

# M-Shwari Comparisons: An Investigation of Income

Kathryn Enriquez  
University of Virginia  
and  
Janiece Jackson  
Clemson University

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## Abstract

M-Shwari is a mobile banking initiative created by the mobile phone service provider Safaricom and the Commercial Bank of Africa. As a supplement to the popular mobile money transfer system M-PESA, M-Shwari gives its users an ability to establish savings and credit through short-term loans from their mobile device. This innovative technology was intended to allow the un- and under-banked to take part in personal, regional, and national economic objectives, while expanding personal economic prosperity through increased access to loans, lower interest rates, and an expansion of personal credit. Data from the Kenya Financial Diaries (KFD) Dataverse and the Financial Inclusion Insights Tracker Surveys (FIITS) were used to investigate M-Shwari's impact on consumers while accounting for their education, income, balances, and poverty status. By reviewing mean income per day and comparing M-Shwari users to a random sample of non-M-Shwari users, significance was found correlating higher income and the use of M-Shwari. Further conclusions have led us to believe that M-Shwari is not reaching its goals in regards to accessibility for the un- and under-banked within Kenya.

*Keywords:* M-Shwari users, M-PESA, un- and under-banked, income, Kenya, culture, demographics

# 1 Introduction

In order to understand the economic impact of M-Shwari, it is necessary to understand the economic faculties of Kenyan community members. This includes the consistently growing and improving M-PESA platform, the M-Shwari savings and loans initiative, and general information on the economic culture and demographics of Kenyan villages and cities.

## 1.1 Background

Mobile money has been a vastly increasing field over the past several decades. This concept has not only reached developed countries but has also found its own niche in the developing world. Kenya's answer to the mobile banking uptick was M-PESA, a form of mobile money technology implemented in 2007 that facilitates deposits, payments, and withdrawals. This payment system revolves around peer-to-peer SMS transfers. It has become very widely used in Kenyan communities with approximately 93% of the population registered with an account as of 2013 (Turner, 2016).

M-PESA is a unique service for the developing economy in Kenya. It has shown to be a successful platform for proper financial inclusion. This includes significant improvement in gender-based inclusion, better allowances of savings, and proper mitigation of risks, including those revolving around abrupt changes in income and health expenditures (Jack and Suri, 2011, Suri and Jack, 2016, Bharadwaj, Jack, and Suri, 2019). It has been shown to be financially accessible because, although it has the ability to be connected to other bank accounts and providers, it is not a requirement to associate one's mobile money service with a credit or savings provider. This is an important distinction as it gives better accessibility to the un- and under-banked who do not have the funds to create or be properly funded with a credit or loans banking system. M-PESA's focus on peer-to-peer transactions and direct financial communication between community members has also been instrumental in the successes of the M-PESA platform and others with similar foci. The Kenyan economic culture is based around interactions with trusted community

members. As will be discussed further, the nature of the interrelations present among Kenyan community members expresses more of an understanding into why the unique nature of the M-PESA platform has allowed for continued success. Its provider, Safaricom, along with other banking institutions like the Commercial Bank of Africa (CBA), have been able to form a network of inclusive institutions for agricultural, commercial, and business enterprises to have a greater control of their finances. There is a continued expectation of these platforms to allow increased accessibility to banking services. One of the more notable and all-encompassing elements of M-PESA is the M-Shwari platform.

In November of 2012, M-Shwari, a mobile banking service utilized in Kenya for credit and loan services, was created. Its mission: to allow for the un- and under-banked to have easy access to savings and loan services directly from mobile phones, without the need to have minimum deposits or be associated with a large bank or other economic institution. “M-Shwari aims to deepen and diversify the consumption and income benefits of M-PESA by providing clients with a facility to save and by offering credit beyond a user’s networks of family and friends” (Huxley, Gibson, Elliott, and Johnson, 2016). M-Shwari is a lesser known application built upon M-PESA technology. It allows for one’s M-PESA funds to be transferred without additional fees. These funds can be utilized to create a credit score and dispense loans directly through the M-Shwari system. Although less utilized, it can be seen as prevalent among young males with high levels of education from urban areas (like Nairobi, Kenya and Mombasa, Kenya) who live above the poverty line, especially within the early days of M-Shwari (Cook and McKay, 2015, Mirzoyants-McKnight and Attfield, 2015). However, locations and demographics can be far reaching, only contingent upon the furthest mobile phone signal or repair location.

