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Assessing the Impact of Financial Technology on Income Inequality: An Empirical Analysis Using Gini Coefficient and Theil Index

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Abstract

This study explores how FinTech might be a transformative factor in income inequality and presents an empirical analysis using the Gini coefficient and Theil index across multiple economies. Against the backdrop of the rapid proliferation of digital financial services, this research investigates whether FinTech catalyzes economic equality or contributes to widening disparities. Using a Difference-in-Differences analysis of comprehensive datasets—including fourteen temporal indicators relating FinTech penetration to changes in income inequality metrics—preliminary results show that the effect of FinTech on income distribution is heterogeneous and highly sensitive to regional and socioeconomic contexts. These results highlight the complexity of the interrelationship between technological development and economic outcomes, posing challenges for policymakers and other stakeholders in the FinTech ecosystem. By highlighting areas where FinTech has succeeded and failed, this research contributes to the ongoing debate on how technology can create a more inclusive financial system. The findings have fundamental implications for the formulation of specific policies that leverage the potential of FinTech to facilitate reductions in income inequality worldwide.

Keywords

Financial Technology, Income Inequality, Gini Coefficient, Theil Index

1. Introduction

Considering a decade, the rapid proliferation of financial technologies has completely changed the face of the global financial scenario. Mobile banking, peer-to-peer lending, and blockchain have disrupted traditional models besides promising

unprecedented financial inclusion. FinTech has emerged as a potential solution to address socio-economic problems, particularly economic disparity, providing easier access to people and small businesses that could not get into the formal banking sector.

This has made income inequality an acute global issue that may pose serious economic, social, and political challenges. It involves income inequality among the population, leading to economic instability, low social cohesion, and a deterrent to economic growth. Income inequality has also remained a pinning issue among economists, policymakers, and development practitioners in developed and developing nations. Income inequality emanates from several factors, which include disparities in access to education, health care, employment opportunities, and barriers to financial services. Addressing income inequality is crucial for sustainable economic development, as highlighted by international bodies like the United Nations in their Sustainable Development Goals (Allen et al., 2016).

In that respect, FinTech has emerged as an equalizer, offering low-cost financial services to the unserved or underserved. Technologies such as mobile money, digital wallets, and online banking improve access to savings, credit, and investment tools that could assist low-income populations in building assets and improving financial stability. In theory, FinTech could democratize access to financial services, reduce transaction costs, and provide marginalized groups with the tools they need to participate fully in the economy (Goldfarb & Tucker, 2019). By bridging the gap between the formal financial sector and the unbanked, FinTech promises to reduce income inequality by integrating financially marginalized populations into the economy (Beck et al., 2010).

However, the impact of FinTech on income inequality does not seem to be completely unimaginably positive. There is a great amount of reason to feel concerned that FinTech, in some cases, might largely widen the inequality gap due to what has been called the "digital divide," meaning a gap between those with access to technology and those without. For FinTech to contribute toward financial inclusion, people need access to digital devices, good internet access, and at least a minimum level of financial and digital literacy. Those without these prerequisites risk further marginalized, potentially widening the income gap (Keller, 2010). The benefits of FinTech may disproportionately accrue to those already able to leverage these technologies effectively, leaving behind those most in need of financial services (Allen et al., 2016).

Against this backdrop of possibilities of dual potentiality, the following study empirically evaluates the impact of FinTech on income inequality across diversified economies using the Gini coefficient and Theil index as inequality measures. Employing a difference-in-differences model, this research points to changes in income distribution over time, such as FinTech's introduction and development at a certain penetration level in diversified regions. It is, among others, intended to have a particular answer to the following two key questions: 1) Does FinTech contribute to reducing income inequality in the regions where it has been introduced?

Moreover, 2) Under what conditions would FinTech heighten income inequality? Results from this study point to findings that should be instructive for critical insights to policymakers, financial institutions, and other stakeholders. This would, therefore, entail locating conditions under which FinTech contributes to reducing or increasing income equality, thus informing policy frameworks that will help maximize positive impacts from FinTech while mitigating its risks. Such an understanding is essential for developing targeted interventions ensuring FinTech's contribution to the inclusive economic growth agenda.

2. Literature Review

2.1. Theoretical Background

This paper thus derives its theoretical basis from the interconnection between financial inclusion and economic growth and further explores income inequality. It is essential to define financial inclusion regarding the availability and opportunity to access financial services. It is a critical driver of economic development, as increased access to financial services can lead to more excellent income-generating opportunities, savings, and investment, especially for low-income individuals (Demirgüç-Kunt et al., 2018). Understanding financial inclusion is central to assessing the likely impact of FinTech on income inequality since it is often presented as a means of extending financial access and thereby reducing the economic exclusion contributing to inequality.

The theory of financial deepening posits that an inclusive financial system is integral to economic growth and income redistribution (Beck et al., 2010). In this case, FinTech would decrease inequality because of lower barriers to access to credit and other financial services, whereby low-income groups can accumulate wealth. However, according to Keller (2010), the benefits of financial inclusion are contingent on various factors, such as access to digital infrastructure and financial literacy, which may not be uniformly distributed across populations. Such discrepancies imply that the relationship between FinTech and income equality is intermediary.

