

Does Technology Reduce Income Inequality? Evidence from Six Developing Economies

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Article

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Abstract

This study examines the relationship between technology adoption and income inequality across six developing economies: Kenya, Tanzania, Mexico, Indonesia, Bangladesh, and the Philippines. Using a comparative case-study design, it synthesizes published research and publicly available secondary indicators on national income inequality, mobile money, e-commerce, agricultural technology, and digital connectivity. Historical Gini Index data are used to provide descriptive context, while country cases identify mechanisms through which technology may affect financial inclusion, market access, productivity, employment, and the distribution of economic opportunities. The evidence is heterogeneous. Mobile money in Kenya and Tanzania is associated with improved financial inclusion and resilience; e-commerce in Indonesia and the Philippines expands market participation opportunities, including for women; agricultural mechanization in Mexico may raise productivity while also changing demand for low-skilled labor; and digital connectivity in Bangladesh broadens access to information and online economic activity. These patterns should not be interpreted as causal estimates of technology's effect on national inequality because the study does not employ a counterfactual identification strategy or a harmonized cross-country econometric model. The contribution is therefore comparative and descriptive: technology can support more inclusive economic participation, but its distributional effects depend on skills, institutions, access, and complementary policies.

1. Introduction

Both individuals and organizations in modern society benefit from technological advancements in a variety of ways. However, numerous scholars have argued in recent years that technological advancements are not reducing income inequality as it was anticipated in the early innovation of revolutionary technologies like computers. Some researchers contend that these advancements actually worsen economic inequality, primarily benefiting wealthy individuals and multinational corporations rather than those from lower socioeconomic backgrounds. The primary argument supporting this claim posits that the introduction and utilization of advanced technology, which low-income employees rely on for daily tasks such as paying for internet services and purchasing equipment, reverses the compensation to the capitalist because they own the same business that provides services and products to low-income populations, who are the majority in society.

This article delves deeper into identifying popular money transfer technologies, a sector traditionally dominated by banks, with a particular focus on mobile money transfers as a new technology-driven approach. This technological advancement has provided opportunities for small-scale traders to receive payments for their goods in a convenient and instantaneous manner, thereby fostering an enabling business environment and thereby having a hand in economic growth in developing countries. The mobile money transfer has also provided an opportunity for those low-skilled laborers to receive instant payment after job completion, thus assisting them to meet immediate end needs.

Advanced technologies can alter the distribution of economic opportunities through several competing channels. Automation may reduce demand for some routine tasks, while digital platforms and connectivity may lower information, transaction, and market-access barriers for firms and households. This study therefore examines whether the country cases are consistent with inequality-reducing or inequality-enhancing mechanisms, rather than presuming a uniform effect of technology adoption.

The comparative evidence reviewed in this paper is heterogeneous. Technology adoption can create opportunities for financial inclusion, market participation, and productivity, but it can also change skill demand and employment conditions in ways that may widen disparities. Accordingly, the paper does not conclude that technology by itself

reduces national income inequality; it evaluates the mechanisms and descriptive patterns observed across the six cases.

This paper employs a comparative review of published evidence and secondary indicators for Kenya, Tanzania, Mexico, the Philippines, Indonesia, and Bangladesh. The purpose is to assess how different forms of technology may shape access to finance, markets, employment, and productive opportunities, while distinguishing descriptive association from causal inference.

2. Literature Review

The age we are living in is one of dazzling technological advancements. According to (Qureshi, 2021), scholars commonly use historical terms such as a new industrial revolution, a second machine age, and brilliant new technologies to describe this era as a time of technological renaissance. Some argue that human civilization is on the brink of a sudden technological shift, which could occur abruptly—a phenomenon known as creative destruction coined by Schumpeter—and that predicting the future of the world could be challenging due to the daily changes in technology (Jr., n.d.) This technological singularity brings both positive and negative outcomes, such as a decrease in income inequality or, in some cases, a widening of the income gap. This section of the paper is the literature review section, which captures the findings of other authors in the past on the impact of technological adoption on income distribution and economic growth in developing countries. This section of the paper critically and comprehensively analyzes peer-reviewed past literature that touches on the impact of technological adoption on income distribution and economic growth in developing countries, and more specifically, the impact of technological adoption on income distribution and economic growth in developing countries.

Some scholars link SBTC, associated with emerging technological developments in computers, as the primary cause of the recent rise in wage disparity (Card & DiNardo, 2002) According to (Wang et al., 2021), this theory suggests that companies that adopt technology first tend to prioritize hiring the most qualified tech-savvy professionals to maintain their relevance, productivity, and competitive edge. This, in turn, often leads to the exclusion of employees lacking high technological skills from employment within large companies, particularly multinational ones. These companies, whose primary goal is to maximize shareholder value, believe that they can only achieve this by recruiting the best in the labor market. This implies that as technology advances, skilled professionals will continue to have higher demand in the labor market, thus causing upward pressure on their wages and salaries, while unskilled professionals will continue to receive lower income. Consequently, the income inequality between the higher-earning population and the lower-earning population will continue to increase. However, on the other hand, hiring the most qualified tech employees may also positively impact economic growth to a certain extent. This is due to the hiring of the best employees, who enable the organization to provide the best services and products to end users. Additionally, these organizations and employees pay taxes to the governments of their host countries, thereby contributing to the country's economic development. According to (Bowlus et al., 2021), there is empirical and theoretical evidence that advances in technology have contributed to the growth of the income group by 1%.