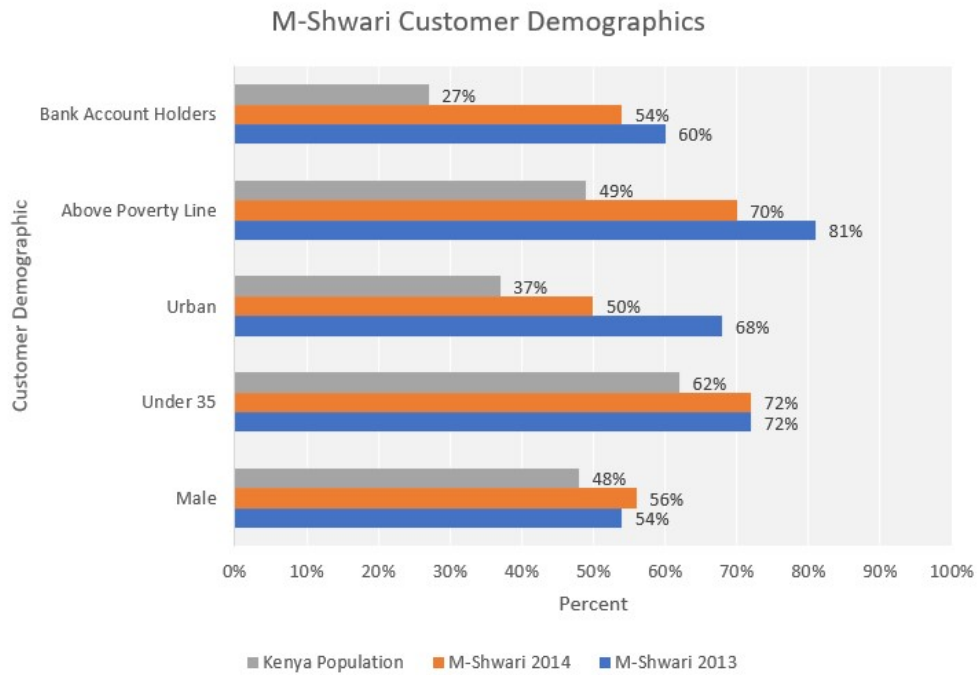


Figure 1: Data obtained from FII Surveys (Sep-Oct 2013 and Sep 2014) delineating between the demographics of M-Shwari users and the general population of Kenya

As seen in Lamb and Kling (2003), there is a necessary switch occurring within econometric research contextualizing the user of a platform as a societal member. In support of this, the results were examined in the context of Kenyan cultural and societal ideals. The culture of Kenyan economics follows from a similar ideal as other poor African and Latin American countries. Communities are formed through ethnic groups or tribes, with a strong economic interdependence with trusted factions, especially family members (Duflo and Banerjee, 2011, Scroope, 2018). Informal economic groups are created in order to allow for the proper implementations of savings and loans in these small communities. These groups include Rotating Savings and Credit Associations (ROSCA), self-help groups

(SHG), moneylenders, “under the bed savings”, and other more formal organizations. Formal organizations include Savings and Credit Cooperative Organizations (SACCO), Fin-Techs, microfinance institutions, and government institutions. Holding savings in these groups and organizations, although fruitful for regularity of funds and assistive for those who do not know how to start saving, often backfires when consumers are faced with times in which they need immediate funding, as is the case when emergencies arise (Cook and McKay, 2015). Often when a family member is in need, emergent healthcare funds are needed to pay for point of service care to ensure survivability.

These communities have strong considerations towards loans. Loans are taken on an emotional basis without logical regards to repayment. Among poor Kenyans, there is a persistent belief that those that have the means to get and renew loans should do so, whether necessary or not, as they have reached the peak of the perceived poverty trap in the area.

Introducing programs like M-Shwari into this culture has multiple potential effects. The continued desire is that extending the high prospects of M-PESA to savings and loans will increase financial security and education among the un- and under-banked. However, there are potential pitfalls from the economic cultural ideals surrounding loans in the affected areas.

Other potential effects follow from pervasive theories within mobile money research. The amplification theory of technology is a concept championed by Kentaro Toyama, a computer scientist and former assistant director of Microsoft Research India, where he undertook international development. His argument is that technology only magnifies existing human objectives and aptitude. In education, for instance, it makes little sense for technology to be introduced when the basic requisites of good teachers and administrators are not in place to enforce the structure needed for a successful school system (Fallows and Toyama, 2011). The amplification theory of technology is applied to social theories and worries about the dangers of constantly increasing accessibility and interconnection between marginalized communities. Some have concluded that technology tends to amplify

existing social inequalities. This theory has been applied within mobile money research to show that updated technologies often overlook the needs of women (Wyche, Simiyu, and Othieno, 2016).