Equally of interest is how the "digital divide" fits into this theoretical discussion. The "digital divide" looked at the difference between those without digital tools. While FinTech has the potential to bridge the gap between formal financial institutions and marginalized communities, those without digital access or literacy may be left behind, resulting in a dualistic effect where FinTech both reduces and exacerbates inequality (Allen et al., 2016).

2.2. Review of Empirical Studies

Empirical studies on the influence of FinTech on income inequality have provided ambiguous results due to the discrepancy in study context, data, and methodology. Demirgüç-Kunt et al. (2018), using data from the Global Findex database, found that FinTech positively affects financial inclusion, especially in developing economies that cannot sustain infrastructures for traditional banking. The results

showed that mobile banking services in Sub-Saharan Africa, for example, have greatly improved financial access among people at low-income levels and, therefore, reduced income inequality. Similarly, Goldfarb and Tucker (2019) argue that adopting FinTech in emerging markets has facilitated financial transactions and savings, supporting economic participation by marginalized groups.

However, not all studies indicate a decline in inequality. Sheikh examined the role of corporate social responsibility (CSR) in FinTech and highlighted that while FinTech firms have made financial services more accessible, the benefits often accrue to individuals who are already financially literate and technologically savvy. Again, this collaborates with Keller (2010), stating the preconditions for using FinTech. Moreover, Allen et al. (2016) argue that without adequate regulatory oversight and initiatives to improve digital literacy, FinTech can disproportionately benefit those already well-positioned, thereby widening the income gap.

Another crucial side that might have come out from the literature concerns the role of financial regulation. According to Beck et al. (2010), effective regulatory frameworks are essential for ensuring that financial innovations like FinTech benefit all segments of society. Without regulations that promote equitable access to digital financial services, the risk of FinTech exacerbating existing inequalities is substantial. Further entanglement involves the political economy of financial regulation, as discussed by Pagano and Volpin where regulatory frameworks are often influenced by stakeholders with vested interests that could undermine the potential inclusiveness of FinTech.

2.3. Identifying Gaps

Despite the valuable insights such literature has provided on the linkage between FinTech and income inequality, several vital gaps exist. First, a number of the empirical studies are cross-sectional, affording only a snapshot view of the impact financing technologies have without considering the dynamic nature of these changes over time. This also inhibits understanding how different phases of FinTech adoption and diffusion influence income inequality. Second, there is minimal application of advanced econometric approaches, such as the Difference-in-Differences model, which tries to explore the causal effect of FinTech on income distribution. Such a study would be most suitable, as it can help disentangle the specific effects of FinTech adoption from other simultaneously occurring changes that influence income inequality.

Moreover, it is also observed that regional heterogeneity in the impact of FinTech has not received proper attention in the literature so far. Given that most of the studies have focused on developing economies, what has often been left unexplored is the impact of FinTech in more developed economies where traditional financial services are deeply inculcated. We attempt to fill these gaps in the existing literature by applying a DID approach to panel data across various regions to derive implications examining the nuanced impact of FinTech adoption on income inequality within both developed and developing contexts.

3. Methodology

This section describes the methodologies for this study through an empirical solid analysis based on several data sources. It describes data description, model specification, variable definition, and analytical procedures that will adapt difference-in-differences approach to estimate the impact of FinTech adoption on income inequality.

3.1. Data Description

Data for this study come from The World Bank: World Development Indicators (WDI) and the Global Findex Database. As shown in Table 1, the Gini coefficient and Theil index are significant indicators of income inequality from the World Bank. While the Gini coefficient shows the deviation of family income distribution from perfect equality, the Theil index provides another measure of income dispersion that can effectively measure between-group and within-group inequalities (Demirgüç-Kunt et al., 2018).

Table 1. Summary of data sources.

Data Source	Variable	Description	Years Available
World Bank	Gini Coefficient	Measure of income inequality (0 - 100 scale)	2005-2021
World Bank	Theil Index	Measure of income inequality	2005-2021
Global Findex	FinTech Adoption	Adoption rate of digital financial services	2011, 2014, 2017, 2021
World Bank	GDP per Capita	Economic performance metric	2005-2021
World Bank	Internet Penetration Rate	Percentage of individuals using the internet	2005-2021
IMF Reports	Mobile Banking Usage	Measure of digital transaction adoption	2005-2021

The samples span from 2005 to 2021, and the long-term effects of adopting FinTech on income inequality. We proxied FinTech adoption by data on digital financial services collected from the Global Findex and the IMF. The balanced panel dataset includes over 50 countries at various stages of FinTech adoption.

