)	4.761 (5.257)	2.965*** (0.857)	2.820*** (0.763)
Inst.Quality	3.689 (2.968)	3.803 (3.052)	5.855*** (1.362)	5.535*** (1.260)
Schooling	0.042 (0.121)	0.039 (0.130)	0.052 (0.063)	0.046 (0.064)
Govt.Exp	0.209 (0.211)	0.201 (0.219)	0.102 (0.162)	0.087 (0.152)
Income Inequality		-8.128 (40.824)		-28.134** (10.930)
Constant			7.455 (13.074)	24.676* (13.511)
Observation	143	143	143	143
R-Squared	0.547	0.548	0.745	0.761

Standard errors in the parenthesis *** p<.01; ** p<.05; * p<.10
Source: Based on the Author's calculation

Based on the Hausman test, the random effect model is more appropriate in our analysis. The coefficients for FinTech are positive and statistically significant across all dimensions of financial inclusion, suggesting that increased use of FinTech tools substantially enhances individuals' access to, usage of, and engagement with formal financial services. This finding aligns with Odei-Appiah et al. (2022) and Tam and Hanh (2018), which reflects the potential of FinTech to bridge gaps in financial services. FinTech offers an effective alternative by providing digital platforms that overcome physical barriers and improve financial accessibility, which has been found relevant by Noreen et al. (2022) in lower-income countries like Pakistan, and by Daud (2023), who suggested that digital technology could enhance financial inclusion.

Moving on, GDP was found to harm financial inclusion. However, Institutional quality was found to positively influence financial inclusion, consistent with previous studies by Emara and El Said (2021), emphasizing the role of strong institutions in promoting better access to financial services. Meanwhile, the adult population size also showed a positive relationship with financial inclusion, indicating that a larger adult demographic correlates with higher financial service

engagement. However, schooling had a more limited effect, primarily influencing account ownership rather than broader financial inclusion dimensions in the random effect model.

Institutional quality was found to positively influence financial inclusion, consistent with previous studies by Emara and El Said (2021), emphasizing the role of strong institutions in promoting better access to financial services. Meanwhile, the adult population size also showed a positive relationship with financial inclusion, indicating that a larger adult demographic correlates with higher financial service engagement. However, schooling had a more limited effect, primarily influencing account ownership rather than broader financial inclusion dimensions in the random effect model.

Interestingly, government expenditure exhibited a significant but negative effect on account ownership, indicating that increased public spending might not necessarily lead to greater access to formal financial services. Furthermore, with a coefficient of -30.099, the negative effect of inequality on financial inclusion was particularly striking. Higher levels of inequality limit access to financial services for marginalized populations.

Effects of Financial Inclusion on FinTech Development

Most of the previous studies examined the role of FinTech in financial inclusion. We are interested in examining the role of financial inclusion in FinTech penetration. Initially, we observed the pooled OLS result to explore the effect, including other control variables, as illustrated in Table A4 in the Appendix. But the p-value based on the Breusch-Pagan Lagrange Multiplier Test illustrated in Table A5 in the appendix was so small that we rejected the pooled OLS model and used an alternative approach. Similarly, the fixed/random effects models are illustrated in Table 4 below.

Table 4: Fixed effects and random effects of financial inclusion on FinTech

Variable	Fixed Effects		Random Effects	
	FinTech (1)	**FinTech (2)**	**FinTech (1)**	**FinTech (2)**
FIN.INC	0.829*** (0.160)	0.901*** (0.169)	1.029*** (0.124)	1.043*** (0.143)
LGDP	4.752 (4.379)	6.149 (4.831)	7.187*** (1.871)	0.790 (0.869)
LPOP	25.190** (10.515)		-7.525*** (1.839)	
Urb.Pop		-0.381 (0.315)		-0.054 (0.364)

Inst.Quality	0.619 (4.523)	-1.423 (4.804)	-2.239 (3.471)	1.225 (3.270)
Schooling	0.015 (0.151)	0.131 (0.142)	0.175** (0.079)	0.257*** (0.082)
Govt.Exp	-0.282 (0.421)	-0.229 (0.428)	0.187 (0.297)	0.226 (0.341)
Trade		-0.042 (0.091)		0.031 (0.038)
Constant			-68.730*** (19.102)	-40.572* (24.097)
Observation	143	143	143	143
R Squared	0.543	0.518	0.774	0.720

Standard errors in the parenthesis *** p<.01; ** p<.05; * p<.10

Source: Based on the Author's calculation

Our analysis reveals that financial inclusion significantly influences FinTech expansion in both pooled and fixed effects models, demonstrating a bidirectional relationship between these two factors. Financial inclusion not only supports the growth of FinTech but is also positively mediated by it, leading to enhanced FinTech development. It aligns with the findings of Aloulou et al. (2024), Kandpal and Mehrotra (2019), and Ozili (2023).