Another theory that has effects within mobile money and digital economics is the theory of the digital divide, which states that households with better access and greater resources, including financial literacy and digital skills, are more likely to start utilizing new, helpful digital services (Van Dijk and Hacker, 2003). The combination of these two theories sparks some questions regarding M-Shwari's true effects on the un- and under-banked.

Investigation is focused on the effects and demographics of those that utilized M-Shwari soon after its implementation, examining the incomes of M-Shwari users in comparison to non-M-Shwari users. This investigation intends to realize the true effects of the introduction of M-Shwari services, keeping in consideration the economic culture of Kenyan communities and the differences between the goals and potential outcomes of these implementations. Utilizing this information, we will point towards statistically relevant information regarding the user base while providing multiple recommendations for future research to provide a true capture of M-Shwari's effectiveness to assist with meeting the economic goals of the un- and under-banked.

This paper is structured in 5 sections. Section 1 explains the background behind M-PESA, M-Shwari, and Kenyan culture necessary to arrive at our conclusions. It continues by providing an explanation of the data we utilized and the access seen within these services. Section 2 reviews the literature that led us to follow in these investigations. In Section 3 we discuss our methods. Section 4 presents our results and Section 5 concludes and explains recommendations to be able to reach further conclusions.

## 1.2 Data

Data was obtained from the Kenya Financial Diaries (KFD) Dataverse. For the period between August 2012 and December 2013, transaction data was collected from 298 Kenyan households. Factors that were investigated as it pertains to each household include demographic information, income, education level, poverty status, and consumption, among other surveilled elements. The purpose of this compilation was to observe and understand the goings-on of low-income Kenyans. Fourteen different communities across five areas of Kenya (Nairobi, Mombasa, Vihiga, Makueni, and El Doret) were surveyed.

Utilization of the income data from the KFD Dataverse requires that the same exclusions that the original curators performed are applied. The exclusions made include the income transactions that occurred during the first two diaries rounds, income transactions made before the household had been observed for at least one month, transactions detailing resources given to the households, and transactions containing gifts given to the household from the research firm.

Another data set that was employed was the Financial Inclusion Insights Tracker Surveys (FIITS), a series of questionnaires administered by independent market research company, Ipsos. Over the course of five years (2013-2017), approximately 3,000 individuals per year throughout Kenya were interviewed regarding multiple aspects of their lives including livelihood, access to mobile technology, and the financial devices they used, to name a few.

The data gathered allowed for multiple statistical analyses, including Student t-tests and regression analyses, to determine the effects of M-Shwari on the lives of Kenyans at different levels of poverty.

## 1.3 Access

### 1.3.1 Cell Phone Access

With the launch of M-PESA in 2007 and M-Shwari in 2012, mobile phones have become an integral part of the lives of countless Kenyans. Pew Research Center conducted a survey

of adults in Sub-Saharan Africa from April 11, 2014 to June 5, 2014. The study found that 82% of the adult population of Kenya owned a phone, a 73 percentage point leap from figures previously recorded in 2002. The same study found that performing mobile transactions was the second most popular cell phone activity among adult cell phone owners in Kenya at 61%, following texting at 88% (Pew Research, 2015).

Because of the growing importance of mobile phones and the Kenyan culture of sharing and community, it is not uncommon to see multiple people using the same device. In fact, 58% of respondents to a study conducted in 2013 said that they share a phone with someone else, while 21% of respondents who are phone owners mentioned that they share their own cellular device with another person (Pew Research, 2015).

In developing countries, it is less common to see smartphones, mostly because of the lack of internet access in vast rural areas. In such cases, Kenyans make use of basic cell phones, SIM cards, and the service tower(s) nearest them to complete the desired activities on their devices. It was discovered that 30% of the Kenyan adult population owns a smartphone, whereas 50% own basic phones; 20% report not owning a phone at all (Silver and Johnson, 2018).

These rates of cellular uptake are partly due to the cost of obtaining a smartphone which typically requires a higher paying job and, often, more education. According to the Spring 2017 Global Attitudes Survey (GAS), another inquiry carried out by Pew Research, 74% of adults that have not completed an educational level higher than secondary school own mobile phones, while 95% of adults that have completed secondary school or higher own mobile phones. There is an even larger gap in possession when it comes to smartphones. Approximately 18% of the less educated and 62% of the more educated own smartphones, a 44 percentage point difference for Kenyans: the greatest disparity of all Sub-Saharan Africa (Silver and Johnson, 2018).

