BRIDGING GAPS: THE ROLE OF FINTECH AND INSTITUTIONAL QUALITY CORRUPTION IN REDUCING INCOME INEQUALITY

Bridging Gaps: The Role of FinTech and Institutional Quality in Reducing Income Inequality

Submitted To:

Dr. Md. Qamruzzaman

Professor, School of Business & Economics (SoBE)

Submitted By:

Rokaya Sultana Kangka

ID: 111 202 181

Major: Finance

Trimester: Fall 243

School of Business and Economics

United international university

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Letter of Transmittal

Dr. Md. Qamruzzaman

Professor (Finance)

United International University

United City, Madani Avenue, Badda

Dhaka 1212, Bangladesh

Dear Sir,

It is with great respect and enthusiasm that I submit my research thesis entitled "Bridging Gaps: The Role of FinTech and Institutional Quality Corruption in Reducing Income Inequality". This submission marks the culmination of several months of rigorous study and analysis to fulfill the requirements for my graduation from United International University.

The interplay of financial technology and institutional quality corruption in reducing income inequality is investigated in this study. Your valued guidance enabled me to work out a detailed analytical framework, integrating quantitative models and empirical analysis for meaningful insight into this critical area. The research direction, methodological soundness, and academic integrity throughout the study owe much to your mentorship.

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Lastly, I would like to acknowledge the continued support from my family, friends, and peers, whose encouragement has been a source of motivation throughout this journey. I strongly believe that the results of this study will provide useful lessons for policymakers, financial institutions, government and researchers.

I would like to take a moment to thank you all for giving your valuable time to review my thesis. I am really looking forward to discussing its findings and implications under your guidance.

Sincerely,

Rokaya Sultana Kangka

ID: 111 202 181

Certification of Similarity Index

Declaration of the Student

Acknowledgement

I would like to express my deepest gratitude to Allah for giving me strength, wisdom and perseverance to finish this research. Always inspiring every part of this journey with his guiding light and blessings.

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Abstract

An interesting topic is Income Inequality (IIQ), that means the uneven allocation of income within a particular population. IIQ is a barrier to economic growth and social unity for many years. It is influenced by institutional quality corruption (IQC), FinTech or technological advancements and many other economic variables. Corruption generally makes governance weaker, promotes rent-seeking behaviors and unfairly allocates resources to a small group. Conversely, FinTech plays the role reducing IIQ by incorporating financial inclusion in each country. Despite global strides in reducing poverty, IIQ continues to exist especially in emerging markets with IQC and uneven access distribution of technology. Inspecting the issue of IIQ remains vital for achieving long-term and inclusive growth, requiring research that investigates these nuanced relationships. Thus, this study aims to examine how IQC and Fintech influence IIQ. The research aims to identify possible solutions to reduce IIQ by understanding the relationships of FinTech and IQC. FinTech's rapid global explosion and its role in connecting financial gaps have motivated this inquiry. Instantaneously, IQC's inescapable impacts on distribution of resources emphasize the need for systematic institutional restructurings.

The study is inspired by the empirical evidence and theoretical proofs, recommending that addressing these issues will result into equal economic opportunities for all and promote social unity. The research employs advanced panel data techniques, including cross-sectional dependence analysis, heterogeneity testing, and cointegration methods. Tests such as the CS-ARDL and NARDL models analyze long-run and short-run dynamics, while causality tests explore directional relationships. Leveraging data across multiple countries, highlighting regional gaps and the interconnectedness between Fintech adoption, IQC, and IIQ. The findings are reliable because of Robustness checks, addressing data stationarity and cross-country interdependencies.

Results show that FinTech largely decreases IIQ by promoting financial inclusion in all areas, including remote and rural areas. However, the reach of Fintech's benefits to all income groups, depends on each country's digital infrastructure, financial and digital knowledge, and how strong a country's governance is. On the other hand, IQC exacerbates IIQ by hindering equitable allocation of resources and by keeping little or no opportunities for general people. While FinTech is generally known to be influencing IIQ in a positive way, but overreliance or unequal adoption of FinTech worsens IIQ. Presence of corruption in institutional quality (IQ), reduces social flexibility and public investment effectiveness. Other authors' findings align with the present study's findings, all highlighting the need for inclusive and well-adjusted technological adoption and systematic institutional reforms. This study expands the understanding of how institutional factors such as good governance, rule of law, institutional quality, corruption and adoption of FinTech influences IIQ, offering nuanced insights into their interplay. It extends existing literature by combining theoretical frameworks and empirical analyses, highlighting regional and economic-specific dynamics. The suggestions of this study expresses the need of connecting FinTech innovations with strong governance to ensure equitable outcomes,

contributing to policy discourses on sustainable development and economic inclusion. According to the findings of this research, policymakers and government should focus on extending Fintech's reach while bridging digital literacy, infrastructure and financial literacy disparities. Furthermore, incorporating anti-corruption policies, such as increasing transparency and institutional capacity-building, must be included, especially in developing countries in order to decrease IIQ. Cooperative efforts, including public-private partnerships, can increase FinTech's potential and address systemic governance issues. Future policies should integrate these strategies to foster inclusive growth and lessen disparities.

Keywords: Income Inequality, Financial Technology, Financial Technology Adoption, Institutional Quality Corruption, Institutional Quality, Financial Inclusion, Good Governance, Equitable Economic Growth.

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Table 1 List of Abbreviations

Abbreviations	Full Form
GG	Good Governance
FI	Financial Institutions
NARDL	Nonlinear Autoregressive Distributed Lag
ADF	Augmented Dickey-Fuller
AMG	Augmented Mean Group
ARDL	AutoRegressive Distributed Lag
BRICS	Brazil, Russia, India, China, South Africa
CADF	Cross-Sectionally Augmented Dickey-Fuller
CIPS	Cross-sectional Augmented IPS Test
CPI	Consumer Price Index
CS-ARDL	Cross-Section AutoRegressive Distributed Lag
CSD	Cross-Sectional Dependence
EXE	Exchange Rate Exposure
FDI	Foreign Direct Investment
IIQ	Income Inequality
IQ	Institutional Quality
IQC	Institutional Quality Corruption
MG	Mean Group
R&D	Research and Development
SDGs	Sustainable Development Goals
TO	Trade Openness

Chapter 01: Introduction

1.1 Background of the Study

Income inequality (IIQ) means unequal allocation of income among a specific population. Dispersion of IIQ is named "Defining Challenge of Our Time" by President Obama. Pew Research Center Era Dabla-Norris (2015); Michael W. Howard (2023), discovered that income disparity between people is considered as an encounter by 60% or higher responders globally. The study found out that having connections with the right persons are also important beside putting efforts and having educational qualifications. As a result, it is a huge barrier for social mobility. After the discovery, researchers and policymakers started studying the effects of income gap (Era Dabla-Norris, 2015).

High level of income disparity can deteriorate social unity, nurture divisions in political fields, and exacerbate the growth of an economy. Because rich and poor feel will feel disconnected, leading to social unrest, while divisions in political fields will worsen the public trust in institutions. The importance of income inequality lies globally, which can bring out useful insights into the processes and development of worldwide economy. A complex yet interesting understanding of previous and ongoing economic trends can be found by studying both income gaps between countries and the variances between them. In the article by (IMF) (2024), they claimed that while global inequality has decreased in recent years because of economic growths in China but they discovered that a small group continues to carry large amount of wealth. To reform fair and thorough economic policies, Guerriero (2024) climaxes the importance of knowing all the effects of IIQ from different economies and regional contexts. Significance of knowing all the effects in different economies and regions will aid the policymakers to create policies designed to specific types of economies. Likewise, other authors such as Sutanto (2023), expressed the need of unbiased policies as high income gap has a negative effect on economies. Different types of economy have different effects by income gap, if the economy is a developed country's economy, then income gap has different effect on economy. Conversely, if the economy is a developing country's economy, then the income gap has a different type of effect on economy. This author highlighted that, to achieve long-term and fair economic growth it is mandatory to decrease poverty and income gap between a country's population. An author named (Arestis, 2018), claimed that reduction of IIQ inspires the relation between economic justice and economic health of a country. His claim is indeed true, because income gap means a large proportionate of income lies within elite groups (specially in financial sector), and this income gap is one of the major reasons for 2007-2008 Global Financial Crisis (Bordo, 2010). Moreover, general people of a country cannot access necessary resources such as good education, proper healthcare, a healthy environment to live in all because of income gap. Whereas, elite groups have easy access to get these services because of privatization, by which they make profits by selling these basic resources. Poor people lose out because those basic

resources have become too expensive to afford, leaving them no opportunities to improve their standard of living. Also, lack of fair income distribution excluded low-income families from opportunities, because they do not have the money available to start their own business, to invest on their children's education or healthcare to keep them safe and healthy for long-term. All these effects of IIQ in an economy creates huge detachment between high-income and low-income people, leading to social unrest. This is why Michael W. Howard (2023), emphasized the critical need for equitable policies to reduce IIQ. A study about IIQ in the US (1975-2022) conducted by Bradley L. Hardy (2024), expressed an increase in income gap detected from 1975 to 2022. He exposed that those who are low-skilled or middle-skilled struggles to find good jobs for themselves. This is likely because a huge demand for high-skilled workers is created by the advances like automation and AI in technology which replaced the jobs of low-skilled and middle-skilled workers. Also, technology enabled many companies or MNCs to shift their production facilities to developing countries where low-paid workers are available. He added, policies are designed to favor only those people who are already high-skilled or belongs to an elite group of people. All these effects are results of IIQ, because children from low-income families might not receive proper education and healthcare which limits them from building a good career, to be employed or marry.

In essence, it is extremely important to figure out the original causes of IIQ in order to reform rules, laws, regulations, and policies with a focus on reducing IIQ and stimulating growth of an economy ((IMF), 2024). If everyone in an economy, has equal access to jobs and resources they will be able to earn a better income and improve their standard of living which reduces the existence of poverty in an economy. The importance of giving equal opportunities to everyone in the economy is they will be able to get proper education, proper healthcare in order to work in jobs and it will result into majority people being employed in an economy. If majority of people have the money to spend on buying products and services, it will increase the profits made in businesses of that country which will further create more jobs in the economy. As a result, everyone in the economy will be able to afford food, clothes, a good house, invest on their children's education, start their own businesses, sustaining long-term well-being. Thus, helping the overall economy to grow.

Importance of IIQ sets the stage to know about the factors that plays a role in influencing the income gap of many countries. It is substantial to know which factors has the most effect on income inequality in order to design policies that addresses every component of the factors that influences IIQ. A figure is given to highlight the major factors that influences a country's income gap.

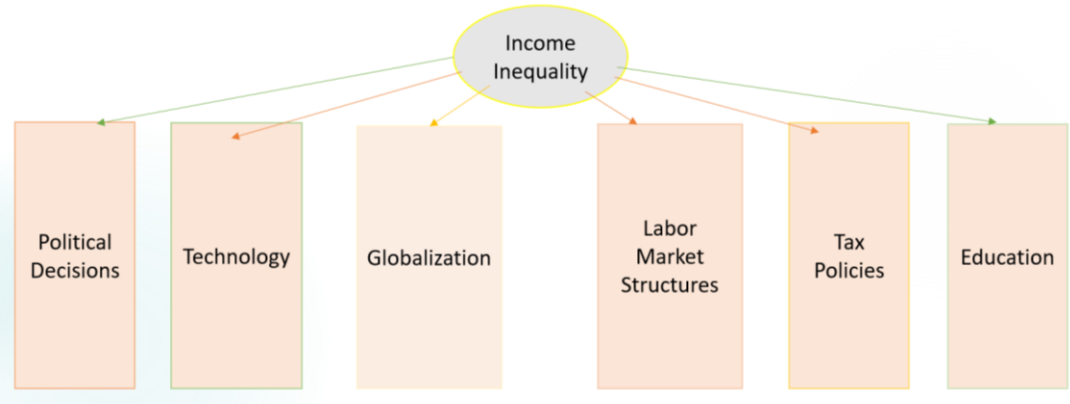

Figure 1 Factors influencing Income Inequality

Starting from 1980s, choices made by political parties performed a significant role on influencing IIQ. It is found in the study of Era Dabla-Norris (2015), that policies such as Neoliberal Policies, has lowered protections of workers and also decreased the progressivity of tax systems. Neoliberal policies concentrate on regressive tax policies, deregulation of industries and privatization of public resources. Regressive tax approach increases IIQ between people because it means low-income people have to pay a large share of their hard-earned money in taxes compared to high-earned people. For instance, VAT requires buyers to pay the same amount of money from everyone, but it affects low-income people more as they already have low income than rich people. Another issue is deregulation of industries, which means limiting what a business can or cannot do and it also means lowering the rules those which protects labor rights. As a result, it leads to low wages, unsafe work environment and fewer benefits for workers. Privatization occurs when government sells public resources such as education, healthcare services, and transportation to private companies. For wealthy people, this policy is beneficious as they can either gain profit by doing business using the necessary resources or by getting better services by using the resources as it is easier for them to afford. On the other hand, poor people will lose the ability of affording the basic resources for themselves as private companies will sell the resources at a high price to make profits. In addition to that, those were employed in these public services may become unemployed because of the shift in ownership of those resources or receive more lower wages.

There are countries where progressive tax systems are used to contribute financial help to poor people which helps in reduction of IIQ, countries with strong policies about protecting poor people has seen reductions in IIQ and their overall economy improved. Countries where policymakers design policies to help underserved groups has reduced some levels of IIQ. For instance, Brazil used a Bolsa Familia Program which significantly reduced their IIQ. The program sent cash transfers to the female of every household, but only if a certain condition was fulfilled, which is to keep their children in school and have them vaccinated (Fassarella et al., 2024). Countries with strong governance are better able to mitigate IIQ, because if a country's

each institutions provide equal opportunities and resources to everyone then each individual of that country will have the necessary resources to grow and improve their standard of living. This will further reduce poverty, increase efficiencies, no resource wastage will take place, people will have the opportunity to show their true potentials, and there will be social unity among people. This will help to reduce IIQ drastically (Haini, 2023).

Technology has asymmetric effects on IIQ. A study was conducted to see how automation drives income inequality by Dizikes (2022), it was found that technological advances such as AI and automation took away mane middle skill and low skill jobs. Technological advancement should be in such a way that does not take away people's earning source, rather it must help in ways so that an individual can perform his duty efficiently by keeping work life balance. Also, technology enabled many companies or MNCs to shift their production facilities to developing countries where low-paid workers are available. As a result, this shift has led to a higher skill premium, where individuals with advanced education and skills earn significantly more than those with lower skills. Policies are designed to favor only those people who are already high-skilled or belongs to an elite group of people and has connections with the "right" people. This further increases IIQ worldwide. Another study on how technology increase IIQ claims that income gap occurs more in developed countries. This is because in developed countries manufacturing jobs has been reduced significantly as businesses in developed countries shifted their production facilities in developing countries to exploit low wage paying facilities. In addition to this many low-skilled jobs are now being done by technology (Xiao, Xu, Skare, Qin, & Wang, 2024).

There are some technologies which helps in reducing IIQ such as Gig Economy Platforms as Uber, and Upwork creates chances to be employed which does not require people to be highly-skilled. Additionally, technology enabled remote work opportunities where workers from underserved groups such as rural people or people from developing countries can work for MNCs remotely. Technologies like financial technology also helps in reducing IIQ by giving access to financial services such as loans, savings and investment to underserved groups. This narrows down the income gap between rich and poor people helping them to improve their standard of living. There are crowdfunding platforms where entrepreneurs or start-up companies can get funding by various investors easily (A. Demir, Pesqué-Cela, Altunbas, & Murinde, 2022).

Globalization has asymmetric effects on IIQ, meaning it can have both positive and negative effects on IIQ. According to the studies conducted by Muhammed Ashiq Villanthenkodath (2023) and Ortiz-Ospina (2018) globalization has contributed in improving economic growth globally. Because of globalization there has been variations in union regulations, wage regulations, factors which has big role on IIQ. To support low-skilled to middle skilled workers, unions deliberately negotiated for getting them higher wage and tried to promote safer work environment for workers. Thus, a reduction in union mass deteriorates their bargaining ability which results into lower wages which further worsens IIQ. Globalization also plays role in

exacerbating IIQ through other dimensions. According to Daniele Checchi (2008), it has increased the skill premium in developed countries because manufacturing jobs has been reduced significantly as businesses in developed countries shifted their production facilities in developing countries to exploit low wage paying facilities, leading to greater income disparity.

Conversely, globalization also plays the role of reducing IIQ because globalization enables companies to shift their production on developing countries. This creates huge job opportunities for low-income population of those emerging countries. If more people of developing countries are employed and buys goods and services from the businesses then it boosts profit of those businesses which creates further demand for workers. As a result, poverty in developing economies gets reduced by globalization, and income gap in developed countries gets high as this lowers the demand for low-skilled people in developed countries. Therefore, impact of globalization on IIQ varies on how it behaves with the particular country's policies and institutions. Countries where there is strong governance, uses progressive tax systems, does not privatize public resources are capable of handling the undesirable effects of globalization.

A major factor of income inequality is education because it impacts an individual's choice in career, access to vacant and the salary ranges. If good educational opportunities are made accessible for everyone in a country, then IIQ would severely be reduced. Because educated population will be able to improve a country lot in several ways, leading to overall economic growth and sustainability. However, in the study of Era Dabla-Norris (2015) the influence of education on inequality rests on the rates of return to education and the size of education investments by individuals and governments. Expensive higher education gets only availed by rich people or elite groups, whereas, low-income people cannot afford these expensive educational opportunities. Therefore, low-income people choose to study in low-quality schools and colleges which does not help them much in building a good career. Moreover, discrepancies in the quality of primary and secondary education can lead to uneven opportunities and results, which further worsens IIQ.

