NOVEL WAYS TO REDUCE INCOME INEQUALITY:

FINANCIAL AND DIGITAL INCLUSION

by

Araiz Murad Dahir

APPROVED BY SUPERVISORY COMMITTEE:

Jonas Bunte, Chair

Lloyd J. Dumas

Harold D. Clarke

NOVEL WAYS TO REDUCE INCOME INEQUALITY:

FINANCIAL AND DIGITAL INCLUSION

by

ARAIZ MURAD DAHIR, BSC

THESIS

Presented to the Faculty of

The University of Texas at Dallas

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE IN

INTERNATIONAL POLITICAL ECONOMY

THE UNIVERSITY OF TEXAS AT DALLAS

and

PHILIPPS-UNIVERSITÄT MARBURG

May 2019

ACKNOWLEDGMENTS

I would like to express my gratitude to Professor Jonas Bunte, my supervisor, for his patient guidance, enthusiastic encouragement, and helpful comments and remarks during the preparation of my thesis; these were a valuable contribution to my work at hand. I would also like to thank Professor Lloyd J. Dumas and Professor Harold D. Clarke for teaching me skills required to develop my thesis. Finally, I wish to thank my parents, family and fellow IPE students for their support and encouragement throughout my study program.

April 2019

NOVEL WAY TO REDUCE INCOME INEQUALITY:

FINANCIAL AND DIGITAL INCLUSION

Araiz Murad Dahir, MS
The University of Texas at Dallas, 2019

Supervising Professor: Jonas Bunte

Income inequality has been constantly increasing throughout the world in recent times. Countries are implementing novel ways of reducing inequality through financial and digital inclusion. The main challenge lies in the assumption that financial and digital inclusion would automatically reduce income inequality. The effectiveness of these services in reducing income inequality will be significantly hindered if people lack knowledge and skills to use these services effectively. It can be argued that the effect of financial and digital inclusion on income inequality will vary depending on their interaction with education level in a country. When financial and digital inclusion interact with education, it is hypothesized to have significant effect on reducing income inequality. Using fixed effects panel data models, this thesis finds strong interaction effect of financial inclusion and education level, but a weak interaction of digital inclusion and education level.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Income inequality has been constantly increasing throughout the world in recent times. It has increased in US, Canada, India, China, Russia and even in Europe (World Inequality Lab, 2018). One may deduce that previous methods to reduce income inequality have not been effective, or perhaps they have failed. So, novel ways of overcoming the problem are being suggested, among these are digital and financial inclusion. Where financial inclusion aims to increase access of financial products and services to the public, digital inclusion targets increasing digital access for all. It is a challenging task for policy makers to implement these services in a way that benefits the whole society and reduces income inequality. The main challenge lies in the assumption that financial and digital inclusion by themselves would reduce income inequality. However, research shows that these services follow skill and literacy biased pattern and their impact diminishes in low literacy regions (Huang et al., 2019; Le et al., 2019; Ramachandran, 2012; Forman et al., 2012).

In the face of increasing inequality in all regions of the world, World Bank (2018) has initiated a Universal Financial Access 2020 Initiative. Financial Inclusion intends to reduce extreme poverty and boost shared prosperity by increasing access of useful and affordable financial products and services to individuals and businesses. These products and services are meant to allow transactions, payments, savings, credit and insurance in a responsible and sustainable way. After recognizing financial inclusion as a very important step to achieve Sustainable Development Goals, Group of 20 (G20) has committed to implement the G20 High-Level Principles for Digital Financial Inclusion. Since 2010, around 55 countries have committed

to target financial inclusion and more than 60 have already launched or are developing a national strategy. Although 69% of adults have an account and 1.2 billion adults have gained access to an account since 2011, 1.7 billion people are still unbanked (World Bank, 2018).

Financial Inclusion is supposed to play a very important role in achieving 2030 Sustainable Development Goals (SDGs). It is featured as a target in eight of the seventeen goals: SDG1, on eliminating poverty; SDG 2 on fighting hunger; SDG 3 on ensuring healthy life and wellbeing; SDG 5 on realizing gender equality; SDG 8 on encouraging economic growth and job creation; SDG 9 on industrial development, innovation, and infrastructure; SDG 10 on reducing inequality; and SDG 17 on solidifying implementation means. Financial Inclusion is intended to spur growth by increasing savings which would help grow investment and consumption. It is due to its important role in achieving SDGs and ultimately reducing poverty and income inequality, careful steps are needed to be taken (UNCDF).

Steps to effectively extend digital technologies have also lagged behind. The world development digital dividends report argues that the aggregate broader development benefits of dispersion of digital technologies, especially internet, has fallen short and is unevenly distributed. In some cases, the digital technologies did help boost growth, improve service delivery, and create jobs; but in other cases, it strengthened concentration of market power, amplified inequality, and increased control of government. If delivered correctly, it has potential to decrease inequality and increase opportunities, like it did in China where 8 million entrepreneurs can use e-commerce platform to export goods to 120 countries. However, in other cases internet dispersion did not increase employment opportunities as workers lacked skills to efficiently use the service.

Although Many countries are taking steps to increase financial and digital inclusion, its effectiveness in reducing poverty and income inequality will be significantly hindered if people lack knowledge and skills to use these services effectively. To tackle this issue, some scholars have recommended increasing digital and financial literacy (Forman et al., 2012; Huang et al., 2019; Le et al., 2019); Ramachandran, 2012). However, not only there is lack of data on financial and digital literacy, it is also a difficult aim to achieve as a policy instrument. The next best alternative is to increase education enrollment in general. This paper argues that the best way to reduce income inequality through financial and digital inclusion would be through educating the public. The reasoning is based on the argument that education makes people capable of using these services more effectively. When financial and digital inclusion interact with education, it is hypothesized to have significant effect on reducing income inequality.

This paper adds to the existing literature in several ways. First it revisits the relationship between income inequality and education with improved data. After that it develops a financial inclusion index using Sarma's (2008) methodology, which is then made to interact with enrollment in education to see its impact on income inequality. At the same time, the paper also interacts digital inclusion with education. Furthermore, special care has been taken in collecting and cleaning the data. This paper uses new and up-to-date data; where previous research on income inequality suffered from poor data, this paper uses a standardized dataset with widest coverage over time and countries. Moreover, analysis of the data revealed more than 20 countries with different names in the datasets, e.g. Iran and Islamic republic of Iran, these have been corrected while merging the data to ensure no data is lost.

This paper proceeds as follows. Next chapter discusses trends of income inequality throughout the world. Chapter three presents theory and rationale behind the relationship between financial and digital inclusion with education level. Chapter four reviews the literature on relationship between inequality and financial inclusion, inequality and digital inclusion, and inequality and education. Chapter five discusses research design with detailed discussion of data and methodology. Chapter six presents result and analysis. The final chapter concludes.

CHAPTER 2

TRENDS IN INCOME INEQUALITY

According to World Inequality Report 2018 compiled by World Inequality Lab, income inequality has been on the rise throughout the world. The report unites macro and microeconomic inequality data to evaluate the prevalence of inequality in different countries and regions of the world. They combine all transparent data sources like national income and wealth accounts, household surveys, fiscal and inheritance data to get the estimates (World Inequality Lab, 2018).

According to the report, income inequality in 2018 increased at different speeds in all regions of the world. One way of looking at inequality is by looking at how much income from

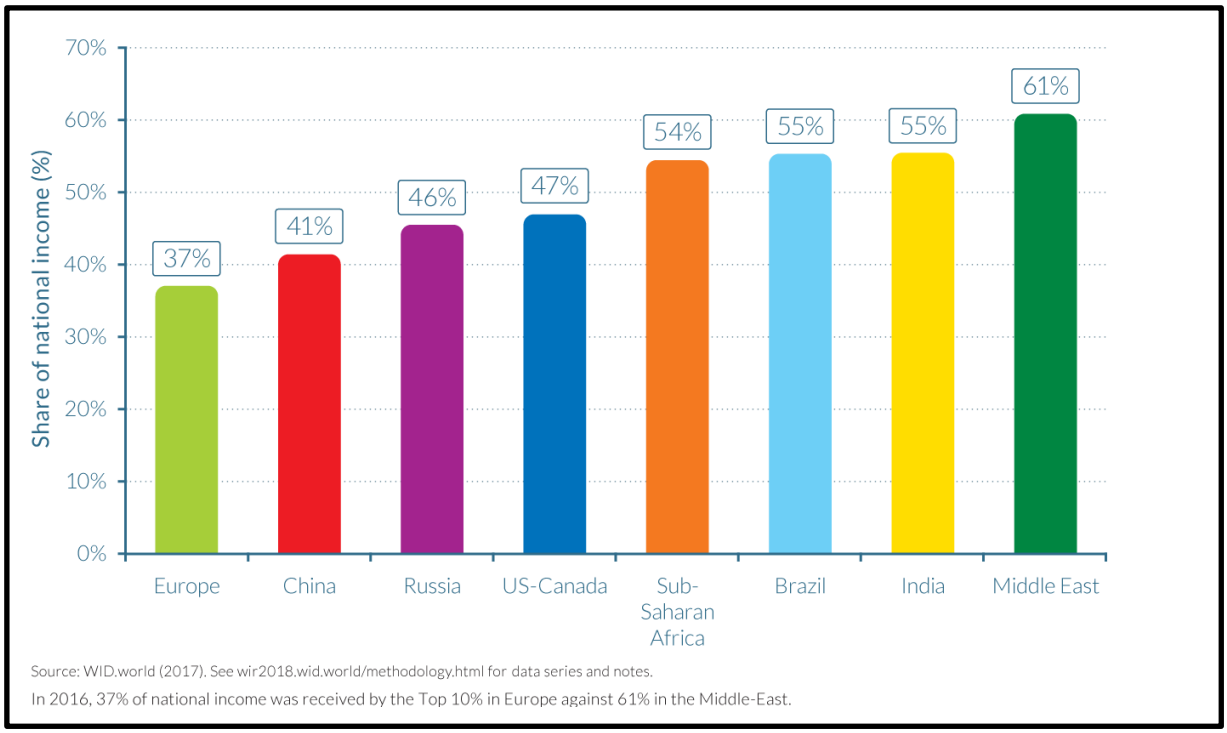


Figure 1: Share of National Income of top 10% income group.

national income accounts is captured by nations top 10% richest. This is shown in Figure 1 below, according to which, the income captured by top 10% richest of the population was

highest in Middle East and lowest in Europe. However, the main cause of concern is the difference of 24% in top and bottom regions in the table. This points towards the impact and important role of national policies and institutions that shape the distribution of income.

The general trend of inequality in different regions of the world is shown in the Figure 2 below. Some regions exhibit increasing trend, but others show decreasing trend. India, US-Canada and Europe almost started from the same level of inequality in 1980, but they stood apart in 2016. And the regions with highest inequality like Middle East, Brazil and Sub-Saharan Africa still face the same problem and remain the most unequal regions.