Additionally, those with higher incomes are also more likely to possess more advanced mobile technology. The GAS details the differences in mobile and smartphone users' income levels as follows: 79% of those below the country's median income level own mobile phones



where 24% own smartphones. Correspondingly, 86% of Kenyans that earn higher income own mobile phones and 43% own smartphones (Silver and Johnson, 2018). Though these disparities are not as evident as those present in the education gaps, this is still evidence of the effects of income on access to mobile banking options.

Having access to these devices allows for opportunities to make use of mobile money services including M-PESA, M-Shwari, Airtel Money, and their counterparts. Focusing on the effects of M-Shwari on certain households in Kenya provides results of its execution and goal attainment for the mobile money market within Kenya.

### **1.3.2 Mobile Money Access**

Kenya is dependent on mobile money usage as a whole for many transactions. This includes services like M-PESA with its sub-beneficiaries including M-Shwari and other focused agricultural and business services. However, it also includes services that expand outside of the reach of Kenya's Safaricom, like Airtel Money, which allows customers to send funds to clients in other African countries including Rwanda, Tanzania, Malawi, and Zambia. With a median of 59% of Sub-Saharan Africans using their devices to complete transactions, 83% of Kenyan mobile phone owners used their cell phone to make or receive payments within 12 months of the survey's administration. Approximately 79% of basic phone owners and 88% of smartphone users in Kenya claim to have made mobile transactions: the highest in Sub-Saharan Africa. It is reported that there were about 20 million registered users of M-PESA in Kenya alone. These users accounted for 50% of the country's GDP in 2017 (Silver and Johnson, 2018).

People resort to utilizing multiple mobile money services as a safety net for their resources. At least one resident of 96% of Kenyan households has a mobile money account (Suri and Jack, 2016). The Central Bank of Kenya reports that, as of May 2021, there were approximately 67.77 million total registered mobile money accounts (See Figure 2) (Faria, 2021). Since the total population of Kenya is currently 55.08 million, this would mean that there are about 12 million more mobile money accounts than there are actual inhabitants

of the country. Due to the fact that many people possess multiple SIM cards administered by different providers, they are able to distribute funds to various mobile wallets. This scattered allocation allows for better safety and the ability to adapt to unexpected shocks, especially for the poor, un-, and under-banked (Jack, Ray, and Suri, 2013).

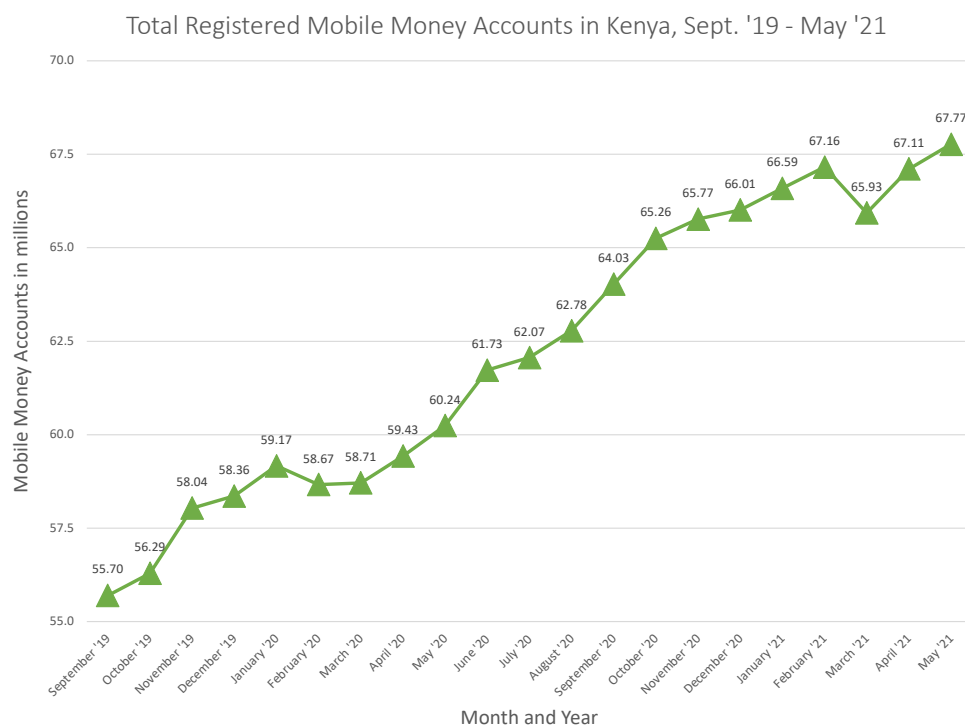


Figure 2: Data obtained from The Central Bank of Kenya detailing the number of mobile money accounts in Kenya from September 2019 to May 2021