While explaining the factors that influence IIQ, I have mentioned technological advancements and political dynamics where financial technology (FinTech) and institutional quality corruption (IQC) occurred to be significant factors to have impacts on IIQ. This section will cover the explanation and rationale of choosing these two particular factors.

Starting with the explanation of choosing FinTech as a factor influencing IIQ. The easiest definition of FinTech is using technology to manage one's money easily, such as bKash. FinTech plays the role of influencing IIQ in multiple ways, revealing asymmetric effects. Generally, FinTech promotes financial inclusion by giving access to loans and other financial services to underserved groups such as rural and marginalized groups. Study conducted by Muhammad Irfan (2024), Mikek (2023) showed that adoption of FinTech improves access to financial services like savings account, micro-savings account, checking accounts, mobile money, peer-to-peer transfers, bill payments, digital lending platforms, payday loans, microinsurance, digital

insurance platforms, crowdfunding platforms and many more services were easier than ever to get access to. These easily accessible services let people to secure their savings so that they can use those saved money later for emergencies or other plans. Moreover, poor individuals often struggle to get loans from traditional banks due to the lack of collateral and high interest rates. Moreover, getting access to credit helps people to invest on their children's education, securing long-term prospects. These offered services has the potential to significantly reduce IIQ and this positive impact can be heightened by more investments on research and development and digital infrastructure of developing economies. In another study conducted by Adugna (2024), claimed that all these services from FinTech companies burdens traditional banks to be more comprehensive to poor people, as the number of people adopting FinTech is increasing day by day and conventional banks' transactions have slowed down. A regional study conducted by Xin Deng (2024) in China finds that disadvantaged groups such as older men and women, women or single mother, men or single fathers are advantaging from adopting FinTech to support their small businesses. They have seen increased profits and are being able to cover their financial expenses.

However, FinTech adoption does not benefit everyone equally, especially when it has not been implemented cautiously. According to the study conducted by Yi Li (2024), it discovered a relationship between FinTech and IIQ where adoption of FinTech primarily decreases rich-poor IIQ but increases IIQ when it's adoption is overdeveloped. In a study of (B. B. Ashenafi, & Yan, D, 2023) in Africa, they discovered that countries where there is a lack of strong governance, adoption of FinTech can worsen IIQ. The reason behind this nuanced finding is that if institutional quality is corrupted then the adoption of FinTech's benefit will only be allocated to the elite groups, leaving behind the underserved groups. Therefore, it increases IIQ. It is discovered by several authors that FinTech's influence on IIQ is shaped by several factors such as institutional quality corruption, digital infrastructure, regional disparities, globalization, digital literacy and other factors as well (Jensen, 2022), (Liu, 2023). According to Barry J. Eichengreen (2021) financial globalization can promote efficient capital allocation and economic growth but also increase income inequality. Financial Globalization means the system where financial markets and institutions from several countries integrates and work together. It also has asymmetric impacts on IIQ. The meditation of foreign properties in high-skill sectors advances the demand and wages for skilled workers, worsening inequality. Financial deregulation and globalization have boosted financial wealth and wages in the finance industry, further widening the income gap. This is because the liberalization of capital flows has led to increased income for elite groups of the finance segment, while the benefits of financial globalization have not been equally distributed across all sections of society.

FinTech is a key factor in this present study because it carries a transformative role to report socio economic inequalities and due to its role in promoting financial inclusion. FinTech's impact on IIQ is shaped by regional and contextual factors and there are theoretical and empirical evidences present in many studies which determined the focus towards FinTech. In

addition to what makes FinTech a critical factor in influencing IIQ is UN's SDG 10, which aims to reduce inequalities. FinTech's role of influencing IIQ aligns with SDG-10 because FinTech has the potential to significantly reduce inequality by promoting financial inclusion when paired with strong governance, digital literacy, and digital infrastructure (Ruobing Ning, 2023) and (Luu, 2023).

Second key independent variable of this study is Institutional Quality Corruption (IQC). Institutional quality means how strong a country's rules and regulations are in case of fairness, equitable distribution of resources and development. Corruption takes place when that country's rules and laws are ignored by powerful people for their personal advantages. IQC has the ability to impact an entire economy and its social structures as it is the rules and regulations of a whole country, this is the reason behind choosing this as a central factor influencing IIQ. As evidenced by thorough empirical research, the determination to assess corruption rises from its significant role in structuring governance, social equality and economic efficiency. Studies on Sub-Saharan Africa and Latin America by Adeleye (2024) and Brandao (2024) displays that corruption nurtures rent-seeking behaviors (individuals or groups try to gain extra money for personal advantage without creating any real value for society) and designs allocation of resources to elite groups only. Presence of corruption in institutional quality leads to the creation of an unfair system where basic resources of a country goes to those who are in power of managing and allocating those resources. Public funds for general people are often exploited and used by already wealthy people instead of using the public fund to provide general people with basic resources like education, health-care services and infrastructure. Corruption limits the access of opportunities for poor people by using favoritism and bribery to make sure that jobs, contracts, and policies benefit the rich. Due to the presence of corruption, there is discouragement of investments, reduced job creations, and wastage of resources. As a result, general people do not get the chance to show their true potential or improve their standard of living. A theory called 'Inequality Trap Theory" by Ali Hussein Samadi (2013), explained how corruption worsens IIQ by creating an effect that feeds back into its cause and is hard to stop or reverse. Because it creates such a cycle where rich people misuses resources and dodges tax payments, while the poor faces difficulties affording to survive within the economy. Income inequality rises via this cycle of destroying equal resource allocation and institutional fairness. In studies conducted by Kunawotor (2020) and Asamoah (2021), they highlight that monitoring corruption can decrease inequality by refining governance and empowering unbiassed resource allocation. Similarly, Göcen (2023) demonstrates that low corruption levels, coupled with economic freedom, significantly reduce IIQ.

Other institutional and economic variables connect together and plays a role in support of corruption to directly impact IIQ. According to Faisal Abbas (2021) and Nam (2024), despite the presence of corruption in an economy's rules and laws there were smaller disparities in income. This is because those country's regulatory framework was strong and transparent. This means corruption impacts IIQ at a lower level when there is a presence of strong governance. In

Dossou (2023), they also finds that governance quality can arbitrate urbanization's properties on IIQ, emphasizing the requirement to study corruption within larger institutional contexts. In some provinces, corruption control primarily upsurges IIQ due to transitional economic dynamics. In developing countries a U-shaped relationship was captured by Khan (2022), that is primary restructurings increased IIQ prior to nurturing long-term stability. Similarly, Hartwig (2024) notes that the relationship between corruption and IIQ is sensitive to control variables, suggesting that country-specific dynamics must be considered. Policy insinuations also play a part behind selecting corruption or IQC as a focus point. Studies such as Laura Policardo (2019) and Badur (2024) points out that to reduce level of corruption from the rules and laws needs structural reorganization to promote transparency, stronger governance and to decrease rent-seeking behavior. Taking these measures will provide everyone with equal opportunities which further promotes economic growth and stability. In the studies conducted by Har Wai Mun (2022) and Rozina Shaheen (2022), they have found that usage of anti-corruption policies can enhance the positive effects of financial development and governance reforms. Worldwide, region and level of income shapes corruption's impact on IIQ, as in the study of Vo (2024), it was discovered that good institutional quality of an economy enhances the positive effects of using FinTech in developing countries. Conversely, in developed nations adopting fintech has limited effects because of the presence of corruption which weakens its benefits and also because rich people are the ones who got the access of FinTech's benefits first. Similarly, Asamoah (2021) and Nam (2024) display that governance reorganizations have stronger effects on IIQ in developing countries compared to advanced economies. This inequality emphasizes the dual role of corruption as both a cause and consequence of IIQ, which makes it a main focus for further research. These findings emphasize corruption's role as a barricade to unbiased growth and its significance as a research attention.

1.2 Objective of the Study

The present study aims to examine the impacts of FinTech and IQC on IIQ, by addressing the direct links of these two key factors in order to provide a detailed understanding of their contributions separately in various regional and contextual settings.

Objective 1: To Analyze the Impact of FinTech on Income Inequality (IIQ) in various regional and contextual settings.

This objective aims to discover how IIQ is influenced by FinTech in different economies. FinTech is a transformative tool which is used to provide financial access to underserved groups, thus narrowing down the income gap. It promotes financial inclusion by using digital payments, mobile banking, and crowdfunding platforms. Authors who explored the impact of FinTech on IIQ claims that FinTech's benefitting role depends on the country's digital literacy, digital infrastructure, institutional quality and economic development. Therefore, the present study's objective aims to examine the ways through which FinTech influences IIQ.

Objective 2: To Investigate the Impact of Institutional Quality Corruption (IQC) on Income Inequality (IIQ) in various regional and contextual settings.

The present study's second objective aims to understand how IQC impacts IIQ. Corruption undermines governance systems, promotes rent-seeking behaviors, and facilitates elite capture of public resources, which severely impacts the level of IIQ in different economies. Countries where there is weak governance, level of corruption is high where wealth and opportunities are wasted among elite groups only, leaving behind the poor people. On the other hand, in countries where strong governance is on play, corruption does not impact the income gap adversely. The current study aims to assess the direct link of corruption on IIQ by analyzing how corruption interacts with governance and other economic factors.

1.3 Research Question

Research Question1. How adoption of financial technology (FinTech) in different economic and regional settings, affect IIQ?

Research Question2. How presence of corruption in institutional in different economic and regional settings, impacts IIQ?

1.4 Hypotheses Development

HD1- IIQ is impacted by the various levels of FinTech adoption in different economic and regional settings.

HD2- Levels of corruption in institutional quality has an impact on IIQ in different economic and regional settings.

1.5 Research Gap

Previous studies have explored both the independent variables' (FinTech and IQC) impact on IIQ separately. No author examined how FinTech and IQC both impacts IIQ. IIQ is a multidimensional issue influenced by both technological and institutional factors, yet their combined dynamics have not been fully explored. While reading through many articles, this particular gap was noticed that the question of how technology and governance factors both work collaboratively to reduce IIQ. Thus, this gap is to be explored by using advanced econometric methods to find out the relations between these three variables.

Chapter 02: Literature Review

2.1 Impact of Institutional Quality Corruption (IQC) on Income Inequality (IIQ)

This literature review generates the findings from various studies exploring the impact of institutional quality, particularly corruption, on income inequality. (Brandao, 2024) conducted a panel data analysis on upper-middle-income Latin American countries from 2008 to 2022, finding that institutional quality factors like control of corruption and rule of law significantly affect income inequality. (C. M. H. Huynh, Hong Hiep, 2024) and (Nam, 2024) employed a two-step System GMM analysis on 30 Asian countries from 2000 to 2019, revealing that financial depth and market development increase income inequality, while financial access and efficiency reduce it, with improved institutional quality mitigating inequality. (Kunawotor, 2020) used dynamic two-step Difference GMM for African countries from 1990 to 2017, discovering that control of corruption and rule of law significantly reduce income inequality. (Vo, 2024) explored 110 countries using Panel Smooth Transition Regression (PSTR) from 2004 to 2020, finding that institutional quality increases financial inclusion in high- and middle-income countries but has limited effects in low-income countries. (Göcen, 2023) analyzed 58 countries with two-step System GMM from 2012 to 2018, concluding that low corruption and high economic freedom reduce income inequality, though high inflation can negate these effects. (Hartwig, 2024) utilized Extreme Bounds Analysis (EBA), IV, and WALS for 150 countries from 1980 onwards, finding that the impact of corruption on income inequality is not robust and sensitive to control variables. (Badur, 2024) examined post-Soviet countries using dynamic panel regression with fixed effects, finding that corruption worsens income inequality and undermines sustainable development. (Uzar, 2023) used panel regression on BRICS-T countries from 1993 to 2016, showing that institutional quality, including corruption control, reduces income inequality, and freedom of the press amplifies these effects. The author (Ullah, 2024) applied time series analysis (1980-2022) using ARDL and ECM in Pakistan, revealing that corruption exacerbates income inequality and environmental degradation. (Asamoah, 2021) employed a dynamic panel threshold model from 1995 to 2017, showing that institutional quality has a quadratic effect on income inequality in advanced countries and a monotonic negative effect in developing countries. (Sohaila Abdul Zahra Al-Hajimi, 2024) conducted an empirical analysis in Iraq, finding that public sector corruption exacerbates income inequality. (Ivan W. Taylor, 2022) used a System Dynamics model and econometric analysis, indicating that improving institutional quality can control corruption, but a country-specific approach is necessary.(Chandan Kumar Jha, 2024) performed a panel data analysis from 1996 to 2019 on MENA countries, showing that corruption is positively associated with income inequality, but democratization effects from the Arab Spring mitigate this impact. (Liyanage Devangi H. Perera, 2013) used System Generalized Method of Moments (GMM) in East and South Asia, finding that economic growth reduces poverty but not income inequality, and improvements in government stability and law and order reduce poverty. The author (Faisal Abbas, 2021) employed FMOLS analytical approach from 2000 to 2021 on SAARC countries, finding that institutional quality reduces income inequality, while corruption and its combined effect with institutional quality increase income inequality. (Abdul Rashid,

2023) used panel quantile regression and panel co-integration in 50 developing countries, showing that a high incidence of the informal sector marginalizes the positive effect of corruption on income inequality. (Dossou, 2023) employed two-stage system GMM on 46 African countries, finding that urbanization increases income inequality, but improved governance quality can enhance income distribution. Collectively, these studies highlight that high-quality institutions and effective control of corruption are essential for mitigating income inequality across different contexts.

Table 2 Summary Literature of IQC

Author	Country (year)	Methodology	Control Variables	Findings
(Adeleye, 2024)	46 Sub-Saharan African countries	Driscoll and Kraay PSCC, Unconditional Quantile Regression (UQR) (2010–2019)	GDP per capita, education, institutional quality, regional fixed effects	Human capital and institutional quality independently increase income inequality, but their interaction reduces it, especially at lower income quantiles. Strengthening institutions enhances human capital's impact on reducing inequality.
(Leong, 2024)	64 low and lower-middle-income countries	Two-step system GMM estimation (2011-2021)	FinTech penetration (ATM penetration), governance quality (political stability), private credit	FinTech penetration fosters financial sector development. Politically stable environments create secure financial systems, promoting financial growth, especially in countries with higher financial exclusion and financial institutions' efficiency.
(C. M. H. Huynh, Hong Hiep, 2024)	35 Asian countries	Feasible Generalized Least Squares (FGLS), System GMM (1990–2021)	GDP per capita, education, urbanization, governance quality	Climate change (temperature and precipitation) worsens income inequality, but higher institutional quality reduces it and mitigates climate impacts.
(Haini, 2023)	100 countries (advanced and developing)	Dynamic panel estimator (2006–2018)	GDP per capita, education, governance quality, regional fixed effects	Institutional quality positively impacts entrepreneurial activity. However, in countries with low institutional quality, income inequality negatively affects entrepreneurship. Rule of law and government effectiveness are key moderators.
(Nam, 2024)	ASEAN countries	Fixed effects (FE), Generalized Method of Moments (GMM),	GDP per capita, education, governance quality,	Trade openness has an inverted U-shaped effect on income inequality: it initially increases inequality, then decreases it.

		Method of Moments Quantile Regression (MMQR) (2000–2021)	regulatory quality	Institutional quality mitigates inequality, especially at higher levels of trade openness.

(I. Z. Khan, Ruoyu; Han, Lei; Khan, Hayat, 2024)	Belt and Road Initiative (BRI) countries	Two-step System GMM (2002–2019)	GDP per capita, energy consumption, political system index, FDI, legal system quality	Institutional quality, particularly the political and legal systems, positively affects CO_2 emissions. Economic growth and energy use increase emissions, while income inequality and FDI reduce them.
(Brandao, 2024)	Brazil, Argentina, Dominican Republic, Peru	Panel data analysis (2008–2022)	Foreign Direct Investment, Global Competitiveness, GDP per capita, education	Institutional quality factors (e.g., control of corruption, rule of law) significantly affect income inequality in upper-middle-income Latin American countries.
(C. M. T. Huynh, Nam Hoai, 2023) https://doi.org/10.1080/23322039.2023.2242128	30 Asian countries	Two-step System GMM (2000–2019)	GDP per capita, education, foreign direct investment, governance quality	Financial depth and market development increase income inequality, while financial access and efficiency reduce it. Institutional quality moderates these effects, mitigating inequality as quality improves.
(Kunawotor, 2020)	African countries	Dynamic two-step Difference GMM (1990–2017)	GDP per capita, education, foreign aid, trade openness	Control of corruption and rule of law significantly reduce income inequality, while other institutional indicators show no effect.
(Vo, 2024)	110 countries	Panel Smooth Transition Regression (PSTR) (2004–2020)	GDP per capita, education, financial development, income level	Institutional quality increases financial inclusion in high- and middle-income countries, but has limited effect in low-income countries.
(Göcen, 2023)	58 countries	Two-step System GMM (2012–2018)	Inflation, GDP per capita	Low corruption and high economic freedom reduce income inequality. However,

				high inflation can negate the inequality-reducing effects of good institutions.
(Hartwig, 2024)	150 countries	Extreme Bounds Analysis (EBA), IV, WALS (data from 1980)	Financial development, old-age dependency, unemployment rate, capital stock to GDP ratio, population growth	Corruption's impact on income inequality is not robust; the relationship is sensitive to control variables. No evidence of a clear positive effect or inverted U-shaped impact.
(Badur, 2024)	Post-Soviet countries	Dynamic panel regression with fixed effects	Unemployment, trade liberalization, foreign direct investment (FDI)	Corruption and income inequality both undermine sustainable development, with corruption worsening inequality and contributing to negative economic and social impacts.
(Uzar, 2023)	BRICS-T countries	Panel regression (1993–2016)	Globalization, economic growth, trade openness	Institutional quality, including corruption control, reduces income inequality, while freedom of the press further amplifies these inequality-reducing effects.
(Ullah, 2024)	Pakistan	Time series analysis (1980–2022) using ARDL and ECM	Environmental degradation, economic development	Corruption, when combined with income inequality, exacerbates environmental degradation, but corruption also strengthens the negative impact of inequality over time.
(Asamoah, 2021)	Developing and advanced countries	Dynamic panel threshold model (1995-2017)	World Governance Indicators, International Country Risk Guide	Institutional quality has a quadratic effect on income inequality in advanced countries and a monotonic negative effect in developing countries. Kuznets inverted U-shaped relationship for both groups. Higher threshold value for developing countries.
(Sohaila Abdul Zahra Al-Hajimi, 2024)	Iraq	Empirical analysis	Corruption Perceptions Index, income levels, economic diversification efforts	A strong relationship exists between the level of corruption in the public sector and income inequality in the Iraqi economy. Corruption in the public sector exacerbates income inequality.