Regarding population, while population growth exhibits a positive relationship with FinTech development in the fixed effects model, a contrasting negative relationship emerges in the pooled OLS model. Generally adult population adopts FinTech more efficiently (Krupa & Buszko, 2023; Swacha-Lech & Solarz, 2021). So, growth in the adult population contributes to deeper FinTech penetration. However, the inconsistency of population growth on FinTech penetration in our study suggests that population size alone is not a decisive factor in FinTech adaptation, and thus, we chose not to dwell on these contradictory results.

Similarly, GDP also emerged as a significant driver of FinTech development, which supports the findings of Mumtaz and Smith (2020). Furthermore, schooling, which is expected to increase knowledge of digital and information technologies, shows a statistically significant positive effect on FinTech development, which aligns with the findings of Bobbo et al. (2024).

Effects of FinTech, Financial Inclusion, and Institutional Quality on Income Inequality

We found that Fintech and financial inclusion have a bidirectional relationship. Now, we examine how these two factors, combined with institutional quality and other macro variables, affect income inequality. The pooled OLS model is illustrated in Tables A6 and A7, presented in the Appendix, but we rejected

that because of a very small p value suggested by the Breusch-Pagan Lagrange Multiplier Test, and fixed/random effect models are illustrated below in Table 5.

Table 5: Fixed effect and random effect of financial inclusion on income inequality

Variables	Fixed Effects		Random Effects	
	Income Inequality (1)	Income Inequality (2)	Income Inequality (1)	Income Inequality (2)
FIN.INC	-0.0002**	-0.0001	-0.0003	-0.0003**
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
FinTech	-0.00001	0.0001	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
LGDP	-0.014**	-0.007	-0.005	0.001
	(0.005)	(0.007)	(0.005)	(0.007)
LPOP		-0.045		-0.008
		(0.040)		(0.008)
Urb.Pop		0.001		0.002
		(0.001)		(0.001)
Govt.Exp	-0.001	-0.0005	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Inst.Quality	-0.016*	-0.015*	0.011	0.011
	(0.009)	(0.008)	(0.009)	(0.009)
Schooling		-0.0001		-0.0003
		(0.0003)		(0.0003)
Trade	-0.0003**	-0.0004***	-0.0002**	-0.0002**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Inflation	-0.00002	0.0001	0.00001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant			0.737***	0.722***
			(0.127)	(0.127)
Observation	143	143	143	143
R Squared	0.092	0.157	0.460	0.484

Standard errors in the parenthesis *** $p<.01$; ** $p<.05$; * $p<.10$
Source: Based on the Author's calculation

Our findings reveal that financial inclusion significantly reduces income inequality, yet surprisingly, FinTech shows no consistent results when examining the univariate relationship. However, when financial inclusion and FinTech are considered together, their combined effect significantly reduces income inequality. In this combined model, FinTech mediates financial inclusion, which, in turn, enhances the reduction of income inequality, which is in line with the findings of Adugna (2024). We further examined that while financial inclusion reduces income inequality, FinTech has the opposite effect, exacerbating inequality in

our model. Our negative relationship between financial inclusion and income inequality supports the findings of Álvarez-Gamboa et al. (2021) and Churchill and Marisetty (2020).

Asian economies, in particular, are characterized by large populations, slow economic growth, and significant structural and political challenges, often accompanied by widespread poverty. In such contexts, FinTech alone cannot effectively contribute to the development of financial capacities or income generation opportunities, as suggested by Quanmei (2022). Therefore, while financial inclusion remains an essential tool for reducing income inequality, the role of FinTech is less clear, as it does not demonstrate a confirmed effect on reducing income inequality across the other models in both pooled and fixed/random effects models. The impact of FinTech is context-dependent.

Institutional quality emerged as a significant factor in reducing income inequality. In both the pooled and fixed effect models, the negative coefficients associated with institutional quality indicate that strong institutions are crucial in shaping public governance. Effective governance, accountability, and transparency lay the foundation for an equitable economic system that can provide equal opportunities for investment, employment, and growth. Thus, high institutional quality helps to mitigate income inequality by fostering an environment conducive to economic opportunities for all. Our findings support the previous findings of Kouadio and Gakpa (2022) and Law and Soon (2020).