On the other hand, (MacCrory et al., 2015) state that every sector has seen a surge in the income percentages of the most skilled individuals, while the earnings of some staff members, particularly casual laborers, have remained stagnant. Due to their increasing importance in output, highly skilled professionals are receiving higher compensation than less skilled employees in the same organizations, which likely contributes to the rise in income inequality, slow economic growth, low interest rates, and stagnant median wages (Nogueira & Madaleno, 2023) (MacCrory et al., 2015) foresaw that advancements in technology would lead to economies of scale, which would

exacerbate inequality in income and, in the long term, lead to unequal distribution of wealth. For example, the advancements in the Integrated Services Digital Network (ISDN) have resulted in the allocation of tasks exclusively to the most skilled and talented professionals, creating a situation akin to a winner-take-all scenario. Companies prioritize the completion of critical, specific tasks by the most qualified professionals, even if it requires them to work remotely and provide the necessary solutions before profits. Before the advancement of telecommunication technologies, organizations shared earnings by encouraging a team to tackle difficult tasks rather than relying solely on the services of a single professional. This implied that if the team found a solution, the organization's benefit and compensation framework would share the income among all team members.

3. Methodology

This study uses a comparative descriptive case-study design based on secondary quantitative indicators and published empirical literature. The six cases were selected to represent distinct forms of technology adoption in developing-economy settings: mobile money in Kenya and Tanzania, e-commerce in Indonesia and the Philippines, agricultural technology in Mexico, and digital connectivity in Bangladesh. The analysis does not estimate a causal treatment effect and does not use a harmonized panel econometric model. Instead, it triangulates national inequality indicators with technology-specific evidence from the cited literature to identify plausible distributional mechanisms and cross-country patterns.

Table 1. Historical National Gini Index by Country and Survey Year (World Bank Poverty and Inequality Platform, via FRED)

Kenya	Tanzania	Indonesia	Philippines	Bangladesh	Mexico
1992: 56.9	1991: 35.3	1984: 32.3	1985: 41.0	1983: 25.9	1984: 48.5
1994: 43.1	2000: 37.3	1996: 34.2	1991: 43.8	1988: 28.8	1992: 52.3
1997: 45.0	2007: 40.3	2005: 29.9	1997: 46.0	1995: 32.9	2000: 53.4
2005: 46.4	2011: 37.8	2010: 34.6	2009: 47.7	2000: 33.4	2006: 49.7
2015: 40.8	2018: 40.5	2013: 38.9	2009: 46.3	2005: 33.2	2010: 47.7
2020: 36.2	–	2018: 36.3	2015: 44.6	2010: 32.1	2016: 46.9
2022: 37.7	–	2022: 35.5	2018: 42.3	2016: 32.4	2020: 44.6
–	–	2025: 34.4	2023: 39.3	2022: 30.9	2024: 42.6

Note: Gini Index ranges from 0 (perfect equality) to 100 (perfect inequality). Higher values indicate greater income inequality.

Table 1 reports historical national Gini Index values for the six countries using publicly available World Bank Poverty and Inequality Platform data accessed through FRED. Figure 1 summarizes the time pattern of the Gini Index and marks the approximate introduction or expansion of the technology emphasized in each case. These timing markers are used only for descriptive orientation. Because survey years differ across countries and technology adoption is not randomly assigned, changes in the Gini Index before or after a technology milestone cannot by themselves establish causality. Technology-specific indicators reported in the remaining tables are drawn from the cited secondary sources and are interpreted as contextual evidence rather than experimental or quasi-experimental estimates.

3.1 Mobile money systems in Kenya

The first mobile money transfer service, M-PESA, also known as a mobile phone-based money transfer, is rapidly expanding as technology advances, attracting tens of thousands of agents and a user base of millions in Kenya, (Wachira & Njuguna, 2023) According to (Wachira & Njuguna, 2023), this mobile payments and microfinancing service has attracted a lot of attention due to its quick expansion, even in the most remote areas of the country. Global actors have praised this mobile service and others for creating revolutionary advantages, providing unbanked Kenyans with new ways to obtain financial services without discrimination, and ensuring financial inclusivity in a way that global society has never imagined before. According to Morawczynski (2009), the people of Kenya have successfully used the M-PESA mobile money service to cultivate livelihood strategies, some of which have acted as pillars to help the country's most vulnerable users, such as low-income earners, cope with stresses and shocks in the same ways as those in the society who earn more. Moreover, Morawczynski (2009) argues that Kenyans have used M-PESA to accumulate and solicit financial assets, thereby contributing to income distribution and economic growth in this developing country.