(Ivan W. Taylor, 2022)	Canada, Pakistan, India, Costa Rica	System Dynamics model, econometric analysis, data from World Bank and World Economic Forum (1996-2020)	Institutional quality, economic and governance institutions	Improving institutional quality can control corruption. The model shows a country-specific approach is necessary for effective policy-making.
(Chandan Kumar Jha, 2024)	MENA countries	Panel data analysis (1996-2019)	Corruption, Arab Spring, economic and institutional variables	Corruption is positively associated with income inequality, but the interaction term between corruption and the Arab Spring is negatively associated with income inequality. Corruption has become more democratized after the Arab Spring.
(Liyanage Devangi H. Perera, 2013)	East and South Asia	System Generalized Method of Moments (GMM) estimation method	Economic growth, institutional quality, poverty levels	Economic growth leads to poverty reduction but not income inequality reduction. Improvements in government stability and law and order reduce poverty, while improvements in corruption, democratic accountability, and bureaucratic quality increase poverty and worsen income distribution.
(Faisal Abbas, 2021)	SAARC countries	FMOLS analytical approach (2000-2021)	Institutional quality, corruption, economic indicators	Institutional quality reduces income inequality, while corruption and the combined effect of corruption and institutional quality increase income inequality.
(Abdul Rashid, 2023)	50 developing countries	Panel quantile regression, panel co-integration (Kao residual co-integration test)	Corruption (CP), income inequality (IN), informal sector (IFS)	High incidence of the informal sector (IFS) marginalizes the positive effect of corruption (CP) on income inequality (IN). Corruption creates asymmetry in income distribution, with higher asymmetry when corruption is at higher percentiles.

(Khan, 2022)	23 emerging countries	Static methods (pooled OLS, fixed effect, random effect, IV regressions), dynamic difference and system GMM	Income inequality, corruption, informal sector	Higher inequality levels lead to higher control of corruption. U-shaped relationship for high-income countries, inverted U-shaped for upper middle-income countries. Uni-directional causality between corruption and income inequality.
(Dossou, 2023)	46 African countries	Two stage system GMM estimation (1996-2020)	Urbanization, governance quality, economic growth	Urbanization increases income inequality. Improved governance quality can enhance income distribution in urban areas and foster positive urbanization, promoting economic growth and reducing inequality.
(Laura Policardo, 2019)	34 OECD countries	Panel data analysis (1995-2011)	Corruption, income inequality, country-specific factors	Corruption increases income inequality, and income inequality positively affects corruption. The causality between corruption and income inequality is country specific.
(Asli Demirgüç-Kunt, 2023)	Various countries	Panel data analysis using Worldwide Bureaucracy Indicators	Public sector wage levels, wage inequality	Wage inequality in the public sector affects the effectiveness of anti-corruption policies. Raising wages can reduce corruption in countries with low wage inequality but can increase corruption where wage inequality is high.
(Kenneth S. Chan, 2019)	China	Provincial panel data analysis (1996-2014)	Corruption, income inequality, informal sector	Lower corruption is associated with higher income inequality. Institutional reforms reduce corruption but may initially exacerbate inequality, especially in the informal sector.
(Song, 2022)	48 African countries	Panel data model using Maximum Likelihood Method (MLM)	Governance indices, longevity of regime, term in power	Governance indices reduce income inequality but exacerbate housing and environmental inequalities. Longevity of regime and term in power exacerbate inequalities in all forms.

(Har Wai Mun, 2022)	43 countries	Quantile regression (2010-2017)	World Governance Indicators (WGI), income inequality	Aggregated WGI has anomalies; recomposed WGI-plus and WGI-minus are significant, except one case. Democracy and free market not always "good quality" institutions; control of corruption signals structural flaws; middle-income countries have more anomalies.
(Wong, 2023)	127 countries	Time-series cross-sectional analysis (1964-2007)	Economic development, corruption, informal sector	Corruption and a large informal sector can reduce income inequality by allowing economic benefits to be widely distributed. However, at low levels of economic development, increased corruption or informal sector alone do not lead to more egalitarian distribution.
(Hugues Kouassi Kouadio, 2021)	West Africa	Time-series cross-sectional analysis	Economic growth, institutional quality, poverty, inequality	Economic growth is necessary for poverty reduction. Improved institutional quality significantly reduces poverty and inequality, especially through better democratic institutions, regulatory quality, and control of corruption.
(Óscar Afonso, 2022)	14 countries	Theoretical model and panel data analysis (2000-2017)	Corruption, institutional quality, offshoring, economic development	Improvement in offshoring increases comparative advantage of developing-South countries and decreases wage gap. Improvement in institutional quality increases comparative advantage of developed-North countries and widens wage gap. Both improvements lead to increased world economic growth rate.
(Rozina Shaheen, 2022)	South Asia	Feasible Generalised Least Squares (FGLS) (2012-2022)	Corruption Perception Index (TI-CPI), Democracy Index (EIU), income inequality, political governance, economic performance	Democracy, regulatory quality, income inequality, and population growth are associated with increased corruption. Effective corruption control, rule of law, and economic growth reduce corruption.
(Norhasima	Malaysia	Time-series analysis (1995-	Financial development,	Financial development has a positive impact on income

h Shaharuddin , 2023)		2021)	corruption, income inequality, economic growth	inequality. Corruption control is an insignificant determinant of per capita income. Interaction between financial development and anti-corruption reduces income inequality.

2.2 Impact of FinTech on Income Inequality (IIQ)

This literature review blends the findings from various studies examining the impact of FinTech on income inequality. (Adugna, 2024) conducted a cross-country study on 65 countries using GMM, showing that FinTech lending and funding help reduce income inequality by providing accessible options for underserved groups, pushing traditional banks to be more inclusive. (Muhammad Irfan, 2024) applied OLS regression on panel data from 93 countries, finding that FinTech and financial inclusion reduce income inequality by improving access to financial services, with R&D spending enhancing Fintech's impact. (Godwin Ahiase, 2024) used a random-effects model for 10 ASEAN countries, demonstrating that FinTech enhances sustainability with a U-shaped relationship between FinTech and sustainable development. (Abebe Gule Girma, 2024) employed pooled OLS regression and SEM on 29 African countries, finding that FinTech positively affects financial inclusion, which reduces income inequality. (Xin Deng, 2024) used empirical analysis on microbusiness owners in China, showing that disadvantaged groups benefit more from FinTech adoption, increasing business revenue. In the paper of (Verma, 2024), they employed panel estimation techniques in Asian economies, finding that financial inclusion significantly reduces income inequality in the long run. (Kefu Liu, 2024) used dynamic panel differential GMM in China, demonstrating that FinTech significantly curbs income inequality, especially in low-income regions. (P. C. Muhammad Suhrab, 2024) analyzed BRICS countries using Driscoll-Kraay and fixed effects tests, showing that digital financial inclusion reduces income inequality. (Yi Li, 2024) used panel data analysis in China, showing a U-shaped relationship between FinTech and the urban-rural income gap. (P. C. Muhammad Suhrab, 2024) and (C. P. Muhammad Suhrab, Ningyu Qian, 2024) applied two-stage least squares regression in BRICS countries, showing that technological advancement and financial inclusion reduce income inequality. (Youqin Liang, 2024) conducted a narrative literature review in China, showing that the digital economy can narrow urban-rural income inequality but faces challenges like infrastructure gaps and uneven regional development. (Roongsriroothiwong, 2024) examined Southeast Asian countries using linear regression and Pearson correlation coefficient analysis from 2018 to 2021, finding that FinTech significantly impacts poverty reduction and technological advancements in FinTech contribute to achieving Sustainable Development Goals by alleviating poverty. (Khan, 2022) applied FMOLS estimator, fixed-effects, and GMM for SAARC countries from 2004 to 2021, showing that financial inclusion mitigates income inequality and poverty, emphasizing expanding financial inclusion to lower disparities. (Ismail, 2024) conducted secondary data analysis on selected developing economies, confirming that FinTech adoption significantly impacts financial inclusion in both the long and short run, providing implications for enhancing financial inclusion through FinTech.(Wang, 2024) used RIF regression on CHFS data, demonstrating that Digital Inclusive Finance positively impacts income inequality by enhancing financial literacy and alleviating constraints. (Guangshun Xu, 2024) used a two-way fixed effect panel model on CHFS data, finding that increasing digital financial literacy within rural households decreases income inequality by promoting entrepreneurship. (Yifei Fu & Liu, 2023) & (Liu, 2023) analyzed 119

countries, finding that income inequality is negatively related to financial service accessibility, with FinTech weakening this relationship but bank branches remaining important. (Mehar, 2023) analyzed data from 148 countries, showing that information technology reduces poverty, income inequality, and unemployment, supporting its role in GDP growth. (Liu, 2023) used China Household Financial Survey data, finding that digital financial inclusion alleviates poverty and reduces income inequality. Another author (Siti Aisyah1, 2023), found that financial development negatively influences IIQ, startups of fintech sectors increases it. According to the study of (Luu, 2023), the study used empirical investigation, finding that Fin Credit positively impacts income inequality, improved by financial inclusion. In the study of (Ruobing Ning, 2023), analyzed provincial data in China, showing that FinTech narrows the urban-rural income gap, with varying effects based on FinTech development levels. (Nambie et al., 2023) employed two-step system GMM on African countries, finding that financial inclusion and FinTech significantly impact economic growth, suggesting policy implications for wealth distribution. (B. B. Ashenafi, & Yan, D, 2023) used panel data on African countries, showing that banking development widens income inequality, but FinTech positively affects financial inclusion. (Usta, 2023) used time series approaches in Turkey, finding that digital banking channels widen income inequality. In the study conducted by (Pham Thi Thanh Xuan, 2022), they have used Ridge and Bayesian Ridge Regression on 60 countries, showing that financial inclusion significantly reduces income inequality, with FinTech credit having a negligible effect. (Jensen, 2022) used OLS multiple variable regression on 86 countries, finding a negative relationship between FinTech and income inequality, especially in higher-income countries. (Kaulihowa, 2022) used longitudinal research design on South Africa, Brazil, China, and Turkey, finding mixed results with a U-shaped pattern between financial innovation and inequality. Collectively, these studies highlight that FinTech and financial inclusion are critical for reducing income inequality by providing broader access to financial services, improving financial literacy, and supporting economic growth across different regions. However, the impacts can vary based on the stage of economic development and the specific financial technologies adopted.

Table 3 Summary Literature of FinTech

Author (year)	Country	Methodology	Control Variables	Findings
(Adugna, 2024)	Cross Country (65 countries)	GMM	GDP per capita, inflation, education levels, unemployment, urbanization, financial development, and institutional quality.	Fintech lending and funding help reduce income inequality by providing accessible options for underserve d groups. It pushes traditional banks to be more inclusive, benefiting low-income
(Muhammad Irfan, 2024)	93 countries	OLS regression on panel data (2011, 2013, 2017)	GDP per capita, education, inflation, urbanization, governance quality	Fintech and financial inclusion reduce income inequality by improving access to financial services. R&D spending enhances Fintech's impact on reducing income disparities.
(Godwin Ahiase, 2024)	10 ASEAN countries	Random-effects model (2015–2022)	GDP per capita, education, internet access, regulatory quality, urbanization	FinTech enhances environmental, economic, and social sustainability, with a stronger effect in countries with lower income inequality. Shows a U-shaped relationship between FinTech and sustainable development.
(Abebe Gule Girma, 2024)	29 African countries	Pooled OLS regression and Structural Equation Modeling (SEM) (2011, 2014, 2017)	GDP per capita, education, inflation, urbanization, financial access	FinTech positively affects financial inclusion, which in turn reduces income inequality. However, FinTech and income inequality show a direct positive association, mitigated by financial inclusion.

(Xin Deng, 2024)	China	Novel dataset of microbusiness owners (2017-2019), empirical analysis	Demographics and regional factors	Disadvantaged groups (seniors, females) less likely to adopt fintech, but benefit more once they do. Fintech adoption increases business revenue more in areas with high discrimination. Helps with cash management, financing constraints, and management capabilities.
(Verma, 2024)	Asian Economies	Panel estimation techniques (Pedroni cointegration, Kao residual-based, FMOLS, ARDL, Granger causality)	GDP, inflation rate, population growth, government expenditure	In the long run, financial inclusion indicators (number of bank branches, deposit accounts, outstanding loans, domestic credit to private sector) significantly reduce income inequality. In the short run, no effect observed.
(Kefu Liu, 2024)	China	Dynamic panel differential GMM, panel threshold models (2011-2020)	Economic growth, regional factors, level of fintech development, income inequality levels	FinTech significantly curbs income inequality, with more significant effects in central and western regions of China. The improvement of fintech reduces inequality across all quantiles, especially in low-income inequality regions. Economic growth plays a significant role in reducing income inequality.

(P. C. Muhammad Suhrab, 2024)	BRICS countries	Driscoll-Kraay (DK) and fixed effects tests (2004-2018)	GDP, inflation, poverty ratio, technological innovation, infrastructure development	Digital financial inclusion significantly reduces income inequality. Technological innovation and infrastructure development strengthen this effect, helping to reduce income inequality more quickly.
(Yi Li, 2024)	China	Python web scraping technology, panel data analysis (2005-2021)	Digital infrastructure, innovation capacity, human capital, regional development levels	The relationship between FinTech and the urban-rural income distribution gap is "U"-shaped. FinTech development initially reduces the income gap, but overdevelopment exacerbates it. Regional differences show significant impacts in eastern and central regions, but not in western regions. Improvements in digital infrastructure, innovation capacity, and human capital amplify the positive impact of FinTech.
(C. P. Muhammad Suhrab, Ningyu Qian, 2024)	BRICS countries	Two-stage least squares regression, principal component analysis (2011-2021)	GDP, inflation, education level, technological infrastructure	Technological advancement negatively impacts income inequality, narrowing the gap. Financial inclusion mediates this effect positively. Emphasizes promoting financial inclusivity to reduce income inequality.

(Youqin Liang, 2024)	China	Narrative literature review (2014-2023)	Urban-rural digital infrastructure, regional economic development, digital talent availability	Digital economy can narrow urban-rural income inequality but faces challenges like infrastructure gaps, uneven regional development, and lack of digital talent. Recommendations include improving digital infrastructure and rural human capital.
(Roongsriroothiwong, 2024)	Southeast Asian countries	Linear regression, Pearson correlation coefficient analysis (2018-2021)	GDP, income level, technological advancement, population growth	Fintech and its sub-measures significantly impact poverty reduction in both middle-income and lower-income Southeast Asian countries. Technological advancements in FinTech contribute meaningfully to achieving the Sustainable Development Goals by alleviating poverty.
(M. A. Khan, 2024)	SAARC countries	FMOLS estimator for individual countries, fixed-effects, GMM for panel data (2004-2021)	Economic growth, inflation, government policies, education level	Financial inclusion mitigates income inequality and poverty. Emphasizes the importance of expanding and promoting financial inclusion to lower poverty and income disparities, achieving SDG01 and SDG10.
(Ismail, 2024)	Selected developing economies	Secondary data analysis, quantitative analysis	Economic development, regulatory environment, financial barriers	FinTech adoption has a strong positive and significant impact on financial inclusion in both the long run and short run. The study confirms financial intermediation theory and provides implications for enhancing financial inclusion through FinTech.

(Verma, 2024)	Asian economies	Panel estimation techniques (Pedroni cointegration test, Kao residual-based test, FMOLS, ARDL, Granger causality)	Gini coefficient, financial depth, GDP, inflation, government policies	In the long run, income inequality is significantly influenced by financial inclusion indicators (bank branches, deposit accounts, outstanding loans, domestic credit). In the short run, these indicators do not affect income inequality. Unidirectional causality from financial inclusion to income inequality highlights the need for policies to enhance financial services access to reduce disparity.
(Wang, 2024)		Recentered Influence Function (RIF) regression, CHFS data (2015, 2017, 2019)	Financial literacy, financing constraints, employment opportunities	Digital Inclusive Finance (DIF) positively impacts income inequality by enhancing financial literacy, alleviating financing constraints, and increasing employment for low-capital households. Positive effects seen in agricultural production, investment, and transfer income, especially in central regions, low-income households, and individuals with high financial literacy.
(Guangshun Xu, 2024)	China	Two-way fixed effect panel model using CHFS data (2017, 2019)	Financial asset allocation, entrepreneurship, household characteristics	Increasing digital financial literacy (DFL) within rural households decreases income inequality by diversifying financial assets, increasing risky financial assets, and promoting entrepreneurship.
(Yifei Fu & Liu, 2023)	119 countries	Density of bank branch network (2004-2018)	Poverty ratio	Income inequality is negatively related to accessibility of financial services, especially in less developed countries. Fintech weakens this relationship but bank branches remain important.