## 2 Literature Review

The many informal saving methods of the poor each have a detriment to the safety, security, or consistent access to their money. ROSCAs and SACCOs are reliant on group security (Mas, 2010). Without the securities of a banking institution, thefts can occur within any saving scenario. Emergent needs can be detrimental to one’s informal institution, both

because of limited liquidity and continued reliance on moneylenders or other community members. Overall, with current saving scenarios in poor countries like Kenya, money loss is common (Wright and Mutesasira, 2001) and extremely detrimental to the well-being of consumers due to the limited economic flow cycle. This is especially concerning because of the number of households that do not utilize the formal savings or loans options that can help to alleviate some of these risks. Households that reside in poorer areas, also reside in “information poor” areas, making them less likely to be aware of helpful services, whether or not they have increased access to them (Van Hove and Dubus, 2019). “Fewer than 30% of Kenyan households save and fewer than 20% borrow with formal institutions... [which] is attributable to financial barriers such as inaccessibility, affordability, and ineligibility” (Nan and Markus, 2019).

Other research has utilized multiple forms of investigation into poverty, each with particular poverty measures. These include per capita consumption which measures general welfare, Gini coefficient which measures income inequality (Bowles and Carlin, 2020), and head count ratio which measures the proportions for incomes below the international poverty line of \$1.90 per head per day (Waiyaki, 2016). These establishments of poverty levels have allowed for further research into the effects of different elements of savings and loans on poverty level. It has been found that an increase in the interest rate spread, increase in non-performing loans, high transaction costs, and low quality of assets increase poverty, while introducing innovations reduces poverty (Waiyaki, 2016). These findings have been useful for correlating findings for M-PESA, M-Shwari, and other digital innovations with poverty levels.

As a part of the many services provided through Safaricom, easy-to-use entities for banking like M-Shwari quickly showed themselves to be necessary for proper association with savings and credit, especially among the un- and under-banked. Initially created on May 18, 2010, M-Kesho was the first representation of a mobile money savings and loans platform. It had similar features to M-Shwari, allowing for easy transfers between itself and M-PESA and no account opening fees or minimums. However, it required paperwork

that must be filled out and filed with a mobile money agent, most of whom were not fully supportive of the process due to the fact that they had to support regular M-PESA customers concurrently (Wamuyu, 2016). With an inability to increase the accessibility of these services, Safaricom was forced to shut down the M-Kesho program, replacing it with M-Shwari.

Although still a relatively new and inaccessible data entity, some research has been done into the specifics of M-Shwari savings and loan services. The demographics and habits of users has been of increasing interest to the field. The goals of our projects is to establish whether the un- and under-banked are being properly incentivized and served by these platforms. M-Shwari users are seen to be mainly young, well-educated males who live in urban areas (Lamb and Kling, 2003, Cook and McKay, 2015, Mirzoyants-McKnight and Attfield, 2015). In addition, they are more likely to be employed and run their own businesses, rather than working in manual labor industries, like farming. They also tend to be well banked, financially independent, and fiscally responsible savers that actively utilize multiple savings devices (Nan, 2018). These findings build upon similar demographic findings with M-PESA services. Well-educated, affluent, fully banked, and urban-living households have been seen to utilize M-PESA services (Jack and Suri, 2011). Other studies have investigated the resilience provided by M-Shwari services, proving that “mobile savings and fixed deposit accounts are indeed providing resilience to low income households” (Wamuyu, 2016).

Given that the demographics of M-Shwari participants have been investigated, as noted above, these findings can be directly connected and correlated to continuous income variables to see if the issues of use by the un- and under-banked arose as access increased or whether they persisted from the beginning of the implementation. As well, this research is unique as it focuses on continuous variables such as income with direct comparisons between M-Shwari users and non-M-Shwari users and connections to extensive transaction and demographic data regarding each household.

### **3 Methodology**

A random sample of 30 households that did not have transactions with M-Shwari and 28 that did have transactions within the 16 months of data collected in the Kenyan Financial Diaries (KFD) Dataverse was used. These two groups were compared in terms of their balances, income, education, and poverty levels. These factors were slightly influenced by the exclusions described within Section 1.2. These exclusions include: transactions occurring in the first two diaries rounds, transactions occurring before a household had been observed for at least one month, transactions including resources given, and transactions including gifts from the research firm. Balances were calculated, with the necessary exclusions applied, by taking all transactions that led to an inflow for the household and subtracting all transactions that were counted as an outflow for that household over the given time period. Incomes were calculated similarly, both through reported mean income over transaction values and through calculated mean income per household.