Many Kenyans are now using mobile payment systems, a service that allows users to receive money, store it on their cell phone, and send it to other users via text messages. Major telecommunication companies like Safaricom and Airtel operating in the country provide the popular mobile money services, Airtel Money and M-PESA, which have lifted a significant number of Kenyans out of poverty and increased per capita consumption levels. Changes in financial behavior, specifically continuing to increase financial resilience and saving, and labor market outcomes, including occupational choice, particularly for women who transitioned from small-scale agriculture to business, seem to be the main causes of the effects. According to (Hove & Dubus, 2019), the fact that M-PESA and other mobile money transfer services serve as tools for facilitating safekeeping and sending money to other users suggests that they have a significant economic impact, potentially reducing the income gap and bringing everyone on a level playing field.

Mobile money users can easily pay for things like water and internet bills, as well as electricity, by simply pressing the button of the phone or swiping the screen of the smartphone. This eliminates the need for individuals to travel to distant offices such as banks to deposit checks or make transfers, or to wait for service providers to verify their transfers, which can take up to 24 or 48 hours to complete. Mobile banking services have always replaced the traditional practice of carrying bundles of cash and risking theft in the streets, and they have also removed the need to visit traditional banking facilities and stand in a long line with other customers to deposit checks or money in the accounts of the receiver or seller of goods and services.

Moreover, mobile money can broaden access to transfers, savings, and short-term liquidity. Suri and Jack (2016) estimate that the expansion of M-PESA lifted about 194,000 Kenyan households - roughly 2% of households - out of poverty and was associated with changes in consumption resilience and occupational choice, especially among women. These findings provide evidence of important welfare and inclusion effects, but they do not establish that M-PESA caused a specific change in Kenya's national Gini coefficient. In this paper, the Kenyan case is therefore interpreted as evidence of potentially inequality-reducing mechanisms rather than as a causal national-inequality estimate.

[Insert Table 2 here]

Table 2
Selected indicators associated with mobile money expansion in Kenya .

Statistic	Pre-expansion benchmark	Later observed value(s)	Explanation
National Gini Index (descriptive context)	46.4 (2005)	40.8 (2015); 36.2 (2020); 38.5 (2022)	Observed World Bank/FRED values. These are descriptive time-series benchmarks and are not interpreted as a causal M-PESA effect.
Financial Inclusion (Banked Population)	26.7% (2006)	82.9% (2019)	The majority of Kenyans now have the opportunity to access banking features through mobile money transfer services, thereby giving a large population of Kenyans access to the M-PESA banking platform. This platform allows Kenyans to receive, save, and send money, making it easy to pay bills and purchase items through the M-PESA paybill services.
Mobile Money Users	0 (2007)	30.53 million monthly active customers (FY2022)	M-PESA has continued to expand where more than half of the population of Kenya has continued to enjoy the service.
Cost of Money Transfers	High	Low	Because M-PESA transaction costs are lower than those of other money transfer services, such as using banks, most Kenyans prefer to save their money in mobile M-PESA instead of using traditional bank methods. This is because accessing money in banks can be a cumbersome process, often resulting in significant costs, which can double the cost of using M-PESA.
Poverty Reduction (Estimated Impact)	Minimal	194,000 households (about 2% of Kenyan households)	Suri and Jack (2016) estimate that M-PESA expansion lifted about 194,000 households out of poverty; this is a welfare/poverty estimate, not a national Gini estimate.

Table 2 summarizes selected descriptive indicators around the expansion of M-PESA in Kenya. The national Gini figures are used only as historical context and should not be interpreted as a causal before-and-after estimate of M-PESA. The broader literature cited in this section provides stronger evidence on financial inclusion, consumption smoothing, poverty, and gender-related outcomes.

The Kenyan government has created a favorable environment for companies offering mobile money services, allowing them to fulfill their objectives, prosper, and continue to deliver top-notch banking services to the populace. As part of a strategy to eradicate poverty and increase access to employment opportunities for the impoverished population, this aims to provide all Kenyans with banking-like services. In their official annual declaration report in 2022, Safaricom PLC, a technology-based and mobile provider service company, claimed that M-PESA has amassed 30 million customers who actively use the service every month in Kenya alone. This indicates that more than half of Kenya's population actively uses the service and finds it satisfactory.

3.2 Mobile money systems in Tanzania

Mobile money has also expanded rapidly in Tanzania and has been associated in the literature with greater financial inclusion and improved resilience to shocks. Tanzania is an important comparative case because formal financial access was limited for a substantial share of the population when mobile money services expanded (Baruti et al.,

2022). These patterns are consistent with potentially inclusive effects, but they do not by themselves establish a causal reduction in national income inequality.