(Mehar, 2023)	148 countries	14 years of data analysis (2009-2023)	Internet usage, mobile banking, credit flow, GDP growth	Information technology, including internet use, mobile banking, and FinTech, effectively reduces poverty, income inequality, and unemployment. Empirical evidence supports its role in poverty alleviation, employment creation, and GDP growth.
(Liu, 2023)	China	Data from China Household Financial Survey, empirical analysis (2015-2019)	Population dependency ratios, use of digital tools, education levels, regional differences	Digital financial inclusion significantly alleviates household vulnerability to relative poverty, especially in households with high population dependency ratios, digital tools, and higher education levels. It reduces income inequality, improves health status, development-oriented consumption, and family happiness.
(Siti Aisyah1, 2023)	15 middle-income countries	Panel data regression with fixed effect model (2012-2019)	Economic growth, population density, financial infrastructure	Financial development index negatively and substantially impacts income inequality. However, the number of FinTech startups and commercial bank branches per 100,000 persons positively and significantly impact income inequality.
(Luu, 2023)	Not Given	Dual-process variable selection approach, empirical analysis	Financial inclusion, economic growth, regulatory environment	Fin Credit has a direct positive impact on income inequality. Financial Inclusion enhances the positive effects of Fin Credit on reducing income inequality, providing empirical evidence and significant policy implications for promoting Fin Credit and Financial Inclusion to reduce income inequality.

(Ruobing Ning, 2023)	China	Provincial panel data analysis (2011-2020), fixed effect model, panel threshold model	Regional economic factors, level of financial technology development	Development of FinTech significantly narrows the urban-rural income gap, with the greatest impact in the western region, followed by the central and eastern regions. Different levels of FinTech development have varying effects, and beyond a certain point, the impact is weakened.
(Nambie et al., 2023)	Africa	Two-step system GMM estimator (2001-2022)	Income inequality, financial inclusion, investment, unemployment, economic growth	Income inequality and unemployment have a significant negative relationship with economic growth. Financial inclusion and investment have a significant positive relationship with economic growth. Financial technology, as a moderator variable, significantly impacts economic growth. Policymakers should ensure equitable wealth distribution, economic stabilization, skill development for young entrepreneurs, and investment in financial technology to enhance economic growth.
(B. B. Ashenafi, & Yan, D, 2023)	49 African countries	Panel data fixed effect, two-stage least squared estimation (2sls) for supply side (1980-2017); survey data (2011, 2014, 2017) for demand side	Institutional quality, economic development, financial regulations	Banking and stock market development widens income inequality, especially in countries with both banking and stock markets. FinTech positively affects financial inclusion and savings but exacerbates income inequality.

(Usta, 2023)	Turkey	Time series approaches, dynamic ordinary least squares, vector autoregressive model, causality analysis	Gini index, investment volume, transaction volume per unit	Digital financial inclusion through digital banking channels has a widening impact on income inequality. The Gini coefficient increases in response to digital banking innovations, and digital banking has a forecasting ability on income inequality.
(Pham Thi Thanh Xuan, 2022)	60 countries	Ridge and Bayesian Ridge Regression	Usage of financial services, digital payments, FinTech credit	Financial inclusion significantly reduces income inequality, with digital payments having a notable impact. The poorest group benefits more in reducing inequality than the richest group. Fintech credit has a negligible effect on income inequality.
(B. B. Ashenafi, & Dong, Y., 2022)	39 African countries	Pooled ordinary least square, two-stage least square (2sls) estimation methods (2011, 2014, 2017	Political stability, control of corruption, government effectiveness	Financial inclusion and FinTech encourage formal bank account ownership but exacerbate income inequality. Policymakers face tradeoffs between promoting financial inclusion and FinTech or reducing income inequality. Pro-poor financial sector development is vital to reducing inequality.
(Jensen, 2022)	86 countries	OLS multiple variable regression, 2SLS instrument variable regression	Income levels, regional factors, FinTech usage	Statistically significant negative relationship between FinTech and income inequality. Negative relationship primarily presents in higher-income countries and in Western Europe and North America.

(Kaulihowa, 2022)	South Africa, Brazil, China, Turkey	Longitudinal research design, Augmented Mean Group estimator (1986-2020)	Financial innovation measures (bank credit, broad money ratio, ATMs)	Mixed results: U-shaped pattern between financial innovation and income inequality for bank credit and broad money ratio, inverse relationship for ATMs. Financial innovation initially reduces income inequality but contributes to widening it beyond a certain point.
(Loviana, 2021)	OECD countries	Analysis using OECD data (various years)	Economic development level, financial literacy gaps, access to financial services	Financial inclusion and FinTech can potentially lower income inequality, but the relationship may vary based on other factors such as the level of economic development. Higher income inequality impacts economic growth negatively.
(A. Demir, Pesqué-Cela, V., Altunbas, Y., & Murinde, V., 2020)	140 countries	Quantile regression analysis using Global Findex data (2011, 2014, 2017)	Financial market imperfections, income levels, financial inclusion	Financial inclusion is a key channel through which FinTech reduces income inequality. Financial inclusion significantly reduces inequality at all quantiles, with effects primarily associated with higher-income countries.
(Kling, 2020)		Theoretical model, empirical testing using CHFS data (2011, 2013)	Initial endowments, financial assets, household income levels	Financial inclusion, defined as access to formal loans and financial assets, can mitigate under-investment in education. However, reliance on formal or informal loans worsens income inequality. Access to bank accounts improves future income distribution prospects, while informal loans benefit households below the 40th percentile of income.

Chapter 03: Data and Methodology of the Study

3.1 Theoretical Development

There are several research papers about the impact of IQ (corruption) on IIQ, some of the best fitted theories according to this research topic is critically evaluated. Starting with the nexus of corruption and IIQ, which is emphasized by Ali Hussein Samadi (2013), he showed that high IIQ leads to increased corruption. In societies where IIQ is high, rich people utilize their financial power to control government policies and avoid taxes, while poor people suffer from lack of opportunities resulting into getting involved in illegal activities. This vicious cycle excavates IIQ, as resources are allotted unevenly, favoring the wealthy and disadvantaging the poor people. This dynamic brings into line with the "inequality trap" theory, which proposes that inequality continues itself through institutional corruption and narrow opportunities for social mobility. Another author Juzhong Zhuang (2010) specified the idea of an “inverted-U” relationship between corruption and inequality. The argument is moderate corruption levels can lead to the highest IIQ, while both low and high levels of corruption results into relatively lower IIQ. The author further elaborates his argument by specifying that, moderate level of corruption allows the rich people to seize significant resources while still managing enough IQ functionality to reserve their personal gains. In circumstances like this, corruption weakens social programs, restricts economic opportunities and exacerbates equitable development. Zhuang’s framework is particularly relevant as it provides a nuanced explanation of how corruption operates differently at varying levels of severity. In the study of Hartwig (2024), he elaborates that corruption negatively impacts talent and resources from creative sectors to rent-seeking deeds, where companies or individuals gains profit via manipulation rather than contributing to economic growth. As a result, overall productivity is reduced and IIQ is more strengthened, especially in middle-income countries across different sectors. Keeping in mind the uneven effects of corruption on IIQ in economies with weak governance, another author Abebe Gule Girma (2024) explored the impact of corruption on IIQ. Due to having weak governance or no rule of law, corruption repetitively results into practicing regressive tax approach, deregulation of industries, privatization, and shifting public resources from welfare programs to personal gain, resulting into higher IIQ. The author Abebe Gule Girma (2024), emphasizes that policymakers should come up with reforms which will give everyone fair and equal rights to opportunities and resources.

There are several research papers about the impact of FinTech on IIQ, below are some of the best fitted theories according to this research topic.

This author kept her focus in developing economies A. Demir, Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2020), assessing the role of FinTech on reducing IIQ. FinTech provides easy access to financial services by promoting financial inclusion in rural and underserved areas. Many underserved populations do not get the services from traditional banks in those areas, in Sub-Saharan Africa and parts of Asia it started adopting mobile banking which helped marginalized group to have savings, take loans and invest. Another study was conducted by

Muhammad Irfan (2024), where he explained that mobile banking, microfinance programs, and e-wallets plays a significant role in delivering financial services to underserved groups in rural areas. These services help people to invest on their children's education, start their small businesses, afford to buy things or invest on things that they have always wanted. By connecting people to formal financial systems, FinTech reduces reliance on informal and exploitative credit sources, which often worsen inequality. An interesting findings were delivered by Abebe Gule Girma (2024), explains that while FinTech's benefits will not reach to the poor people if institutional quality is corrupted, the area does not have any digital infrastructure, and people are digitally illiterate. To make financial systems and internet penetration strong, heavy initial investment will be required and that will again exacerbate IIQ, highlighting the need to create policies and investment strategies ensuring that it does not exacerbate IIQ. Other authors and A. Demir, Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2020) highlighted the significant need to restructure govt. policies such as promoting progressive tax approach, avoiding deregulation that puts labor in danger and assurance of equal resource allocation to ensure FinTech adoption in a country is accessible to all equally. For instance, governments can use digital platforms to improve tax compliance, ensure transparency in financial transactions, and deliver welfare benefits directly to beneficiaries. These measures not only increase financial inclusion but also help bridge income gaps by ensuring that public resources are distributed more effectively.

While FinTech does have the transformative role, challenges continue to exist. Digital literacy, access to reliable internet, and affordability of FinTech services are still some of the major barriers in many countries. Policymakers must emphasis on refining infrastructure, providing education, and promoting fair competition in the FinTech sector to feat its potential. The impacts of institutional quality (corruption) and FinTech on income inequality are significant but separate. Corruption worsens IIQ by unfair resource allocation, thus, tackling corruption requires healthy institutions and reorganizations that promote transparency and accountability.

By studying these two independent variables' direct links with IIQ, the present study aims to examine the impacts of FinTech and IQC on IIQ, by addressing the direct links of these two key factors in order to provide a detailed understanding of their contributions separately in various regional and contextual settings.

For this present study, the most relevant theory is by A. Demir et al. (2022), because it emphasizes how FinTech enhances financial inclusion by bridging the gap between underserved populations and formal financial systems. This aligns directly with the current research's focus on FinTech as a tool to reduce IIQ by providing economic opportunities to marginalized groups. Examples like mobile banking and microfinance are particularly relevant in developing countries, where financial inclusion has shown significant potential to improve economic equity. This research fits in this theory because, the research topic examines the effect of FinTech adoption on IIQ. By building on Demir's argument, it can be explored how FinTech services, such as mobile wallets and microfinance, contribute to narrowing income inequality. This study will validate or expand Demir's findings by analyzing the context of developing economies and

evaluating the role of regulatory frameworks and infrastructure in maximizing FinTech's effectiveness.

For IQC, the theoretical foundation of Ali Hussein Samadi (2013)'s "Inequality Trap Theory" is the most relevant theory for the influence of IQC on IIQ. It is relevant because Samadi's theory captures how corruption exacerbates IIQ through a self-boosting sequence of inequality. Wealthy individuals' feat institutions to control resources and dodge taxes, while the poor face reduced opportunities and social mobility. This directly relates the focus on corruption's role in increasing IIQ by distorting resource allocation and institutional fairness. This research examines how institutional corruption perpetuates IIQ. By incorporating Samadi's inequality trap theory, it can be analyzed how corruption affects equitable resource distribution and perpetuates disparities. This aligns with the current research's goal to highlight the institutional reforms needed to break this cycle and ensure more inclusive economic growth.

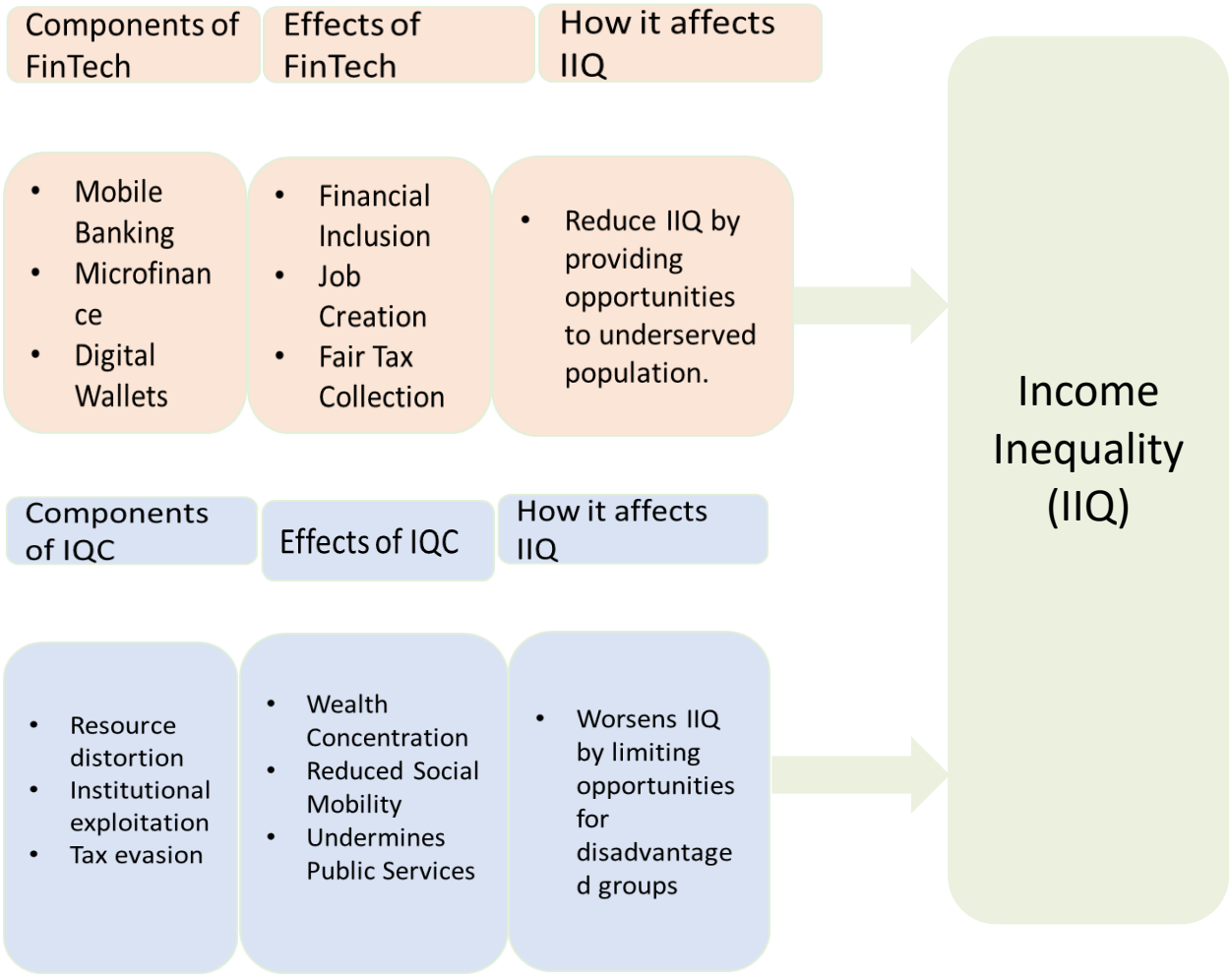

Figure 2 Mechanism Analysis

3.2 Estimation Strategies

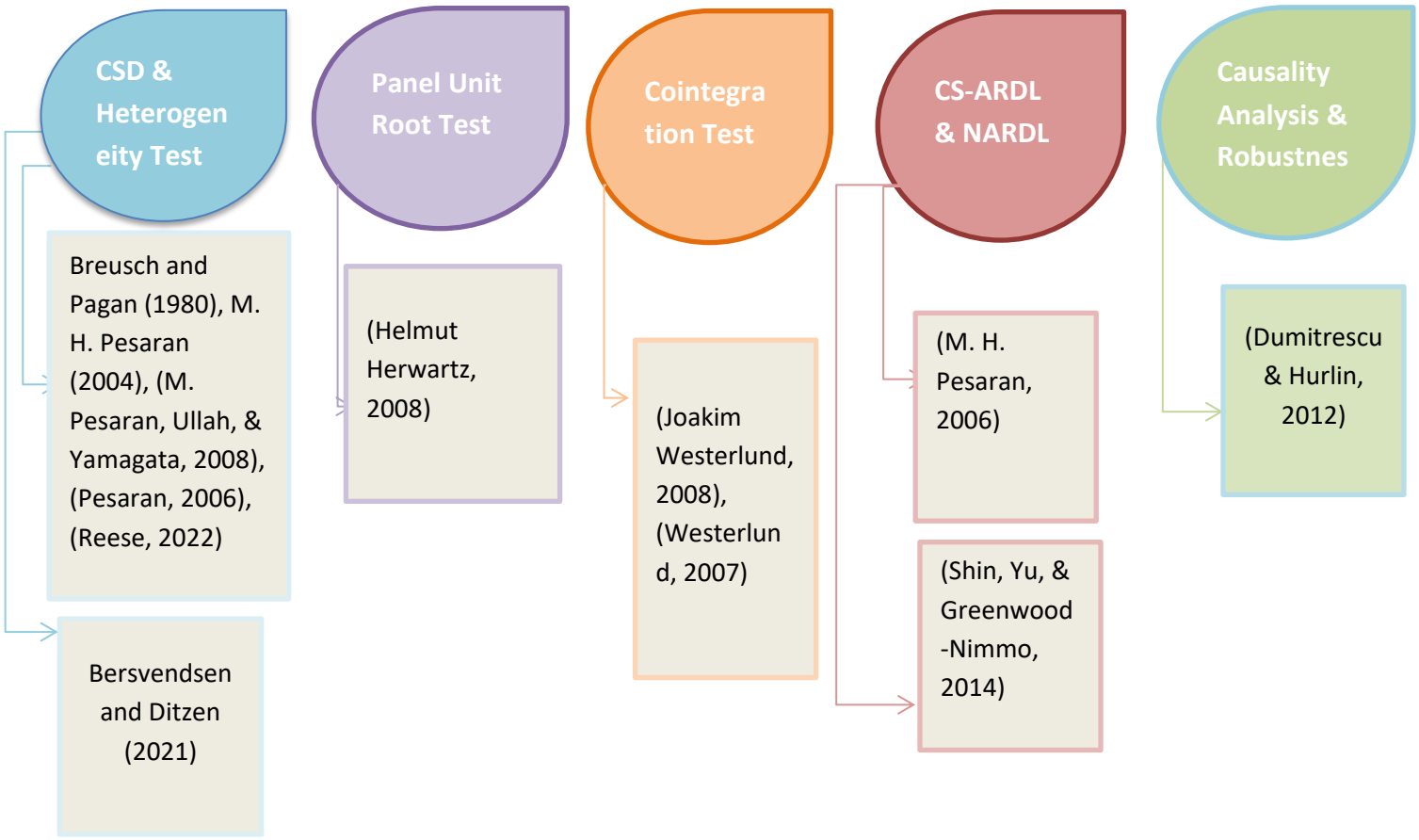

Figure 3 Estimation Strategies

3.2.1 Slope of Heterogeneity Test

The Slope of Heterogeneity test developed by Bersvendsen and Ditzen (2021) is designed to determine if there is significant variation in the slope coefficients across different cross-sectional countries, firms, regions in panel data models. The test checks whether the relationship between the independent variables and the dependent variable diverges systematically among the cross-sectional units. Unlike simpler SH testing techniques, which may ignore cross-sectional dependencies or structural breaks. Using this test incorporates advanced econometric models that capture these complexities, making it ideal for real-world data analysis. Its inclusion of the adjusted Delta Statistic further enhances its reliability by correcting for potential biases related to sample size and distribution, ensuring more accurate and empirically valid results. The Bersvendsen and Ditzen SH test is highly effective for examining whether the impact of independent variables differs across various units, such as countries or regions. For studies on the influence of FinTech on income inequality, this test helps identify variations in the relationship between urban and rural areas or among countries with differing levels of technological development. By highlighting significant differences in slope coefficients, the test supports

improved model selection, such as opting for random effects or multi-level models rather than assuming uniform effects. This insight enables policymakers to develop more precise and context-sensitive strategies, acknowledging that policy impacts can vary across different settings. Ultimately, the SH test offers a reliable approach for uncovering heterogeneity, providing deeper insights and facilitating more accurate, tailored research conclusions.