Additionally, GDP was found to have a negative coefficient, indicating that increases in GDP are associated with reductions in income inequality, particularly in the fixed effects model. However, a previous study by Rubin and Segal (2015) suggests a positive relationship between GDP growth and income inequality, but Halmos (2011) found a negative relationship, supporting our findings. There is no common agreement among previous studies on the relationship between GDP and income inequality. Moreover, trade also contributed to reducing income inequality in the fixed and random effect models. Although trade exhibited a positive relationship in the pooled OLS model, we do not emphasize this finding, particularly given the stronger results found in the fixed/random effect models. Trade plays a vital role in creating employment opportunities across various sectors, benefiting both urban and rural populations, which helps to reduce poverty and unemployment. Similarly, trade facilitates sustained economic growth, higher per capita income, and reduced economic vulnerability, all of which contribute to a more equitable income distribution. However, the effect of trade on income inequality is ambiguous, as suggested by Dorn et al. (2022) and Siddique (2021).

We also examined the GDP distribution to assess inequality based on national income and observed significant inequality in Asia, as illustrated in Figure 1. The notable variation in GDP across this region can be largely attributed to

differences in geographical territory, population distribution, and the economic size of individual countries.

Figure 1: Lorenz curve for GDP inequality
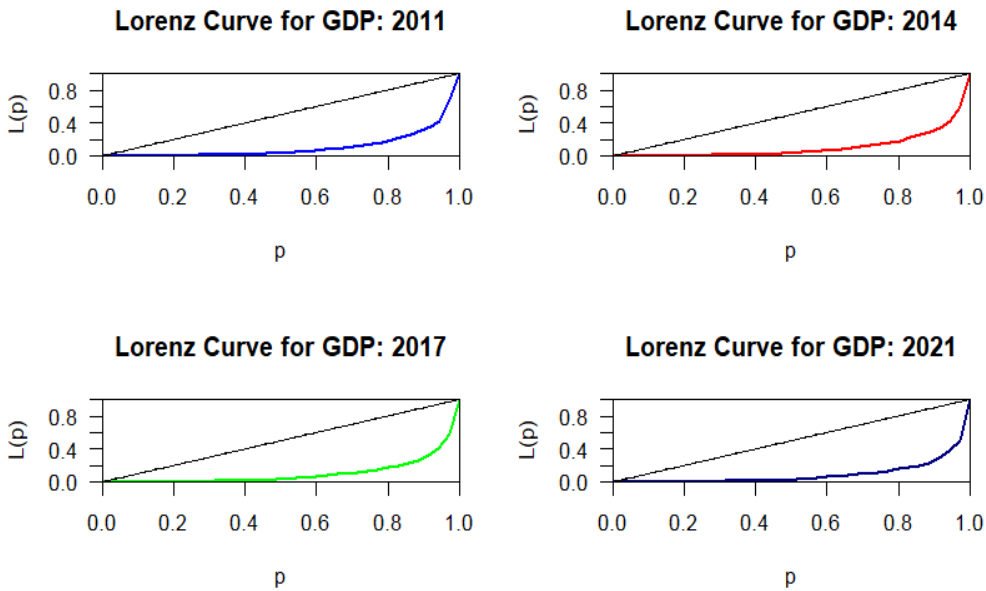
Note: Hyperbolic curves expanding further away from the horizontal straight lines signify increased national income inequality.

Robustness and Diagnostic Check

Any statistical analysis that generates numerical outcomes must be statistically reliable and robust. In our analysis, we first performed pooled OLS regression, followed by fixed and random effects models on various measurement variables. While we encountered heteroscedasticity in some models, our primary focus was on understanding the relationships between variables rather than obtaining precise estimates that would not have been very problematic. Anyway, to address the heteroscedasticity, we re-estimated each coefficient using robust standard errors.

We assessed the assumptions of linearity, normality, and multicollinearity, and found no significant violations of these assumptions. Given that our data is sourced from four interval surveys, we also tested for serial autocorrelation, which was satisfactory in all models. To further ensure the robustness of our results, we tested the effects of explanatory variables by experimenting with different model specifications and adding and removing various sets of explanatory variables.