(Abiona & Koppensteiner, 2020) conducted a study on the evidence from the expansion of mobile money in Tanzania while researching poverty, shocks, and financial inclusion. They discovered that the most poverty-stricken households in Tanzania, impacted by negative shocks, can smooth their consumption with mobile money, thereby preventing them from falling into temporary poverty. According to Abiona & Koppensteiner's research from 2022, having access to mobile money can help families, particularly those with low incomes, adopt preventative measures, such as practicing preventative healthcare. For instance, if these families can afford to purchase and use treated mosquito nets to prevent malaria, it would help them avoid spending a significant amount of financial resources on medical care, thereby reducing healthcare costs. In a similar vein, (Abiona & Koppensteiner, 2020) also discovered in their research that mobile money prevents girls from spending more time fetching water from rivers and traveling to the forest to collect firewood as a response to economic shocks.

3.3 E-commerce platforms in the Philippines and Indonesia

In this era of technological advancement, computer technology and the Internet of Things are propelling the growth of electronic commerce globally. Since 2015, the size of Southeast Asia's e-commerce market has tripled (Faiz et al., 2020) Researchers have forecasted using data, and the results have consistently shown that the region will see a further surge in its usage by 2025 as individuals increasingly shift to online business due to its convenience.

According to a World Bank report, gender-based income inequality has a significant negative impact on a country's and region's economy, resulting in a loss of \$25,367 per person in the Pacific region and East Asia in 2017 (Olusegun, 2024) (Olusegun, 2024) asserts that the only effective solution to address gender inequality in earnings is for a jurisdiction to integrate technology into business operations and employment practices. This is because technology is currently the driving force behind the majority of profitable businesses and plays a crucial role in facilitating convenient, accurate, and efficient work processes. Take a look at a country like the Philippines and Indonesia, where women have a higher likelihood of not being participants in the labor force. For instance, (Olusegun, 2024) reports that approximately half of the female population in the Philippines and Indonesia actively participates in business activities, a significantly smaller proportion compared to the 73 percent of men in the Philippines and the 82 percent of men in Indonesia. In Indonesia alone, only 50 percent of men and 45 percent of women use internet-related activities (Faiz et al., 2020) Another researcher reveals that in the Southeast Asian region, the percentage of men who use the internet on a daily basis exceeds that of women by 11 percent (Faiz et al., 2020) Technological advancement presents a promising opportunity for women to enter the workforce and become entrepreneurs through e-commerce.

3.4 Opportunities for Women in E-commerce in Indonesia and the Philippines

E-commerce presents a plethora of easy-to-navigate opportunities for women in Indonesia and the Philippines who aspire to venture into business, showcasing their talents and skills in higher-earning sectors. Additionally, it provides an opportunity for these women to enhance their productivity. Technology can help women achieve their goals and overcome the societal challenges that have long been present. However, numerous obstacles have hindered women from reaping the benefits of technologies like e-commerce, a booming sector in Indonesia, where women have ample opportunities to thrive if given equal opportunities as men. They can expand their businesses, research the best products to sell online, and bridge market gaps. They can use the same internet to access the most prominent

e-commerce platforms, many of which offer free registration, flexible work schedules, and the ability to earn money from the comfort of their own homes, thereby contributing to the reduction of income inequality.

E-commerce Increases Market Access. Technological advancement has created and enabled e-commerce platforms, a unique type of marketing platform that provides instant access to a wider range of potential customers in a more efficient manner, all from the comfort of a seller's home or business premises (Corporation, 2021) Therefore, sellers who are using e-commerce to market their products over the various platforms provided by the internet of things have the opportunity to scale more quickly and get a greater return on their investment, thanks to a sustainable environment of services that includes, in one place, business enablers such as logistics services, payment capabilities, and integrated marketing tools (Pertiwi et al., 2019) All these services provide extraordinary opportunities to boost productivity and increase income for those venturing into the business world in this era of higher technological advancements.

3.5 Agricultural technology adoption in Mexico

Technologically advanced machines and technology in Mexico have the potential to significantly alter the labor market, boost productivity, and revolutionize production processes (Bushong et al., 2020) However, various researchers have highlighted and found that the mechanization of agriculture and the use of sophisticated technology in this sector can have both positive and negative effects, leading to both job creation and job loss among the population.

[Insert Table 3 here]

Table 3
Agricultural Technology Market

Aspect	Details
Market Size (2024)	USD 732.35 million
Market Size (2029)	USD 908.28 million
CAGR (2024–2029)	4.40%
Compound Annual Growth Rate	
Arable Land Area (2021)	20.1 million hectares
Key Drivers	Motivated by the need to increase agricultural productivity High population growth which has led to growth in increased agricultural production.
Corn Consumption (2022–2023)	Increase from 44,000 metric tons to 45,700 metric tons
Combined Harvester-Threshers Imports	1,541 units in 2022 This is an 18.6% increase from the previous year
Key Import Sources	United States, India, China, Japan
Major Manufacturers	- Deere and Company
	- AGCO Corporation
	- CNH Industrial NV
	- Kubota Mexico S.A. de C.V.