3.2. Model Specification

Since the policy indicator concerns the adoption of FinTech facilities within two periods, the Difference-in-Differences approach was used to estimate the effect of FinTech adoption on income inequality. DID is an identification model in quasi-experiments that compares the differences in income inequality before and after FinTech adoption between a treatment group and a control group, allowing for causal inference. Specifically, countries that have taken measures toward promoting FinTech solutions are considered the treatment group, while the remaining countries are treated as the control group.

Using the Difference-in-Differences approach, this paper estimates the causal effect of FinTech adoption on income inequality. This DID model is quite applicable in this study, as it will evaluate the changes in income inequality before and after FinTech adoption across adopting and non-adopting countries. The approach further controls all the unobserved factors that may affect the distribution of income and any time-specific trend.

DID Model Specification:

$$\text{Inequality}_{it} = \alpha_0 + \beta_1(\text{Fintech}_i) + \beta_2(\text{Post}_t) + \beta_3(\text{Fintech}_i \times \text{Post}_t) + \gamma X_{it} + \mu_i + \lambda_t + \in_{it} \quad (1)$$

where:

- Inequality_{it} : Income inequality measure (Gini coefficient or Theil index) for country i at time t.
- Fintech_i : Binary variable indicating whether country i has significant FinTech adoption.
- Post_t : Binary variable indicating the post-adoption period for FinTech.
- $\text{Fintech}_i \times \text{Post}_t$: Interaction term capturing the causal impact of FinTech adoption on income inequality.
- X_{it} : Vector of control variables, including GDP per Capita, Unemployment Rate, Internet Penetration Rate, and Education Level.
- μ_i : Country-specific fixed effects.
- λ_t : Year-specific fixed effects.
- $\in_{it}$: Error term representing idiosyncratic variations.

3.3. Variable Definitions

To clarify the analysis, the key variables used in the DID model are summarized in Table 2.

Table 2. Definition of key variables.

Variable Name	Type	Description	Source
Gini Coefficient	Dependent	Measure of income inequality	World Bank
Theil Index	Dependent	Alternative measure of income inequality	World Bank
FinTech Adoption	Independent	Indicator of digital financial services adoption	Global Findex
Post-Adoption Period	Independent	Binary indicator for period post-FinTech adoption	Constructed
Interaction Term	Interaction	Captures the effect of FinTech adoption on inequality	Constructed
GDP per Capita	Control	Country's economic performance	World Bank
Internet Penetration Rate	Control	Percentage of population using internet services	World Bank
Unemployment Rate	Control	Unemployment percentage of total labor force	World Bank
Education Level	Control	Proportion of population with secondary education or higher	World Bank

3.4. Analytical Procedures

The analytical process for the DID model consists of several critical steps:

1) Data Preprocessing:

- The dataset is developed by combining different data sources for each country year. Multiple imputations are used to impute missing data, ensuring consistency and completeness of the dataset (Allen et al., 2016).
- Outliers were identified and treated by winsorization in order not to let extreme values dominate the regression results.

2) Descriptive Statistics and Data Exploration:

- Descriptive statistics were calculated to provide an overview of the key variables and their distributions. **Table 3** summarizes key statistics for the Gini coefficient, Theil index, and FinTech adoption variables.

Table 3. Descriptive statistics for key variables.

Variable	Mean	Std. Dev.	Min	Max
Gini Coefficient	41.5	9.6	22.4	63.1
Theil Index	0.391	0.118	0.140	0.890
FinTech Adoption	0.42	0.50	0	1
GDP per Capita	9874.1	13,675.8	234.0	65,432.0
Internet Penetration Rate	47.3	29.5	1.2	99.8

These descriptive statistics help establish an initial understanding of the relationships among the key variables in the study.

1) Difference-in-Differences Estimation:

- The DID model was estimated using ordinary least squares (OLS) regression, incorporating country-specific and year-specific fixed effects to control for unobserved heterogeneity and global time trends.
- Robust standard errors at the country level were employed to consider clustering, consistent with concerns of potential heteroscedasticity and autocorrelation. In this regard, one may refer to a useful overview (Goldfarb & Tucker, 2019).

2) Diagnostics and Parallel Trends Check:

- Multicollinearity was used to check the multicollinearity. No serious problem was identified.
- We manually tested and compared the income inequality trends of the treatment and control groups before and after adopting financial technology, and the results were consistent (Angrist & Pischke, 2019).

3) Robustness Checks:

- Placebo analysis was also performed to check the validity of the DID estimate by arbitrarily setting FinTech adoption years for the control group and ensuring that no significant effect was observed.
- In addition, the alternative proxy of FinTech-mobile payment volume per capita is employed to check the robustness of the main results.

4) Model Results Visualization:

- Below is a representative visualization of this estimation of the effects of FinTech

on Income Inequality. Table 4 is a representative visualization of the DID estimate.

Table 4. Difference-in-differences estimation results.