Slope of Heterogeneity test (Dumitrescu & Hurlin, 2012) equations are as follows:

The Delta Statistic is calculated as follows:

$$\Delta = \frac{\sum_{i=1}^{N}(b_i - \overline{b})^2}{\sum_{i=1}^{N}\sigma_i^2} \qquad \text{Equation 1}$$

The Adjusted Delta Statistic is calculated as follows:

$$\text{Adjusted } \Delta = \Delta \times (1 - \frac{1}{N}) \qquad \text{Equation 2}$$

3.2.2 Cross-Sectional Dependence (CSD) Test

Equations of Breusch and Pagan (1980), M. H. Pesaran (2004), M. Pesaran et al. (2008), M. H. Pesaran (2006) and Reese (2022) are used in this current study. These tests check whether countries in the panel data are interdependent, ensuring that any correlations between countries are properly accounted for to avoid biased results. In panel data models, this is critical as cross-sectional dependence can lead to biased estimates. The hypotheses test whether the residuals (errors) from different units are correlated or not, with implications for model validity. The present study involves multiple countries or regions, so exploratory cross-sectional dependence is important. The behavior of one country's fintech adoption or institutional quality may influence others, leading to cross-sectional dependence. The analysis ensures that such interdependencies are accounted for, preventing misleading conclusions about the effects of fintech and institutional quality The Bias-Corrected LM Test (CD_LM) is applied, particularly suitable for datasets with a large number of cross-sectional units (N) and a relatively short time series (T). This method is ideal for the study's structure, as it corrects biases in the test statistic and improves accuracy in analyzing such datasets on IIQ.

The original LM Test is better for situations with small N and large T, which doesn't fit the study's data structure. The Bias-Corrected LM Test was selected because it addresses the issue of large cross-sectional units and corrects for any biases in the test statistic that could arise from the panel's structure. CSD analysis helps identify any interdependencies across cross-sectional units, which can lead to more accurate modeling. It improves the reliability of results by ensuring that these dependencies do not bias the conclusions, making it more applicable for studies involving global datasets with potential cross-country influences.

Hypotheses for CSD Tests:

H_0: $\rho_{ij} = 0$ (No CSD among cross-sectional units)

H_1: $\rho_{ij} \neq 0$ (CSD exists among cross-sectional units)

If the test statistic is significant ($\rho<0.05$), reject null, indicating cross-sectional dependency.

If ($\rho\geq0.05$), fail to reject null, indicating no cross-sectional dependency.

Original LM Test (for small N, large T):

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \widehat{\rho_{ij}^2} \qquad \text{Equation 3}$$

Bias-Corrected LM Test (for large N, small T):

$$CD_{LM} = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{jj} \qquad \text{Equation 4}$$

Variance-Adjusted LM Test (for very large N):

$$CD_{LM} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=j+1}^{N} \left[\frac{(T-K)\hat{\rho}_{ij}^2}{\hat{v}_{ij}^2}\right] \qquad \text{Equation 5}$$

Compute Residuals:

$$\epsilon_{i,t} = IIQ_{i,t} - \left(\alpha_i + \beta_1 FT_{i,t} + \beta_2 IQC_{i,t}\right) \qquad \text{Equation 6}$$

Pairwise Correlation Coefficient:

$$\widehat{\boldsymbol{\rho_{ij}}} = \frac{\boldsymbol{\Sigma_{t=1}^{T}(\epsilon_{i,t}-\bar{\epsilon}_i)(\epsilon_{j,t}-\bar{\epsilon}_j)}}{\boldsymbol{\sqrt{\Sigma_{t=1}^{T}(\epsilon_{i,t}-\bar{\epsilon}_i)^2 \Sigma_{t=1}^{T}(\epsilon_{j,t}-\bar{\epsilon}_j)^2}}} \qquad \text{Equation 7}$$

CD Test Statistic:

$$\boldsymbol{CD} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \widehat{\boldsymbol{\rho_{ij}}} \qquad \text{Equation 8}$$

Lagged Model:

$$IIQ_{i,t} = \alpha_i + \beta_1 FT_{i,t} + \beta_2 IQC_{i,t} + \gamma IIQ_{i,t-1} + \epsilon_{i,t} \qquad \text{Equation 9}$$

Combined Model- $IIQ_{i,t} = \alpha_i + \beta_1 FT_{i,t} + \beta_2 IQC_{i,t} + \epsilon_{i,t}$

FinTech Model - $IIQ_{i,t} = \alpha_i + \beta_1 FT_{i,t} + \epsilon_{i,t}$

IQ-corruption Model - $IIQ_{i,t} = \alpha_i + \beta_2 IQC_{i,t} + \varepsilon_{i,t}$

3.2.3 Unit Root Analysis

Unit root analysis tests of Helmut Herwartz (2008) are used in this current study to see whether a time series is stationary or exhibits a unit root, implying that the series has a persistent shock. Non-stationary data can lead to spurious regression results. The Augmented Dickey-Fuller (ADF) test and Cross-Sectionally Augmented Dickey-Fuller (CADF) tests are used to check for unit roots and correct for cross-sectional dependence in panel data. Unit root tests are critical for ensuring the stationarity of the time series data used in the study. Non-stationary data could lead to misleading conclusions regarding the effects of Fintech and Institutional Quality-Corruption on income inequality. By performing unit root tests, the study ensures that the relationships being modeled are valid and based on stationary data.

There is usage of CIPS as it corrects the CSD commonly found in panel data, because the data may display dependence between countries this test is more appropriate than traditional unit root tests like ADF or CADF, which do not account for cross-sectional dependencies. The ADF test was not chosen because it does not account for cross-sectional dependence, which is a potential issue in panel data with multiple countries. The CIPS test, which incorporates cross-sectional averages, is a better fit as it handles cross-sectional dependencies more effectively. Unit root analysis ensures that the data being analyzed is stationary, which is a prerequisite for valid econometric modeling.

For Individual Testing (ADF Equation):

$$\triangle Y_{i,t} = \mu_i + \theta_i Y_{i,t-1} + \sum_{k=1}^{p} \phi_{ik} \triangle Y_{i,t-k} + \epsilon_{it} \quad \text{Equation 10}$$

For Cross-Section Dependence Correction (CADF):

$$\Delta Y_{i,t} = \mu_i + \theta_i Y_{i,t-1} + \gamma_i \overline{Y_{t-1}} + \sum_{k=1}^{p} \phi_{ik} \Delta Y_{i,t-k} + \tau_t + \epsilon_{it} \quad \text{Equation 11}$$

Where, Cross sectional average of the series is: $\overline{Y_{t-1}} = \frac{1}{N} \sum_{i=1}^{N} Y_{i,t-1}$ Equation 12

Cross-Sectionally Augmented IPS Test (CIPS):

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} CADF_i \quad \text{Equation 13}$$

3.2.4 Panel Cointegration Test

Cointegration analysis by Westerlund (2007), examines test examines whether FinTech, institutional quality, and income inequality move together over time, indicating a long-term relationship between these variables. It helps determine whether these variables co-move over time, suggesting a stable long-term effect, or if they are independent of each other in the long run.

The study uses Westerlund's Cointegration Regression, which is robust for handling panel data with cross-sectional dependence. Given the complex interdependencies between fintech, institutional quality, and income inequality, Westerlund's method is preferred because it accounts for multiple variables and provides more accurate results in the presence of cross-sectional dependence. Cointegration analysis allows the study to uncover long-term equilibrium relationships between the variables, crucial for understanding persistent effects. The Westerlund method's strength lies in its ability to handle panel data with cross-sectional dependence, improving the reliability of long-run estimates. Other cointegration methods might not account for cross-sectional dependence or may be less robust in panel data settings. Westerlund's test was chosen for its ability to handle panel data effectively and provide more reliable long-run relationships.

Westerlund's Cointegration Regression:

$$\Delta Z_{it} = \acute{\partial}_i d_i + \phi_i Z_{i,t-1} - \acute{\delta}_ı W_{i,t-1} + \sum_{r=1}^{p} \phi_{i,r} \Delta Z_{i,t-r} + \sum_{r=0}^{p} \gamma_{i,j} \Delta W_{i,t-r} + \epsilon_{i,t} \quad \text{Equation 14}$$

Group Mean Test:

$$G_T = \frac{1}{N} \sum_{i=1}^{N} \frac{\phi_i}{SE(\phi_i)} \quad \text{Equation 15}$$

Group Mean Augmented Test:

$$G_a = \frac{1}{N} \sum_{i=1}^{N} T\phi_i(1) \quad \text{Equation 16}$$

Panel Test:

$$P_T = \frac{\phi}{SE(\phi)} \quad \text{Equation 17}$$

Panel Augmented Test:

$$P_a = T\phi \quad \text{Equation 18}$$

3.2.5 Long-run and Short-run Coefficients: CS-ARDL and NARDL

The Panel CS-ARDL (Cross-Sectional Autoregressive Distributed Lag) model by Pesaran (2006) is used for examining both short-run and long-run relationships between variables in a panel data setting. It combines dynamic short-term adjustments with long-term equilibrium relationships, useful for understanding the cumulative effects over time. This analysis is necessary for the study because it provides a comprehensive understanding of the long-term impact of fintech adoption and institutional quality-corruption on income inequality, while also capturing short-term dynamics. It helps reveal how these factors evolve over time and interact with each other.

The study used the CS-ARDL specification because it is well-suited for panel data with potentially mixed order of integration (stationary and non-stationary series). This model also handles cross-sectional averages, which are essential for ensuring that country-specific effects are correctly captured, especially when cross-country interdependencies exist. Prior techniques like simple static models would not capture the dynamic relationships and could miss important short-term effects. The CS-ARDL model is chosen because it effectively captures both the short-term adjustments and the long-term relationships, which is crucial for the present study's focus on FinTech and Institutional Quality-Corruption. The CS-ARDL model's primary advantage is its ability to handle dynamic short- and long-term relationships in panel data. It allows for a flexible structure where both long-run equilibrium and short-run adjustments can be analyzed simultaneously, making it ideal for examining complex relationships over time.

The Panel NARDL (Nonlinear Autoregressive Distributed Lag) model by Shin et al. (2014), employed in this research to analyze the asymmetric effects of FinTech adoption (FT) and institutional quality corruption (IQC) on income inequality (IIQ) over time. This test is particularly suitable for exploring whether positive and negative changes in these variables have different impacts on IIQ. It captures both short- and long-term dynamics and allows for nonlinearity in the relationships. Similar to the CSD test, the Panel NARDL model ensures that the analysis reflects real-world complexities, such as varying effects across contexts, leading to more nuanced and reliable conclusions. Using the Panel NARDL model in this current research on FinTech and IQC's role in reducing IIQ is advantageous because it captures asymmetric effects, handles nonstationary data, and incorporates both long-run and short-run dynamics. It also accommodates differences across countries or regions, providing a robust and comprehensive analysis. This helps in understanding how improvements or declines in FinTech and institutional quality impact income inequality.

Panel CS-ARDL Equation:

Long-Run Model:

$$IIQ_{it} = \alpha_i + \sum_{j=1}^{P} \beta_{ij} IIQ_{i,t-j} + \sum_{j=0}^{q} \gamma_{ij} FT_{i,t-j} + \sum_{j=0}^{q} \delta_{ij} IQC_{i,t-j} + \acute{\omega}_t G_t + \epsilon_{it} \quad \text{Equation 19}$$

Cross-sectional mean of intercepts: $\alpha_i = \frac{1}{N}\sum_{i=1}^{N}\alpha_i$

Mean of lagged income inequality: $IIQ_{t-j} = \frac{1}{N}\sum_{i=1}^{N} IIQ_{i,t-j}$

Mean long-run coefficient for lagged IIQ: $\beta_j = \frac{1}{N}\sum_{i=1}^{N}\beta_{ij}$

Mean of lagged FinTech adoption: $FT_{i-j} = \frac{1}{N}\sum_{i=1}^{N} FT_{i,t-j}$

Mean long-run coefficient for FT: $\gamma_j = \frac{1}{N}\sum_{i=1}^{N}\gamma_{ij}$

Mean of lagged institutional quality (corruption): $IQC_{t-j} = \frac{1}{N}\sum_{i=1}^{N} IQC_{i,t-j}$

Mean long-run coefficient for IQC: $\delta_j = \frac{1}{N}\sum_{i=1}^{N}\delta_{ij}$

Short-Run Model:

$$\Delta IIQ_{it} = \alpha_i + \xi_i(IIQ_{t-1} - \acute{\omega}_t(FT_{it-1} + IQC_{it-1})) + \sum_{j=1}^{p}\lambda_{ij}\Delta IIQ_{i,t-j} + \sum_{j=0}^{q}\gamma_{ij}\Delta FT_{i,t-j} + \sum_{j=0}^{q}\delta_{ij}\Delta IQC_{i,t-j} + \mu_{it}$$ Equation 20

Short-run coefficients of lagged changes in Income Inequality (IIQ): $\lambda_{ij} = \frac{\sum_{i=1}^{N}\Delta IIQ_{i,t-j}}{N}$

Short-run coefficients for lagged changes in FinTech (FT): $\gamma_{ij} = \frac{\sum_{i=1}^{N}\Delta FT_{i,t-j}}{N}$

Short-run coefficients for lagged changes in Institutional Quality-Corruption (IQC):

$\delta_{ij} = \frac{\sum_{i=1}^{N}\Delta IQC_{i,t-j}}{N}$

White noise error term for country i at time t: $\mu_{it} = \frac{\sum_{i=1}^{N}\epsilon_{i,t}}{N}$

Panel CS-ARDL with Cross-Sectional Averages:

To include accumulated cross-sectional averages:

$$G_t = IIQ_{it} - \alpha_i - \sum_{j=1}^{p}\beta_{ij}IIQ_{i,t-j} - \sum_{j=0}^{q}\gamma_{ij}FT_{i,t-j} - \sum_{j=0}^{q}\delta_{ij}IQC_{i,t-j}$$ Equation 21

Reparameterization for Error Correction Model (ECM):

$$\Delta IIQ_{it} = \alpha_i + \xi_i\left(IIQ_{it-1} - \acute{\omega}_t(FT_{it-1} + IQC_{it-1})\right) + \sum_{j=1}^{p}\lambda_{ij}\Delta IIQ_{i,t-j} + \sum_{j=0}^{q}\gamma_{ij}\Delta FT_{i,t-j} + \sum_{j=0}^{q}\delta_{ij}\Delta IQC_{i,t-j} + \mu_{it}$$ Equation 22

The panel NARDL equation can be expressed as:

$$\Delta IIQ_{it} = \beta_{0i} + \beta_{1i} IIQ_{t-1} + \beta_{2i} FT^{+}_{t-1} + \beta_{3i} FT^{-}_{t-1} + \beta_{4i} IQC^{+}_{t-1} + \beta_{5i} IQC^{-}_{t-1} + \sum_{j=1}^{p} \gamma_{ij} \Delta IIQ_{i,t-j} + \sum_{j=0}^{q} \gamma^{+}_{ij} \Delta FT^{+}_{i,t-j} + \sum_{j=0}^{q} \gamma^{-}_{ij} \Delta FT^{-}_{i,t-j} + \epsilon_{it}$$ Equation 23

Decompositions for FinTech (FT) and Institutional Quality-corruption (IQC):

Positive and Negative Changes in FinTech (FT):

Positive:

$$FT^{+}_{i} = \sum_{t=1}^{T} \max(\Delta FT_{it}, 0)$$

Negative:

$$FT^{-}_{i} = \sum_{t=1}^{T} \min(\Delta FT_{it}, 0)$$

Positive and Negative Changes in Institutional Quality-Corruption (IQC):

Positive:

$$IQC^{+}_{i} = \sum_{t=1}^{T} \max(\Delta IQC_{it}, 0)$$

Negative:

$$IQC^{-}_{i} = \sum_{t=1}^{T} \min(\Delta IQC_{it}, 0)$$

3.2.6 Causality Analysis

Causality analysis by Dumitrescu and Hurlin (2012) examines determine the direction and nature of the relationship between variables, such as whether fintech adoption or institutional quality (corruption) causes changes in income inequality or vice versa. This is important to understand the causal effects and to avoid drawing incorrect conclusions about correlations that may simply be coincidental. Causality analysis is crucial for understanding the direction of the relationships between FinTech, Institutional Quality-Corruption, and Income Inequality. It allows the study to determine not just if there is a relationship, but whether FinTech adoption or changes in IQC cause changes in income inequality, or if the relationship flows in the opposite direction. This helps establish a clearer understanding of the mechanisms through which these variables interact, which is key for policy recommendations.