Some researchers contend that the adoption of machinery in Mexico could potentially decrease the need for human labor over time. This is due to the automation of certain technologies, which require less human intervention to produce high-quality results quickly. These technologies are capable of efficiently completing tasks in minutes that hundreds of workers could have completed in hours or days, and most of these machines are so perfect that they can avoid common human errors. This suggests that the adoption of technology in Mexican farms and agricultural fields may lead to a gradual reduction in job opportunities, primarily affecting low-skilled laborers who survive on low-wage compensation benefits.

However, other researchers have shown that the introduction of machinery with highly advanced technologies has positively impacted employment, creating new job opportunities. Regarding the potential job opportunities offered by new technology for agriculture in Mexico, (OTITOJU et al., 2023) assert that its utilization is not flawless, as there are instances where these technologies require repairs, maintenance, and operations. This, in turn, creates job opportunities for individuals who possess the necessary skills for performing these machinery repairs. This implies that if the agricultural field had not utilized the machinery, the individual responsible for its repair after failure would not have found employment in Mexico.

Furthermore, the extensive use of machines based on technological advancements in downstream industries like marketing, transportation, and food processing will greatly benefit people with the skills to work in these industries over time. Furthermore, it's important to acknowledge that the implementation of agricultural mechanization influences the remuneration and benefits that employees receive. One way is that most agricultural machines are

designed to perform labor-intensive tasks that take human laborers a considerable amount of time to complete. This has an impact on the people who were previously performing these labor-intensive tasks, as it forces them to lower their expectations of the wages they should receive after completing them (OTITOJU et al., 2023) This is because investors now have the option to use machines, resulting in a decline in demand for their services, which in turn leads to a decrease in compensation. In other cases, agricultural mechanization may have a positive impact on productivity, leading to an increase in economic growth. This, in turn, may lead to a rise in wages as companies begin to demand the services of skilled professionals, thereby improving labor market conditions in Mexico.

3.6 The Impact of Digital Connectivity in Bangladesh

Bangladesh has experienced rapid expansion of digital connectivity. The DAI (2022) assessment documents the country's digital ecosystem and continuing access and skills gaps. For the end of 2023, official Bangladesh Telecommunication Regulatory Commission data report 131.37 million internet subscriptions (118.49 million mobile internet subscriptions and 12.88 million ISP/PSTN subscriptions), with an internet penetration rate of 74.08%. These are subscription counts rather than a count of unique individual internet users. Expanding connectivity creates opportunities for information access, digital payments, online services, education, and e-commerce, while unequal access and digital skills remain important constraints on inclusive participation.

Growth is an essential element of Bangladesh's investment pitch. Bangladesh is a country that has recorded an average GDP growth of 7% over the last ten years and no years of recession over the previous thirty. This suggests that the nation's growth statistics are truly impressive.

Educated individuals are better equipped to utilize the technology skills they have acquired over the years in school. This suggests that individuals with a higher level of education can reap greater benefits from the opportunities presented by technology, such as e-commerce, access to a global community, the ability to share ideas through social media, and the ability to utilize artificial intelligence in their daily lives.

4. Major findings: Analysis of Economic Data

[Insert Table 4 here]

Table 4						
E-commerce Participation and GMV (Gross Merchandise Value) by Gender						
Aspect	Country	Male Ownership (%)	Female Ownership (%)	Male GMV (pre-COVID)	Female GMV (pre-COVID)	Female GMV Drop (COVID)
E-commerce Participation	Indonesia	64%	36%	100%	164%	-44%
	Philippines	31%	69%	100%	106%	-27%
Source: Women and E-Commerce in Southeast Asia, IFC						
[Insert Table 5 here]						

Table 5
Illustrative two-group income scenarios and Gini calculations for Indonesia and the Philippines
(author-created inputs; not observed household microdata; USD)

1	2	3	4	5 = 3*4
Country	Group (x_i, x_j)	Average Income (Annual)	Number of Households (n)	Total Income
Indonesia	Male	3,000	100	300,000
	Female	2,000	100	200,000
The Philippines	Male	3,500	100	350,000
	Female	2,500	100	250,000

We know the Gini Finding Formula is $G = \frac{\sum_{i=1}^n \sum_{j=1}^n |x_i - x_j|}{2n^2 \bar{x}}$

For Indonesia: Mean Income, $\bar{x} = (300000 + 200000) / (100 + 100) = 2500$

- Male: 100 households with an income 3,000
- Female: 100 households with an income 2,000
- Total households: $n = 100 + 100 = 200$

There are only two income levels, so:

