FinTech and the COVID-19 Pandemic: Evidence from Electronic Payment Systems

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July 2020

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This Version: March 2021

Abstract

This paper investigates the effects of the Covid-19 pandemic on financial institutions and consumers' adoption of FinTech in payments. We find [1] The covid-19 pandemic has accelerated the adoption of FinTech platforms in payments. We document an approximate increase of 54% in mobile banking transactions, an increase of 19.56% in Mobile agents and an increase of 14.56% in Mobile banking accounts [2] The use of all electronic payment cards has significantly declined during the pandemic. [3] The pandemic has magnified interbank contagion and liquidity risks and has reduced both domestic and international electronic fund transfers via both the Real-Gross Settlement system (RTGS) and via Clearing house (ACH). Overall, our results shows that FinTech not only alleviated the negative impact of the Covid-19 pandemic during Q1 but that the pandemic has also accelerated consumers' adoption of FinTech platforms and digital onboarding specially in Q3 and Q4.

JEL Classifications: E58, E52, E32, G20, G21, G28, G32, O55, O16, O33

Keywords: Covid-19, Coronavirus, Fintech, Mobile Banking, Financial Technologies, Banks, Interbank transfers, Kenya, Africa, Clearing Houses, Financial Stability, Pandemic, M-PESA, Digital Banking.

1 Introduction

In this paper, we study the short-term effects of the Covid-19 pandemic on electronic payment systems. In particular, we address the question of whether the Covid-19 pandemic has accelerated the adoption of FinTech platforms in payment. The Covid-19 pandemic has impacted the ways in which banks' clients access financial products and services. Electronic payments, including mobile banking and other FinTech platforms, are important determinants of the cyclical position of the economy and are indicators of economic growth (Aditya et al. 2019, Baker 2018, Galbraith and Tkacz, 2007). Electronic payments are also a unique source of information for short-term forecasting (Aprigliano, Ardizzi and Monterforte, 2019) and are therefore useful in assessing the impacts of extreme events, such as the ongoing Covid-19 pandemic, on consumers' choices and spending patterns.[1]

To examine whether the Covid-19 pandemic has accelerated the adoption of FinTech and other related digital platforms in payments, we focus on a country that has significant investments in FinTech and a significant fraction of the population using mobile and digital banking: Kenya. Approximately 80% of Kenya's adult population widely uses mobile banking for purposes such as opening a bank account, executing bank account transactions, purchasing pre-paid phone credit, obtaining micro-loans and short-term loans, paying utility bills, peer-to-peer lending and purchasing groceries (Jack and Suri, 2011, 2014)[2]. While there are several banking platforms, the most dominant banking digital platform is M-PESA[3]. The platform uses a simple short messaging service (SMS) technology and

[1]Some important works in the use of payment data for forecasting include: Carlsen and Storgaard, 2010, Esteves, 2009, Galbraith and Tkazc, 2009, Hopkins and Sherman 2020

[2]The adoption of FinTech has partially been driven by limited number of bank branches and ATM machines. As of 2020Q1, there are only 1,255 bank branches and 2,423 ATM machines in a country the size of Belgium and France combined

[3]Note that "M" stands for mobile and that "PESA" is a Kiswahili word meaning "Money". M-PESA therefore translates to "Mobile Money".

mobile banking agents exchange cash for "e-money" that can then be transferred from one account to another. M-PESA also issues receipts per transaction, which in a country with weak legal institutions significantly reduce ex-post transaction costs.[4] Commercial banks in Kenya have partnered with FinTech platforms such as M-PESA and provide a wide range of financial services via these channels.

In this paper, we first address the question: What are the effects of the Covid-19 pandemic on the adoption of mobile banking and related digital platforms? We examine both the transaction values and transaction volumes and find that mobile banking transaction values declined by 6.98% between December 2019 and April 2020, and declined by 15.5% between March and April 2020. The results demonstrate that the Covid-19 pandemic initally had an adverse effect on both the transaction values and transaction volumes of mobile banking. However, when we examine beyond the first quarter, we find that the number of mobile banking agents increased by 19.56% between the first quarter and the last quarter of 2020, suggesting that the Covid-19 pandemic has accelerated consumers' onboarding into the FinTech space. And that financial intermediaries are responding to expected future changes in the forms of payments during the ongoing Covid-19 pandemic. The estimated increase in transactions values between the first quarter and the fourth quarter of 2020 is approximately 53.97%, and the estimated increase in mobile banking accounts is about 14.56%. The rise in mobile banking during the pandemic is further accelerated by regulatory measures imposed by the government. These measures include an increase in daily limits and an eliminaton of fees and charges. The government required commercial banks to eliminate all charges related to transfers between mobile money wallets and bank accounts as well as to also eliminate all charges for balance enquiries on all FinTech platforms.[5]The government also reclassified the tax brackets on mobile banking transactions.These results suggest that the adoption of FinTech and other

[4]Mas and Morawczynski, 2009

[5]See Central Bank of Kenya (CBK), Press Release, March 2020.

digital platforms combined with favorable regulatory measures might weaken or reverse, to some extent, the adverse effects of the Covid-19 pandemic on the economy.

Second, we examine how the Covid-19 pandemic has impacted the use of electronic payment cards[6]. In 2013, Kenya shifted away from magnetic strip based cards to EMV chip enabled cards. This led to an increase of 11.3% in the use of electronic payment cards between 2013 and 2020. Our results show that a year over year decline of 19.23% in credit cards transaction values 26%, a decline of 7.05% in debit cards transaction values a decline of 11.16% in POS machines transaction values, a decline of 40.87% in prepaid cards transaction values. However, we find that while the year over year decline in transaction values of charge cards is 43.37%, they were an attractive form of payments during the onset of the Covid-19 pandemic. In particular, there was a 50% increase in charge cards' transaction values between April and May 2020. Charge cards are an attractive short-term form of borrowing as they do not charge interest on outstanding amounts, and the consumer is only required to settle the full amount at the due date. However, as consumers shifted towards mobile banking due to health risks and uncertainty regarding the length of the pandemic, the use of charge cards declined as well. Overall, our results show that there is a decline in both the values and volume of electronic payment cards in Kenya during the Covid-19 pandemic. The results on electronic payment cards suggest that the Covid-19 pandemic has dampened consumers' spending behaviour and usage of electronic cards. Consumers are also shifting away from high interest forms of payment towards low interest forms of payment.[7]

[6]Although there is no well-defined and exact definition of FinTech, our working definition is based on FSB: that is, a "technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services". https://www.fsb.org/work-of-the-fsb/policy-development/additional-policy-areas/monitoring-of-fintech/

[7]This is an important shift in consumers' spending behaviour as the average monthly interest rate in Kenya on a credit card is about 3.5%. Banks receive a spread of about 11%, which is 40% above the global average. A shift towards cheaper forms of payment indicates that the Covid-19 pandemic has increased the marginal value of the shilling for the average consumer.