The study uses the Mean Wald Statistic for causality because it is robust in panel data settings, capturing the average causality effects across all cross-sectional units (countries/regions). This statistic allows for testing the joint hypothesis of causality for the panel as a whole. The Standardized Z-statistic is then used to derive the significance of these causality effects under the null hypothesis of no causality, ensuring that the conclusions drawn are statistically robust.

Other techniques, such as Granger causality tests, may not be suitable for panel data with heterogeneity across units or potential cross-sectional dependencies. The Mean Wald Statistic and Standardized Z-statistic were chosen because they are tailored to handle the panel structure and are more reliable for making inferences about causality across large datasets with multiple cross-sectional units and time periods. The advantages of this causality analysis include its ability to test the direction of relationships in a panel context, offering insights into which variables influence others over time. The Mean Wald Statistic allows for testing causality across multiple cross-sectional units simultaneously, making it ideal for studies involving multiple countries. The Standardized Z-statistic helps ensure that the results are significant and that the null hypothesis (no causality) is adequately tested. Together, these methods provide a more comprehensive understanding of the causal dynamics between fintech, institutional quality, and income inequality.

The general panel causality equation is:

$$IIQ_{it} = \alpha_i + \sum_{k=1}^{P} \gamma_{ik} IIQ_{i,t-k} + \sum_{k=1}^{P} \beta_{ik} FT_{i,t-k} + \sum_{k=1}^{P} \delta_{ik} IQC_{i,t-k} + \mu_{it} \qquad \text{Equation 24}$$

Mean Wald Statistic

To test for causality across the panel, we compute the average Wald statistic across all cross-sections:

$$W_{Hnc}^{NT} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \qquad \text{Equation 25}$$

Standardized Z-statistic

The standardized Z-statistic is derived under the null hypothesis of no causality:

$$Z = \sqrt{N}\left[\frac{W_{Hnc}^{NT} - P}{\sqrt{2P}}\right] \qquad \text{Equation 26}$$

3.3 Data Definition and Proxy

In the study conducted by A. Demir, Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2020) investigated the direct and indirect effects of FinTech and IIQ via financial inclusion. Her concept was in developing countries, financial inclusion is mediated by FinTech decreases IIQ. She measured this effect by using Quantile Regression Analysis using digital banking and payment adoption rates and Gini Coefficients. The anticipated effects were that increased level of FinTech adoption nurtures economic inclusion, which further decreases IIQ. In a study based on Africa, B. B. Ashenafi, & Dong, Y. (2022), examined the role of FinTech in nexus of IIQ through formal financial inclusion. Their concept is FinTech enables formal banking access but it can make income disparities broader if unaided by robust policy measures. For measurement, they used cross-sectional data on financial institution penetration and poverty rates. Policymakers must balance promoting FinTech adoption with addressing underlying inequality drivers as FinTech without policy measures can exacerbate IIQ in Africa. By evaluating the impact of digital financial services on IIQ in 65 countries, Adugna (2024) established a concept that FinTech reduces income disparity by broadening credit access and nurturing competition with conventional banks. In the study, it was measured using Generalized Method of Moments (GMM) estimation using FinTech adoption metrics and Gini coefficients. Moreover, the anticipated effects were that, increased access to FinTech services decreases IIQ, especially among underserved population. In the study of Muhammad Irfan (2024) , he specifies the impact of FinTech on reducing IIQ globally. The concept of the study is proper investment on research and development in FinTech will improve FinTech's ability on lessening IIQ and poverty. They have performed panel data analysis on innovations of FinTech and income inequality metrics. The anticipated effects found were, adoption of FinTech promotes inclusive growth but without supportive infrastructure and policies, it has no or little impact on poverty and IIQ. Another study of Verma (2024) examines the effect of FinTech and financial inclusion on IIQ in Asian economies over the long term. The concept they specified is, financial inclusions, such as loans reduce inequality in the long run but it needs sustained efforts. They have used Pedroni Cointegration and ARDL models for assessing banking access and poverty headcounts. The effect they found by the assessment is policies that promote easy access to financial services boosts long term equitable economic results.

In case of IQ (corruption)'s impact on IIQ, a researcher analyzes the interplay between fair IQ and entrepreneurial activity across 100 countries (Haini, 2023). The concept behind this study is that fair IQ positively impacts entrepreneurship, but IQ (corruption) worsens IIQ. In order to measure it, researchers exploited rule of law, corruption perception index (CPI), and Gini coefficients. The anticipated effects found were high level of corruption in IQ weakens entrepreneurship, leading to increased level of income disparity. Another researcher Nam (2024), studies how IQ and trade openness both act to influence IIQ in ASEAN economies. The concept in this study is, IQ controls inequality-inducing effects of trade openness, resulting in an inverted U-shaped pattern. Researchers measured this impact using governance indicators, regulatory quality, and Gini coefficient. The effects found were IQ with less or no corruption reduces IIQ

by nurturing equitable trade policies. Another study by I. Z. Khan, Ruoyu; Han, Lei; Khan, Hayat (2024), showed that IQ's role in influencing CO_2 emissions and income inequality in Belt and Road Initiative countries. Robust legal and political schemes diminish inequality but require active governance frameworks. Measurements were done using corruption metrics, FDI levels, and Gini coefficients. They found that corrupted institutional quality aggravates environmental and income inequalities. The following study was conducted for Africa by Kunawotor (2020). It evaluates how governance quality impacts income distribution across African nations. Control of corruption and rule of law significantly reduce income inequality. The measurements were done using African Governance Indicators, poverty headcounts, and Gini coefficients. Institutional reforms and anti-corruption measures are critical for equitable economic growth. The study of Brandao (2024), evaluates the influence of IQ (corruption) on IIQ in Brazil, Argentina, and other Latin American countries. Their concept is control of corruption reduces IIQ in middle-income countries. They used governance indicators, FDI levels, and income distribution data to measure it. They have found that supported anti-corruption measures reduce income disparities.

Table 4 Data Definition and Proxy

Variables	Proxy	Authors	Data Sources
FinTech	Digital financial inclusion, FinTech adoption, FinTech credit volume, Internet access	(A. Demir, Pesqué-Cela, V., Altunbas, Y., & Murinde, V., 2020)	Global Findex Database
	Mobile banking usage, digital payment transactions	(B. B. Ashenafi, & Dong, Y., 2022)	Supply and demand-side financial datasets
	Digital tools adoption rates, regulatory quality	(Adugna, 2024)	Panel data on FinTech usage across 65 countries
	FinTech credit, financial innovations	(Muhammad Irfan, 2024)	Multinational data from global financial inclusion reports
	Financial inclusion indicators (bank branches, accounts, loans)	(Verma, 2024)	World Bank Financial Inclusion and Inequality Data
IQ (corruption)	Rule of Law, Corruption Perception Index (CPI), Governance Indicators	(Haini, 2023)	World Bank, Transparency International
	Corruption Levels, Political Stability, Rule of Law	(Nam, 2024)	World Governance Indicators
	Control of Corruption, Legal System Quality	(I. Z. Khan, Ruoyu; Han, Lei; Khan, Hayat, 2024)	Political Stability Dataset, Legal Quality Metrics
	Control of Corruption, Rule of Law	(Kunawotor, 2020)	African Development Bank, IMF Governance Dataset
	GINI Coefficient Index	(Ali Hussein Samadi, 2013)	UNU-WIDER database (WIID)
IIQ	Gini Coefficient, Poverty Headcount, Wealth Distribution	(Haini, 2023), (Nam, 2024)	World Development Indicators
	Distribution of Income by Quintiles, Economic Access Metrics	(Brandao, 2024)	Latin American Development Bank
	Regional Wealth Inequality Metrics	(Jochen Hartwig, 2024)	IMF and World Bank regional statistics
	Gini coefficient, Urban-rural income distribution gap, Poverty levels	(A. Demir, Pesqué-Cela, V., Altunbas, Y., & Murinde, V., 2020), (Adugna, 2024)	World Development Indicators
	Regional income disparities, social inequality indices	(B. B. Ashenafi, & Dong, Y., 2022), (Abebe Gule Girma, 2024)	IMF and World Bank regional reports

Chapter 04: Estimation and Interpretation

The SH test, developed by Bersvendsen and Ditzen (2021), assesses the slope heterogeneity in panel data. In this context, it examines whether the relationship between FinTech and IQ-Corruption on income inequality (IIQ) remains consistent across different cross-sectional countries over time. The results indicate significant slope heterogeneity, as evidenced by the Delta Statistic (4.6529) and the Adjusted Delta Statistic (5.4082), both significant at the 1% level (***). This suggests that the impact of FinTech and IQ-Corruption on IIQ varies across different countries. Specifically, the relationship is not uniform, and there are significant changes over time or across countries, indicating that some countries might experience a stronger or weaker impact compared to others. These variations can result from differences in economic structures, levels of technological adoption, regulatory environments, and other country-specific factors.

Table 5 Slope of Heterogeneity Test ((***) at the 1% significance level (p < 0.01))

Panel B: Slope of Heterogeneity test- Bersvendsen and Ditzen (2021)			
	Delta Statistic	Adjusted Delta Statistic	SH exists
Model	4.6529***	5.4082***	Yes

The results of the cross-sectional dependency tests (in table 5) indicate a strong relationship between the variables studied—Income Inequality (IIQ), Financial Technology (FinTech), Institutional Quality (IQ), Good Governance (GG), Foreign Direct Investment (FDI), and Trade Openness (TO). These relationships are characterized by significant cross-sectional dependence, as revealed by consistently high statistics across all tests. Cross-sectional dependence implies that changes or shocks affecting one country or region are likely to have spillover effects on others due to interconnected economic and financial systems.

For IIQ, the Breusch and Pagan (1980) test yields a high statistic of (271.9), indicating strong dependence among countries, suggesting that factors influencing income inequality in one country are significantly linked to changes in others. Results from M. Pesaran et al. (2008), M. H. Pesaran (2004) are (41.798) and (226.348), respectively, ensuring the robustness of these connections. Test by M. H. Pesaran (2006) displays a lower statistic of (23.738), yet it remains highly significant, pointing to the persistence of shared trends. Test results by Reese (2022) present a statistic of (11.7078), emphasizing dependencies, even though it has less intensity compared to other tests.

In case of FinTech, a statistic of (382.937) shows huge dependencies, indicating that FinTech adoption and its effects are largely unified across various countries. This is because of the global nature of technological innovations and increase in the adoption of digital financial systems across the world. Pesaran's tests (2004: 23.548 and 2008: 193.935), along with Juodis and Reese

(2022: 9.1333), supports the interrelatedness despite having varying degrees. The meaning of these dependencies suggests that adoption of FinTech in one country or region creates a standard that influences other countries to adopt and innovate financial inclusion as well.

In case of IQC (in table 6), it also shows large cross-sectional dependence indicated by the high statistics across all the tests. In Breusch and Pagan (1980) test results, a statistic of (364.83), while Pesaran's tests (2004: 15.438 and 2008: 205.487) indicates that governance frameworks, rule of law, and IQC are not limited in one country but influenced by global or regional governance trends. The high statistic from Pesaran (2006: 49.328), in relation to other variables suggests that governance matters are vulnerable to spillover effects because of global regulatory structures or global transparency standards.

GG (Good Governance) with significant values such as (220.091) under the Breusch and Pagan test shows that it's evident that governance practices in one country have a ripple effect on others. For example, regional governance collaborations, international standards, or donor-imposed reforms can create interdependencies.

FDI (Foreign Direct Investment) cross-sectional dependence (297.064) highlights the global interconnectedness of investment flows. An increase in FDI in one region can attract or divert investments in neighboring countries due to competition or complementary benefits.

Finally, Trade Openness (TO) demonstrates significant, albeit slightly lower, dependencies compared to other variables, with Breusch and Pagan (1980) reporting a statistic of (155.479). This highlights the critical role of globalization and trade interdependencies. Pesaran (2008: 143.919 and 2006: 34.323) confirm the interconnected nature of trade policies and their effects on economic dynamics. These results highlight those global shocks, such as financial crises, technological breakthroughs, or policy shifts, can significantly affect multiple regions simultaneously.

Table 6 Cross Sectional Dependency Test ((***) at the 1% significance level (p < 0.01))

	(Breusch and Pagan 1980)	Pesaran (2004)	Pesaran, Ullah et al. (2008)	Pesaran (2006)	Reese (2022)
IIQ	271.9***	41.798***	226.348***	23.738***	11.7078***
FINTECH	382.937***	23.548***	193.935***	6.849***	9.1333***
IQ	364.83***	15.438***	205.487***	49.328***	10.7795***
GG	220.091***	38.77***	167.657***	50.658***	10.8795***
FDI	297.064***	44.779***	212.289***	23.068***	8.7792***
TO	155.479***	29.736***	143.919***	34.323***	9.0078***

The unit root test results indicate whether the variables in the study are stationary, meaning their statistical properties like mean and variance remain consistent over time. Stationarity is crucial for reliable econometric analysis; non-stationary variables can lead to misleading regression results. The tests reveal that all variables—Income Inequality (IIQ), Financial Technology (FinTech), Institutional Quality (IQ), Good Governance (GG), Foreign Direct Investment (FDI), and Trade Openness (TO)—are non-stationary at their levels but become stationary after first differencing, as indicated by highly significant test statistics (***).

For Income Inequality (IIQ), the CADF test statistic at the level is (-2.585), while the first-difference value is (-2.402), indicating stationarity after differencing. Similarly, the CIPS test statistic changes from (-2.814) at the level to (-3.345) after differencing. In Helmut Herwartz (2008) test, it shows a dramatic shift from (1.4114) at the level to (6.1272) at the first difference. These results suggest that IIQ is influenced by persistent trends over time, requiring differencing to stabilize its variations.

In case of FinTech, CADF test at the level, the statistic is -2.65, not significant. At the first difference, it is -7.57***, showing significance. This means the original FinTech data has trends, but changes over time are consistent. CIPS test at the level, the statistic is -1.125, not significant. At the first difference, it is -5.21***, indicating significance. This supports the stability of changes over time. In Helmut Herwartz (2008) at the level, the statistic is 0.1522, not significant. At the first difference, it is 4.7666***, confirming that the trends become stable when looking at changes.

For institutional quality (IQ), its CADF test at the level, the statistic is -1.331, not significant. At the first difference, it is -6.026***, showing significance. This suggests that the data trends become consistent over time. Also, CIPS, at the level, the statistic is -1.904, not significant. At the first difference, it is -7.097***, indicating significance. This supports consistent changes over time. In Helmut Herwartz test, at the level, the statistic is -0.774, not significant. At the first difference, it is 4.2715***, confirming stability in changes.

For good governance (GG) CADF at the level, the statistic is -1.855, not significant. At the first difference, it is -6.578***, showing significance. This indicates that the data trends become stable over time. CIPS, at the level, the statistic is -2.844, not significant. At the first difference, it is -4.779***, indicating significance. This supports consistent changes over time. In Helmut Herwartz test, at the level, the statistic is 0.477, not significant. At the first difference, it is 4.6884***, confirming stability in changes.

For Good Governance (GG), the results indicate that at levels, the test statistics (CADF: -1.855, CIPS: -2.844, and Herwartz: 0.477) show non-stationarity, meaning GG has persistent trends or variations over time that make its statistical properties unstable. After first differencing, the test statistics (CADF: -6.578***, CIPS: -4.779***, and Herwartz: 4.6884***) are highly significant, indicating that the changes in GG over time are stable and consistent. This means the

original GG data reflects long-term trends, but analyzing its differences (rate of change) provides a reliable basis for understanding its impact.

Foreign Direct Investment (FDI) and Trade Openness (TO) also exhibit non-stationarity at the level but achieve stationarity after differencing. FDI's CADF statistic improves from (-2.66) to (-5.576), with similar changes in the CIPS (-1.616) to (-6.07) and Herwartz and Siedenburg tests (-0.6675) to (5.3847). For TO, the CADF statistic shifts from (-1.937) to (-3.141), with corresponding changes in CIPS (-2.014) to (-5.039) and Herwartz and Siedenburg (0.7029) to (6.6767). These trends reflect the dynamic interplay between globalization, economic openness, and foreign investment flows.