We performed an examination of statistical significance using the Student t-distribution; the standard testing procedures for the field to compare whether values are significantly different between two samples (Nan, 2018). By using packages in R to assess the acquired data points, we established statistically significant and insignificant figures which led to the conclusions drawn. We conducted the t-tests on the balances, poverty, and income data obtained, comparing the values for M-Shwari users and non-M-Shwari users. Within the

poverty data set, t-tests were also conducted comparing the balances of those in different poverty levels and those that were above and below the same poverty threshold. The critical value,  $\alpha$ , was set to 0.05. If p-values were less than or equal to 0.05, the null hypothesis was rejected, suggesting that the mean values for each of the samples are significantly different. T-values, which are ratios of the differences between the means of the two sample sets and the variation that exists within the sample sets, were used to help determine similarities and differences in the two sample means (Hayes, 2020). In these contexts, a positive t-value with statistical significance indicated that M-Shwari users (or those above the poverty threshold) had higher values, while a negative t-value indicated that non-M-Shwari users (or those below the poverty threshold) had lower values.

A series of regression analyses were also conducted to compare variables that could have possibly had effects on one another. Single linear regressions were performed using the ggplot2 library's ggplot function and the lm (linear model) function. Education data procured from the KFD Dataverse, specifically total years of attained education for the heads of households that adopted M-Shwari, was analyzed for its potential effects on balances for these households. A p-value and measures of central tendency were obtained from this inquiry and are presented in Section 4.

## 4 Results

In comparing the calculated mean incomes of M-Shwari users against non-M-Shwari users, it was determined that those who use M-Shwari are significantly more likely to have higher mean incomes. With this data, a t-value of  $t = 4.2553$  with degrees of freedom  $df = 27$  was derived, indicating a positive difference between the two data sets. The t-value of approximately 4.26 is not only unusual, but statistically significant as our p-value was found to be  $p = 0.0001123$ . This result was confirmed with the given mean income data from the KFD Dataverse. With these data, similar results were found, netting a t-value of  $t = 2.5198$  with degrees of freedom  $df = 32.137$ . These results were similarly statistically

significant, as well. This is seen by the p-value of  $p = 0.008454$ .

In attempting to further these conclusions, an investigation was performed on the difference between the end-of-study balances for M-Shwari users and non-M-Shwari users. With a t-value of  $t = 0.88973$ , degrees of freedom  $df = 27$ , and p-value of  $p = 0.1907$  which falls above the  $\alpha$  level of 0.05, no direct conclusions can be drawn concerning the differences between the balances of M-Shwari users and non-M-Shwari users.

Poverty Threshold	M-Shwari Users: Above vs. Below Threshold	Above Threshold: M-Shwari vs. Non-M-Shwari Users	Below Threshold: M-Shwari vs. Non-M-Shwari Users	Non-M-Shwari Users: Above vs. Below Threshold
425 Kenyan Shillings per Day	0.162586799	N/A	0.368515653	N/A
170 Kenyan Shillings per Day	0.083582224	0.327310194	0.259994242	0.146204214
85 Kenyan Shillings per Day	0.134005141	0.205097849	0.148567576	0.113519582

Figure 3: Table detailing the p-values of the 12 t-tests run to compare balances of households split by poverty threshold and consumer type

The resulting p-values of our t-testing into poverty is shown in Figure 3. Although none of these comparisons resulted in statistically significant differences, it can be seen in Figure 4 that there is a sizable difference in the medians and the variances of the balances dependent on poverty threshold and consumer type. It can also be seen that our income results are supported by these poverty analyses due to the fact that there are no consumers within our non-M-Shwari sample that have an income above the 425 KES per day threshold

(NMSR425). As well, the highest median and variance is seen within the M-Shwari sample with an income above 425 KES per day (MSR425).

In the boxplot seen in Figure 4, labels are coded by M-Shwari or non-M-Shwari participants (MS and NMS, respectively), above the threshold or below the threshold (R and P, respectively), and by the poverty threshold based on the income of the household which includes 425 KES per day, 170 KES per day, and 85 KES per day.