A closer look at Figure 2 shows that there is an increasing inequality trend in India with share of national income by top 10% increasing from about 32% to about 55% from 1980 to 2016. In US-Canada, we see a similar trend of increasing inequality from about 34% in 1980 to 47% in 2016; although the pace of increase is far lower than in India. The case of China is similar to that of US-Canada; there is an increasing trend with inequality increasing from 28% to 41%. However, the case of Russia is interesting, as there was very low inequality of 21% in 1980, which rose significantly from 23% in 1991 to 48% in 1995, and after that there were several ups and downs around a mean of 46%. And although Europe has the lowest inequality of all regions, it still increased from 33% in 1980 to 37% in 2016.

Breaking the increasing trend of inequality are the regions with high inequality. These regions include Middle East, Brazil and Sub-Saharan Africa. In Middle East, the inequality decreased from 66% in 1990 to 61% 2016. In Brazil, it decreased from 59% to 55%. And in Sub-

Saharan Africa, the inequality has remained almost constant at a mean of around 55%. However, there is no reason to celebrate because the inequality was already so high and has not decreased significantly (World Inequality Lab, 2018).

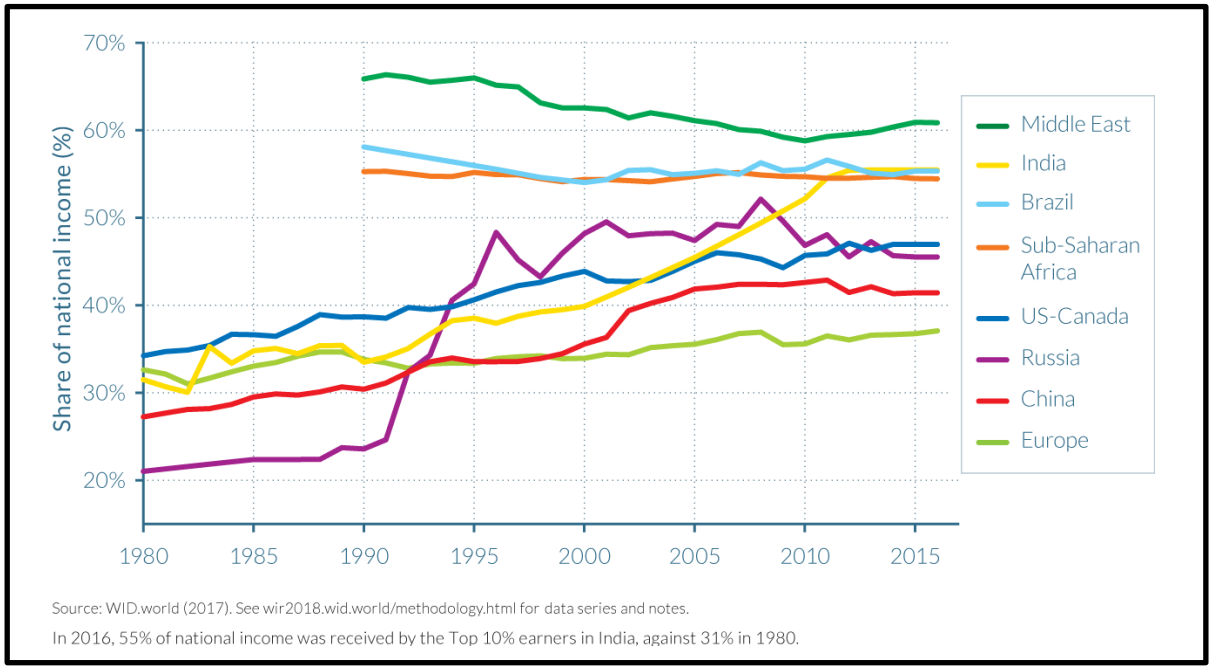


Figure 2: Income Inequality in different regions of the world.

Another way of looking at inequality trend is by comparing share of national income of top 1% against bottom 50%. Figure 3 shows this comparison in US and Western Europe and Figure 4 shows it throughout the world.

In US, the share of income by top 1% has increased significantly from about 11% in 1980 to about 20% in 2016. And opposite has happened for bottom 50%, with their income share reducing from 20.5% to 13%. This opposite trends in incomes of the two groups has had sharp impact on overall inequality in the United States.

In the case of Western Europe, there has been a slight change in income share of the two groups. As seen in Figure 3 below, the top 1% share of income has increased by a mere 2% from 10% in 1980 to 12% 2016. And the share of bottom 50% has reduced from 24% in 1980 to 22% in 2016. Overall, the rate of change of income has not been drastic.

Finally, a very important analysis is the comparison of share of income of the two groups throughout the world. The graph shows that the income share of two groups has gradually increased, although the share of top 1% has increased more. The share of income of top 1% has increased from about 16% in 1980 to 20% in 2016. And the income share of bottom 50% has increased form 8% in 1980 to 10% in 2016. This means that the global middle class is the group that has lost most. (World Inequality Lab, 2018).

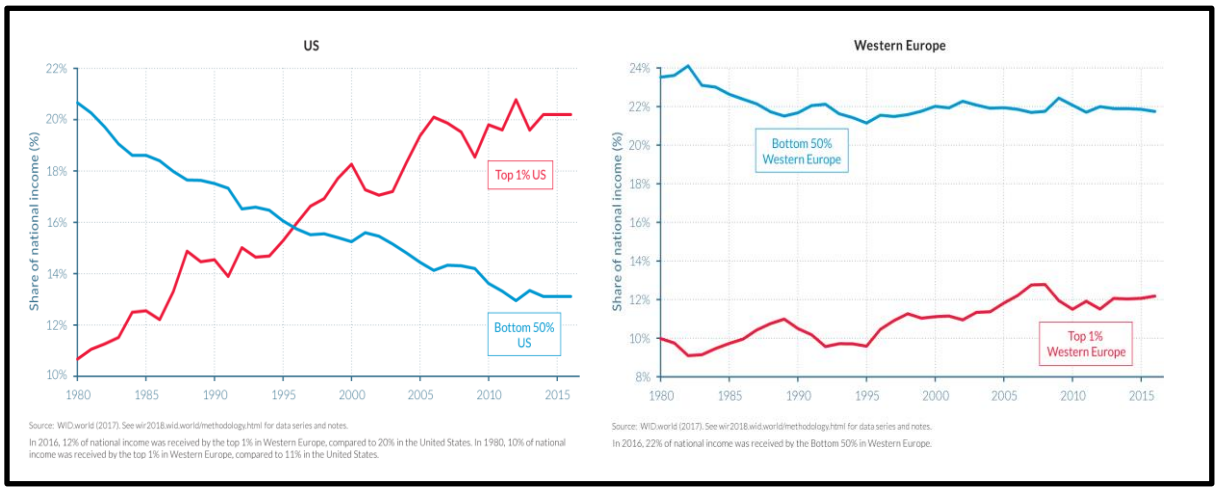


Figure 3: Income Inequality in United States and Europe.

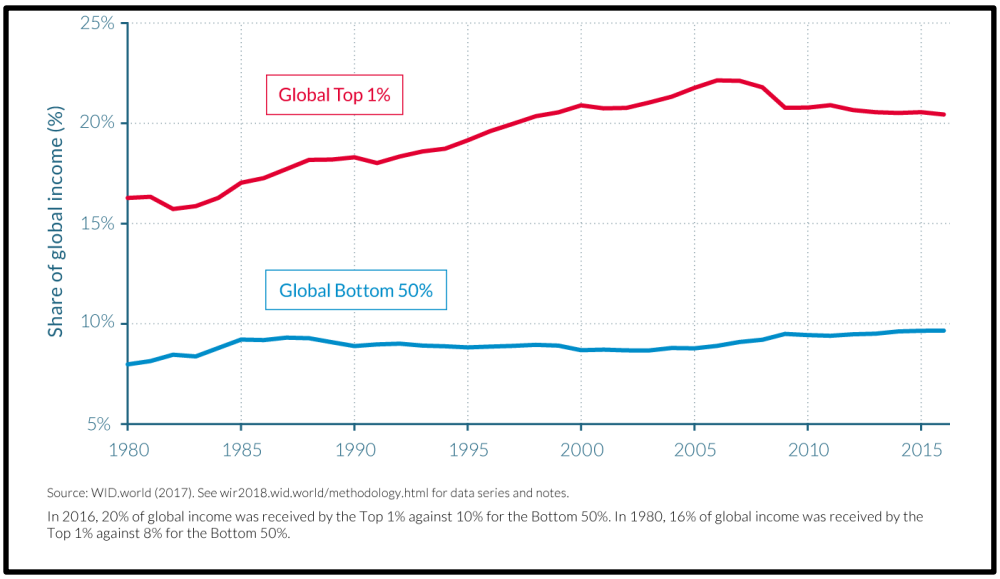


Figure 4: Share of income of Global top 1%.

CHAPTER 3

LINKING EDUCATION WITH FINANCIAL AND DIGITAL INCLUSION

3.1 Education and Financial Inclusion:

As financial inclusion is a target in eight of the seventeen sustainable development goals, it is vital that its implementation is effective. According to World Literacy Foundation report 2018, illiterate people find it difficult to balance a chequebook, filling out a home loan application, reading a bank statement, using computer to do banking, and calculating a financial investment among other financial decisions (Gualteros, 2018). Not only education helps increase the use of financial services, but it also increases the possibility of benefiting from these services. Therefore, education amplifies the impact of financial inclusion quantitively and qualitatively.

Gualteros (2018) found serious repercussions of illiteracy for financial inclusion. The report states that individual's ability to create financial wealth, build healthy and stable families, and make entrepreneurial decisions diminish if he or she is illiterate. The opportunity cost of illiteracy is the lost wealth that people would have gained if they understood mortgages or loans, and in many cases illiterate people make financial decisions without fully understanding them. This is a major problem in countries like Egypt where illiteracy rate is 28 percent, as Ain Shams University claims that many illiterate adults in the country don't even know how to use credit cards and ATMs. Similarly, Walker (1980) research on agricultural credit in developing countries found that illiterate small farmers regarded loan application forms with hostility as they couldn't understand the content of these forms.

In a study on automated teller machines (ATMs) in Bangladesh, Mahmud et al. (2015) found that literate people benefited more from the service. They used survey method to find that

education level was an important factor in determining the effectiveness of the service. Similarly, Danlami et al. (2014) study in Nigeria found that majority of ATM users were educated. They found the association between education attainment of respondents and their usage of ATMs, which implies that education encourages people to use the service more. They also found that among different occupations, civil servants used the service most, which again reinforces their claim as this occupation group his well-educated.