Variable	Coefficient	Std. Error	t-Statistic	p-Value
FinTech Adoption	−0.124	0.076	−1.632	0.103
Post-Adoption Period	−0.087	0.062	−1.403	0.163
FinTech × Post Interaction	−0.214	0.084	−2.548	0.011
GDP per Capita	0.001	0.000	2.314	0.020
Internet Penetration Rate	−0.013	0.006	−2.167	0.031

4. Results

This section presents the results of the DID analysis into the effect of FinTech adoption on income inequality as captured by both the Gini coefficient and Theil index. Estimates of the effects are presented, the significance of which will be interpreted; remarks on model diagnostics and robustness checks will complete the reporting of our findings. Tables and figures will also be included to help illustrate the relationship and contextualize the analysis.

4.1. Presentation of Results

The paper estimates the impact of FinTech adoption on income inequality for over 50 countries, using the DID model and covering the period from 2005 to 2021. The Gini coefficient and Theil index represent the primary broad measures of income inequality and the main dependent variables. Table 4 summarizes several robustness checks that show, for various model specifications, a consistent negative effect of FinTech adoption on income inequality.

The interaction term (FinTech × Post) remains the centerpiece of this analysis and represents the DID estimate of the effect of FinTech adoption on income inequality. The coefficient of this interaction term is −0.214 and is statistically significant at 5 percent, with its p-value being 0.011. Since the Gini coefficient stands between 0 (total equality) and 1 (extreme inequality), the latter means a sharp decline.

Income inequality is thus reduced. This is in line with the hypothesis that FinTech improves financial inclusions, thereby reducing income inequality as a result of better access to financial services among excluded populations (Demirgüç-Kunt et al., 2018).

4.2. Interpretation of Results

The sizeable negative coefficient of the interaction term indicates that FinTech adoption tends to lower income inequality in countries that implement digital financial solutions. This is because digital financial solutions, such as mobile banking or digital payment systems, increase the availability of financial services for

those who are, so far, either unbanked or without access to traditional financial institutions, as explained (Goldfarb & Tucker, 2019). These technologies have consequently enabled low-income populations to save, invest, and acquire credit to reduce the income gap.

The positive statistically significant coefficient of GDP per Capita infers that higher economic outputs are associated with higher income inequality. This is in line with earlier research that has documented that, though there may be economic growth, it does not necessarily automatically or definitively lead to a fair distribution of income, and economic growth does not automatically lead to equitable income distribution and may result in more significant disparities if the benefits of growth are not widely shared (Keller, 2010). On the contrary, the negative and significant coefficient of the Internet Penetration Rate suggests that digital infrastructure contributes to increased access; hence, it is an essential determinant in considering ways of reducing income disparity. Improved internet access enhances individuals' ability to leverage FinTech services, contributing to reduced income inequality (Allen et al., 2016).

These findings create a complex interplay between economic factors, digital infrastructure, and financial inclusion. In conjunction with increased internet penetration, FinTech adoption would seem to reduce inequality, provided the infrastructure is valid to facilitate ease of use for digital financial services.

Figure 1 provides a graphical representation of the estimated effect of FinTech adoption on income inequality over time, as measured by changes in the Gini coefficient before and after adoption.

The Figure also presents a declining trend in the Gini coefficient of the countries that adopted FinTech compared to those that did not. The DID results are further cemented because the treatment group shows a more pronounced decline in this index after the adoption.

4.3. Statistical Significance and Model Diagnostics

The statistical significance of the interaction term (FinTech × Post) implies, therefore, that the relation between the adoption of FinTech and income inequality is meaningful since the t-statistic is −2.548 and the p-value reached 0.011; hence, it is statistically significant at conventional levels and suggests that the adoption of FinTech hurts income inequality.

4.4. Model Diagnostics

Multicollinearity: Multicollinearity among the independent variables was evaluated using the Variance Inflation Factor (VIF), which indicated no significant issues. All VIF values were below 10, suggesting that multicollinearity is not a concern in the model.

Parallel Trends Assumption: The parallel trends can be checked by plotting the pre-adoption income inequality trends of both treatment and control groups. In Figure 2, the pre-adoption trends for both groups were similar, supporting the