- Differences within the same group = $|3000 - 3000| = 0$ and $|2000 - 2000| = 0$
- Differences across groups = $|3000 - 2000| = 1,000$
- Number of cross pairs = $2 * 100 * 100 = 20000$
- Total absolute differences = $20,000 \times 1,000 = 20,000,000$
- Denominator = $2n^2 \bar{x} = 2(200)^2 (2500) = 200,000,000$
- $Gini_{(Indonesia)} = \frac{20000000}{200000000} = 0.10$

For the Philippines: Mean Income, $\bar{x} = (350000 + 250000) / (100 + 100) = 3000$

- Male: 100 households with an income 3,500
- Female: 100 households with an income 2,500
- Total households: $n = 100 + 100 = 200$

There are only two income levels, so:

- Differences within the same group = $|3500 - 3500| = 0$ and $|2500 - 2500| = 0$
- Differences across groups = $|3500 - 2500| = 1,000$
- Number of cross pairs = $2 * 100 * 100 = 20000$
- Total absolute differences = $20,000 \times 1,000 = 20,000,000$

- Denominator = $2n^2\bar{x} = 2(200)^2(3000) = 240,000,000$
- $Gini_{(Philippines)} = \frac{20000000}{240000000} = 0.083$

The simplified subgroup calculations reported here illustrate how dispersion differs across the assumed income groups. They are not national Gini coefficients and should not be interpreted as estimates of economy-wide inequality or as causal effects of e-commerce.

For national context, the current World Bank WDI/Poverty and Inequality Platform series reports a Gini Index of 36.1 for Indonesia in 2023 and 39.3 for the Philippines in 2023. These national survey-based indicators are conceptually different from the illustrative two-group calculations above and are not used as before-and-after causal estimates of e-commerce adoption.

[Insert Table 6 here]

Table 6 Analyzing the Current State of Agricultural Technology in Mexico				
Aspect	Current Situation	Challenges	Programs	Impact
Adoption Rates	50% use hybrid seeds 3 tons/ha yields	Limited tech adoption	-	Low productivity
Economic Impact	Yields: 0.6–2.5 tons/ha on small farms	Lack of info credit access	Technological Guarantee Program (TGP)	Aims to increase yields
Income Distribution	25% rural poverty avg. income: US\$2,200/year	Inequality low income	-	Widened income gap
[Insert Table 7 here]				

Table 7 Illustrative two-group income scenario for agricultural-technology users and non-users in Mexico (author-created inputs; not observed household microdata; USD)			
1	2	3	4 = 2*3
Group (x _i , x _j)	Income per Household (Annual)	Number of Households (n)	Total Income (Annual)
Non-users	20,000	100	2,000,000
Users	35,000	100	3,500,000

Finding of Gini Coefficient:

Gini Finding Formula is $G = \frac{\sum_{i=1}^n \sum_{j=1}^n |x_i - x_j|}{2n^2\bar{x}}$

Calculation of the Total Income

- Total Income = Income from Non-users + Income from Users = 2,000,000 + 3,500,000 = 5,500,000

For Mexico: Mean Income, $\overline{x} = 5,500,000 / 200 = 27500$

- Non-Users: 100 households with an income of 20,000
- Users: 100 households with an income of 35,000
- Total households: $n = 100 + 100 = 200$

There are only two income levels, so:

- Differences within the same group = $|20000 - 20000| = 0$ and $|35000 - 35000| = 0$
- Differences across groups = $|20000 - 35000| = 15000$
- Number of cross pairs = $2 * 100 * 100 = 20000$
- Total absolute differences = $20000 * 15000 = 300,000,000$
- Denominator = $2n^2 \overline{x} = 2(200)^2 (27500) = 2200,000,000$

Gini(Mexico) = 0.136

The corrected two-group illustrative Gini coefficient for the assumed Mexican user/non-user incomes is 0.136. This value describes only the dispersion in the simplified two-group example; it is not directly comparable with Mexico's national Gini Index and does not establish that agricultural technology caused a change in national inequality.

[Insert Table 8 here]

Table 8
Internet and Mobile Connectivity in Bangladesh

Aspect	Details	Year	Growth	Impact	Challenges
Growth in IT	Significant development in IT	Since 1996	Expanded internet and mobile	Increased connectivity	Limited rural infrastructure
Internet Users (March 2021)	Not used in synchronized analysis; earlier 116 million figure not independently verified	2021	Growing user base	Greater access to internet	Digital literacy issues
4G Network Launch	4G started	Feb 2018	Improved mobile speeds	Better mobile internet	Service quality varies
VSAT Data Circuit	Not used in synchronized analysis; June 1996 VSAT statement not independently verified	June 1996	Initial digital infrastructure	Enabled data communication	High setup cost
Current State (2023)	Internet and mobile overview	2023	Rapid growth in users	Widespread mobile usage	Meeting demand
Internet Users (2023)	131.37 million subscriptions (118.49M mobile; 12.88M ISP/PSTN)	2023	Increased adoption	Online services access	Urban-rural digital divide
Internet Penetration Rate (2023)	74.08%	2023	Growing penetration	Digital inclusion	Rural access issues
Population Estimate (2023)	171.47 million	2023	High connection rate	Enhanced communication	Mobile reliance
Mobile Connections (2023)	190.81 million subscriptions	2023	User base reflects reach	Supports digital planning	Needs updated data
Tech Impact on Income Inequality	Significant influence	Ongoing	Improved job access	Access to remote work	Access inequality

For national context, the World Bank WDI/Poverty and Inequality Platform reports a Gini Index of 30.9 for Bangladesh in 2022.