Research also shows the importance of education for financial information and inclusion. In a study by Babych et al. (2018), they found that people with lower educational attainment were more likely to have less financial information. In a survey in Georgia in 2016, the researches asked questions to 1000 individuals related to inflation, interest rate, financial risks, and effective interest rates. The study found that only 5.8% of the people could answer all four questions correctly while more than 50% only answered one or no correct answers. One of the main reasons cited for poor financial knowledge of respondents was low level of educational attainment, as less educated people were more likely to answer the questions wrongly. Agyemang-Badu et al. (2018) also argue that education is very important for successful inclusion of people in financial system. Their regression results indicate a significant positive impact of education on financial inclusion. They reason that education is essential as it provides individuals with information on availability of financial institutions, the need to save, and relevance of financial intuitions for business and family among other things.

Moreover, studies also show that financial inclusion might even increase income inequality if people are illiterate. Huang et al. (2019) study in 30 provinces of China found that lower level of education in rural areas of China caused financial inclusion to increased income

inequality between rural and urban areas in the short run. The paper argues that rural residents could not use financial services effectively because of their lack of knowledge about the services. Therefore, according to them provinces with higher education levels in rural areas would use financial services more effectively, which would ultimately lower urban-rural income gap in the short run. Recognizing the importance of education, China has been targeting increasing literacy rates in rural areas over the past 30 years through poverty student loans and equality of college admission among other plans.

3.2 Education and Digital Inclusion:

The way an educated person uses internet differs from the way an uneducated person uses internet. A target of universal digital inclusion is a misplaced target because illiterate people can't use internet efficiently. Moreover, illiterate people are also not able to understand the content on internet as it's in a different language.

In a 2014 report by McKinsey & Company (2014) on barriers to internet adoption, they found illiteracy to be one of the main barriers. According to their findings, close to 100% of online population could read and write, and 28% of offline population was illiterate. The report found that under sourced education system and user incapability's like lack of digital literacy and language literacy were major reasons for not adopting internet.

Kenny (2002) argues that the target of universal internet access as a tool of reducing poverty is misplaced. He maintains that the widespread access of internet would not be beneficial because illiterate and poor people cannot take full benefits of the service. According to author, internet usage requires a person to be educated to use it constructively. Similarly, a study by Birru et al. (2004) noted how students in grade 3 and 8 used internet to search medical

information. Their results showed that most health websites required high school level reading proficiency; therefore, low literacy created hindrances and informational obstacles for people while searching for medical information on internet.

Another important reason for illiterate people not being able to use internet effectively is the language barrier. According to a 1999 survey, 72% of websites on internet were in English, 12 % in Japanese and German, and remaining in other major language (qtd. in Kenny, 2002). Since, uneducated people in non-English speaking countries can't understand English, it limits their ability to use internet fruitfully. According to Kenny (2002), minority languages are severally under-represented on World Wide Web; for example, the minority language Igbo spoken by 17 million people in Nigeria was almost completely absent from the internet.

Moreover, not able to understand the content on internet also increases the digital divide; where educated people are more likely to use internet. A study in Africa showed that 87% of internet users in Zimbabwe and 98% in Ethiopia were graduates from a university. This meant that majority of internet users in these countries were well educated. Moreover, another study conducted in Jakarta, Tokyo, Beijing, Singapore and Seoul, showed that English speakers were two to four times more likely to use internet than non-English speakers. This means that more educated people not only use internet more effectively, they are indeed more likely to use it in the first place (qtd. in Kenny, 2002)

Based on the rationale, as discussed in this chapter, that education helps people use financial and digital services in a productive way, this paper tests following hypothesis:

Hypothesis 1: Education level has negative and significant impact on income inequality.

Hypothesis 2: Financial Inclusion is hypothesized to have strong negative marginal effect on income inequality after its interaction with education level.

Hypothesis 3: Digital Inclusion is hypothesized to have strong negative marginal effect on income inequality after its interaction with education level.

CHAPTER 4

LITERATURE REVIEW

This section will review literature on the relationship between dependent variable, income inequality, and the main variables of interest i.e., financial inclusion, digital inclusion, and education. Although research on education has been going on for a very long time, literature on financial and digital inclusion is very recent.

4.1 Income Inequality and Financial Inclusion

This research area is new with most studies only conducted in last couple of decades; and results of these studies are mainly inconclusive. Where some studies have found the results to be negative and significant (Neaime et al. 2018; Le et al. 2019; Huang et al. 2019) others have found it to be insignificant (Agyemang-Badu et al. 2018; Park et al, 2016) and some have also found the relationship to be positive and significant (Anas et al., 2017). The results vary as the methodologies and regions covered in these studies change.

A study by Neaime et al. (2018) analyzed the impact of financial inclusion on income inequality in MENA region. In past few decades MENA region registered high unemployment, high inequality, financial exclusion and political marginalization, which made people protest in Tunisia, Egypt, Syria, and Libya. Hence, several governments in the region implemented policies aimed at reducing economic and financial exclusion. the paper uses Generalized Method of Moments (GMM) and Generalized Least Squares (GLS) to find the impact of financial inclusion on income inequality in eight MENA countries over the period 2002-15. For income inequality they used Gini coefficient, and to calculate financial inclusion, they used data on number of

Automated Teller Machines (ATMs) and commercial banks per 100,000 adults from International Monetary Fund Financial Access Survey database as proxies. After controlling for Secondary enrolment ratio, Labor force female (% of all), population, inflation, age dependency ratio, and GDP, their results indicate that the relationship between inequality and financial inclusion was negative and statistically significant at 1% level. The results hold even after several transformations are applied. This implies that having high number of banks will help poor to access financial services, which would reduce in income gap. These results hold in Egypt, Tunisia, Morocco, Qatar, Saudi Arabia, UAE, Algeria, and Jordan.

A noteworthy study by Le et al. (2019) tests the impact of financial inclusion on income inequality in transition economies. Transition economies are those economies which are in the process of transforming from planned to market economies. These countries include Central and Easter European countries, Baltics, and also some commonwealth independent states in Asia. They use two-stage least squares (2SLS) model and simple panel regression to uncover this relationship in 22 transition economies from 2005 to 2015. The study found a negative and statistically significant relationship between financial inclusion index and GINI coefficient. Although the relationship was significant in both models tested, but the coefficient of financial inclusion varied significantly. The authors provide policy recommendations stating that the success of financial inclusion to reduce inequality largely depended on financial improvement in rural areas. This can be achieved by improving the literacy rates and by teaching people how to use financial services. They also recommend expanding some banking services like payment transfer and savings. Finally, they also suggest that in some cases financial services should be

provided free of cost to the poor to increase the penetration. Although this would be costly for institutions in the short run, in the long run this would benefit the whole society.

To study the impact of financial inclusion in Asia, Park et al (2016) used data on 37 developing Asian economies from 2004 to 2012; they failed to achieve significant relationship between the two variables in five of seven models. They built their own financial inclusion index using five separate measures, to cover the availability and usage of banking services. To test their hypotheses, they use 7 different specifications to analyze the impact of financial inclusion on income inequality. They found that the relationship between the two variables was significant in only 2 of the 7 specifications. A reason could be that these 2 models had more control variables than other models. The authors conclude that improving the provisions for young and old people in terms of retirement pensions, better rule of law and financial regulatory oversight among other things would increase financial inclusion, which would ultimately lower income inequality. The results reveal that economies with large population had greater access to financial services, and those with high dependency ratios had lower access. This would have important policy implications for rapidly aging populations. Moreover, they also found that good governance and high institutional quality increased financial inclusion significantly in Asia. Finally, the study also found strong correlation between financial inclusion and poverty, a major issue in Asia. Hence, financial inclusion is deemed necessary to reduce poverty and income inequality in developing Asia.

Another study by Agyemang-Badu et al. (2018) did not find a significant relationship between income inequality and financial inclusion in Africa. Although there have been many reforms targeting the financial sector to trigger economic growth in Africa and reduce the

income gap between rich and the poor, they have significantly failed, and Africa remains the poorest and one of the most unequal regions in the world. The scholars used Palma index to measure income inequality, and for financial inclusion, they built their own index for 48 African countries between 2004 to 2015, keeping in mind the prevailing conditions and availability of data from World Bank Development Indicators. They built this index using data on ATMs, commercial bank branches, borrowers from commercial banks, and depositors with commercial banks. Their analysis revealed a negative relationship between the two interest variables, indicating that financial inclusion reduced inequality, although the result was not statistically significant. However, a main reason of this insignificance could be the prevalence of poor democratic conditions in these countries.

Moving on, Huang et al. (2019) used Chinese provincial data on 30 provinces from 1985-2013 to analyze the impact of financial inclusion on urban-rural income inequality in the short and long run. They used panel cointegration method on 870 observations to reveal that financial inclusion narrowed urban-rural income inequality in the long run but increased it in the short run. They got similar results using different estimation methods with the coefficient of financial inclusion being negative and significant at 10% level in the long run. And in the short run Financial inclusion coefficient was positive and significant in most of the models. The scholars provide two reasons for the unexpected short run consequence of financial inclusion on urban-rural income inequality; it could be due to different expansion speed of financial networks between urban and rural areas, another reason could be the lower financial literacy rate in rural areas of China as compared to urban areas. According to the authors, financial inclusion policies were consistent with the goals of central and local governments in China, as they were being

implemented effectively. Although the policies were successful in the long run, the short run opposite effects were also improving gradually.

Another study on the relationship between inequality and financial inclusion was done by Anas et al. (2017) in Indonesia. The scholars used panel data of 31 provinces in Indonesia between 20005-2013 to build simultaneous equation models based on multiple linear regression methodology. The research found some interesting results; it found that the impact of financial inclusion on poverty was negative and statistically significant, but for inequality the relationship was positive and significant. This meant that financial inclusion decreased poverty but increased income inequality in Indonesia. The results are interesting and not consistent with other literature. The model built by the scholars was very simple and did not control for important variables. Therefore, it is likely that their model was underspecified, which might have shown some unexpected results.

Another study by Sethy et al. (2018) analyzed the relationship between financial inclusion and income inequality in India. It used financial inclusion index (FII) to find that no state in India had high financial inclusion during the period under consideration. A close inspection of the data revealed that in 2015, the number of commercial banks in India was 152 and total operating branches were 125672. Although the number of branches increased in rural areas, but its proportion in total number of branches reduced. The highest growth in terms of proportion of branches was in Semi urban areas, where the proportion of branches increased from 22.8 percent in 2007 to 26.8 percent in 2015. Furthermore, they found that some of the states including Kerala, Goa, Delhi, Punjab, Tamil Nadu, and West Bengal had medium financial inclusion, and rest of the states had low financial inclusion. In terms of percentage of account

holders, Himachal Pradesh lead with 89.1% of population with bank accounts, Goa with 86.8%, Uttarakhand with 80.7% and Delhi with 77.7%. Furthermore, they used data from 22 Indian states to build a model of Financial Inclusion with only three control variables. Their results indicated that there was significant relationship between financial inclusion and inequality. Hence, they encourage the government to pursue Financial Inclusion to bring people out of poverty.

4.2 Income Inequality and Digital Inclusion.

In the case of digital inclusion and income inequality, the results are mixed but mostly incline towards negative relationship. Where most studies indicate a negative relationship between the two variables, few studies also find no significant relationship.