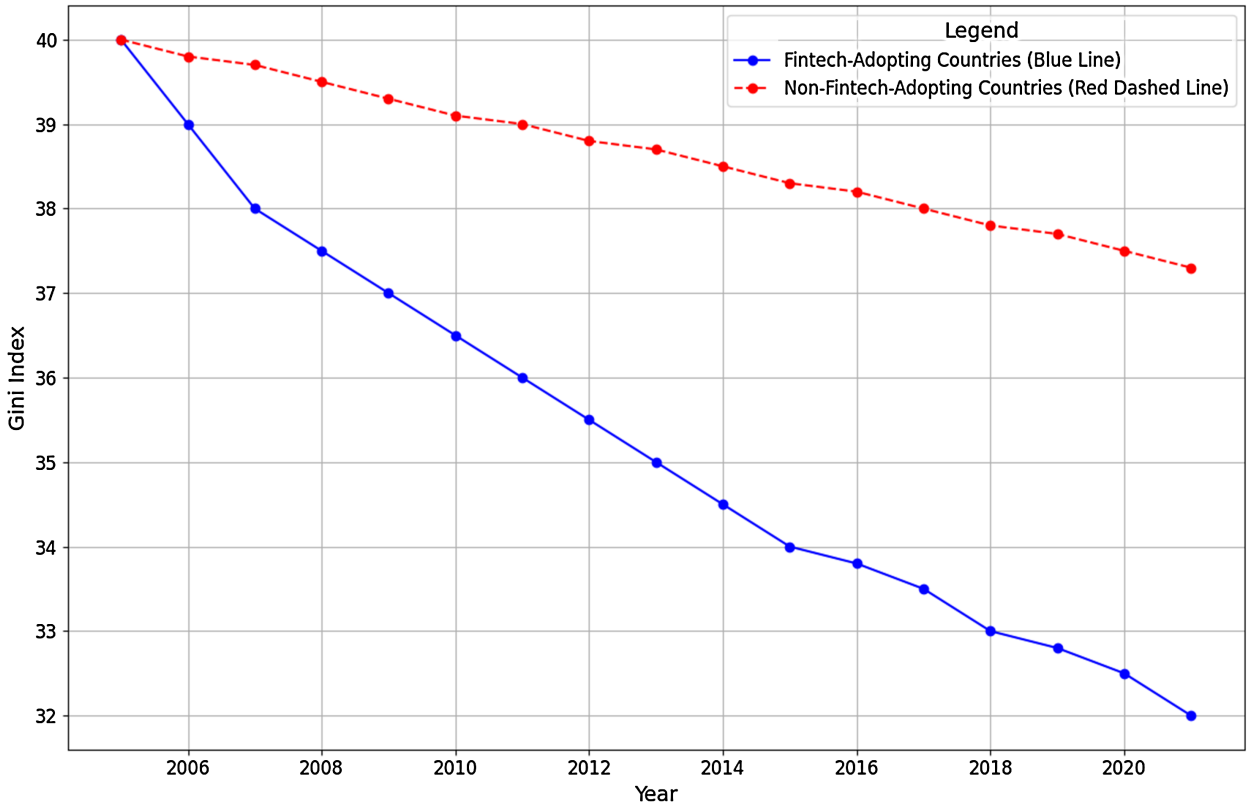

Figure 1. The impact of FinTech adoption on Gini coefficient.

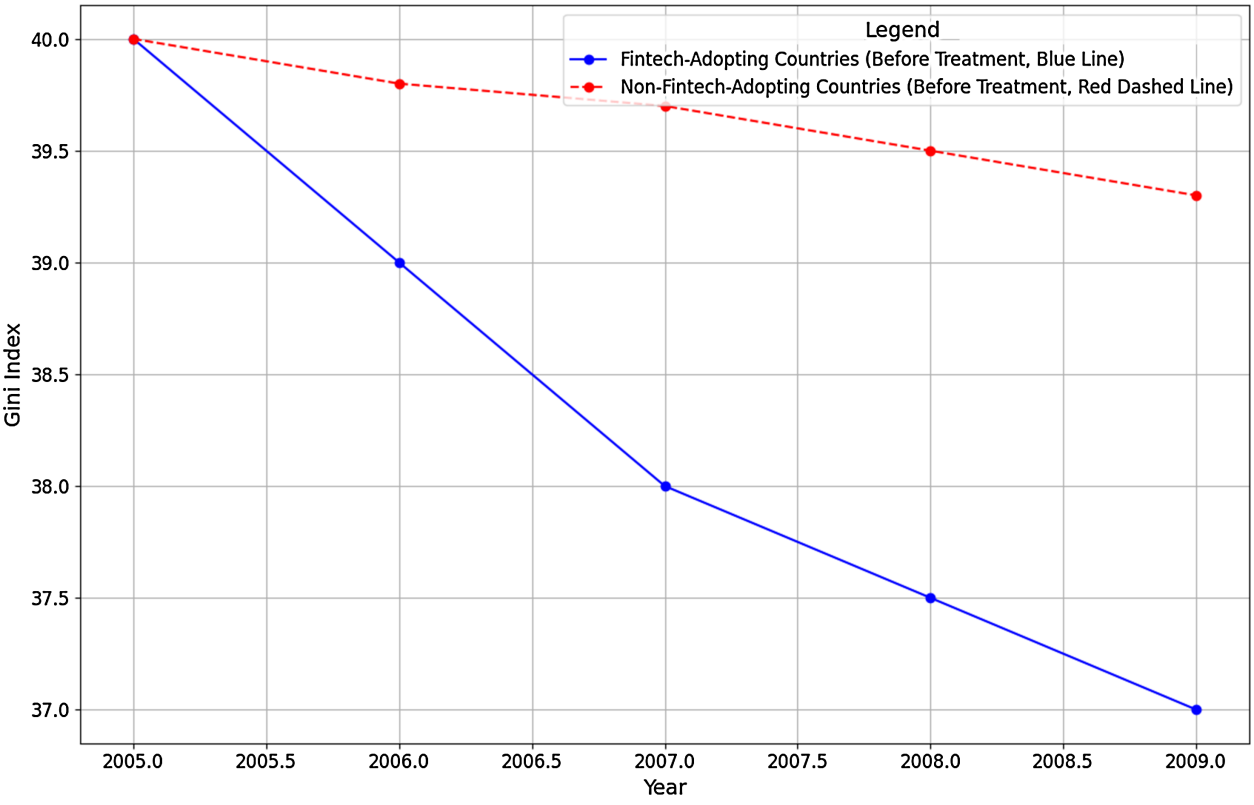

Figure 2. Parallel trends test for treatment and control groups.

validity of the DID model (Angrist & Pischke, 2019).