Third, we examine how the Covid-19 pandemic has impacted interbank linkages and interbank liquidity flows via real-time gross settlement system (RTGS) and via the automated clearing house (ACH). RTGS is the major channel of funds transfer in Kenya. The effects of the Covid-19 pandemic on RTGS and ACH has significant implications for other forms of electronic payment systems in Kenya. We document that the Covid-19 pandemic initially had a negative effect on RTGS. The decline in values and volumes via the RTGS between and April 2020 are approximately 21.97% and 7.96% respectively. We also document a year-over-year decline in transaction values via the clearing house of approximately 10.68% for debit cheques and 2.37% for credit electronic funds transfers. We also document a year-over-year decline of 32.59% in foreign denominated currencies (US). The results from RTGS and ACH suggest that the Covid-19 pandemic has had a significant adverse effect on domestic, regional and international interbank liquidity flows and has potentially compounded credit and settlement risks in Kenya's financial system.[8]

Our analysis considers the effects of the Covid-19 pandemic on electronic payment system in Kenya. There are several important reasons why Kenya can serve as a natural experiment. Kenya is a small indebted emerging open market economy, with 54% of the domestic debt held by closely linked domestic commercial banks. The ratio of commercial banks relative to the population (adult) is about 0.79 (1.5), the highest in Africa, implying that the country is significantly overbanked. Commercial banks' assets constitute about 49.5% of nominal GDP. Kenya also has the highest usage and adoption of moble banking and FinTech platforms in Africa. The banking sector, digital platforms and the stock exchange are interlinked through the central bank's managed automated clearing house and real-time gross settlement system (RTGS). This suggests that Kenya's financial system is susceptible to potential contagion risks arising from the Covid-19 pandemic.

[8]These results combined with the documented deteriorating of banks' asset quality are consistent with the notion that outbreaks have a contagion effect: Bae, Karolyi and Stulz 2003, Allen and Gale 2000, Bhagwati 1998, Kaminsky and Reinhard 2000, Cabrales, Gale and Gattardi, 2016.

Additionally, Kenya is the third largest economy in the Sub-Saharan Africa and has strong trade ties with the Eastern and Southern African regions, Europe, North America and Asia - particularly with China. As these trade partners face severe shocks and contractions, Kenya is likely to experience weakening economic environment, lower net exports and lower investments flows[9], which will impact the adoption of FinTech and other digital platforms in payments. As a result, Kenya can serve as a natural experiment for showing the effects of the Covid-19 pandemic on electronic payment systems, FinTech adoption and digital banking in an emerging economy.

Our paper makes several contributions. First, given the recency of the Covid-19 pandemic, there is very little work on the effects of the pandemic on the FinTech space and electronic payment systems. Our paper, documents that the covid-19 pandemic has accelerated consumers adoption of FinTech in payment. We also show that in the case of Kenya, positive regulatory measures on Mobile banking have further facilitated the onboarding and the adoption of FinTech during the covid-19 pandemic. Our results make a significant contribution to the larger body of literature on technology as a positive engine for economic growth (Demirgüç-Kunt, Klapper, Singe, Hanser and Hess, 2018, Philipon 2016, Rysman and Schuh, 2017). Our results on electronic payment systems are complementary to studies that show that such systems are important in monitoring macroeconomic conditions and are determinants of the cyclical position of the economy (Aditya et al. 2019, Aprigliano et al., 2019 and Baker, 2018). We also contribute to the literature on contagion and interbank risks (Bae, Karolyi and Stulz, 2003, Degryse and Nguyen, 2017, Allen and Gale, 2000, Van Lelyveld and Lierdorp, 2014, Diamond and Dybig, 1983), showing that the Covid-19 pandemic has had a negative effect on electronic funds transfers via clearing house.

The rest of this paper is organised as follows. Section 2 presents the data. Section 3

[9]Kenya's 2020Q1 growth declined by 5.5% when compared to 2019Q1. GDP estimates has been revised down to only 1.6% from an initial estimate of 5.9%: Central Bank of Kenya and Cytonn MPC Report, 2020

discusses and presents our empirical results. Section 4 concludes.

2 Data

We obtain our monthly data on electronic payments from the Central Bank of Kenya (CBK). Data on financial access and financial intermediaries are obtained from the FinAccess Household Surveys and the FinAccess Geospatial Mapping Surveys. Data on the Covid-19 tests is obtained from Our World in Data. The available data is aggregated at the national level. Note that micro-level data is proprietary(Central bank) and as a result, this paper mainly uses univariate analysis to address the impact of the covid-19 pandemic on electronic payment systems in Kenya.

Table 1 presents summary statistics for the period: January 2010 to May 2020. Given the strong economic and trade ties between China and Kenya (21% of imports originate from China), we define the Covid-19 pandemic event window as between December 2019 and May 2020. This is because the first cases of Coronavirus were reported in Wuhan, China in December 2019.[10] Our analysis also pays special attention to the, March-April 2020 window which is considered to be the crux of the Covid-19 pandemic for the rest of the world as World Health Organization (WHO) declared Covid-19 as a pandemic on 11^{th} March 2020.

Table 1 presents summary statistics of our variables of interest. Table 1 shows that between the period 2010-2020, the average transaction values of mobile payments is about 220.89 billion Kenyan shillings, which is approximately 2.08 billion US dollars at the current market exchange rate. The distribution of mobile payment ranges from 130.7 billion Kenyan shillings at the 25^{th} per centile and about 308.9 billions shillings at the 75^{th} per centile. Figure 1 shows that the rate of positive Covid-19 tests has been steadily increasing between March and July 2020. There was only one positive case in early March but cases increased to about 1,888 by the end of May 2020 and the figure stands at more than 140,000 in December

[10] **Source:** World Health Organization(WHO): https://www.who.int/news-room/detail/29-06-2020-covidtimeline

2020.