Conclusion

We examine the complex relationship between FinTech, financial inclusion, and income inequality across Asian countries, utilizing unbalanced pooled, fixed/random models with various control variables. Socio-economic inequality is unjust and poses a serious threat to societal well-being, hindering the achievement of the Sustainable Development Goals (SDGs). Despite notable economic progress, much of Asia continues to fall behind the global average in terms of growth, technological adoption, and social inclusion. Although these issues are widely discussed, many developing economies fail to fully capitalize on their potential, struggling to build the resilient infrastructure and strong institutions needed to address chronic structural deficiencies and provide economic opportunities.

In light of this background, our findings reveal that FinTech significantly enhances financial inclusion, and in turn, is positively affected by it. Increased access to FinTech tools improves individuals' engagement with formal financial services, especially in rural and underserved regions where modern financial infrastructures are lacking. FinTech has considerable potential to address the financial inclusion challenges faced by large rural populations in Asia, where access to physical banking services is often limited. However, we could not establish a strong nexus between FinTech and income inequality. While financial inclusion significantly reduces income inequality, the effects of FinTech are more context-dependent and do not consistently show the same result. In developed countries, FinTech tends to reduce inequality, but this is not always the case in developing economies, where structural issues such as poverty, unemployment, low wages, gender disparities, and limited digital infrastructures hinder the effectiveness of FinTech. Additionally, our study also highlights the importance of institutional quality in mitigating income inequality. Strong regulatory frameworks, effective governance, and transparency are critical to ensuring that FinTech and financial inclusion initiatives deliver tangible benefits to marginalized populations. Furthermore, GDP growth and trade can contribute to reducing income inequality; their effects are complex and may not benefit all segments of society equally, especially in countries facing significant political and economic challenges.

Governments may prioritize strengthening institutional frameworks that enhance financial systems, especially in developing economies where the lack of reliable institutions remains a key barrier to financial inclusion. Investments in digital financial infrastructure in rural and underserved areas are needed to ensure that FinTech tools are accessible to all segments of the population. Additionally, policies that promote financial literacy and digital education could help bridge the gap in adoption among populations unfamiliar with digital tools. Addressing inequality should also remain a core policy objective because high

levels of inequality significantly hinder financial inclusion. This can be achieved through policies aimed at improving access to education, expanding social safety nets, and fostering equitable economic growth. Furthermore, governments may ensure that FinTech innovations do not exacerbate existing inequalities by designing digital financial services that cater to marginalized groups, such as low-income individuals. A key strategy, above all these policy suggestions, is the implementation of a public-private partnership to enhance FinTech penetration and financial inclusion in low- and lower-middle-income countries in Asia, driving immediate and significant improvements in income inequality.

Limitations

This study focuses on the analysis of 39 Asian countries to examine the impact of FinTech, financial inclusion, and institutional inequality on income inequality, using an unbalanced panel regression model. As a macro-level study, it may not capture the complex relationships between these variables at the country level. Therefore, the findings may not fully reflect the specific dynamics present within individual countries. Future research could address this limitation by utilizing more refined cross-sectional data at the country level, which would allow for a deeper understanding of the relationships between these variables. Additionally, employing panel time-series data could provide a more robust analysis.

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Appendix

Table A1: Effect of FinTech on financial inclusion

Variable	ACT	BOR	SAV	FIN.INC (1)	FIN.INC (2)
FinTech	0.803*** (0.071)	0.450*** (0.067)	0.329*** (0.051)	0.527*** (0.042)	0.531*** (0.041)
LGDP	-3.360*** (1.273)	-5.067** (2.159)	-1.139 (1.277)	-3.189*** (1.117)	-3.078*** (1.079)
LPOP	4.381*** (1.277)	4.847** (2.127)	2.714** (1.233)	3.981*** (1.084)	3.851*** (1.056)
Inst.Quality	5.202** (2.021)	5.351** (2.123)	8.250*** (1.780)	6.268*** (1.269)	5.600*** (1.266)
SCL	0.241*** (0.063)	-0.072 (0.067)	-0.082 (0.065)	0.029 (0.046)	0.032 (0.046)
Govt.Exp	-0.414* (0.227)	0.096 (0.243)	0.127 (0.197)	-0.064 (0.156)	-0.068 (0.151)
Income Inequality					-30.099*** (8.257)
Constant	21.456 (15.535)	55.981** (21.847)	-3.743 (15.317)	24.565** (11.346)	40.715*** (10.623)
Observation	143	143	143	143	143
R-Squared	0.851	0.563	0.677	0.854	0.864

Standard error inside parenthesis *** p<.01; p<.05; p<.10
Source: Based on the Author's calculation.

Table A2: Breusch-Pagan Lagrange Multiplier test

LM Test	p = 4.082e-12 and 1.6e-10	Pooled OLS is not appropriate, and an alternative approach has to be incorporated.