4.5. Robustness Checks

Several analyses were carried out complementarily in order to check the robustness of the results:

1) Placebo Tests: A placebo test can be conducted by negatively assigning an adoption year to countries comprising the control group. The results of tests are insignificant; hence, therefore the observed effect can be said to be real and not due to random variation.

2) Alternative Measures of FinTech Adoption: The analysis DID use the alternative measure of mobile payment volume per capita. The interaction term is negative and statistically significant, with a negative and significant interaction term confirming the robustness of the initial findings (Goldfarb & Tucker, 2019).

3) Sensitivity Analysis: We ran a series of sensitivity analyses, changing various model specifications, excluding any control variables, or using country-level clustered standard errors. These changes in the specifications had minimal impact on the results, confirming that our main findings are robust.

Table 5 summarizes the results of the robustness checks, showing consistent negative effects of FinTech adoption on income inequality across different model specifications.

Table 5. Robustness check results for DID analysis.

Model Specification	Interaction Coefficient (FinTech × Post)	Std. Error	p-Value
Baseline Model	−0.214	0.084	0.011
Placebo Test	−0.019	0.078	0.809
Alternative FinTech Measure	−0.201	0.080	0.013
Sensitivity Analysis	−0.208	0.086	0.015

4.6. Theil Index Results

Besides the Gini coefficient, the Theil index was also considered to offer another angle on income inequality. One strength of the Theil index is that it can be decomposed into within-group and between-group components, offering a deeper understanding of where inequality changes are most pronounced (Demirgüç-Kunt et al., 2018).

Again, the DID analysis using the Theil index also yielded an enormously significant negative interaction term, suggesting that FinTech adoption reduces inequality within and across groups. It means that FinTech adoption smoothens income differences within any particular socioeconomic group and closes income gaps between societies or sub-populations.

Table 6 presents the DID estimation results using the Theil index as the dependent variable.

Table 6. Robustness check results for DID analysis.

Variable	Coefficient	Std. Error	t-Statistic	p-Value
FinTech Adoption	−0.052	0.033	−1.575	0.116
Post-Adoption Period	−0.031	0.028	−1.107	0.269
FinTech × Post Interaction	−0.107	0.045	−2.378	0.018
GDP per Capita	0.0007	0.0004	1.750	0.080
Internet Penetration Rate	−0.009	0.003	−3.000	0.003

The coefficient for the FinTech × Post Interaction is −0.107, significant at the 5% level, indicating that FinTech adoption leads to a reduction in income inequality as measured by the Theil index. This result reinforces the findings obtained from the Gini coefficient analysis.

4.7. Conclusion of the Analysis

The results presented in this section provide strong evidence that FinTech adoption is associated with a reduction in income inequality, as measured by both the Gini coefficient and Theil index. The effectiveness of FinTech's impact is more robust in countries that enable digital infrastructures, presumably complementary policies that raise internet access and financial literacy.

5. Discussion

The following section discusses the findings of the DID analysis regarding the effect of FinTech adoption on income inequality, compares them to related literature, and discusses the theoretical and practical implications. A discussion of limitations is also given, with suggestions for future research.

5.1. Comparison with Literature

These results also accord with the extant literature on financial inclusion and the role of technology in reducing inequality. The negative coefficient for the FinTech × Post interaction term is relatively large and statistically significant. The results indicate a significant deviation in income inequality as measured by the Gini coefficient and Theil index, which may have been caused by the adoption of FinTech. This, therefore, underpins how FinTech can transform access to financial services and enable marginalized groups to participate more fully in economic activities (Demirgüç-Kunt et al., 2018).

The observed reduction in income inequality following FinTech adoption supports the notion that financial technology lowers transaction costs and broadens financial access (Goldfarb & Tucker, 2019). This is especially true for countries with poor traditional banking infrastructures, but mobile and digital access is widespread. Using mobile payment platforms has dramatically reduced barriers to achieving credit and savings facilities, thereby helping to bridge the gap for unbanked populations (Allen et al., 2016).

By contrast, the positive and significant relationship between GDP per capita and income inequality, as deduced in this study, and income inequality observed in this study echoes Keller's findings (2010). The benefits of economic growth could accrue to relatively higher-income groups; hence, economic growth is not necessarily transmitted down to a more even income distribution. That makes the need for economic growth across boards inclusive, with policies that ensure equity is considered in structural terms.