[INSERT TABLE 1 & Figure 1 ABOUT HERE]

3 Empirical Results:

3.1 Mobile Banking and Mobile Payments

The use of financial technologies has been significantly on the rise in Kenya. Figure 2 demonstrates that the use of mobile banking and other FinTech platforms is much higher and is being adopted at a faster rate than any other channel of financial access. The usage of mobile banking increased by 80% between 2006 and 2020, while the usage of traditional banks increased only by 30% over the same time period. This drastic increase has mostly been driven by the rise in 3G and 4G networks in the country and the associated low transaction costs (Rao, 2011, Jack and Suri, 2014). As a result, mobile banking has become an integral part of the financial system in Kenya. Mobile banking and other FinTech platforms are used by consumers to access short-term loans and micro-loans, for bank account transaction, to transfer credit, for peer-to-peer lending and for payment of general expenses such as utility bills and groceries. Mobile banking platforms have also become an important tool for building a credit history, especially for low income and regionally marginalized consumers.[11]

[INSERT FIGURE 2 ABOUT HERE]

In this section, we address the effects of the Covid-19 pandemic on mobile banking in Kenya. We attempt to answer the following question: Has the Covid-19 pandemic accelerated the adoption of FinTech and other related digital platforms? There are two economic rationales as to why this question is important and why the effects of the

[11]Similar results on demographic usage in FinTech are observed even in developed economies. For example in the US, millenials and younger generations are adopting mobile banking and other digital platforms at a much higher rate than the rest of the population:Crowe, Tavilla and Mcguire, 2017.

pandemic on the adoption of FinTech, such as mobile banking, are ex ante not obvious. Firstly, it could be the case that the pandemic has led to an increase in the use of mobile banking, driven by the ease of use, limited access to traditional banks due to restrictions in hours of operation and an increase in short-term demand for essential goods. Consumers' online spending, e-commerce related activities and adoption of mobile banking digital applications might increase as consumers are likely to minimize face-to-face contact, as a result of restrictive social distancing guidelines combined with strong containment and mitigation measures.[12,13,14] Additionally, consumers might be anticipating an upward pressure on prices stemming from disruptions in both the local supply chains and the global supply chains. Approximately 21% of Kenya's imports come from China, and so the disruption in supply chains and the average higher cost(s) of imports from alternative trade partners indicates an upward pressure on prices. Local firms might also increase prices as they experience declining profit margins. Consumers might respond to this inflationary pressure by increasing spending as they stockpile essential goods. These factors would have a positive impact on the utilization and adoption of mobile banking and other FinTech platforms.

[INSERT FIGURE 3 ABOUT HERE]

Second, Figure 3 illustrates that mobile banking and other FinTech platforms have the highest incidence of money loss and the highest rate of loan default, second only to the informal banking sector. Given the contractions in economic activities, financial intermediaries might either increase fees and interest charges or reduce total loan

[12]Early evidence from Ireland shows that sectors that are highly dependent on face-to-face contact or physical interaction have been hit the hardest. See: Quarterly Bulletin No. 3, 2020

[13]There is some anecdotal evidence that consumers are worried that Covid-19 might be transmitted via cash: NYT, 2020. "No more dirty cash". https://www.nytimes.com/2020/07/06/business/cashless-transactions.html

[14]See NYT 2020, for some examples of adopted strict and punitive Covid-19 containment measures- https://www.nytimes.com/2020/05/08/world/africa/kenya-coronavirus-quarantine.htmlhttps://www.nytimes.com/reuters/2020/07/20/world/africa/20reuters-health-coronavirus-kenya.html

borrowings.[15] And because of the adverse effects of the Covid-19 pandemic on the labor market, the marginal value of a shilling (Ksh.) is much higher than before the onset of the pandemic. Consumers might prefer to save (precautionary saving motive) rather than spend due to the uncertainty regarding the nature, the length and the potential pathways of the Covid-19 pandemic. Consumers might also be less likely to use mobile banking due to the vulnerability from evolving and emerging digital risks[16]. Note that more than 40% of money loss incidences in mobile banking and other FinTech platforms in Kenya are due to data breaches and fraudulent activities such as "hacking" (CBK, 2019). Additionally, a significant portion of mobile banking customers are denied loans due to overdrawn accounts and loan arrears that negatively impact their credit ratings. These factors would have a negative effect on the utilization and adoption of mobile banking and other FinTech platforms during the ongoing Covid-19 pandemic.

[INSERT FIGURE 4, Figure 5 & TABLE 2 ABOUT HERE]

In Figure 4, we examine both the transaction values and transaction volumes of mobile banking during the Covid-19 pandemic. Figure 4 shows two effects. First, the Figure shows that there is a precipitous decline in the values and the volume of transactions between December 2019 and April 2020. As shown in Table 2 and Table 3, the estimated decline in the mobile transaction values for the period is about 6.98%. This translates to a decline of 14.5% in April 2020 transaction values when compared to April 2019 transaction values. At the crux of the pandemic, that is between March and April 2020, mobile transactions declined by 15.51%. Interestingly, the decline in mobile banking transactions and volume is not driven by changes in the number of mobile banking accounts. Figure 5 shows that the month-to-

[15]Transfers between bank accounts and mobile accounts are charged a minimum of 4%, where the interest rate is a function of the transferred amount. There are additional charges for checking balances on mobile banking.

[16]The government of Kenya has passed regulations and laws to curb some of these fraudulent activities: See National payment System Act 2011, and Payment System Regulations 2014.

month growth rate in the number of mobile banking accounts remained fairly stable during this period while the month-to-month growth rate in the number of transactions has sharply declined during the onset of the Covid-19 pandemic. The results show that the pandemic initially had an adverse effects on consumers' spending patterns and on the adoption of mobile banking and digital platforms in Kenya.