Liu (2017) used a sample of 51 countries from 1991 to 2005 to examine the impact of internet diffusion on income inequality. The author uses lightning density as an instrument for internet diffusion to take care of potential endogeneity issue. The data on lightening density is explained by satellite data on lightning intensity and is taken from National Aeronautics and Space Administration (NASA). After controlling for openness, GDP per capita, population growth, education level, and initial level of inequality, the study finds negative and statistically significant effect of internet diffusion on income inequality. After that the paper also performs sensitivity analysis by changing the sample years (1991-1999); these analyses also confirm the results which remain unchanged.

Houngbonon et al. (2017) analyzes the impact of high-speed broadband internet on income inequality in France. They employ unique town-level data on broadband adoption and quality to find its effect on mean income and income distribution using both Wald-DiD and OLS

estimation. Their model provides evidence for their hypothesis that broadband adoption and quality increases mean income and deceases income inequality. Moreover, their robustness checks also reveal similar results with broadband adoption and quality having significantly more impact on the income level of bottom deciles when compared to top deciles. Therefore, they encourage the use of policy targeting the deployment of faster broadband internet.

Panichsombat (2016) use panel data to analyze the impact of internet penetration on income inequality in Asia Pacific. Although their focus was Asian economies, they used data on 191 countries for period 1990 to 2015 to yield their results. Model 1 showed that number of internet users had weak and negative correlation with inequality. Model 2 showed that internet penetration had significant impact on reducing income inequality in OECD countries when compared to non-OECD countries. In Model 3, the effect of internet penetration in Asia Pacific increased inequality when compared to rest of the world. And in Model 4, they found that the negative impact of internet penetration on income inequality was lower in developed Asia when compared to developing Asia.

Similarly, the study by Caria et al (2018) examine the determinants of income inequality in Southeast Asian countries. The study uses panel regression analysis to find the impact of technological change, tax policy and globalization on income inequality. Using internet penetration as a proxy for technological change, the study finds negative and significant impact of technological change on income inequality. Moreover, Globalization measured by GDP and trade to GDP ratio had increasing but insignificant impact on inequality, and tax revenue to GDP ratio also had negative but insignificant coefficient.

In the case of USA, businesses and corporations made huge investments in internet during 1990s. Forman et al. (2012) use data from 1995 to 2000, when internet investment was highest, to trace the relationship between internet investment and county-level wage growth. They first find a significant but small correlation between internet investment and wage growth, before finding that it also led to an increase in regional wage differentials. Their analysis presents a puzzle where internet access is widespread, but the payoffs are not. In 6 percent of counties representing 42 percent of US population, internet investment was correlated with wages and employment growth. However, these counties already had high income, high skills and concentrated information technology. Due to internets significant impact on these counties, the regional wage inequality in US increased significantly. Their results suggest that internet dispersion followed skill biased pattern as highly educated labor force used internet more effectively to realize wage gains. Other factors included industry composition, income, local population size, and composition of local labor market. However, internet investment had significant impact on wage rates in only few counties, the overall effect was not significant.

4.3 Income Inequality and Education

The literature on the association between education and income inequality has a long history and the relationship is mostly conclusive i.e., education reduces income inequality. The link between the two variables can be found in the works of Adam Smith, who in his book "An Inquiry into the Nature and Causes of the Wealth of Nations" said that education made it possible for a person to gain skills and capabilities which benefits the individual and also society. Similarly, Alfred Marshall argued that education and training were very important for an

economy and should be considered national investment. He went further and suggested that every individual in a society should be required to take general training courses which would not only improve their current skills but would help them gain more skills (qtd. in Shahabadi et al., 2018).

Another study by Kang H. Park (1996) analyzes distribution of income due to education variables using cross section data on 59 countries. In their model, they only control for the level of educational attainment, dispersion of educational attainment and GDP per capita. They hypothesize that education would have negative impact on inequality because this relationship is the essence of human capital theory and also because law of diminishing returns to education has been documented by previous literature. Their results show that the dispersion of schooling among labor force has positive impact on income inequality. The study also points out that the dis-equalizing effect of schooling on income inequality is larger than suggested by previous studies.

Gregorio et al. (2003) used panel data for the period 1960 to 1990 to analyze the relationship amongst level of income, level and dispersion of education, and income inequality across countries. After controlling for educational inequality, educational attainment, GDP per capita, social expenditures and income dummies, they find that countries with higher educational attainment had lower income inequality, and inequality of schooling had a positive impact on income inequality. They also found similar results after using lagged independent variables to control for possible endogeneity problem.

A study by Shahbadi et al (2018) studies the impact of education on income inequality in a selection of Islamic countries between 1990 and 2013. They take care of heterogeneity of the

units and risk of bias in results by using Panel data model to produce unbiased and consistent results. They find that enrollment rate in primary and secondary schools has a negative and statistically significant impact on income inequality. Their study finds education as one of the most effective ways to reduce income inequality. Education not only creates economic opportunities but also improves labor productivity by improving quality of workforce. However, another interesting aspect of their results was that university education increased income inequality. Their reasoning for this result is that firms probably pay higher wages to university graduates due to their better skills when compared to work force trained in primary and secondary schools.

Coady et al (2017) use new econometric techniques to uncover the relationship between the two variables. They use dynamic panel estimation techniques to take care of endogeneity problem and the statistical results also show that their dynamic estimators are consistent. Their results indicate a positive and statistically significant relationship between inequality of schooling and income inequality, especially among older age cohorts and in emerging and developing countries. They also found a positive and significant relationship between income inequality and average years of schooling, which is small and is not always significant. However, they found a negative relationship with years of schooling of younger cohorts.

An important study by Abdullah et al (2013) tries to find the relationship between income inequality and secondary enrollment in Africa. Education and income inequality are both major issues in Africa and the exact relationship and mechanisms between the two variables are significant. They revisit previous empirical literature on the relationship between the two

variables to provide a meta-regression analysis of 64 empirical studies using 868 estimates. Their results indicate that education impacts both tails of the income distribution by having a negative impact on the income of top earners and positive impact on the income of bottom earners. In some of their models, they also found that secondary schooling had a stronger effect on reducing income inequality than primary schooling. Furthermore, their main hypothesis was confirmed as they found that education had a strong impact on reducing inequality in Africa.

Some other country specific studies also found a significant and negative relationship between the two variables. Lam et al (1991) decomposition of standard human capital earnings equation for the period 1976-1985 led to the conclusion that reduction in variance of schooling had a negative impact on income inequality. However, this impact of education on inequality, which was very high during this period, was offset due to other sources of inequality. Another study by Tinbergen (1972) used number of years of schooling as a proxy for quality of labor and the theory which considers income distribution as the distribution of prices of factors of production to explain variation in income distribution in USA, Canada and Netherlands. Some of the findings indicate that an increase in years of schooling had only a moderately reducing impact on inequality in the three countries.

CHAPTER 5

RESEARCH DESIGN

This section will discuss the variables used for analysis in this study. For dependent and main interest variables we first discuss how previous research tackled the issue of lack of data, and then provide the source of data and the reason to use it in this study. The variables used for this study are shown in Table 1 below.

Table 1: Summary Statistics

Variable	Source	Obs	Mean	Std.Dev.	Min	Max
Inequality	SWIID	5355	37.78	8.603	17.3	62.6
Education	WDI	3709	43.391	18.9	0	98.381
Internet	WDI	3431	21.131	27.142	0	98.2
GDP Per Capita	WDI	4874	12375.2	16852.42	182.709	112000
Inflation	WDI	4464	23.39	184.956	-18.109	7481
Unemployment	WDI	3585	8.431	5.853	.16	44.157
Trade	WDI	4685	79.02	53.738	.175	442.62
Pop Growth	WDI	5037	1.443	1.351	-6.185	16.332
Govt effective	WGI	2653	.088	.976	-1.776	2.437
Borrowers	IMF	818	197.197	220.337	.018	1232.996
ATMs	IMF	1644	45.434	46.069	0	288.632
Branches	IMF	1764	18.229	17.773	.132	110.939
Depositors	IMF	759	579.186	582.211	.473	3379.808
Credit	IMF	4334	45.183	42.115	.005	312.019
Accounts	IMF	973	1225.374	1193.608	1.3	7987.9

Source: Authors' Calculations based on data obtained from sources mentioned.

This section also discusses the problems of research design faced by previous studies. A viable research design for testing the relationship between income inequality, financial inclusion, digital inclusion and education would need to confront problems present in previous literature. These problems include specification error, unreliable measurement of variables, and small sample size in previous literature (Muller, 1988). This paper will first discuss these hinderances in each variable of interest before providing an effective solution to each problem.

5.1 Income Inequality data.

There are several ways on measuring inequality. These methods include calculating inequality using graphs, indices and ratios. In the case of ratios, Inequality can be represented by a simple graphical method of Lorenz curve shown in graph below. The horizontal or x-axis rank the cumulative number of income recipients from poor to rich and the y-axis or vertical axis present cumulative percentage of total income. The 45 degree line represents "Line of equality: where everyone receives equal share of income. Hence, the more the distance of curve from 45-degree line, the more inequality is present in a society. The graph below shows that poorest 20% of the population owns 4.2% of the income, and richest 20% own 47.7% of the total income (Afonso et al., 2015).

Another method of calculating inequality is through indices like Gini index, Atkinson's index, Hoover index, and Theil index and General Entropy (GE) measures. Gini index is a widely used index which uses the Lorenz curve to derive inequality. It calculates inequality by dividing the area between 45-degree line and the curve with total area below the 45-degree line.

The higher the number, the higher the inequality in a society. Whereas, Hoover index calculates the maximum vertical distance between the Lorenz curve and 45-degree line. It shows the

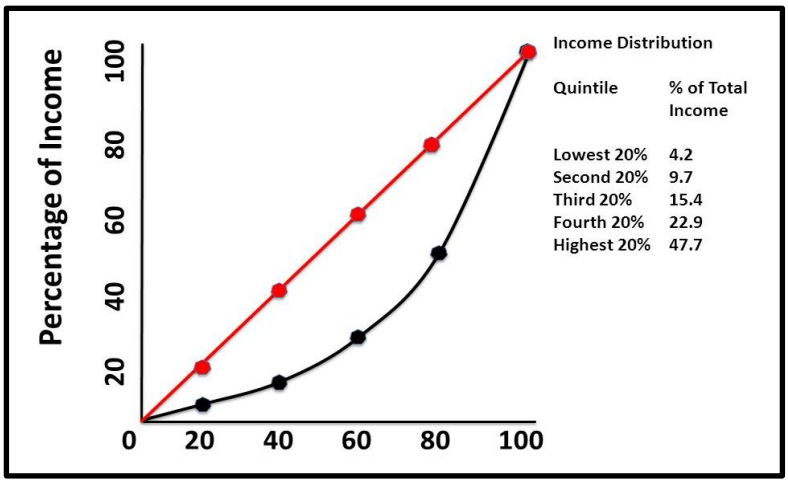


Figure 5: The Lorenz Curve.

income that has to be redistributed to attain perfect equality. Moreover, Atkinson's index is a popular welfare-based measure of inequality. The index represents opportunity cost, where it represents the percentage of income that society must forgo to have more equality between its citizens. Therefore, if inequality is high then giving up some income by rich will mean more equal distribution. And the Theil index and General entropy measures break down inequality into population groups or income sources or into different dimensions useful for policy making (Afonso et al.,2015). Finally, inequality can also be measured through ratios like decile dispersion ratio, Palma ratio or 20/20 ratio. Decile ratio measures the average income of richest x % (10) of population to income of poorest x % (10%). The Palma index follows similar methodology by comparing income of top 10% of the population with bottom 40% of the population (Cobham et al., 2016). And 20/20 ratio is Used by the United Nations Human

Development Report, where it compares income of richest 20 % with poorest 20% of the population.