To determine the impact of technology on income inequality in Bangladesh, we can apply the following formula:

$$INE = \beta_0 + \beta_1 \cdot TA + \beta_2 \cdot EG + \beta_3 \cdot EDU + \epsilon$$

Where:

- INE = Income Inequality (Gini coefficient)
- TA = Technological Adoption
- EG = Economic Growth in GDP

- EDU = Education Level (the rates at which people can read and write)

The equation is presented as a conceptual framework rather than an estimated econometric model. A future empirical application could model income inequality as a function of technological adoption, economic growth, education, and additional controls. In the present study, however, the coefficients are not estimated because a consistent longitudinal dataset and identification strategy are not available. The equation therefore organizes the hypothesized channels rather than providing statistical evidence of effect size or significance.

Analysis of the Context of Mobile Money in Kenya

[Insert Table 9 here]

Group	Income per Household (Annual)	Number of Households	Total Income (USD)
Non-users	1,500	100	150,000
Users	3,000	100	300,000
Finding of Gini Coefficient:			
Gini Finding Formula is $G = \frac{\sum_{i=1}^n \sum_{j=1}^n x_i - x_j }{2n^2 \bar{x}}$			
• Total Income = Income from Non-users + Income from Users = 150,000 + 300,000 = 450,000			
For Kenya: Mean Income, $\bar{x} = 450,000 / 200 = 2250$			
• Non-Users: 100 households with an income of 1,500			
• Users: 100 households with an income of 3,000			
• Total households: $n = 100 + 100 = 200$			
There are only two income levels, so:			

- Differences within the same group = $|1500 - 1500| = 0$ and $|3000 - 3000| = 0$
- Differences across groups = $|1500 - 3000| = 1500$
- Number of cross pairs = $2 \times 100 \times 100 = 20000$
- Total absolute differences = $20000 \times 1500 = 30,000,000$
- Denominator = $2n^2 \bar{x} = 2(200)^2 (2250) = 180,000,000$

Gini(Kenya) = 0.167 (rounded from 0.1667)

The simplified Kenya calculation is an illustrative two-group measure based on author-created scenario values, not observed household microdata. It is not directly comparable with the national Gini Index and should not be interpreted as evidence that mobile technology caused a particular reduction in national income inequality.

4.1 Limitations

This study has several limitations. First, it is descriptive and comparative rather than causal; the observed evolution of inequality may reflect macroeconomic conditions, labor-market institutions, education, fiscal policy, demographic change, or other factors that coincide with technology adoption. Second, the six cases rely on different technologies, indicators, source years, and levels of aggregation, which limits direct cross-country comparability. Third, national Gini coefficients cannot be directly compared with simplified subgroup calculations or technology-user indicators as if they measured the same population. Accordingly, subgroup calculations are treated only as illustrations and are not used to infer changes in national inequality. Fourth, some technology indicators come from institutional reports and case-study literature rather than a single harmonized database. Future research should use consistent microdata or panel data and an explicit identification strategy - such as difference-in-differences, instrumental variables, or event-study designs - to estimate the causal distributional effects of technology adoption.

5. Conclusion

The comparative evidence indicates that technology is neither inherently equalizing nor inherently inequality-enhancing. Its distributional consequences depend on who gains access, which skills are rewarded, how markets and institutions adapt, and whether complementary policies broaden participation. In Kenya and Tanzania, mobile money is associated with wider access to financial services and greater capacity to manage economic shocks. In Indonesia and the Philippines, e-commerce can lower barriers to market participation, including for women entrepreneurs. In Mexico, agricultural technologies may improve productivity while simultaneously reducing demand for some routine low-skilled tasks and increasing demand for technical skills. In Bangladesh, expanding digital connectivity creates new channels for information, services, and online economic activity, but unequal access and digital skills remain constraints. These findings support a conditional conclusion: technology can contribute to more inclusive development when access, skills, consumer protection, infrastructure, and labor-market adjustment policies are strengthened. Because the study is descriptive, it does not claim that technology adoption alone caused the observed changes in national inequality.

Declarations

Competing interests

The author declares no competing interests.

Ethical Approval

This article does not contain any studies with human participants performed by the author.