[INSERT FIGURE 6, Figure 7 & TABLE 3 ABOUT HERE]

However, there is a positive note to these results. Observe that that there is a very sharp upward trend between April 2020 and December 2020. The estimated value of this upward trend is approximately 53%. This was driven by increase in the adoption of mobile banking, an ease in regulatory measures and lockdown restriction combined with a reduction and elimination of mobile banking transaction fees and charges by most commercial banks.[17] As commercial banks reduce or eliminate charges and fees on mobile banking and other FinTech platforms, consumers shifted towards these platforms, as shown by the upward trend between April and May following such measures. Figure 6 shows that there is an upward trend in both the transactions per account and transaction value per agent. The estimated increase in transactions per account between April and May 2020 is approximately 7.26% and the estimated value in the increase in the transaction value-per-agent is about 15.64%. Figure 7 shows that there has been a sharp upward trend in the number of mobile banking agents and in the value of transactions. The number of mobile agents increased by 19.56% between the first and the fourth quarter of 2020, an overall year-over-year increase of 13.4%. The values in the amount of mobile transactions increased by 53.97% between the first and the fourth quarter of 2020, an increase of 19.97% year-over-year.These results suggest that the Covid-19 pandemic and the government's instituted short-term regulatory measures[18] aimed at relaxing constraints on mobile banking are having positive effects on

[17]In late March 2020, three Tier 1 banks—Standard Chartered bank, Co-operative Bank and Stanbic bank eliminated all mobile Banking charges until June 30^{th} 2020.

[18]The Central Bank of Kenya (CBK) required that commercial banks eliminate some charges and fees

consumers' spending and on the overall economy. Our results are consistent with the notion that the improvement in regulatory measures is a significant determinant in the diffusion of FinTech (Philippon, 2016). These results support the notion that FinTech are a critical component of economic growth (Frost, Gambarcota and Gambacorta, 2020) and might be critical instruments in styming the adverse effects of the Covid-19 pandemic on the global economy. Overall, our results are consistent with the notion that the Covid-19 pandemic has accelerated the adoption of FinTech platforms such as mobile and digital banking in payments.

3.2 Electronic Payment Cards

One way to estimate the effects of the Covid-19 pandemic on economic activities and on the adoption of FinTech platforms is to examine consumers' spending patterns. Prior literature finds that transactions using electronic cards are real-time indicators of the cyclical position of the economy and are useful in evaluating the impact of extreme events on the real economy (Galbraith and Tkacz, 2007, Aditya et al., 2019). Additionally, understanding how the Covid-19 pandemic has impacted the use of payment cards is important as consumers' are still uninformed on the value of FinTech platforms over current existing payment systems (Rysman and Schuh, 2017). In Kenya, electronic payment cards and FinTech platforms such as M-PESA are complementary means of payment. In 2013, commercial banks migrated away from strip based cards to EMV chip enabled cards. This transition made Kenya's electronic payment cards a secure form of payment and globally acceptable. As a result of this migration to EMV chip enabled cards, the total number of cards increased by 23.2% between 2013 and 2019.

on Mobile banking during the pandemic. The CBK also double the daily limits to Ksh. 300,000 (approx. $3,000), eliminate monthly limits on mobile tansfers and Lowered tariffs charge on mobile transactions. And instituted a 100% elimination of charges on values under Ksh. 1,000 and transfers between mobile wallets and bank account. These measures have now been extended until December 2020. - CBK, Circular 2020

In this section, we address the following question: What are the effects of the Covid-19 pandemic on electronic payment cards? It is not obvious that consumers' spending and use of electronic payment cards would decline during the Covid-19 pandemic. On the one hand, consumers might be informed on the adverse effects of the Covid-19 pandemic on global supply chains. Specifically, on the disruptions in both the local and global supply chains. This might lead to an increase in retail spending and stockpiling of essential items, which would result in an increase in transaction values and volumes of electronic payment cards. On the other hand, due to restrictive lockdown measures, restrictions on movement of labor and capital flows, immoderate and sudden rise in external debt[19] coupled with uncertainty regarding the future would imply that consumers are less likely to spend. Specifically, as consumers revise their expectations about the future, they are more likely to increase savings and reduce current consumption. The net result would be a decline in the transaction values and transaction volumes of electronic payment cards.

[INSERT FIGURE 8 ABOUT HERE]

Electronic payment cards in Kenya can largely be broken down into five major categories or types: credit cards, debit cards, charge cards, prepaid cards and POS Machines. Table 2, Table 3 and Figure 8 represent univariate analysis and time series trends in the transaction values of electronic payment cards. Payment cards usage declined precipiously in value by about 32.4% from March 2020 to April 2020. This represents a decline of 22.5% between December 2019 and the first quarter of 2020. Table 3 shows that the overall year-to-year decline in the values of electronic payment cards translates to about 7.3%.

When we examine the effects of the Covid-19 pandemic on each type of electronic card payment, we find that transaction values via credit cards declined by about 15.4% between March 2020 and April 2020. This translates to a decline of about 26.84% between December 2019 and the first quarter of 2020. The overall effect is a year-over-year decline of about

[19]Kenya's extenal debt increased by 5.81% between March and May 2020: Central Bank of Kenya, 2020.

19.24% in credit cards transaction values.

[INSERT FIGURE 9 ABOUT HERE]

Transaction values in the use of debit cards declined by about 32.4% between March and April of 2020. This represents a decline of 22.5% between December 2019 and the first quarter of 2020. The year-over-year decline in debit cards transactions is about 7.05% . The use of prepaid cards declined 58.58% between December 2019 and May 2020, which translates to a year-over-year decline of 40.9%. The Transaction values of POS Machines declined by 28.6% between December 2019 and the first quarter of 2020. This represents a year-over-year decline of 11.2%. Note that while transaction values in charge cards declined by 38.7% between March and April 2020, there was a sudden increase in May 2020. The increase in transaction values of charge cards was about 50% between December 2019 and May 2020. And a 50% increase in transaction values between April 2020 and May 2020. Note that charge cards do not charge interest on the outstanding amount, the consumer is only required to settle the full amount at due date. The results on charge cards reflect the fact that consumers are substituting away from costly forms of payment to cheaper short-term forms of payment during the Covid-19 pandemic. But following the introduction of regulatory measures aimed at easing the use of mobile banking and as more information becomes available regarding the duration of the pandemic, consumers shifted away from charge cards into mobile banking. Charge cards declined by 21.9% between the first and the fourth quarter of 2020, an overall year-over-year decline of 43.37%

These results are important for two main reasons. First, the overall declined in the usage of electronic payment cards combined with the singificant rise in the use of mobile banking suggests that, during the ongoing Covid-19 pandemic, consumers are shifting towards FinTech and digital banking platforms relative to other forms of payment. Second, a decline in consumers' spending patterns might translate into systemic risk and the inability of banks and other financial institutions to settle claims (Crockett, 1998). This

documented decline in the values of transactions of electronic payment cards points to a potential disruption in the flow of money and in the clearance of payment instruments due to the Covid-19 pandemic. The results signal to the pandemic as a potential source of contagion risks, credit risk, liquidity and settlement risk. The next section examines the effects of the Covid-19 pandemic on interbank lending activities and transfer of funds. Specifically, we ask whether the Covid-19 pandemic is a potential source of interbank contagion and liquidity risk. Additionally, since the Real-time gross settlement system (RTGS) is the largest form of money transfer system in the country, the results provide an important insight into the rate adoption of FinTech relative to other electronic funds transfer systems.