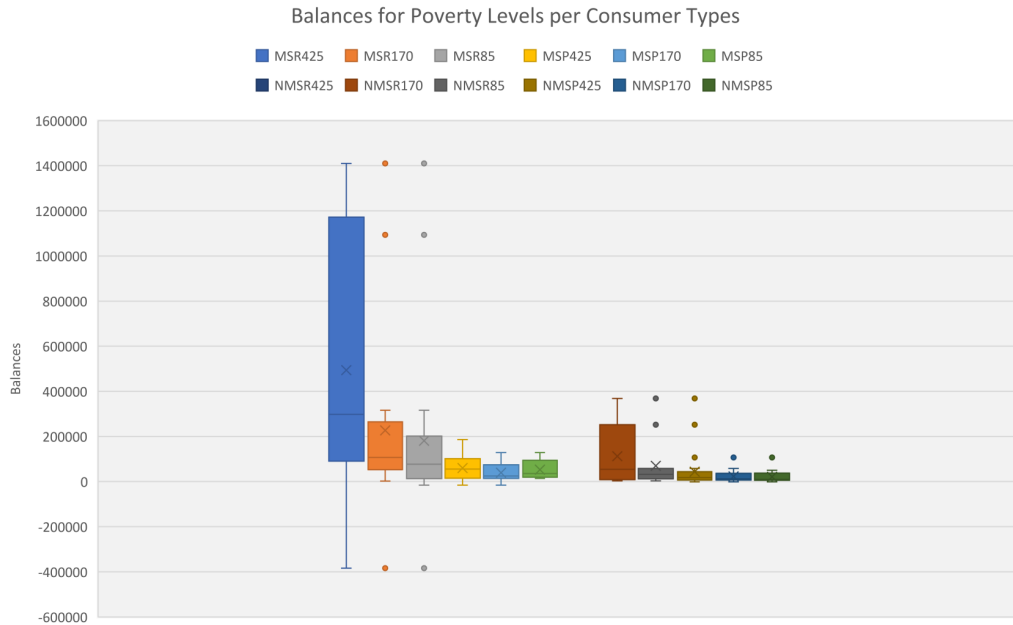


Figure 4: Boxplot representing the median and variances of balances of households split by poverty threshold and consumer type

To further analyze what could have affected the lack of significant differences in balances, we performed a single linear regression comparing the end-of-study balances of M-Shwari users against the years of attained education the heads of each household received. This was based on the ideas within Section 1.3.1, where it was seen that education had an effect on use and access to cell phones and other forms of technology. The results of this linear regression can be seen in Figure 5. Measures of central tendency were obtained for this



subset of the study to describe the normalcy of these data. The average number of years of education of M-Shwari users from this sample is  $\bar{x} = 10.07$  years. The median for this data set is  $\tilde{x} = 11$  years, while the mode is 12 years of education, which is consistent with our finding that M-Shwari users tend to be better educated than those that do not utilize the service. However, after procuring a p-value of  $p\text{-value} = 0.4979$ , we were able to conclude that the regression did not result in statistical significance. This indicates that there is no correlation between the number of years of education that the head of household receives and the balance retained at the end of the study for M-Shwari users.

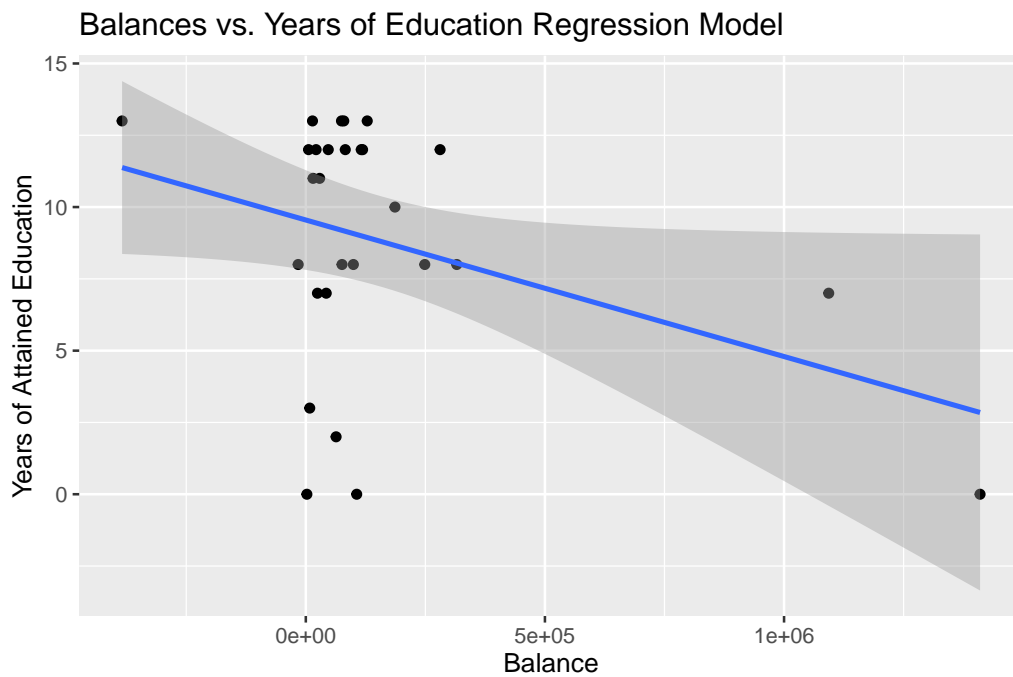


Figure 5: Single Linear Regression delineating the correlation between end-of-study balances and years of attained education for the head of each M-Shwari user’s household