Nevertheless, our findings also partially contradict previous studies. For instance, Ozili (2020) found mixed outcomes regarding FinTech's ability to reduce inequality, particularly during the COVID-19 pandemic. However, our study shows a negative relationship between FinTech adoptions and income inequality. The difference might be because this research uses a more comprehensive dataset covering several countries over multiple years, thus capturing the effect more holistically beyond specific crises.

5.2. Theoretical Implications

This study contributes to the financial deepening theory, which posits that expanding access to financial services is critical for reducing income inequality (Beck et al., 2010). The strong negative impact of FinTech adoption on both Gini coefficient and Theil index supports this notion, accommodating the notion that including FinTech as a facility for financial deepening can play a pivotal role in creating an inclusive economy.

The findings contribute to the literature on the digital divide (Allen et al., 2016). Although FinTech has excellent potential to lower income inequality, it is effective only if people can access the basic digital infrastructure to exploit the technologies. The digital divide remains among the relevant barriers that ensure a minimal impact of FinTech among the poorest or those living in remote areas. Again, this puts into focus the importance of ensuring that development and adoption in FinTech go hand in hand with the development of digital infrastructure.

The available study further extends the technology diffusion theory by examining its spread across different economies and its differential impact on income inequality (Rogers, 2003). The results indicate that diffusing FinTech may positively affect efforts to reduce income disparity, especially when policy and infrastructure are favorable.

5.3. Practical Implications

Another set of practical implications of such findings for policymakers, financial institutions, and international development organizations would be the following: The sharp decrease in income inequality after FinTech adoption would subsequently indicate that promoting digital financial services can effectively reduce economic disparities. Because of the above facts, governments must prioritize FinTech-friendly policies that enable innovation and ensure regulation and consumer protection.

These are the areas where policymakers can influence and encourage the adoption of FinTech in as many areas as possible, including most of the underserved areas in rural areas where traditional banking services are unavailable. Examples of such incentives include tax breaks for FinTech companies extending their services into rural or low-income areas. Additionally, public-private partnerships can be established to build the necessary digital infrastructure to enable widespread access to FinTech services (Demirgüç-Kunt et al., 2018).

To maximize the full potential of FinTech, issues of digital literacy must first be addressed. It follows that while there is a prospect for FinTech to lower barriers to accessing financial services, there remains a reliance on the ability of individuals to interface with digital platforms. Therefore, programs that increase digital literacy among excluded groups enable broaden the benefits of FinTech and its inclusivity. Financial institutions can also contribute by designing user-friendly FinTech products accessible to individuals with low levels of financial literacy (Beck et al., 2010).

Financial institutions should develop specific financial products for each socioeconomic class. These products will directly benefit low-income people, and they may take the form of micro-loans, micro-savings, and cheap remittances so that people can save, invest, and participate in economic activities. Such initiatives can help bridge the financial gap and promote a more inclusive financial system, aligning with the financial deepening agenda (Allen et al., 2016).

5.4. Limitations

Although providing valuable insights, this study has several limitations. First, the difference-in-differences (DID) approach relies on the assumption of parallel trends, which may be violated if unobserved factors differentially affect the treatment and control groups. Although diagnostic checks indicated that this assumption held for our dataset, it remains a potential source of bias (Angrist & Pischke, 2019).

Another limitation is the potential issue of endogeneity. Countries that adopt FinTech may have certain socioeconomic conditions influencing their adoption decisions, potentially leading to selection bias. Although the DID model helps mitigate this issue by focusing on changes over time, instrumental variable (IV) approaches could provide additional robustness by addressing any remaining endogeneity concerns (Goldfarb & Tucker, 2019).

The study also does not fully account for spillover effects. FinTech adoption in one country may affect neighboring countries, mainly through increased cross-border transactions or shared knowledge, leading to spillover benefits not captured within the DID model. Future research should consider using spatial econometric models to capture these effects more effectively (Beck et al., 2010).

Lastly, this research focused primarily on adopting digital payments and mobile banking. However, FinTech is a broad field that includes other areas, such as robo-advisory and blockchain, which were not considered here. Future research could

explore how different facets of FinTech impact income inequality, providing a more granular understanding of how FinTech influences economic outcomes (Ozili, 2020).

5.5. Future Research Directions

The identified limitations point to many avenues of future research. First, the heterogeneous effects of FinTech adoption across different demographic segments-for example, rural-urban divides or even gender-based divides in access to FinTech-could be a meaningful direction. These offer more fine-tuned views of which groups gain most from FinTech adoption and for what reasons.

Another promising future research direction is examining the synergies between FinTech adoption and other socioeconomic policies. For instance, examining how it interacts with policies that target the increase of education, health, and employment could provide insights into how different combinations of policies can maximize the impact of financial technology in reducing inequality (Allen et al., 2016).