3.3 Real-Time Gross Settlement System (RTGS)

The expansion in economic activities, increase in transaction values and growth in emerging markets has led to the adoption of the Real-Time Gross Settlement System (RTGS) by the central banks. RTGS exhibits economies of scale and scope and reduces settlement risk as payments are settled one-by-one in real time, and payments are deemed final and irrecoverable (Borio and Van den Bergh, 1993, Bech, Shimizu and Wong, 2017). In 2005, the Central Bank of Kenya (CBK) introduced and adopted the Kenya Electronic Payment and Settlement System (KEPSS). KEPSS is a fast automated electronic RTGS which has since interconnected about 93% of Kenya's commercial banks and financial institutions. Prior to KEPSS, the Central Bank of Kenya used a paper-based interbank settlement system which was subjected to systemic settlement risk inherent in large value net settlements.

The main objective of the KEPSS is to speed up and securely facilitate real-time interbank transfer of funds. The KEPSS has integrated the banking system and the financial markets in Kenya and is classified as a systematically important payment system (SIPS). The adoption of this technology has led to a greater volume of transactions and a greater flow in interbank

transfers. In 2005, KEPSS handled Ksh. 6.5 trillion annually and for the period 2010-2020 (Table 1), KEPSS handled about Ksh. 21.4 trillion annually, which is approximately 183 billion U.S dollars at the current market exchange rate. The Central Bank of Kenya (CBK) has also mandated that banks can no longer use cheques for any transaction amount of more than Ksh. 1million. These transactions of more than one million Kenyan shillings must be conducted through the KEPSS. Additonally, over the last few years, transactions amongst brokers in the Nairobi Securities Exchange (NSE) are also conducted through the KEPSS. In 2019, the system cleared about 412,322 transactions per month and about 20,600 transactions per day, an increase of about 3,150% in daily transactions from its inception in 2005. As a result, the KEPSS has not only become an important driver of financial stability but also a channel for transmission of shocks and disturbances.

While the centrality of RTGS might mitigate interbank lending liquidity shocks (Allen and Gale, 2000, Cabrales, Degryse and Nguyen, 2007, Gale and Gottardi, 2016), the Covid-19 pandemic shock is an exogenous global shock to the interbank networks, and as a result would result in positively correlated liquidity shocks, creating contagion risk for Kenya's banking system. To this end, we attempt to answer the following question: What are the short-term effects of the Covid-19 pandemic on liquidity and interbank fund transfers via KEPSS/RTGS?

[INSERT FIGURE 10 & Figure 11 ABOUT HERE]

Figure 10 plots the time series trend in the monthly transaction values and transactions volume in KEPSS (RTGS) from January 2019 to May 2020. The figure documents and illustrates three key findings. First, there is a decline in both transaction values and transaction volume during the Covid-19 pandemic. Second, the decline is not uniform as there was a sharp decline in values between December 2019 and January 2020 but then there was an increase between February and March 2020 and a sharp precipitous decline between March and May 2020. Specifically, as shown in Table 2, the decline between

March and April 2020 in transaction values was about 21.97%. This translates to a decline of about 19.21% from December 2019 to May 2020. Third, the decline in volume from December 2019 to May 2020 is an almost sharp and a uniform drop of 10.94% as shown in Table 3. The decline in volume between March and April 2020 is about 7.96%. However, as the economy slowly re-opens there is a sudden increase in transaction values of about 2.65% between the first quarter of 2020 and the fourth quarter of 2020. The increase translates to a year over year increase of 1.66%. However, Figure 10 shows that the value per transaction via RTGS declined significantly during the ongoing covid-19 pandemic.

Taken together, the decline in transaction values and in transaction volume suggests that the Covid-19 pandemic has had an adverse effect on interbank lending activities in Kenya. The adverse effect translates to a total decline of 9.28% in the value per unit of transanctions from December 2019 to May 2020 and a total decline of 15.22% in the value per unit of transaction from March 2020 to April 2020, a period which is considered to be the crux of the Covid-19 pandemic. These results combined with the decline in interbank lending rates and volumes (Figure 11) point to potential credit, liquidity and settlement risks emanating from the decline in economic activities due to the Covid-19 pandemic.

3.3.1 Automated Clearing House (ACH)

The Nairobi automated clearing house (ACH) is another instrument in Kenya's financial system and in the interbank market. Cheques and electronic fund transfers (EFTs) of under one million Kenyan shillings are processed through the clearing house. Debit cheques and credit ETFs greater than one million are generally processed through the RTGS. As a result, the efficiency of the clearing cycle has improved over the last seven years from T+3 to T+1. The clearing house has facilitated the banking sector consolidation and it is therefore an important mechanism in how banks manage risks. As a result, the clearing house is a potential channel for contagion risks. This is because the clearing house is an appendage

in the market structure and an important determinant of interbank linkages in Kenya. As such, the clearing house is a source of liquidity and serves as an indirect measure of banks' credit exposure. Prior literature has established that such an integrated structure is prone to contagion risk (Van Lelyveld and Liedorp 2004, Muller, 2003).

[INSERT FIGURE 12 ABOUT HERE]

Figure 12 demonstrates the impact of the Covid-19 pandemic on electronic fund transfers (debit and cheques) processed via the clearing house. The results show that between December 2019 and the first quarter of 2020, there is a steep decline in electronic fund transfer, which translates to a decline of 29.8% in debit cheques and a decline of 25.3% in credit electronic fund transfers (EFTs). As shown in Table 3, column 5, the the value of debit etfs declined by 4.88% and the value of credit EFTs increased by 14.29% between the first quarter and the fourth quarter of 2020. This translates to a year over year decline of 10.68% for debit ETFs and 2.37% for Credit EFTs.