The presence of these methods did not solve the major hinderance faced by previous research on inequality and democracy. Several studies have transformed data into different ways to analyze the impact of democracy on income inequality. Measurements of inequality have been imprecise as different scholars experimented with different methodologies. Where some scholars used household surveys, others used only urban surveys, and some even used pre or post-tax returns. A brief review of these methods will reveal the evolution of inequality data and methodology. This has led to the development of the data produced by Fredrick Solt, which we use here. We start the review from 1985.

Several studies tried to analyze the relationship between income inequality and democracy. In 1985, Bollen et al. (1985) used the data on income inequality provided by world bank sources. They only focused on data originating in national surveys, but they only got a sample size of no greater than 60 including some missing data. And as a measure of inequality, they took the ratio of wealthiest 20% with poorest 40% of the population. Muller (1988) compiled his own data set, as he was not satisfied with the existing compilations. He compiled data on Gini coefficient from 55 noncommunist countries from 1965-75 based on the assumption that the measurements of inequality were comparable within 11-year intervals. Similarly, Simpson (1989) also created his own dataset on inequality by combining estimates from all surveys of individuals that fall between 1965 and 1975. He further added some non-Eastern bloc countries and removed other countries that did not meet the criteria he set. After further analysis, he came up with data for 62 nations.

The search for a viable dataset on income inequality continued in 1990s. In 1992, John () used two measures of inequality, i.e., Gini coefficient and percentage of income going to top quantile of the population to create dataset for 60 countries. Their data differed from Muller as it household surveys and not only data on economically active population. In 1997, Burkhart () had to decide on which data set to use, so compared the dataset provided by world bank and by Hoover (). He argued that although both datasets and their calculating methodologies were not perfect, but they were best possible datasets available. So, he used both data from both sources to create a sample. And in 1998, li et al used a new data set on Gini coefficients. While discussing the pitfalls in the available inequality data, he mentioned that the definitions of what was being measured by the Gini coefficient varied across countries, so it was difficult to do a cross-sectional study. A further analysis revealed that there was statistically significant difference in income-based and expenditure-based inequality coefficients. Therefore, he used a methodology to adjust for the differences between income based and expenditure-based coefficients. Moreover, as the method used to calculate Gini index varied in different sources, he tried to standardize the data points using his own methodology.

As we move into the 21st century, the availability of data was improved. The inequality index used in this study is Standardized World Income Inequality Database (SWIID), provided by Frederick Solt. The dataset contains information on 196 countries from 1960 to present time. It offers widest possible coverage across countries and over time to meet the need of scholars working on the topic of income inequality. It uses data from various sources including datasets from OECD Income Distribution Database, Eurostat, World Bank, UN and from other organizations and national statistical offices around the world to make a standardized income

inequality database. The database provides inequality data on household post-tax income, household pre-tax income, and also on absolute and relative income; but in this paper, inequality data on household post-tax income is used (Solt, 2019).

5.2 Financial Inclusion data.

Data on financial inclusion in different countries was not easy to come by in the past. This limited the ability of scholars to carefully study the topic. However, after recognizing its important in G20 and the release of Global Financial Inclusion database, scholars have started studying it in recent years. Apart from this index, sometimes scholars also create their own financial inclusion index according to country specific requirements.

The Global Findex database was launched in 2011 with funding from Bill & Milenda Gates foundation. It provides world's most comprehensive data on savings, borrowing, payment and risk behavior of adults. The data set represents nationally representative surveys of more than 150,000 adults in 140 countries in cooperation with Gallup, Inc. According to the 2017 Global Findex, 1.2 billion adults got access to accounts since 2011, a significant increase. The database provides data on several indicators of financial inclusion including data on access to formal and informal financial services, and data on use of financial technology (The World Bank, 2017).

Most of the studies done on financial inclusion use the Financial Inclusion index (FII) based on the methodology of Sarma (2008). He uses various aspects of financial inclusion to build a multidimensional index. These dimensions include banking penetration, availability and usage of banking services. For banking penetration, he used the proxy of number of bank

accounts per 1000 population, for availability of banking services he use number of bank branches and ATMs per 1000 population, and for usage dimension he used the volume of credit plus deposit relative to GDP. After calculating the dimension indexes, the weight of 1 is given to accessibility, 0.5 to availability and 0.5 to usage. The reason for giving 0.5 weight to the last two dimensions is due to lack of availability of data on these dimensions. And finally, Sarma (2008) uses standardization formula to standardize the index, which falls between 0 and 1, where 0 means full financial exclusion and 1 means complete inclusion in a country.

Similarly, other authors use similar methodology but sometimes different measures to calculate the financial inclusion index. Huang et al. (2019) followed the methodology of Sarma(2008) to construct the index for each province in China. Neaime et al. (2018) use data retrieved from International Monetary Funds' (IMF) Financial Access Survey database on number of ATMs and commercial banks per 100,000 adults to calculate the index for MENA countries. Agyemang-Badu et al. (2018) used data on ATMs, Commercial bank branches, borrowers and depositors in commercial banks to build the index for each of the 48 countries in Africa. Sethy et al. (2018) also used Sarma (2008) methodology to calculate the index for each state of India. Finally, Park et al (2016) use five measures to calculate the index using the methodology provided by Sarma (2008). These include number of ATMs per 100,000 adults, Commercial bank branches per 100,000 adults, depositors in commercial banks per 1000 adults, borrowers from commercial banks per 1000 adults, and domestic credit to GDP ratio.

This study will construct the financial inclusion index based on the methodology of Sarma (2008). The methodology uses three different dimensions to calculate the index: Availability, Usage and Penetration of financial services. After that, indicators are chosen to

capture each dimension. These indicators reflect the qualitative as well as quantitative aspects of financial inclusion. The Figure below shows the dimensions and indicators used to construct the financial inclusion index (FII).

Penetration (dimension 1)

To capture the quantitative aspect of an inclusive financial system, this paper uses the penetration of financial services as one of the dimensions. Increasing banking penetration is achieved by making unbanked population banked i.e., increasing number of bank accounts held by people in a country. If every person in a country owns a bank account, then the value of this dimension would be one, and if no one has a bank account then zero (Sarma, 2008). This paper uses "Deposit accounts with commercial banks per 1,000 adults" to capture this dimension.

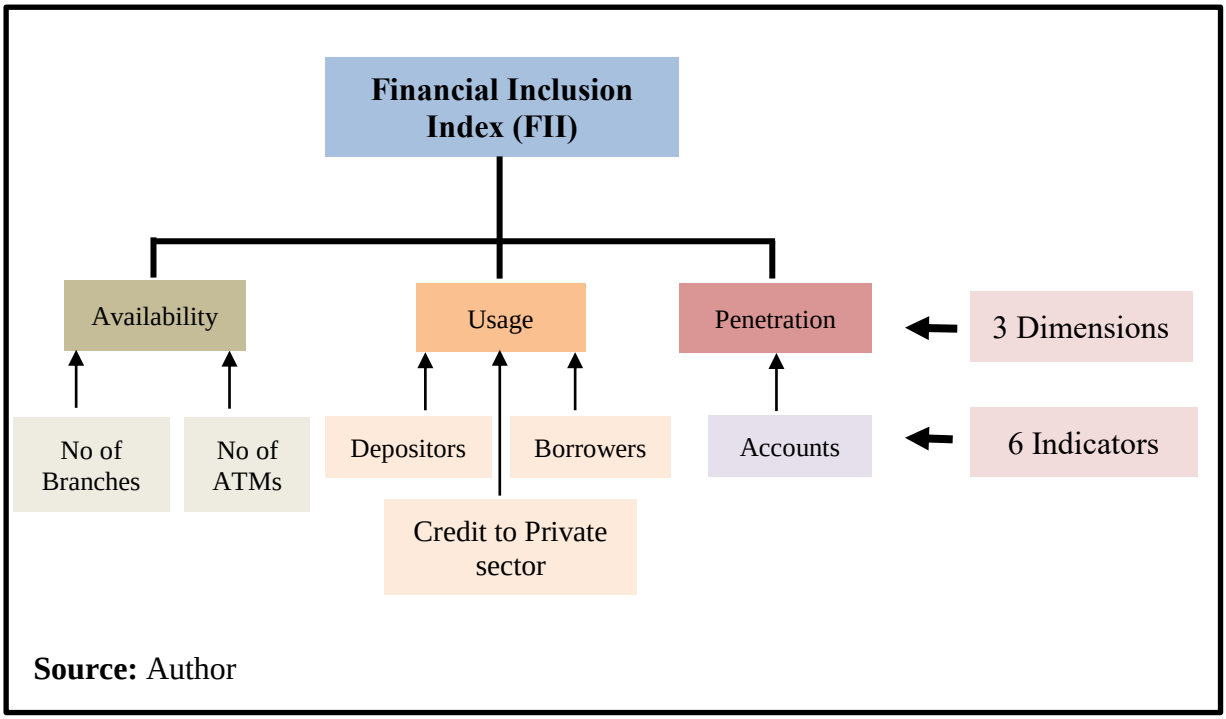


Figure 6: Financial Inclusion Index.

Usage (dimension 2)

To cover the qualitative aspect of financial inclusion, we consider its usage by people. Just having a bank account doesn't mean that the financial system is an inclusive one, more important is its usage. The more the people use financial services, the more inclusive a financial system is (Sarma, 2008). To capture this dimension, this paper uses following indicators: Borrowers at commercial banks per 1,000 adults, Depositors with commercial banks per 1,000 adults, and Domestic credit to private sector as % of GDP.

Availability (dimension 3)

Another important quantitative dimension for an inclusive financial system is its availability to the public. This means that a more inclusive financial system is easily available to people. For this dimension, the paper uses the number of ATMs per 1000 people and number of commercial bank branches per 1000 people (Sarma, 2008).