Future research could also follow qualitative approaches, such as case studies of various countries, to develop insights into contextual factors and promote FinTech adoption and what happens to inequality. All these case studies would fill in the gaps of the quantitative analysis done here with more contextual information that could be used to provide fuller insight into policy decisions.

6. Conclusion

As the results of this study show, FinTech is indeed bound to play a crucially important role in reducing income inequality, especially under favorable conditions provided by digital infrastructure and inclusive policy frameworks. The analysis, conducted through a difference-in-differences model, demonstrated that FinTech adoption was significantly associated with reductions in income inequality, as described by the Gini coefficient and Theil index. This conclusion is consistent with earlier research emphasizing the transformative potential of FinTech in improving financial inclusion and reducing economic disparities (Demirgüç-Kunt et al., 2018; Goldfarb & Tucker, 2019).

The significant adverse impacts of FinTech adoption on income inequality point to a critical role of financial inclusion since expanding access to essential financial services such as payments, savings, and credit to hitherto excluded groups in the formal economic system decreases inequalities in economic activities. This finding underscores the importance of promoting FinTech as a viable solution for tackling income inequality, particularly in developing economies where traditional banking services are limited (Allen et al., 2016).

At the same time, the study postulates that mere FinTech adoption does not guarantee uniform growth. The results point to the necessity of complementary digital infrastructure—including access to reliable internet and appropriate mobile technology—as a prerequisite for FinTech's inclusive benefits. This complements

the arguments of Pagano and Volpin regarding the importance of supporting infrastructure to realize the full potential of financial innovation. Therefore, the full development of FinTech requires governments to invest in improving digital connectivity and reducing the digital divide.

6.1. Policy Recommendations

The implications of these findings are substantial for policymakers, financial institutions, and development practitioners. Policymakers should create an enabling environment for FinTech by adopting FinTech-friendly regulations that facilitate innovation while protecting consumers. Financial inclusion requires targeted policies prioritizing marginalized groups, such as individuals in rural areas or those without formal identification—a historical barrier to accessing financial services (Beck et al., 2010).

Moreover, to further boost FinTech use, governments, and development bodies are encouraged to implement digital literacy programs that equip people to actively use digital financial services. As Allen et al. (2016) noted, digital literacy is essential in FinTech usage, mainly because less well-off citizens may lack the competencies to engage with these digital platforms. Programs teaching mobile banking, digital payments, and other FinTech solutions hold significant potential for widening outreach and reducing income inequality.

Financial institutions also play an essential role by designing accessible FinTech products that are affordable for underserved populations. Developing microloans, savings accounts, and low-cost remittance services targeted at the most vulnerable can address financial exclusion and contribute to greater economic equality (Goldfarb & Tucker, 2019).

6.2. Limitations and Future Research Directions

These promising results are offset by a few limitations that must be recognized. First, the DID approach used here is based on the identifying assumption of parallel trends, which is a strict assumption that may potentially expose it to biases from unobserved interference factors across both the treated and comparison units. Although there was reason to believe it held in this case, additional econometric approaches could be considered in future studies, such as instrumental variable (IV) estimation, to further mitigate potential biases (Angrist & Pischke, 2019).

Another limitation is the generalization of the findings. This study has primarily employed digital payments and mobile banking as proxies for adopting FinTech. Nonetheless, FinTech encompasses a broad range of innovations. Other forms, like insurance, robo-advisory services, and blockchain applications, may affect income inequality differently. Future research could adopt a more granular approach to investigating how various types of FinTech affect income inequality in different contexts (Ozili, 2020).

Further research should also be done on the heterogeneous effects of FinTech

adoption across different population groups. A study of how FinTech adoption affects income inequality across urban and rural areas or between men and women provides additional insight into how these technologies might better be used to target particular vulnerable groups. This will add to the fuller understanding of how FinTech can drive inclusive growth.

Further qualitative approaches, such as country case studies, could be used in future studies to understand the contextual factors that favor or impede FinTech adoption and its impact on income inequality. Such a case study would be critical in acquiring richer contexts for policymakers and practitioners with more specific challenges and best practices in FinTech implementation to complement the quantitative findings and provide a richer context for policymakers and practitioners (Allen et al., 2016).

6.3. Summary of Findings

This study establishes that FinTech's effects could constitute a game-changing intervention in economic policy to reduce income inequality. Evidence from the Difference-in-Differences (DID) analysis demonstrates that FinTech adoption reduces income inequality, highlighting the need for significant digital and financial literacy investment to ensure its benefits are widely shared (Demirgüç-Kunt et al., 2018).

The findings support the notion that any strategy aimed at financial inclusion must be holistic: encouraging FinTech adoption should be accompanied by investments in the necessary digital and financial education to share its benefits equitably. This implies that realizing the potential of FinTech for a more balanced economic landscape requires active and informed collaboration among governments, the private sector, and international development organizations. Indeed, the successful promotion of financial inclusion through digital innovations—even among the most vulnerable in society—means that FinTech can be instrumental in fostering inclusive economic growth and helping to reduce persistently high levels of income inequality.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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