[INSERT FIGURE 13 HERE]

We next examine the effects of the Covid-19 pandemic on regional and international interbank liquidity flow. Specifically, we look at interbank domestic foreign currency cheques inflows via the automated clearing house. These cheques reflect cross-border payment transfers and international trade activities. The cheques are generally demoninated in either Euro or U.S dollar[20]. Figure 13 shows that there is a general decline in both the values and the volumes of domestic foreign currency cheques (DFCC). The year over year declines in in DFCC (USD) and DFCC(Euro) are 32.6% and 18.66% respectively. The results point to a general decline in both the number of interbank money market monthly deals and total deal values during the Covid-19 pandemic. The results reflect a dampening in international and regional trades,a contraction in trade partners' economies

[20]Given that Kenya is a former British colony and has close trade ties to the UK, about 4% of the domestic foreign currency cheques are denominated in British pounds. Most trades settlements from the EU zone are denominated in either Euros or US dollars

and disruptions in global supply chains due to the Covid-19 pandemic.

The results on the effects of hte pandemic on RTGS and on the automated clearing house demonstrate that the Covid-19 pandemic has had an adverse effect on interbank liquidity flow. The estimates in the reduction on monetary transaction values and transaction volumes suggest that the Covid-19 pandemic is a negative shock to the economy and has had a significant negative impact on the whole of Kenya's financial system. There is a concern that these liquidity shortages and exposures might lead to credit and potential contagion risk. These would negatively impact the solvency positions of some of the local commercial banks[21]. Prior literature finds that such knock-on effects can amplify interbank exposure and might potentially trigger banks failures (Wells, 2004).

I

4 Conclusion

This paper examines the effects of the ongoing Covid-19 pandemic on electronic payment systems. We first examine whether the pandemic has accelerated consumers' adoption of FinTech and other digital platforms in payments. We find that the pandemic initially had a negative impact on mobile banking, but following a set of favorable regulatory measures, these negative effects have been not only reversed but there is a significant increase in the adoption of mobile banking. The pandemic has accelerated the adoption of FinTech in Kenya.

Second, we find that the Covid-19 pandemic has had a negative impact on the use of all electronic payment cards. We observe some positive effects in the first quarter of 2020 for

[21]In recognition of potential contagion and liquidity risks due to the Covid-19 pandemic, the Central Bank of Kenya has thus far undertaken the following short-term measures: [a] lowering the Central Bank Rate to 7.25% from 8.25% [b] reducing the cash reserve ratio (CRR) to 4.25% from 5.25% [c] Making an additional Ksh. 35.2 billions in liquidity available to distressed banks: CBK, MPC, 2020.

charge cards and some positive effects in the last quarters of 2020 for debit cards. We argue that this is because consumers who use charge cards do not incur interest on outstanding amounts but are only expected to settle the full amount at due date. The positive results for debit cards are driven by the slow re-opneing of the economy. The results regarding electronic payment cards suggest that consumers are shifting away from more expensive forms of payment towards cheaper forms but that consumers are also shifting towards FinTech platforms such as mobile banking.

Third, we document a decline in interbank fund transfers via the real-time gross settlement system (RTGS) and via the automated clearing house (ACH). Our results suggest that the pandemic has had a negative impact on the main money transfer systems in Kenya except for mobile banking.

Taken together, our results suggest that the Covid-19 pandemic has had a significant negative impact on economic activities and that this has accelerated the adoption of FinTech and digital platforms in payments but that favorable regulatory measures are also important factors in the adoption of FinTech and in mitigating the negative impacts of the Covid-19 pandemic on the economy. In sum, while the pandemic has had a significant negative effect on electronic payment systems in Kenya, it has significantly accelerated digital (M-PESA) onboarding. Mobile banking has become the main form of transaction in Kenya during the ongoing Covid-19 pandemic.

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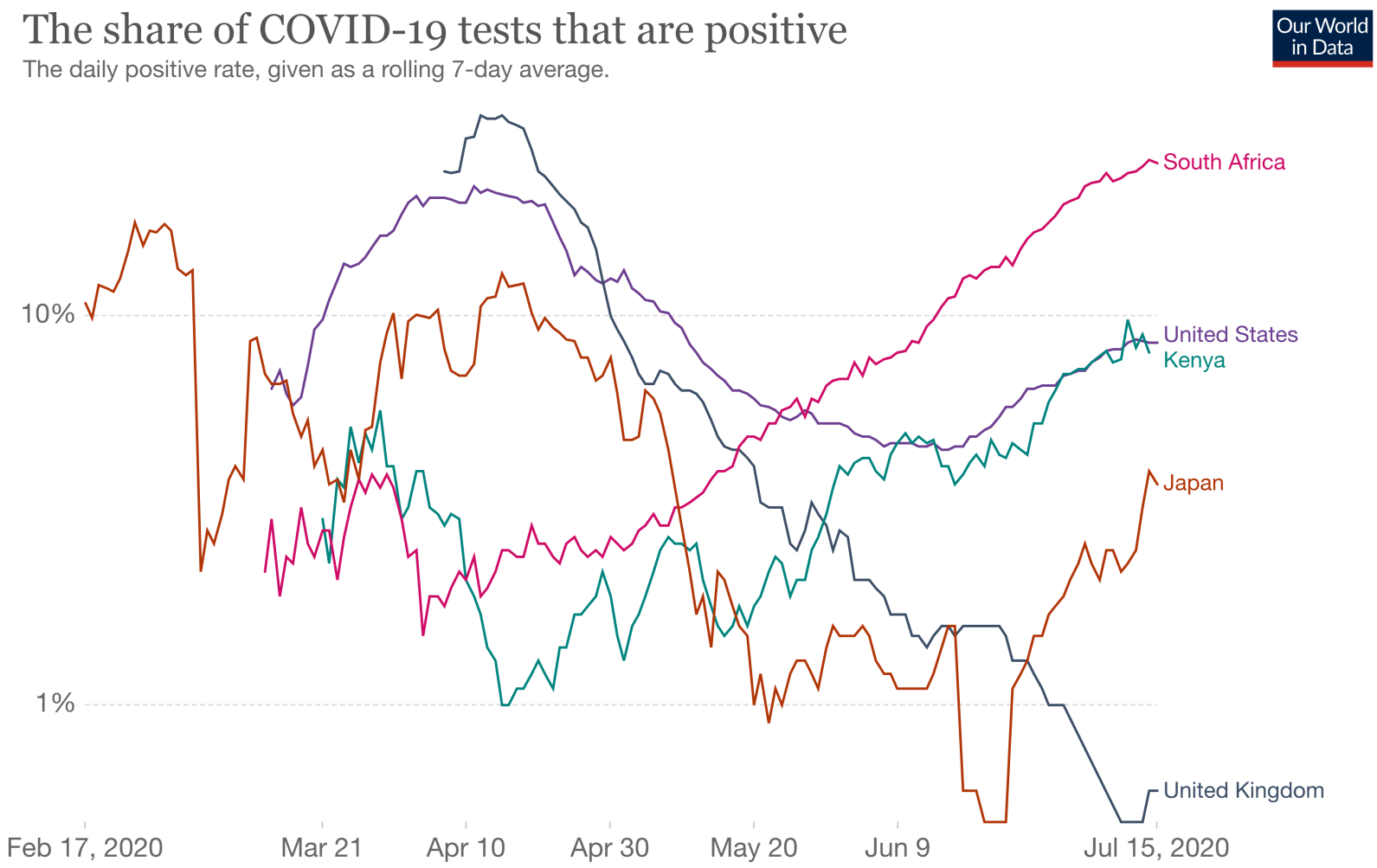
Figure 1: ***Positive Cases in Kenya***