Informed Consent

Not applicable. This study uses publicly available secondary data and published literature and does not involve human participants.

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Author Contribution

I am the sole author who wrote and prepared the manuscript.

Data availability

All quantitative materials used for the revised manuscript are derived from publicly available secondary sources cited in the manuscript and documented in the accompanying supplementary workbook, HSSC_FINAL_Supplementary_Data_and_Calculations.xlsx. The workbook identifies source URLs and audit status for the national Gini series and selected country indicators and provides formulas for the simplified two-group Gini calculations. The income and group-size inputs used in the Indonesia, Philippines, Mexico, and Kenya two-group examples are author-created illustrative scenarios and are explicitly identified as such; they are not observed household microdata. No confidential, proprietary, or individual-level participant data were collected. Items that could not be independently verified are not used as evidentiary inputs in the synchronized manuscript.

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Figures

Figure 1. Historical National Gini Index by Country, with Technology-Adoption Year Marked

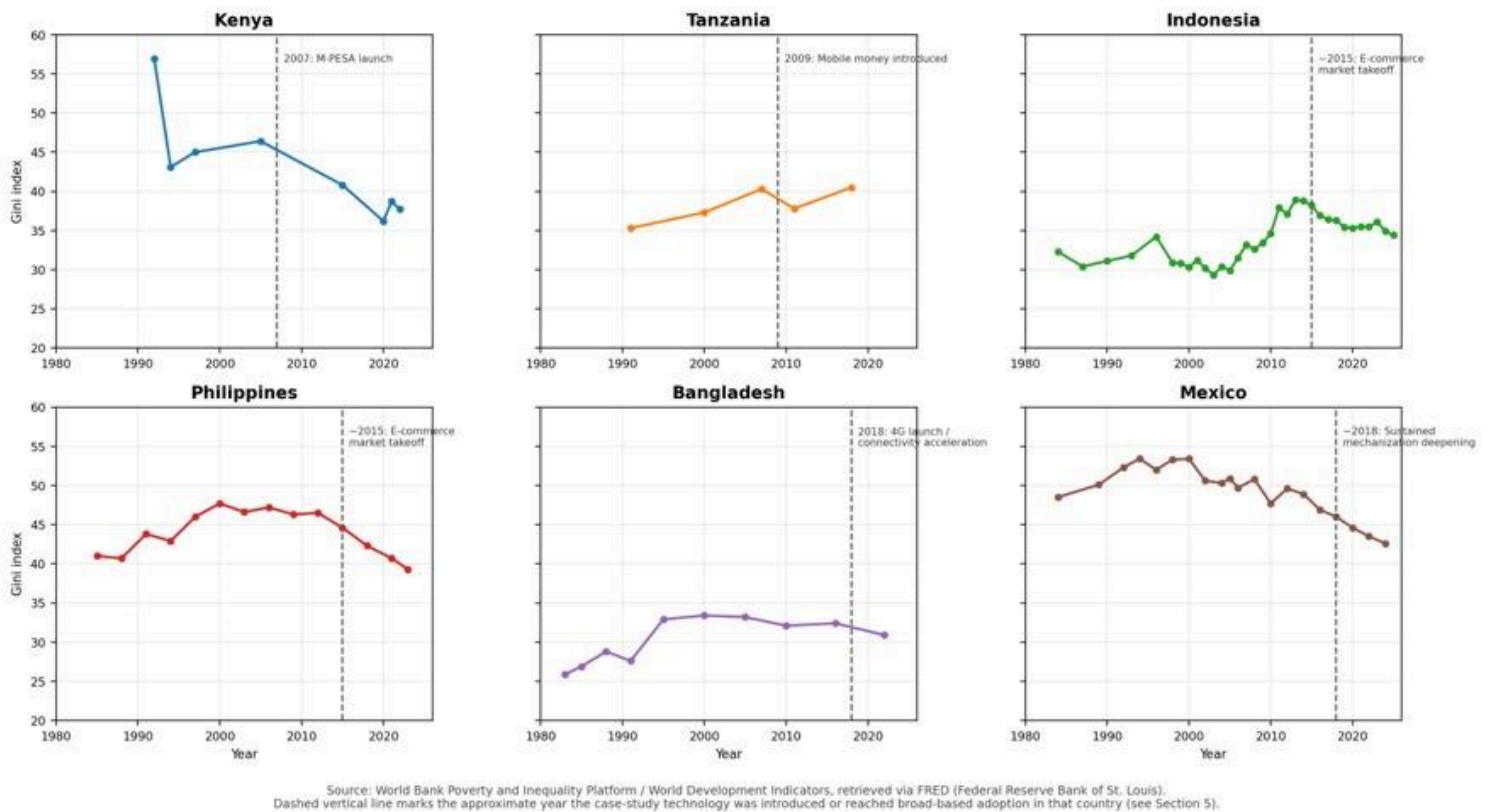


Figure 1

See image above for figure legend

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