The transformation of variables from non-stationary to stationary after differencing indicates that these variables are subject to long-term trends driven by global economic, technological, and policy developments. For IIQ, the non-stationarity at the level suggests persistent disparities influenced by structural factors like wealth concentration and policy changes. After differencing, the focus shifts to more immediate, short-term adjustments in inequality levels. For FinTech, the dynamic nature of FinTech, driven by rapid technological advances and market adoption, explains its non-stationarity. Differencing accounts for these evolving trends, isolating the short-term impacts on income inequality. Both Institutional Quality and Good Governance are shaped by evolving policies and international collaborations, which introduce long-term variability. Differencing allows for analyzing more stable, short-term effects. FDI and TO are highly sensitive to global market fluctuations and policy changes. The stationarity achieved after differencing suggests that their short-term impacts are consistent and predictable once long-term trends are removed. All variables—Income Inequality (IIQ), Financial Technology (FinTech), Institutional Quality (IQ), Good Governance (GG), Foreign Direct Investment (FDI), and Trade Openness (TO)—exhibit persistent trends or patterns over time. This suggests that these factors are not static but evolve with structural changes, economic dynamics, or external shocks.

Table 7 Panel Unit Root Test

Variables	CADF test statistic		CIPS test statistic		Helmut Herwartz (2008)	
	Level	First Difference	Level	First Difference	Level	First Difference
IIQ	-2.585	-2.402***	-2.814	-3.345***	1.4114	6.1272***
FINTECH	-2.65	-7.57***	-1.125	-5.21***	0.1522	4.7666***
IQ	-1.331	-6.026***	-1.904	-7.097***	-0.774	4.2715***
GG	-1.855	-6.578***	-2.844	-4.779***	0.477	4.6884***
FDI	-2.66	-5.576***	-1.616	-6.07***	-0.6675	5.3847***
TO	-1.937	-3.141***	-2.014	-5.039***	0.7029	6.6767***

The panel cointegration test examines whether a long-term relationship exists among the variables in the study despite short-term fluctuations. The results of the test reveal statistically significant cointegration across all scenarios—no shift, mean shift, and regime shift—indicating that variables such as FinTech, Institutional Quality (IQ), Income Inequality (IIQ), and others in the model maintain a stable, long-term equilibrium relationship even when there are changes in average levels or structural breaks. Under the "no shift" model, both the LMτ (-4.8774), and LMΦ (-4.3202), show high statistical significance at the 1% level. This indicates that even without accounting for potential changes in the data, the variables in the model (FinTech and IQ impacting IIQ) are tightly linked and move together in the long run. When considering a mean shift, the LMτ (-3.5992), and LMΦ (-2.1873) remain statistically significant. This implies that even if there are shifts in the average levels of the variables, such as changes in the baseline levels of IIQ or FinTech, the long-term relationship persists. The stability indicates that economic or policy interventions influencing average trends do not disrupt the inherent relationship between these variables. For the regime shift model, the LMτ (-4.3825), and LMΦ (-4.9891) remain highly significant. This suggests that even during structural changes or major policy shifts such as technological disruptions, changes in governance, or global economic crises, the relationship between variables remains intact. The stability across regime shifts is particularly important as it emphasizes resilience in the relationships, allowing policymakers to plan for long-term outcomes despite changing external conditions.

The additional panel test statistics Gt (-8.19) and Ga (-8.888) for group mean, and Pt (-10.036) and Pa (-15.599) for panel statistics, assures further existence of cointegration. The assurance is that the variables not only exhibit long-term relationships at the individual country but also collectively as a panel. The robustness of these test results is supported by the consistently significant values. These values confirm the relations and connections between FinTech, IQC, and IIQ, indicating for long-term policy modeling. These results suggest that long-term interventions targeting FinTech adoption or governance improvements are likely to yield sustainable impacts on income inequality, even amidst economic transitions or policy changes.

Table 8 Panel Cointegration Test-Model 1

Panel Cointegration Test- Model 1	Test Statistic	No Shift	Mean Shift	Regime Shift
	LMτ	-4.8774***	-3.5992***	-4.3825***
	LMΦ	-4.3202***	-2.1873***	-4.9891***

Additional Panel Test Statistics-	Value
Gt	-8.19***
Ga	-8.888***
Pt	-10.036***
Pa	-15.599***

Table 10 shows the results of the CS-ARDL model, which looks at the long-run and short-run impacts of different factors on income inequality.

In the long run, financial technology (FinTech) has a negative coefficient of -0.0492, which means that an increase in FinTech is associated with a decrease in the dependent variable. This result is statistically significant, as shown by the high t-statistic (-12.6153). In the short run, the coefficient is 0.026, meaning that an increase in FinTech slightly increases income inequality. This suggests that initially, FinTech development might widen the income gap before its long-term benefits are realized. This may occur due to initial access disparities, where urban or affluent populations adopt FinTech tools faster than rural or low-income groups. However, as FinTech scales and becomes more inclusive, its long-run effects reduce inequality

The long-run coefficient of IQ is 0.0488, indicating that better institutional quality increases income inequality. This implies that in the long run, improvements in institutional quality might inadvertently widen the income gap. IQ has a negative short-run coefficient of -0.0432, indicating that in the short term, higher IQ levels correlate with a decrease in the dependent variable, with a significant t-statistic of -18.7826. This indicates that in the short term, improvements in institutional quality help reduce income inequality by 4.32%. This suggests that immediate interventions, such as policy enforcement or anti-corruption measures, can yield quick and positive results.

Looking at Good Governance (GG), the long-run coefficient is -0.1402 with a standard error of 0.0093 and a t-stat of -15.0752, which suggests that good governance significantly reduces income inequality in the long-run. This means better governance helps in making income distribution more equitable over time. In the short-run, the coefficient is -0.0508 with a standard error of 0.01 and a t-stat of -5.08, indicating a smaller but still significant reduction in income inequality. Showing that good governance reduces income inequality in the short run, though the effect is smaller compared to the long run.

The coefficient of FDI is -0.0638, indicating that higher FDI leads to a decrease in income inequality in the long run. This suggests that attracting foreign investments can help reduce income gaps. A unit increase in FDI reduces income inequality by 6.38%. This suggests that foreign investments contribute to reducing income gaps by creating employment opportunities and fostering economic growth in developing sectors. FDI has a short-run negative coefficient of -0.0408, indicating a similar effect where increased FDI leads to a decrease in the dependent variable, with a t-statistic of -7.0344. The coefficient is -0.0408, indicating that higher FDI reduces income inequality in the short run, which aligns with its long-term effect.

Trade Openness (TO) has a substantial positive short-run coefficient of 0.0725, suggesting that increases in trade openness are strongly associated with increases in the dependent variable, with a t-statistic of 38.1578. The coefficient is -0.1307, showing that more trade openness reduces

income inequality in the long run. This implies that engaging in international trade helps in balancing income distribution. A unit increase in trade openness reduces income inequality by 13.07%. This underscores the potential of international trade to provide diverse opportunities and income sources for various economic groups, promoting more balanced wealth distribution

The Error Correction Term (ECT) has a negative coefficient of -0.1499, indicating that deviations from the long-run equilibrium will correct over time, with a strong t-statistic of -28.283. The diagnostic tests show that the model passes key checks: the cross-sectional dependence (CD) test result is 0.021933, suggesting minimal issues with cross-sectional dependence; the Wooldridge test for autocorrelation gives a value of 0.483303, implying no significant autocorrelation; the normality test value of 0.760706 indicates that the residuals are approximately normally distributed; and the Ramsey RESET test value of 0.596638 suggests that the model is well-specified without omitted variable bias. This indicates that approximately 15% of any deviation from the long-run equilibrium is corrected in each period. It confirms that the model rapidly adjusts to restore balance after short-term shocks, emphasizing the stability of the relationships among these variables.

Table 9 Long-run and Short-run coefficients: CS-ARDL

	Coefficient	Std. Error	t-stat		Coefficient	Std. Error	t-stat
Long-run				Short-run			
FinTech	-0.0492	0.0039	-12.6153	FinTech	0.026	0.0108	2.4074
IQ	0.0488	0.0035	13.9428	IQ	-0.0432	0.0023	-18.7826
GG	-0.1402	0.0093	-15.0752	GG	-0.0508	0.01	-5.08
FDI	-0.0638	0.0085	-7.5058	FDI	-0.0408	0.0058	-7.0344
TO	-0.1307	0.0086	-15.1976	TO	0.0725	0.0019	38.1578
C	0.0659	0.0044	14.9772	ECT	-0.1499	0.0053	-28.283
CD test				0.021933			
Wooldridge Test for autoco				0.483303			
Normality test				0.760706			
Remsey RESET test				0.596638			

The NARDL (Nonlinear Autoregressive Distributed Lag) model results reveal asymmetry in the long-run and short-run impacts of FinTech, Institutional Quality (IQ), Green Growth (GG), Foreign Direct Investment (FDI), and Trade Openness (TO) on Income Inequality (IIQ). The

asymmetry indicates that positive and negative changes in these variables influence IIQ differently. The Error Correction Term (ECT) also shows the adjustment speed toward long-run equilibrium after any shock.

Positive changes (FINTECH+): A 1-unit increase in FinTech reduces IIQ by 0.1203 (coefficient: -0.1203; t-stat: -7.7612), suggesting that advancements in FinTech lead to a significant reduction in income inequality.

Negative changes (FINTECH-): A 1-unit decline in FinTech increases IIQ by 0.1441 (coefficient: -0.1441; t-stat: -5.9057). The larger magnitude compared to FINTECH+ highlights that a drop in FinTech has a stronger adverse effect on inequality than its positive changes reduce it.

Positive changes (IQ+): A 1-unit improvement in IQC increases IIQ by 0.093 (coefficient: 0.093; t-stat: 2.5905). This counterintuitive result suggests that institutional reforms may initially favor the wealthy, exacerbating inequality in some cases.

Negative changes (IQ-): A 1-unit decline in IQ also increases IIQ by 0.0962 (coefficient: 0.0962; t-stat: 4.3727). While both positive and negative changes raise inequality, the effects are relatively symmetric in the long run.

GG has a significant long-run negative relationship with IIQ (coefficient: -0.0945; t-stat: -3.0681). A 1-unit increase in GG reduces inequality by approximately 0.0945. This indicates that sustainable practices and environmentally conscious policies contribute to narrowing income disparities. FDI exhibits a strong negative impact on IIQ (coefficient: -0.1463; t-stat: -5.3786). A 1-unit increase in FDI reduces inequality by 0.1463. This reflects the role of FDI in creating jobs, improving infrastructure, and fostering economic inclusivity. TO reduces IIQ significantly in the long run (coefficient: -0.1478; t-stat: -4.0272). A 1-unit increase in TO lowers inequality by 0.1478, suggesting that global trade integration can bring broader economic benefits and reduce wealth concentration.

Positive changes in FinTech (FINTECH+): The short-run coefficient is 0.0055 (t-stat: 0.9322), indicating a negligible impact on IIQ. Negative changes (FINTECH-): A 1-unit decline in FinTech increases IIQ by 0.0317 (coefficient: -0.0317; t-stat: -5.9811), showing that the adverse effects of FinTech reductions are more pronounced in the short run.

Positive changes (IQ+): The short-run coefficient is -0.0511 (t-stat: -8.9649), indicating that institutional reforms initially reduce inequality, contrasting with long-run findings. Negative changes (IQ-): A 1-unit decline in IQ increases IIQ by 0.0506 (t-stat: -6.6578), reflecting a significant short-term adverse effect.

GG has a positive short-run effect on IIQ (coefficient: 0.0316; t-stat: 8.7777). This suggests that while GG reduces inequality in the long term, it may require time for policies to translate into

equitable outcomes. FDI positively affects IIQ in the short run (coefficient: 0.0338; t-stat: 13.52). This indicates that while FDI eventually reduces inequality, initial stages might favor wealthier segments due to capital intensity. TO has a significant positive short-run effect on IIQ (coefficient: 0.0294; t-stat: 6.5333), suggesting that trade liberalization initially exacerbates inequality before stabilizing in the long run.

The ECT coefficient is -0.339 (t-stat: -39.882), indicating that approximately 33.9% of any short-term disequilibrium is corrected in each period. This demonstrates a relatively rapid adjustment to the long-run equilibrium. The NARDL model results emphasize the importance of both direction and magnitude of changes in economic variables on IIQ. Positive advancements in FinTech, IQ, and other factors can significantly alter inequality patterns over different time horizons. The findings provide a nuanced understanding of how policy interventions can address income disparities effectively.

Table 10 Asymmetric Long-run and Short-run Coefficients: NARDL

	Long-run			Short-run		
Variables	Coefficient	St. error	t-stat	Coefficient	St. error	t-stat
FINTECH+	-0.1203	0.0155	-7.7612	0.0055	0.0059	0.9322
FINTECH-	-0.1441	0.0244	-5.9057	-0.0317	0.0053	-5.9811
IQ+	0.093	0.0359	2.5905	-0.0511	0.0057	-8.9649
IQ-	0.0962	0.022	4.3727	-0.0506	0.0076	-6.6578
GG	-0.0945	0.0308	-3.0681	0.0316	0.0036	8.7777
FDI	-0.1463	0.0272	-5.3786	0.0338	0.0025	13.52
TO	-0.1478	0.0367	-4.0272	0.0294	0.0045	6.5333
ECT				-0.339	0.0085	-39.882
$W_{FinTecH}$		8.1285			9.8202	
W_{EX}		10.1482			14.0322	

The causality test results reveal how various factors influence income inequality (IIQ). These results show the relationships between IIQ and other key variables like FinTech, Institutional Quality (IQ), Good Governance (GG), Foreign Direct Investment (FDI), and Trade Openness (TO). Understanding these relationships helps us see how changes in one area can affect others, highlighting the interconnections within economic and institutional systems.

The causality test shows that changes in FinTech significantly affect IIQ with a test statistic of (3.0807), indicating a causal relationship. The high t-statistic for FinTech implies that advancements in financial technology contribute to reducing income inequality by enabling broader access to financial services and digital inclusion. Institutional Quality (IQ) influences IIQ with a statistic of 1.3113, although the effect is weaker compared to FinTech. This suggests

that while institutional reforms play a role in addressing income disparities, their influence may be more indirect or slower to manifest. The relationship between Good Governance (GG) and Income Inequality (IIQ) is significant, with a test statistic of 3.6323. This suggests that improvements in governance positively impact income equality. Good governance ensures effective public institutions, fair distribution of resources, and reduced corruption, all of which contribute to narrowing income disparities. For instance, well-functioning governance systems promote transparency and inclusivity, leading to policies that benefit marginalized populations and foster equality. Foreign Direct Investment significantly influences IIQ as indicated by a statistic of 1.2879, albeit with a moderate effect. FDI drives economic activity and can help reduce disparities, but its benefits depend on equitable distribution and local labor market conditions. The strongest causality is observed between Trade Openness and IIQ, with a highly significant statistic of (4.9309). This highlights the role of global trade in shaping income patterns by creating jobs, driving growth, and fostering competitive markets. FinTech is significantly influenced by IQ (3.5026), indicating that strong institutions support FinTech adoption and functionality. FDI also affects FinTech with a statistic of (4.6865), suggesting that foreign investments contribute to technological advancements in finance. A weaker but notable influence comes from TO (2.1912), indicating that open trade policies help foster FinTech innovations. IIQ strongly influences IQ with a statistic of (2.7534), highlighting the reciprocal relationship between income distribution and institutional quality. FinTech (6.035) and Good Governance (5.6471) have a substantial impact on Institutional Quality (IQ), reflecting how technological and governance initiatives drive institutional improvements. FDI's effect on IQ is also significant (3.4229), showing the role of foreign investments in shaping governance and institutional frameworks. IIQ significantly affects Good Governance (4.2646), demonstrating how inclusive economic policies can enhance governance efforts. FinTech (6.2051), IQ (5.8214), and FDI (3.832) also drive Good Governance, reflecting their collective impact on institutional development and sustainability. IIQ influences FDI with a statistic of (2.0839), indicating that equitable income distribution can attract foreign investments. FinTech (4.2656) and TO (4.2837) play crucial roles in driving FDI, reflecting the interconnected nature of economic variables. IIQ strongly affects TO (4.7268), highlighting the importance of equitable growth in fostering global trade. IQ (3.9362), GG (4.6896), and FDI (2.3995) also significantly influence TO, demonstrating the role of institutions, sustainability, and foreign investments in enhancing trade openness.

Improvements in FinTech reduce income inequality by increasing financial inclusion and access to digital platforms. However, when FinTech adoption lags, disparities can widen due to unequal access to technological benefits. Stronger institutions help reduce inequality by fostering transparency, accountability, and better economic policies. Conversely, weak institutions exacerbate disparities by failing to address corruption and inefficiencies. Good Governance initiatives create employment opportunities and improve resource management, which helps to reduce inequality. However, regions with inadequate investments in good governance might miss out on these benefits, leading to increased disparities. Foreign Direct Investment (FDI) can

reduce inequality when it generates employment and enhances local industries. This shows how important it is for regions to invest in good governance and attract FDI to create a fairer and more equitable society. Yet, without proper policies, FDI benefits might be concentrated among specific groups, limiting its broader impact. Openness to trade reduces inequality by enabling economic growth and diversification. Nonetheless, initial liberalization phases may disproportionately benefit higher-income groups, emphasizing the need for policies ensuring equitable benefits.

The causality test reveals a web of interdependent relationships between IIQ and variables such as FinTech, IQ, GG, FDI, and TO. Positive changes in these variables tend to reduce income inequality, while negative changes or stagnation exacerbate disparities. These findings emphasize the importance of integrated policies that leverage FinTech innovations, institutional reforms, good governance, foreign investments, and global trade for equitable economic development.