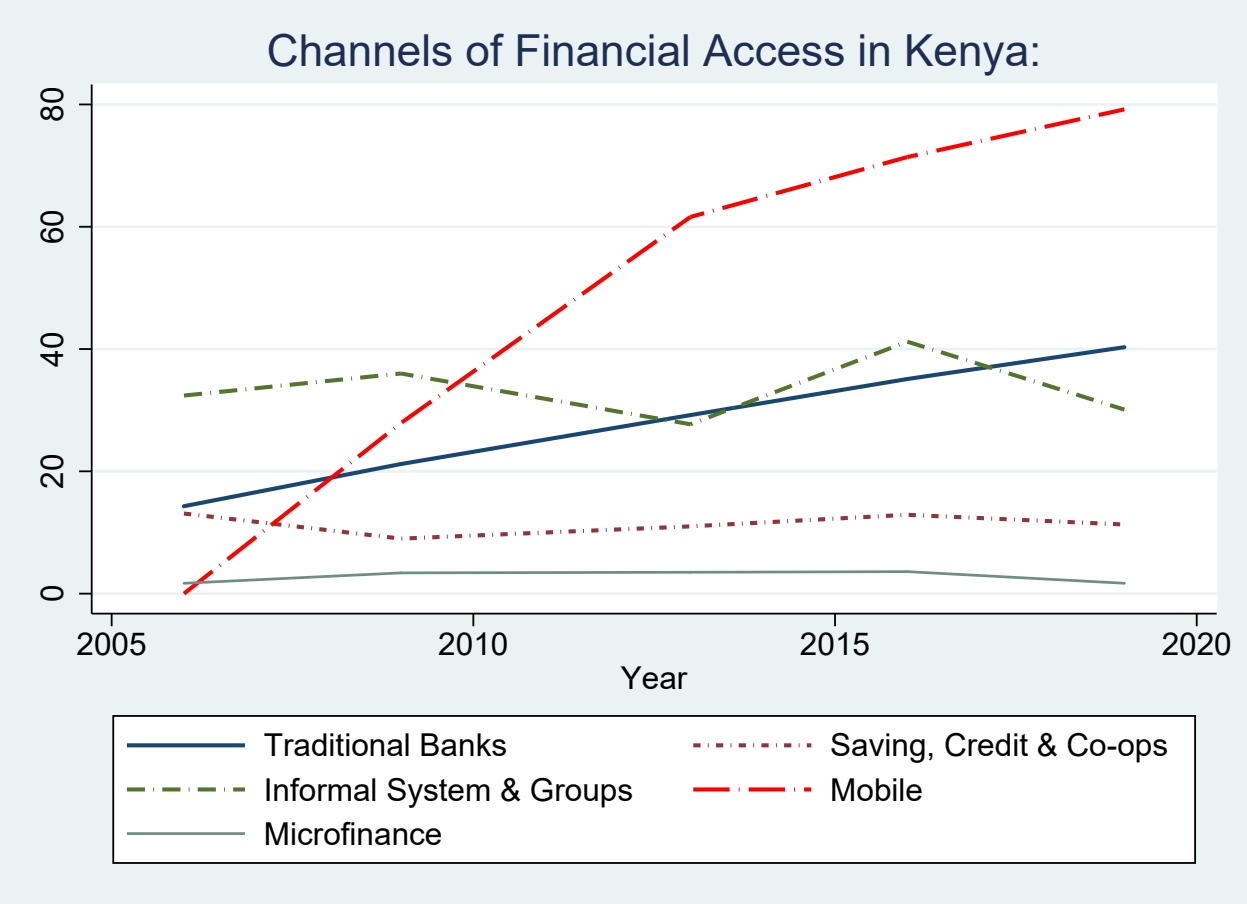


Figure 2: ***Channels of Financial Access:***

Figure 2: This figure illustrates the evolution of channels of financial access over time in Kenya.