The first step involves computation of a dimension index for each dimension of financial inclusion using the formula below:

$$d_i = \frac{A_i - m_i}{M_i - m_i}$$

where

A_i = Actual value of dimension i

m_i = minimum value of dimension i

M_i = maximum value of dimension i

After calculating the dimension index for each dimension of financial inclusion, the index for each country is measured by normalized inverse Euclidean distance of a dimension point from an ideal point. An ideal point for a dimension would be (1,1,1) and the worst point would be (0,0,0). Using this point, the formula below is used to calculate Financial inclusion index for each country:

$$IFI_i = 1 - \frac{\sqrt{(1-d_1)^2 + (1-d_2)^2 + .. + (1-d_n)^2}}{\sqrt{n}}$$

The index would lie between the value of zero and one. Therefore, a more financially inclusive country would have IFI value of closer to one, and a less financially inclusive country would have IFI value closer to zero.

5.3 Digital inclusion data:

For Digital inclusion, the proxy "Individuals using Internet (% of total population)" is taken from World Development Indicators. World Bank defines internet users as individuals who have used internet in last three months from any location. This would include individuals using internet on Personal computers, cell phones, gaming machines, digital TV, or on any other device. are individuals who have used the Internet (from any location) in the last 3 months.

In the past other scholars have used different methods to collect data on digital inclusion. Liu (2017) used the satellite data on lightning density for period 1991 to 2005 collected from National Aeronautics and Space Administration (NASA) as an instrument to measure internet diffusion. Houngbonon et al. (2017) measuring digital inclusion in France by collecting data on number of residential connections on cable and fiber, cooper and other technologies. They

measured broadband penetration by calculating ratio of number of households and number of residential connections. Panichsombat (2016) uses the data provided by World Bank on number of internet users as percentage of total population to calculate the impact of digital inclusion on income inequality in Asia. And Forman et al. (2012) used data on internet investments by businesses and corporations from 1995 to 2000 as a measure of internet penetration.

These methods and others used in the literature have their own merits, but for the purpose of consistency and coverage, this paper uses data from WDI, as used by Panichsombat (2016). One of the main reasons for using this index is its coverage; It provides data on number of internet users from 1995 to 2018, although for this research we only use data from 1997 to 2017. Another reason for using this dataset is to get reliable and consistent results. Most of the data for independent variables used in this research is taken from World Development Indicators (WDI). Although the methodology used by WDI varies across variables, but the formatting and data formation techniques makes it a viable variable to merge with the remaining data and get reliable results.

5.4 Education data:

Gross Secondary school enrollment is another significant explaining inequality. The variable is taken from World Development Indicators (WDI) database. It is calculated by taking the ratio of enrolled students in secondary schools, regardless of age, to the population of age group that officially falls in secondary schools. This paper has used gross instead of net Figures because net secondary enrollment only provides ratio of students of official secondary school age group to the total population in that age group; this does not give the true picture of real

enrollment. Secondary education arrives after completion of basic or primary education and provides basics for lifelong knowledge and human development.

Secondary education is considered more important for reducing income inequality than other kind of education. It has been used extensively in literature to capture the impact of education on income inequality. Where Lee (2005) uses it as part of internal development model to describe income inequality; Timmons (2010) uses it to analyze impact of human capital on income inequality; and li et al (1998) uses it to understand how more educated population influences policy. These scholars and others in literature found it to have a significant and negative impact on income inequality.

5.5 Other Variables:

Another variable that has significant impact on reducing income inequality is inflation. The data has been taken from World Development Indicators (WDI). The WDI database measures inflation through consumer price index, which "…reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly". Moreover, the database uses Laspeyres formula to measure it. Since Consumer Price index includes fixed basket of goods and services including necessitates like food and living, it will impact the poor more than the rich by decreases their purchasing power. Therefore, it is expected that inflation will have positive impact on income inequality.

This paper also controls for population growth in a country. Population of a country includes all residents in a country regardless of legal status or citizenship and is calculated on de

facto definition of population basis. The annual population growth rate for year x is measure as an exponential rate of growth of midyear population from year x-1 to x (WDI). High population growth is expected to increase income inequality because lower income groups experience faster natural rate of increase in population. This means that the poor have more mouths to feed with same income, which increases the income gap between rich and the poor (Bollen et al., 1985).

For Openness, this paper also controls for Trade (% of GDP) as a proxy for openness of a country. The variable is taken from World Development Index (WDI) and is calculated by total sum of exports and imports of goods and services as a share of GDP.

CHAPTER 6

RESULT AND ANALYSIS

This paper's empirical approach involves investigating the relationship between Inequality, digital inclusion, and financial inclusion. First specification focuses on digital inclusion and its interaction with education level. Second specification focuses on Financial inclusion and its interaction with education level.

6.1 Specification 1: Interaction of Financial Inclusion and Education.

In specification 1, we use fixed effects panel data model of over 190 countries to establish the relationship between Inequality and Financial inclusion. The reason to use fixed effects model was based on Hausman test. Variables like Geography, Culture, or historical differences, as well as common time shocks do not change over time. To control for these unobserved variables, we use Fixed effects model to remove omitted variable bias. The decision to use fixed effects model was based on Hausman Test. The empirical model has the following form:

$$\mathbf{Inequality_{i,t} = \alpha_i + \sum_{j=1}^{k} \beta_j\ X_{j,i,t} + \delta_1 Education_{i,t} + \delta_2 Financial_i + \delta_3 Education \times Financial_i + \varepsilon_i}$$

Here, the dependent variable is inequality, which represents Gini indices of disposable income, $X_{j,i}$ are k exogenous control variables affecting income inequality, Education records education level, $Financial_i$ represents the index of Financial Inclusion, and $Education_i \times Financial_i$ represents the corresponding interaction variables, α is a constant and ε_i is the error term. The panel data results for specification 2 are shown in Table 2 below. The strategy used to develop

results involves the process of including main interest variable first, and then adding control variables one by one to see the individual impact of each variable on the main interest variable.

Table 2 below shows the results of specification 1. According to the Table, coefficient of financial inclusion is not significant in first five models, but it becomes significant after we control for digital inclusion in model 6. The coefficient of Education and interaction of Education and financial inclusion is negative and significant in all models, which means that education and the interaction term reduce income inequality. Furthermore, the coefficients of Openness proxied by Trade and unemployment are also significant and positive in all models, which means that these variables increase income inequality. Population Growth and GDPpc have positive coefficient but are statistically insignificant. Finally, digital inclusion in model 6 is also statistically significant at 1% level, and it also has a negative influence on income inequality.

The marginal effects plot shown in Figure 7 below provides a clear picture of the impact of interaction of education and financial inclusion on income inequality. The interaction effect can be measured by the slope of the marginal effect line, which is statistically significant. Moreover, the interaction effect can also be seen from the point estimates when education is 0% (0.910) and when education is 100% (-2.8), which are considerably different.

The plot also shows that financial inclusion has positive impact of 0.910 on income inequality when education level is 0. The marginal effect of financial inclusion remains positive until education level of about 23%, where the marginal effect line crosses the x-axis. This result is consistent with the findings of Huang et al. (2019), who found that lower level of education in rural districts of China was a major reason for increase in rural-urban income inequality due to

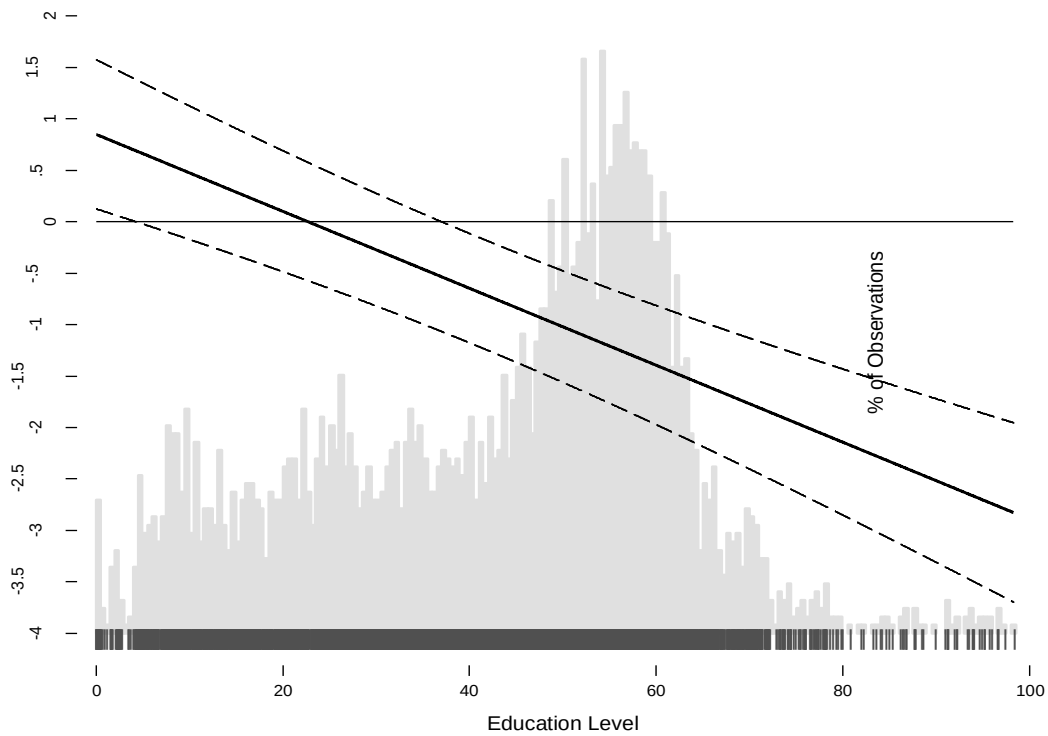
financial inclusion. Moreover, the study by Le et al. (2019) on transition economies also suggest increasing literacy levels to make financial inclusion successful. After education level of 23%, financial inclusion reduces income inequality. This means that as more people become educated, they can effectively use financial services to increase their income level, which then reduces income inequality.

Table 2: Income Inequality and Financial Inclusion.

Panel results: Income Inequality and Financial Inclusion.
Dependent Variable: Income Inequality.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Financial Inclusion	-0.0135	-0.0511	0.305	0.288	0.331	0.910**
	(0.310)	(0.307)	(0.300)	(0.301)	(0.304)	(0.377)
Education	-0.0197*	-0.0187*	-0.0220**	-0.0209**	-0.0214**	-0.0275***
	(0.0102)	(0.0101)	(0.00977)	(0.00984)	(0.00985)	(0.0101)
Fin-Inc * Education	-0.0194***	-0.0179***	-0.0194***	-0.0194***	-0.0197***	-0.0228***
	(0.00364)	(0.00363)	(0.00351)	(0.00351)	(0.00353)	(0.00375)
Openness		0.0138***	0.0112***	0.0111***	0.0105***	0.0111***
		(0.00326)	(0.00321)	(0.00321)	(0.00328)	(0.00333)
Unemployment			0.140***	0.147***	0.154***	0.155***
			(0.0196)	(0.0211)	(0.0226)	(0.0224)
Population Growth				0.0954	0.0912	0.108
				(0.105)	(0.105)	(0.104)
GDPpc					0.0000310	0.0000220
					(0.0000336)	(0.0000336)
Digital Inclusion						-0.355**
						(0.147)
Constant	37.07***	35.98***	35.97***	35.72***	35.38***	37.54***
	(1.013)	(1.033)	(0.999)	(1.041)	(1.102)	(1.391)
Time Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.188	0.212	0.276	0.277	0.278	0.286
AIC	1812.7	1771.6	1702.8	1702.3	1701.9	1683.0
BIC	1890.4	1853.6	1789.1	1793.2	1797.3	1782.7
F	8.840	9.526	12.57	11.92	11.37	11.14
Observations	711	703	695	694	693	689

Standard errors in parentheses
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$



Source**:** Author calculations based on data collected from WB, IMF

Figure 7: Marginal effects of Financial Inclusion on Income Inequality.