Table 11 Causality Test

	IIQ	FinTech	IQ	GG	FDI	TO
IIQ		(3.0807)**	1.3113	(3.6323)**	1.2879	(4.9309)***
		[3.2471]	[1.3821]	[3.8284]	[1.3575]	[5.1971]
FinTech	1.407		(3.5026)**	1.0712	(4.6865)**	(2.1912)*
	[1.4829]		[3.6918]	[1.129]	[4.9395]	[2.3096]
IQ	(2.7534)*	(6.035)***		(5.6471)***	(3.4229)**	1.2146
	[2.9021]	[6.3609]		[5.9521]	[3.6077]	[1.2802]
GG	(4.2646)**	(6.2051)***	(5.8214)***		(3.832)**	1.1647
	[4.4949]	[6.5401]	[6.1358]		[4.039]	[1.2276]
FDI	(2.0839)*	(4.2656)**	1.3931	1.0148		(4.2837)**
	[2.1964]	[4.496]	[1.4684]	[1.0696]		[4.515]
TO	(4.7268)**	0.8278	(3.9362)**	(4.6896)**	(2.3995)*	
	[4.9821]	[0.8725]	[4.1487]	[4.9429]	[2.5291]	

Mean Group (MG), Augmented Mean Group (AMG), and Cross-Sectionally Augmented ARDL (CS-ARDL) are examined in this robustness test which verifies the reliability of model estimates using these econometric approaches. These methods provide insights into the consistency of the relationships between variables such as FinTech, Exchange Rate Exposure (EXE), Good Governance (GG), Foreign Direct Investment (FDI), Trade Openness (TO), and Income Inequality (IIQ). Statistical tests like CD (Cross-Sectional Dependence), Wooldridge Autocorrelation, Normality, and Ramsey RESET ensure the models' validity and robustness.

Across all three estimation methods, FinTech demonstrates positive coefficients (MG: 0.0732, AMG: 0.0787, CS-ARDL: 0.1136) with significant t-statistics (15.5744, 24.5937, and 20.2857,

respectively). It means that a higher level of using financial technology contributes in improving the standard of living of people, which leads to economic development. However, the relatively higher coefficient in the CS-ARDL model indicates a more substantial effect when controlling for cross-sectional dependencies. The t-statistics (15.5744, 24.5937, 20.2857) highlight the strength and consistency of this relationship, supported by relatively small standard errors. This finding aligns with studies such as A. Demir et al. (2022) which highlighted the role of FinTech in reducing income disparities by expanding access to digital financial services. However, the results also emphasize the need for robust institutional frameworks to ensure FinTech benefits are equitably distributed.

The positive coefficients for Exchange Rate Exposure (EXE) across different models—MG: 0.0475, AMG: 0.098, CS-ARDL: 0.1764—indicate that higher exposure to exchange rate dynamics is associated with reduced income inequality. This suggests that economies that are more integrated into global trade and financial systems, and hence experience higher exchange rate exposure, may benefit from mechanisms that mitigate inequality, such as increased trade volumes, foreign investments, or access to global markets. The exceptionally high t-statistic in the AMG model (44.5454) highlights the critical importance of effectively managing exchange rate exposure in achieving equitable economic outcomes. Efficient management of exchange rate exposure ensures that the benefits of global engagement, like job creation and wealth distribution, reach underserved populations. It may also reflect the role of stable and predictable exchange rate policies in fostering equitable growth by reducing economic shocks that disproportionately affect lower-income groups.

The coefficients for GG (Good Governance) are negative across all models (MG: -0.0448, AMG: -0.1064, CS-ARDL: -0.1171), indicating that improvements in governance contribute to reducing income inequality. The significant t-statistics (-6.1369, -15.2, -13.7764) reflect a strong relationship, particularly in the AMG and CS-ARDL models, where cross-sectional dependencies are accounted for. These results emphasize the importance of good governance in mitigating economic disparities.

FDI consistently shows negative coefficients (MG: -0.0361, AMG: -0.0343, CS-ARDL: -0.0641), suggesting that foreign investments contribute to reducing income inequality. The significant t-statistics (-5.0845, -6.5961, -16.8684) confirm the robustness of this relationship. However, the results also caution against the potential concentration of FDI benefits among specific sectors or regions, necessitating equitable policy frameworks.

The coefficients for TO are positive (MG: 0.0328, AMG: 0.1259, CS-ARDL: 0.0752), indicating that increased trade openness can exacerbate income inequality if not accompanied by inclusive policies. The significant t-statistics (14.2608, 15.3536, 8.6436) reinforce the need for balanced trade policies that mitigate adverse distributional effects. The CD test results (MG: 0.0229, AMG: 0.0233, CS-ARDL: 0.0294) confirm significant dependence among panel units. This

indicates that shocks in one country (economic crises or policy changes) can influence others, highlighting the interconnected nature of global economies.

-Values below 0.05 indicate no significant autocorrelation, ensuring the reliability of the models.

- Normality test results (MG: 0.0219, AMG: 0.0256, CS-ARDL: 0.028) validate the assumption that the residuals are normally distributed, ensuring unbiased estimates.

-The RESET test values (MG: 0.0305, AMG: 0.0267, CS-ARDL: 0.0241) confirm the functional form of the models is correctly specified.

The constant term (C) indicates a baseline positive effect in the absence of variations in the explanatory variables as it is positive and significant (MG: 0.0732, AMG: 0.0787, CS-ARDL: 0.1136).

The robustness test results confirm that the relationships between FinTech, EXE, GG, FDI, TO, and IIQ are consistent and reliable across different econometric models. These findings underscore the need for integrated and context-specific strategies to address income inequality in a globalized world.

Table 12 Robustness Test

	MG			AMG			CS-ARDL		
	Coef	t-stat	std. error	Coef	t-stat	std. error	Coef	t-stat	std. error
FinTech	0.0732	0.0047	15.5744	0.0787	0.0032	24.5937	0.1136	0.0056	20.2857
EXE	0.0475	0.0077	6.1688	0.098	0.0022	44.5454	0.1764	0.0091	19.3846
GG	-0.0448	0.0073	-6.1369	-0.1064	0.007	-15.2	-0.1171	0.0085	-13.7764
FDI	-0.0361	0.0071	-5.0845	-0.0343	0.0052	-6.5961	-0.0641	0.0038	-16.8684
TO	0.0328	0.0023	14.2608	0.1259	0.0082	15.3536	0.0752	0.0087	8.6436
C	0.0732	0.0047	15.5744	0.0787	0.0032	24.5937	0.1136	0.0056	20.2857
CD test		0.0229			0.0233			0.0294	
Wooldridge Test		0.0318			0.0321			0.0223	
Normality test		0.0219			0.0256			0.028	
Remsey RESET test		0.0305			0.0267			0.0241	

Chapter 05: Discussion of the Study Findings

This chapter discusses the major findings of this research, focusing on the impact of financial technology (FinTech) and institutional quality, specifically corruption, on income inequality (IIQ). By addressing the research objectives, this study provides empirical evidence to fill critical gaps in the existing literature. The research aims to enhance understanding of how FinTech adoption can serve as a tool for financial inclusion and equitable income distribution, while also examining the role of institutional quality in mitigating or exacerbating income inequality. Using advanced econometric models, such as CS-ARDL and NARDL, the study establishes both short-term and long-term relationships between the variables.

The present study expands the theoretical understanding in the role of IQC influencing IIQ and connection between FinTech and IIQ. The current study's findings about the role of IQC influencing IIQ showed that while anti-corruption measures and better governance reduce inequality in the short term, long-term benefits depend on inclusive policies that address systemic biases. The findings about IQC and IIQ aligns with Hartwig (2024) and Faisal Abbas (2021) findings. They suggested that the irregular implementation of institutional reforms can favor elite groups, exacerbating inequality. The present study's result shows that incorporating anti-corruption measures and maintaining a strong governance can decrease IIQ temporarily, but to ensure sustainability regarding the benefits of anti-corruption measures and maintaining a strong governance depends on inclusive policies that address systemic biases. These policies need to go beyond curbing corruption and focus on creating equitable opportunities for marginalized populations, such as access to quality education, healthcare, and financial services. The current study extends the theoretical framework by highlighting the interconnectedness between IQ and economic variables like FinTech and trade openness, as also emphasized by (Kunawotor, 2020) and (Uzar, 2023).

The nexus between FinTech and IIQ is reflected in the findings, which unleash the nature of its influence. The findings also reveal that financial inclusion significantly reduces income inequality in the long term. The results reveal that FinTech improves access to financial services, reduces barriers to financial participation, and promotes inclusivity. The results reveal that FinTech improves access to financial services, reduces barriers to financial participation, and

promotes inclusivity. These findings align with the findings of Adugna (2024) and Muhammad Irfan (2024), which emphasize FinTech's role in reaching underserved populations. The current research builds on this by showing that FinTech's impact is not uniform across countries but is influenced by economic structures, regulatory environments, and levels of technological development. For example, countries with higher levels of digital infrastructure and financial literacy experience greater reductions in income inequality, as observed in studies by (Liu, 2023) and (Guangshun Xu, 2024). Fintech decreases IIQ in the long-term, while its temporary effects increase IIQ. Regional disparities in digital infrastructure, technological literacy, and regulatory

support limit its impact in certain areas. The reason behind these findings is, most of FinTech's early adopters are wealthy people, elite groups, resource allocators or affluent population. These groups already earn high and gets to use the benefits of FinTech first through favoritism and bribery, while leaving nothing or little for poor people. Thus, creating short-term increase in IIQ. This asymmetrical finding was discovered in the NARDL results, where positive changes in FinTech adoption reduce inequality, but negative changes exacerbate it. The study expands on Verma (2024) and Jensen (2022) emphasizing the requirement for targeted interferences to guarantee that FinTech's benefits reach marginalized groups.

Practical implications for policymakers, institutions, and corporations are generated from the findings for the goal of reducing IIQ via equitable adoption of FinTech and institutional reorganizations. For policymakers, the findings show a significant need of creating digital infrastructure for equal fintech adoption while instantaneously solving institutional weaknesses. To bridge the digital divide policymakers should prioritize expanding digital infrastructure and financial literacy programs, so that the underserved population gets easy access of fintech services by using internet and also knows how to use the services safely. Moreover, anti-corruption measures should be created by focusing on unbiased and equitable policy implementation to assure that governance improvement benefit all income groups. For example, the study's findings support policies promoting digital financial inclusion, as highlighted in the work of (Mehar, 2023) and (Nambie et al., 2023). In their study, they have examined that countries where digital infrastructure is robust and accountability and transparency is present in governance structures are better performing in reduction of IIQ by using the benefits of FinTech. Policymakers must also account for the short-term disruptions caused by technological and institutional changes, as observed in the asymmetry of FinTech's impact.

FinTech is related to corruption, because Fintech is adopted in corporations first. Thus, fintech companies can use these findings to customize their offerings to rural and marginalized people. FinTech companies can expand their reach to low-income groups, by focusing on affordability, accessibility, and user-friendly designs. These two authors, Xin Deng (2024) and Wang (2024), also recommends fintech companies to make marginalized groups part of their customer segment for business development and social impact. FinTech firms should collaborate with governments and financial institutions to develop inclusive financial products that address the unique needs of disadvantaged groups.

For financial institutions (FI), connecting conventional banking systems with FinTech solutions will increase the reach of fintech adoption more and reduce IIQ. Findings of the present study displays that anti-corruption measures and rule of law combined with FinTech adoption can significantly reduce IIQ. Financial institutions should invest in partnerships with FinTech companies to offer low-cost financial services, such as microloans and digital savings accounts, to underserved populations. This approach aligns with the works of Siti Aisyah1 (2023) and A. Demir, Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2020), which highlight the role of inclusive financial systems in addressing income disparities. Moreover, banks should leverage

the insights from this research to design strategies that mitigate the initial inequality-enhancing effects of FinTech adoption.

The current study fills the gap in literature by displaying the empirical evidence on the joined impact of FinTech and IQC on IIQ. Prior studies are extended because this study emphasized the asymmetric effects of FinTech and IQC on IIQ, proving that IQC and Fintech both plays roles to influence IIQ and FinTech's benefits are hindered due to presence of corruption in country's institutional quality. The findings emphasize the importance of considering both short-term and long-term impacts, as well as the interplay between technological and institutional factors.

While this study provides valuable insights, it is not without limitations. One limitation is the reliance on aggregate data, which may obscure the nuanced effects of FinTech and institutional quality at the micro level. Future research could use household or firm-level data to explore these dynamics in greater detail. Additionally, the study focuses on general trends across countries and regions, which may not fully capture country-specific factors. Comparative studies could provide deeper insights into how contextual differences influence the relationship between FinTech, institutional quality, and income inequality.

Another limitation is the exclusion of specific FinTech innovations, such as mobile payments or blockchain technology, which may have unique impacts on income inequality. Future research could investigate the effects of these technologies on different income groups. Moreover, the study's focus on institutional quality as a broad concept leaves room for exploring the roles of specific governance indicators, such as rule of law or regulatory quality, in shaping income inequality.

Chapter 06: Conclusion and Policy Suggestions

6.1 Conclusion

This research aimed to inspect the connection between financial technology (FinTech) adoption, institutional quality corruption (IQC), and income inequality (IIQ). The study addressed two key research questions: How does FinTech adoption influence income inequality across various economic and regional contexts? How does institutional quality corruption affect income inequality in different regions? Through robust econometric analysis, the research provided some novel insights into these relationships, filling the critical gap of the dual influence on IIQ in the literature by analyzing the combined effects of FinTech and IQC on IIQ.

This study showed how significant FinTech and good governance are in decreasing IIQ. FinTech gives the access to financial services, helps people participate in the economy and encourage inclusion. All these contributes in reduction of IIQ. Even though FinTech worsens IIQ temporarily after adoption, but this finding is signaling the policymakers to ensure that FinTech benefits everyone, focusing more on underserved and rural groups.

Another variable that has the potential to significantly reduce IIQ is GG (good governance), as it can achieve social unity, more equal resource and opportunity distribution by promoting fairness, transparency and accountability. Corruption weakens a country's GG, making it harder for lower-income groups to gain from reforms. In some cases, even anti-corruption measures increased IIQ, due to uneven application of reforms which only benefitted the elite groups. This study's findings suggest policymakers to create institution's framework ensuring they promote inequality.

Previous studies have explored both the independent variables' (FinTech and IQC) impact on IIQ separately. Previous authors did not examine how FinTech and IQC both impacts IIQ. IIQ is a multidimensional issue influenced by both technological and institutional factors, yet their combined dynamics have not been fully explored. This research contributed to the existing literature by addressing the ignored interplay between FinTech and IQC. It advances theoretical understanding by challenging the fragmented approach of analyzing these factors separately and demonstrating their joint effects. It also suggests practical policies for Fintech companies, government and policymakers on the matter of promoting equal and sustainable economic results.

6.2 Policy Suggestions

Based on the test results and findings joint efforts are required to leverage Fintech and IQC to reduce IIQ. To ensure equitable policies, it is important to address the constraints of Fintech adoption, combat corruption, and assure that governance reforms are created to focus on all of the income groups. Actionable policies are given below, which are structure to provide inclusive strategies to achieve the goal of reducing IIQ.

1. Increasing Digital Infrastructure and Financial Literacy to make Fintech adoption more accessible to all income groups.

The focus of this policy is the uneven access to FinTech services especially in remote areas and low-income areas. The reason behind such a policy is that this research found an asymmetric effect of FinTech adoption. FinTech adoption has the ability to reduce IIQ for long-term, but exacerbates it in short-term. This means that short-term benefits are provided to a small group, and the reason behind this is lack of digital infrastructure and financial literacy to make Fintech adoption more accessible to all income groups. Thus, expansion of digital infrastructure and financial literacy can bridge this disparity, assuring that everyone can access and benefit from the adoption.

To implement the suggested policy, research and development is required from the government on expanding digital infrastructure, such as internet connectivity and mobile network coverage, in underserved regions. Instantaneously, all schools, colleges and universities should prioritize educating children the management of finances and learn about financial literacy and community outreach initiatives to equip individuals with the knowledge needed to use FinTech effectively. This is possible, if FinTech companies, educational institutions and private organizations join together to make an effort on reducing IIQ.

2. Establishing Anti-Corruption Measures and Governance Restructures

The focus of this second policy is the systematic corruption that weakens equal allocation of public resources and hinders the effectiveness of IQ. The justification of the policy is that the present study found that IQ without corruption usually decreases IIQ, but presence of corruption can negate the advantages and worsen IIQ. Thus, looking into the matter of corruption is most important to make sure that governance's strategies to reduce IIQ reaches all income groups.

To make the policy actionable, accountability and transparency is extremely important for governments in each country. By investing on tools like blockchain, governments can decrease chances of corruption. To enhance the effect of incorporating accountability and transparency, independent anti-corruption bodies can be empowered with authority and resources to inspect and prosecute corrupted cases. Moreover, public awareness campaigns should be setup from govt. so that general people are well-known about their rights as a citizen in their own country which will also encourage civic participation in governance oversight.

3. FinTech Solutions can be more Inclusive via Public-Private Partnerships

The focus of this policy is to target and harness the advantages of Fintech to address the financial needs of different income groups via joint efforts between public-private sectors. Reason behind suggesting this policy is that this research highlighted the transformative role of Fintech in reducing IIQ by increasing financial access. But to achieve that, the advantages need some targeted design and delivery to reach all income groups. Public-private partnerships can create inclusive financial products and services tailored to low-income populations.

To make this policy actionable, governments will have to incentivize FinTech institutions to create inexpensive financial products by providing subsidies, grants, or tax breaks. Partnerships with banks and microfinance institutions can enable the integration of FinTech into traditional financial systems, expanding its reach. Regulatory frameworks should be designed to encourage innovation while ensuring consumer protection and data security.

These policy recommendations address the critical barriers identified in this research, providing a pathway for reducing income inequality through FinTech adoption and governance reforms. By enhancing digital infrastructure, combating corruption, and fostering public-private collaboration, stakeholders can create a more inclusive financial ecosystem. These measures not only address immediate challenges but also lay the foundation for sustainable and equitable economic growth.

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