Table A3: Hausman test for examining the effect of financial inclusion on Fintech

Hausman Test	p = 0.1296 and 0.2188	The random effect model is appropriate in both models.

Table A4: Effect of financial inclusion on FinTech penetration

Variable	FinTech (1)	FinTech (2)	FinTech (3)	FinTech (4)	FinTech (5)
FIN.INC	1.402*** (0.047)	1.100*** (0.092)	1.098*** (0.091)	1.087*** (0.083)	1.109*** (0.092)
LGDP			0.816 (0.568)	7.282*** (1.420)	0.757 (0.568)
LPOP				-7.748*** (1.392)	
Urb.POP					0.702 (0.505)
Inst. Quality		2.719 (2.403)	-0.146 (2.482)	-2.733 (2.586)	0.287 (2.524)
Schooling		0.239*** (0.064)	0.238*** (0.064)	0.141*** (0.054)	0.247*** (0.063)
Govt.Exp		0.613*** (0.237)	0.777*** (0.225)	0.484** (0.228)	0.746*** (0.229)
Trade			0.053* (0.029)		0.049* (0.029)
Constant	-4.859*** (1.579)	-23.801*** (6.406)	-51.490*** (17.103)	-70.465*** (14.863)	-51.865*** (17.186)
R Squared	0.806	0.837	0.843	0.877	0.845
AIC	1144.423	1125.402	1123.904	1089.050	1124.104
BIC	1153.311	1143.179	1147.607	1112.753	1150.770

Standard errors in the parenthesis *** $p<.01$; ** $p<.05$; * $p<.10$
Source: Based on the Author's calculation.

Table A5: Breusch-Pagan Lagrange Multiplier test

LM Test	p = 6.931e-10 and 7.425e-12	Pooled OLS is not appropriate, and an alternative approach has to be incorporated.

Table A6: Hausman Test for Examining the effect of Fintech on financial inclusion

Hausman Test	p = 0.01026 and 0.02393	The fixed effect model is appropriate in both models.

Table A7: Pooled OLS regression of Fintech and financial inclusion in income inequality

Variable	Income Inequality (1)	Income Inequality (2)	Income Inequality (3)	Income Inequality (4)	Income Inequality (5)	Income Inequality (6)
FIN.INC	-0.001** (0.0004)			-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)
FinTech		-0.0002 (0.0002)		0.001*** (0.0004)	0.001** (0.0004)	0.001** (0.0005)
FIN.INC. TECH			-0.0001** (0.0000)			
LGDP				0.004 (0.003)	0.004 (0.003)	-0.007 (0.009)
LPOP						0.013 (0.010)
Urb.Pop						0.007** (0.003)
Govt.Exp					0.001 (0.001)	0.001 (0.001)
Inst.Quality				-0.022** (0.011)	-0.020* (0.012)	-0.011 (0.011)
Schooling						0.0003 (0.0004)
Trade				0.0002* (0.0001)	0.0003** (0.0001)	0.0003** (0.0001)
Inflation					0.001*** (0.0002)	0.001*** (0.0002)
Constant	0.594*** (0.011)	0.578*** (0.008)	0.583*** (0.007)	0.471*** (0.073)	0.440*** (0.080)	0.461*** (0.085)
R Squared	0.052	0.011	0.060	0.137	0.149	0.209
AIC	-383.962	-377.942	-385.082	-389.286	-387.363	-391.781
BIC	-375.074	-369.054	-376.194	-368.546	-360.698	-356.227

Standard errors in the parenthesis *** p<.01; ** p<.05; * p<.10
Source: Based on the Author's calculation.

Table A8: Hausman test for examining the effect on income inequality

Hausman Test	p = 0.000 indicates that the first model's fixed effect model is appropriate.	p = 0.2188 suggests that the second model's random effect model is appropriate.

Country	Country	Country	Country
Afghanistan	Indonesia	Lebanon	Singapore
Armenia	Iran, Islamic Rep.	Malaysia	Sri Lanka
Bahrain	Iraq	Maldives	Tajikistan
Bangladesh	Israel	Mongolia	Thailand
Bhutan	Japan	Nepal	Turkey
Cambodia	Jordan	Oman	United Arab Em.
China	Kazakhstan	Pakistan	Uzbekistan
Cyprus	Korea, Rep.	Philippines	Vietnam
Georgia	Kuwait	Qatar	Yemen, Rep.
India	Lao PDR	Saudi Arabia	Total: 39