6.2 Specification 2: Interaction of Digital Inclusion and Education.

In specification 2, we use fixed effects panel data model of over 190 countries to establish the relationship between income inequality and Digital inclusion. The reason to use fixed effects model was based on Hausman test. The empirical model has the following form:

$$\mathbf{Inequality_{i,t} = \alpha_i + \sum_{j=1}^{k} \beta_j\ X_{j,i,t} + \delta_1 Education_{i,t} + \delta_2 Internet_i + \delta_3 Education \times Internet_i + \varepsilon_i}$$

Here, the dependent variable is inequality, which represents Gini indices of disposable income, $X_{j,i}$ are k exogenous control variables affecting income inequality, $Education_{i,t}$ records education level, $Internet_i$ represents the measure of Digital Inclusion, and Education × $Internet_i$

represents the corresponding interaction variables, α is a constant and ε_i is the error term. The panel data results for specification are shown in Table 1 below. The strategy used to construct results is similar to specification 1 i.e., adding each control variable one by one.

The results of this specification are shown in Table 3 below. The coefficient of digital inclusion is negative and statistically significant in all models, which means that digital inclusion reduces income inequality. The coefficient of education is also negative and significant in all models, but the coefficient of interaction of education and digital inclusion is positive in first 5 models and is negative and significant at 10% level in model 6. Moreover, population growth is significant in first 3 models, but not significant in model 5 and 6. The coefficients of credit to private sector, openness, unemployment, and government effectiveness are also significant in model 6.

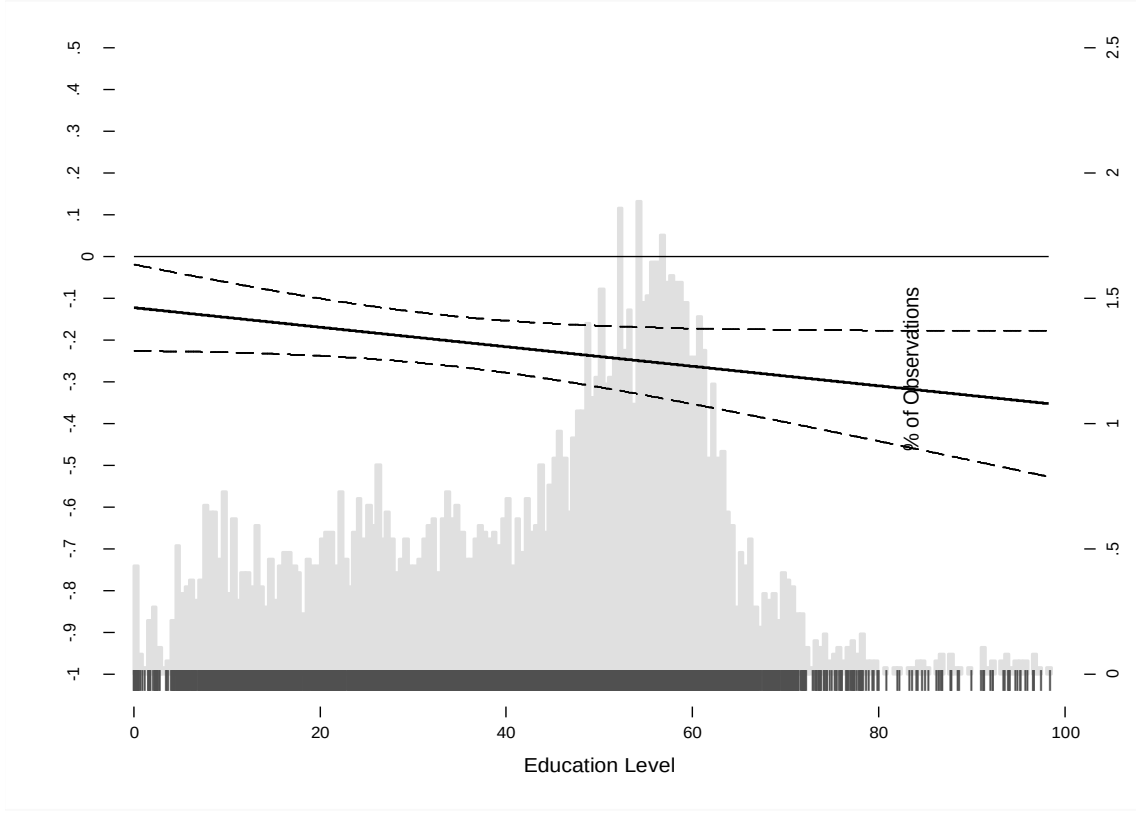
The plot of interaction term is shown in Figure 8 below. According to the plot digital inclusion reduces inequality on its own, and the size/direction/significance of this effect does not depend on the level of education. The plot also shows that the marginal effect of internet on income inequality at different levels of education is always negative. The coefficient of interaction term is significant at 10% level, which implies that only a weak interaction effect exists. The marginal effect of internet at education == 0 is about -0.1 (with a confidence interval from -0.2 to -0.0), which is not significantly different from the effect of internet at education == 160 (the confidence interval there includes -0.2). Hence, if we take 5% significance level, then the interaction effect does not exist, which means that internet by itself reduces income inequality.

Table 3: Income Inequality and Digital Inclusion.

Panel results: Income Inequality and Digital Inclusion.
Dependent Variable: Income Inequality.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Digital Inclusion	-0.178***	-0.187***	-0.125***	-0.121***	-0.0952**	-0.122**
	(0.0367)	(0.0368)	(0.0397)	(0.0422)	(0.0418)	(0.0527)
Education	-0.0451***	-0.0474***	-0.0450***	-0.0447***	-0.0438***	-0.0157*
	(0.00675)	(0.00679)	(0.00732)	(0.00742)	(0.00737)	(0.00846)
Dig-Inc * Education	0.00551***	0.00573***	0.00283***	0.00226**	0.00214**	-0.00234*
	(0.000734)	(0.000737)	(0.000903)	(0.000953)	(0.000953)	(0.00129)
Population growth		-0.136***	-0.125**	-0.114**	-0.0424	0.0609
		(0.0482)	(0.0494)	(0.0497)	(0.0501)	(0.0527)
Credit			0.00710***	0.00729***	0.00647***	0.00545***
			(0.00187)	(0.00189)	(0.00187)	(0.00204)
Openness				0.00444**	0.00457**	0.00741***
				(0.00225)	(0.00222)	(0.00227)
Unemployment					0.124***	0.133***
					(0.0139)	(0.0146)
Govt Effectiveness						0.643***
						(0.191)
Constant	39.00***	39.26***	39.65***	39.28***	38.12***	36.92***
	(0.303)	(0.316)	(0.344)	(0.388)	(0.403)	(0.437)
R^2	0.037	0.041	0.038	0.041	0.078	0.131
AIC	8708.6	8699.2	7746.7	7535.1	7344.7	5543.7
BIC	8731.9	8728.3	7780.9	7574.9	7390.0	5592.8
F	29.92	24.49	16.13	14.08	23.84	29.46

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$



Source: Author calculations based on data collected from WB, IMF and WIID

Figure 8: Marginal effects of Digital Inclusion on Income Inequality.

CHAPTER 7

CONCLUSION AND FURTHER RESEARCH

This paper tested the role of education, digital inclusion and financial inclusion in reducing income inequality. The topics of financial and digital inclusion are contemporary and their role on reducing income inequality needed more inspection.

For that purpose, the paper first provided literature on the impact of these variables on income inequality as tested in prior research. After that the paper discussed the data and methodology to test two different specifications with several models. Specification one showed that the interaction of financial inclusion and education level had significant impact on income inequality. Specification two showed that the interaction of digital inclusion and education level had a weak interaction effect significant at only 10% level.

These results are very important for policy makers and international organizations who are targeting digitally and financially include people in the society. It means that financial inclusion alone would not be effective. The main focus should be on education and increasing literacy rates in a country because educated people will more effectively use the financial services. Although the interaction effect of digital inclusion and education level is weak, still increase in education can help increase the use and positive effects of internet.

Increase in Financial and digital services is inevitable with the passage of time, so studying their impact and how they interact with different variables would provide vital policy implications. Since this study area is new, there are many aspects of financial and digital inclusion that future scholars can investigate. Future research could focus on the interaction of these services with quality of democracy and autocracy, which would point out the system more

suitable of financial and digital success. Researchers could also look into the impact of financial and digital inclusion on stability of a country. As many countries in the world today face instability of different kinds, financial and digital inclusion could open possible doors of achieving stability in these countries. Another suggestion would be testing for the impact of financial and digital inclusion on social inclusion in a country. These are just few of the many possible areas that scholars can investigate.

REFERENCES

Abdullah, Abdul, et al. "Does Education Reduce Income Inequality? A Meta-Regression Analysis." *Journal of Economic Surveys*, vol. 29, no. 2, 2013, pp. 301–316., doi:10.1111/joes.12056.

Agyemang-Badu, Albert A., et al. "Financial Inclusion, Poverty and Income Inequality: Evidence from Africa." *Spiritan International Journal of Poverty Studies*, vol. 2, no. 2, 1 Apr. 2018, papers.ssrn.com/sol3/papers.cfm?abstract_id=3167200.

Anas, Iswanto Anwar, and Amrullah Amiruddin. "Impact Of Financial Inclusion Towards Poverty In Indonesia." *2nd International Conference on Accounting, Management, and Economics 2017*, Oct. 2017, doi:https://doi.org/10.2991/icame-17.2017.32.

Afonso, Helena, et al. "Development Issues No. 2: Inequality Measurement | Economic Analysis & Policy Division." *United Nations*, United Nations, 21 Oct. 2015, www.un.org/development/desa/dpad/publication/no-2-inequality-measurement/.

Bollen, Kenneth A., and Robert W. Jackman. "Political Democracy and the Size Distribution of Income." *American Sociological Review*, vol. 50, no. 4, Aug. 1985, pp. 438–457., https://www.jstor.org/stable/2095432.