## 5 Conclusions and Recommendations

### 5.1 Conclusion

Continuing the findings of Nan and Markus (2019), which observes binary variables and percents of consumers that utilize a service, this research has investigated the continuous variables of income and balance per household, directly comparing M-Shwari users to non-M-Shwari users. Conclusions were found that those that are using the platform have significantly higher income. This suggests that the M-Shwari service is not reaching its goal of properly serving the very impoverished and un- and under-banked.

There were no significant differences in the balances between those utilizing the M-Shwari platform and those that did not. In attempting to expound upon this result, further investigation was performed into how attained years of education and poverty level affect the balances of M-Shwari users. As well, the data focused around poverty level was utilized to analyze the differences between the means, medians, and variances of balances for the households by consumer type and poverty level. Although there was no significant differences found in the effects on the balances, the income findings were supported in comparing these households by establishing the lack of consumers within the sector of non-M-Shwari users with an income above the 425 KES threshold. Without a significant difference in balances or poverty level, it cannot be concluded whether or not M-Shwari is expanding the income gap between those in Kenyan communities.

From the amplification theory of technology, it is known that whether people's intentions are good or bad, technology will "amplify" the outcomes. If a plan is made and executed correctly, technology can and will boost the positive effects of said plan. If a program or service is ineffectively enacted, the technology used will only worsen the outcome and reinforce how wrong the business was to begin with. Connecting this ideal with other pervasive theories in digital economics including the theory of the digital divide only reinforces our hypothesis (Nan and Markus, 2019, Van Dijk and Hacker, 2003). Therefore, it is likely that, with a larger data set and similar analyses, M-Shwari is likely widening

this gap between the un- and under-banked and the sufficiently banked who are divided by their education, poverty level, income, and other demographics.

Technology on its own cannot bring about social, economic, or any other change; these desires must be combined with the well-intentions of those implementing the changes. M-Shwari, for example, cannot work for the poor and un- and under-banked in the way it was created simply because it is a more technologically advanced approach to the problem of poverty. It must be combined with the efforts of governments, banks, and other organizations committed to lowering the poverty rate in Kenya.

## **5.2 Recommendations for Future Research**

Future research should explore different statistical methods and questions that could be answered given access to more of Safaricom's facts and figures for the several and more current years, though the data are currently proprietary and unavailable.

Statistical mechanisms should include logistic growth models, Auto-regressive Moving Average (ARIMA) models, and the Granger Causality Test. Logistic growth models could be performed in order to get a better idea of where the future of M-Shwari lies. Using past data, predictions can be made in the carrying capacity for the number of adopters that Safaricom can expect to see for M-Shwari. An ARIMA model is a statistical forecasting method. In utilizing this model, past data could predict future values of various elements related to M-Shwari. These can include uptake, household balances, household incomes, poverty status, and more. In order to be successful, 38 points of data, ideally monthly or daily figures, would be of use to carry out this technique. The Granger Causality Test would allow us to determine whether our hypotheses are due to correlation or causation. With the proper data, the ability to surmise a correlation based on the different areas compared would be available.

Of further interest to the research group are a few outstanding questions regarding the uptake and continued use of M-Shwari. Firstly, investigation into whether or not the use

of M-Shwari is related to financial education and fiscal responsibility. Given the culture of borrowing within Kenyan communities, it is of interest in order to continue to draw conclusions based on the findings of no significant differences seen within the balances results.

Although the hypotheses regarding the expansion or contraction of the income inequality gap and M-Shwari's effects on it are postulated, further research and data are needed to solidify this conclusion and be able to properly and completely formulate recommendations for policymakers and service developers. The research group takes an interest into the intentions behind the use of M-Shwari, hoping to see if a lack of trust is the access blockade for the un- and under-banked into this service. Given proper experimentation abilities, it would also be of interest to continue research into the effects of interface design by correlating them with the demographics of M-Shwari users (Chiang et al., 2017).

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