Babych, Yaroslava, et al. "financial inclusion, financial literacy, and financial education in georgia." *ADBI Working Paper Series*, ser. 849, June 2018. *849*, www.adb.org/sites/default/files/publication/428771/adbi-wp849.pdf.

Birru, Mehret S, et al. "Internet Usage by Low-Literacy Adults Seeking Health Information: An Observational Analysis." *Journal of Medical Internet Research*, July 2004, doi:10.2196/jmir.6.3.e2

Coady, David, and Allan Dizioli. "Income Inequality and Education Revisited: Persistence, Endogeneity, and Heterogeneity." *IMF working papers*, 26 May 2017, www.imf.org/en/Publications/WP/Issues/2017/05/26/Income-Inequality-and-Education-Revisited-Persistence-Endogeneity-and-Heterogeneity-44854.

Caria, Ningsih, and Choi Yong-Jae. "An Effect of Internet Penetration on Income Inequality in Southeast Asian Countries." *22nd ITS Biennial Conference, Seoul*, 2018, hdl.handle.net/10419/190399.

Cobham, Alex, et al. "Inequality and the Tails: the Palma Proposition and Ratio." *Global Policy*, vol. 7, no. 1, 2016, pp. 25–36., doi:10.1111/1758-5899.12320.

Danlami, Mohammed Ibrahim, and Dada Richard Mayowa. "An Empirical Investigation of Automated Teller Machines (ATMs)and Customers' Satisfaction in Nigeria: A Case Study of Ilorin, Kwara State." 7 Nov. 2014, mpra.ub.uni-muenchen.de/59757/1/MPRA_paper_59757.pdf.

Forman, Chris, et al. "The Internet and Local Wages: A Puzzle." *The American Economic Review*, vol. 102, no. 1, Feb. 2012, pp. 556–575., https://www.jstor.org/stable/41408784.

Gualteros, Andrea. "The economic & social cost of illiteracy." 2018, worldliteracyfoundation.org/wp-content/uploads/2018/11/TheEconomicSocialCostofIlliteracy.pdf.

Gregorio, José De, and Jong–Wha Lee. "Education and Income Inequality: New Evidence From Cross-Country Data." *The International Association for Research in Income and Wealth 2002*, vol. 48, no. 3, 7 Jan. 2003, pp. 395–416., doi:https://doi.org/10.1111/1475-4991.00060.

Huang, Youxing, and Yan Zhang. "Financial Inclusion and Urban–Rural Income Inequality: Long-Run and Short-Run Relationships." *Emerging Markets Finance and Trade*, doi:https://doi.org/10.1080/1540496X.2018.1562896.

Houngbonon, Georges Vivien, and Julienne Liang. "Broadband Internet and Income Inequality." *HAL*, hal.archives-ouvertes.fr/hal-01653815.

Kang H.Park. "Educational Expansion and Educational Inequality on Income Distribution." *Economics of Education Review*, vol. 15, no. 1, Feb. 1996, pp. 51–58., doi:https://doi.org/10.1016/0272-7757(95)00000-3.

Kenny, Charles. "the costs and benefits of communication technologies for direct poverty alleviation." *Development Policy Review*, 20 May 2002, pp. 141–157., charleskenny.blogs.com/weblog/files/devpolrevpovertypapfinal.pdf.

Lam, David, and Deborah Levison. "Declining Inequality in Schooling in Brazil and Its Effects on Inequality in Earnings☆." *Journal of Development Economics*, vol. 37, no. 1-2, Nov. 1991, pp. 199–225., doi:https://doi.org/10.1016/0304-3878(91)90088-D.

Le, Quoc Hoi, et al. *Management Science Letters*, vol. 9, no. 5, 2019, pp. 661–672., doi:10.5267/j.msl.2019.2.005.

Lee, Cheol-Sung. "Income Inequality, Democracy, and Public Sector Size." *American Sociological Review*, vol. 70, no. 1, 2005, pp. 158–181., doi:https://doi.org/10.1177/000312240507000108.

Liu, Yongzheng. "Internet and Income Inequality: A Research Note." *International Center for Public Policy*, Dec. 2017, icepp.gsu.edu/files/2017/12/paper1723.pdf.

Li, Hongyi, et al. "Explaining International and Intertemporal Variations in Income Inequality." *The Economic Journal*, vol. 108, no. 446, Jan. 1998, pp. 26–43., doi: https://doi.org/10.1111/1468-0297.00271.

Muller, Edward N. "Democracy, Economic Development, and Income Inequality." *American Sociological Review* , vol. 53, no. 1, Feb. 1988, pp. 50–68., www.jstor.org/stable/2095732.

Mahmud, Baktiar, et al. "Empirical Study of the Use of Automated Teller Machine (ATM) among Bank Customers in Dhaka City, Bangladesh." *European Journal of Business and Management Www.iiste.org*, vol. 7, no. 1, 2015, pdfs.semanticscholar.org/1582/de62a9907aa9dab1ae257ba864da5113b554.pdf.

McKinsey & Company. *Offline and Falling behind: Barriers to Internet Adoption*. McKinsey & Company, Sept. 2014, www.mckinsey.com/industries/high-tech/our-insights/offline-and-falling-behind-barriers-to-internet-adoption.

Neaime, Simon, and Isabelle Gaysset. "Financial Inclusion and Stability in MENA: Evidence from Poverty and Inequality." *Finance Research Letters*, vol. 24, Mar. 2018, pp. 230–237., doi:https://doi.org/10.1016/j.frl.2017.09.007.

Park, Cyn-Young, and Rogelio V. Mercado Jr. "Does Financial Inclusion Reduce Poverty and Income Inequality in Developing Asia?" *Financial Inclusion in Asia*, Palgrave Macmillan, London, 2016, pp. 61–92, link.springer.com/chapter/10.1057/978-1-137-58337-6_3#citeas.

Panichsombat, Rachaphum. "Impact of Internet Penetration on Income Inequality in Developing Asia: an Econometric Analysis." *ASR: CMU Journal of Social Sciences and Humanities* , vol. 3, no. 2, 2016, pp. 151–167., cmuj.cmu.ac.th/asr/full/1820171201145053.pdf.

Ramachandran, Ramakrishnan, Financial Literacy and Financial Inclusion (June 9, 2012). 13th Thinkers and Writers Forum, June 2012. Available at SSRN: https://ssrn.com/abstract=2204173

Shahabadi, Abolfazl, et al. "the effect of education on income inequality in selected islamic countries." *IJAPS*, vol. 14, no. 2, 2018, pp. 61–78., doi: https://doi.org/10.21315/ijaps2018.14.2.3.

Sethy, Susanta Kumar, and Phanindra Goyari. "Measuring Financial Inclusion of Indian States: An Empirical Study." *Indian Journal of Economics and Development* , vol. 14, no. 1, 4 July 2018, papers.ssrn.com/sol3/papers.cfm?abstract_id=3195986.

Solt, Frederick. 2019. “Measuring Income Inequality Across Countries and Over Time: The Standardized World Income Inequality Database.” SWIID Version 8.0, February 2019. World Inequality Lab. *Executive summary*. World Inequality Lab, 2018.

Sarma, Mandira. “Index of Financial Inclusion.” *Indian council for research on international economic relations*, June 2008, icrier.org/pdf/Working_Paper_215.pdf.

Tinbergen, Jan. “The Impact Of Education On Income Distribution.” *Review of Income and Wealth*, vol. 18, no. 3, Sept. 1972, pp. 255–265., doi:10.1111/j.1475-4991.1972.tb00865.x.

The World Bank. “The Global Findex Database 2017.” *The Global Findex Database 2017*, The World Bank, 2017, globalfindex.worldbank.org/.

Timmons, Jeffrey F. “Does Democracy Reduce Economic Inequality?”*British Journal of Political Science*, vol. 40, no. 4, Oct. 2010, pp. 741–757. *JSTOR*, www.jstor.org/stable/40930584.

UNCDF. *Financial Inclusion and the SDGs*. UNCDF, 2019, www.uncdf.org/financial-inclusion-and-the-sdgs.

WDI. *World Development Indicators*. World Bank, datacatalog.worldbank.org/dataset/world-development-indicators.

Walker, Donnetta, "Agricultural credit to small farmers in developing countries" (1980). Retrospective Theses and Dissertations. 17030. https://lib.dr.iastate.edu/rtd/17030

World Bank. *UFA2020 Overview: Universal Financial Access by 2020*. The World Bank, 1 Oct. 2018, www.worldbank.org/en/topic/financialinclusion/brief/achieving-universal-financial-access-by-2020.

BIOGRAPHICAL SKETCH

Araiz Murad Dahir was born in Rahim Yar Khan, Pakistan. He is a graduate of a Dual Degree Master of Science program in International Political Economy from The University of Texas at Dallas, USA, and the Philipps University of Marburg, Germany. Following a Bachelor of Science in Economics, he decided to better adapt his studies to his interests and to extend his knowledge with the respective graduate program.

CURRICULUM VITAE

EXPERIENCE

SponsorUnited **(Present- May 19)**
Sponsorship Analyst Intern

- Analyze TV & radio broadcast sponsorship content and research on digital sponsorship's.
- Prepare reports on collected qualitative data in a form understandable to the whole team.

Harvard Kennedy School **(Spring 2016)**
Data Analyst

- Data collection and entry for Research Project lead by Michael Callen on exploring the reasons behind social resistance to polio vaccination in the district of Lahore, Punjab.

Pakistan's Ministry of Planning, Development & Reforms **(Summer 2015)**
Internship

- Used primary data directly available from Ministry to offer Policy Analysis on Priorities for Education Policy in Pakistan.
- The report pointed out the loopholes in Education policy of each province and suggested five measures that should be prioritized to effectively tackle the challenging situation.

London School of Economics **(Summer 2013)**
Data collection and entry

- Worked with Professor Mahvish Shami from London School of Economics on her Research in slums of Lahore.
- Field research involved 45 min surveys with family heads to understand the political economy of slums in Lahore

EDUCATION

Masters Double Degree in International Political Economy (IPE) **(May 2019 expected)**
University of Texas at Dallas (UTD), USA | Phillips University Marburg, Germany

- Scholarship sponsored by UTD and Deans List with 4.0 CGPA.

BSC (Honours) Economics **(2009-2014)**
Lahore University of Management Sciences (LUMS)

- Two semesters in Lahore School of Economics (LSE) with Merit Scholarship
- Cultural ambassador and Deans List with 3.71 CGPA in Delta State University, MS, USA.

TECHNICAL SKILLS AND INTERESTS

Technical Skills: R, STATA, Adobe illustrator, LATEX, SPSS, Photoshop, Microsoft Office

Volunteer work: LCSS Orphan help department, women empowerment conference in Mississippi, volunteered in Pak-US Alumni Network activities.

Languages: Fluent in English, Saraiki (Native), Urdu, Punjabi.

Interests: Interested in Data analysis, News, Hiking, Cycling and experiencing new cultures. Learned adaptability, public speaking, and persuasion skills through cultural integration.