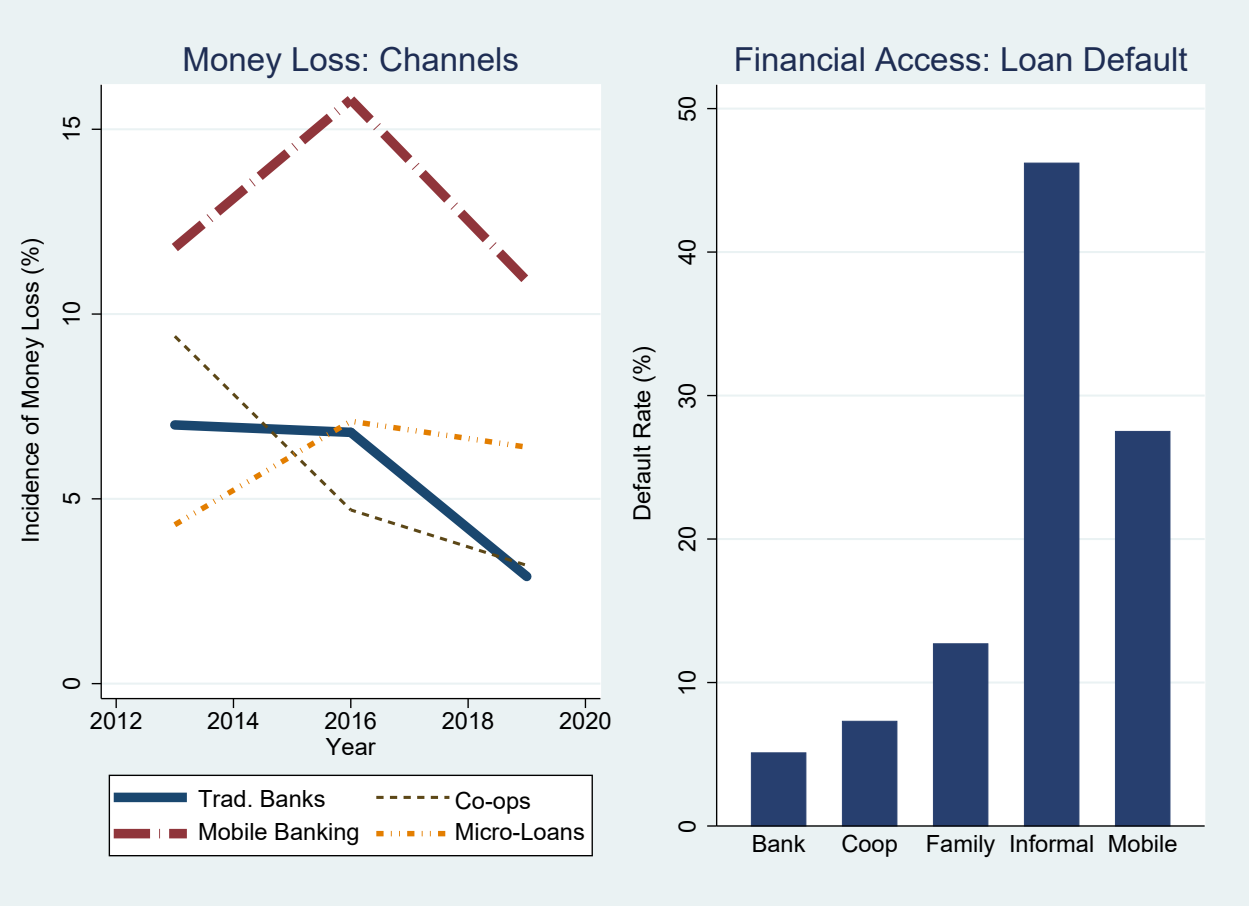


Figure 3: ***Money Loss via Channels***

Figure 3: These figures illustrate incidence of money loss and rate of default across different financial intermediaries and channels

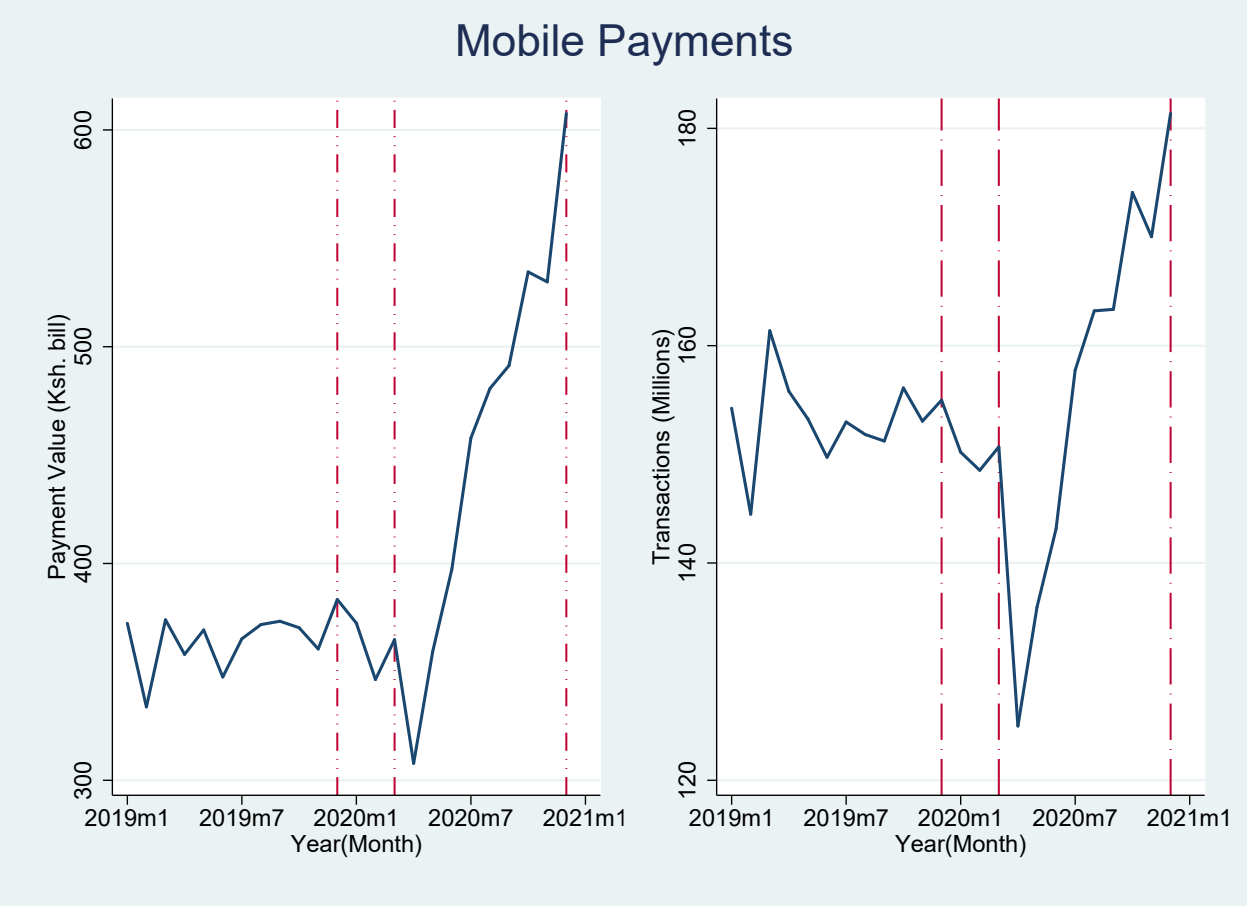


Figure 4: ***Mobile Banking***

Figure 4: These figures illustrate the effects of the Covid-19 pandemic on mobile banking transaction values and transactionsvolumes.

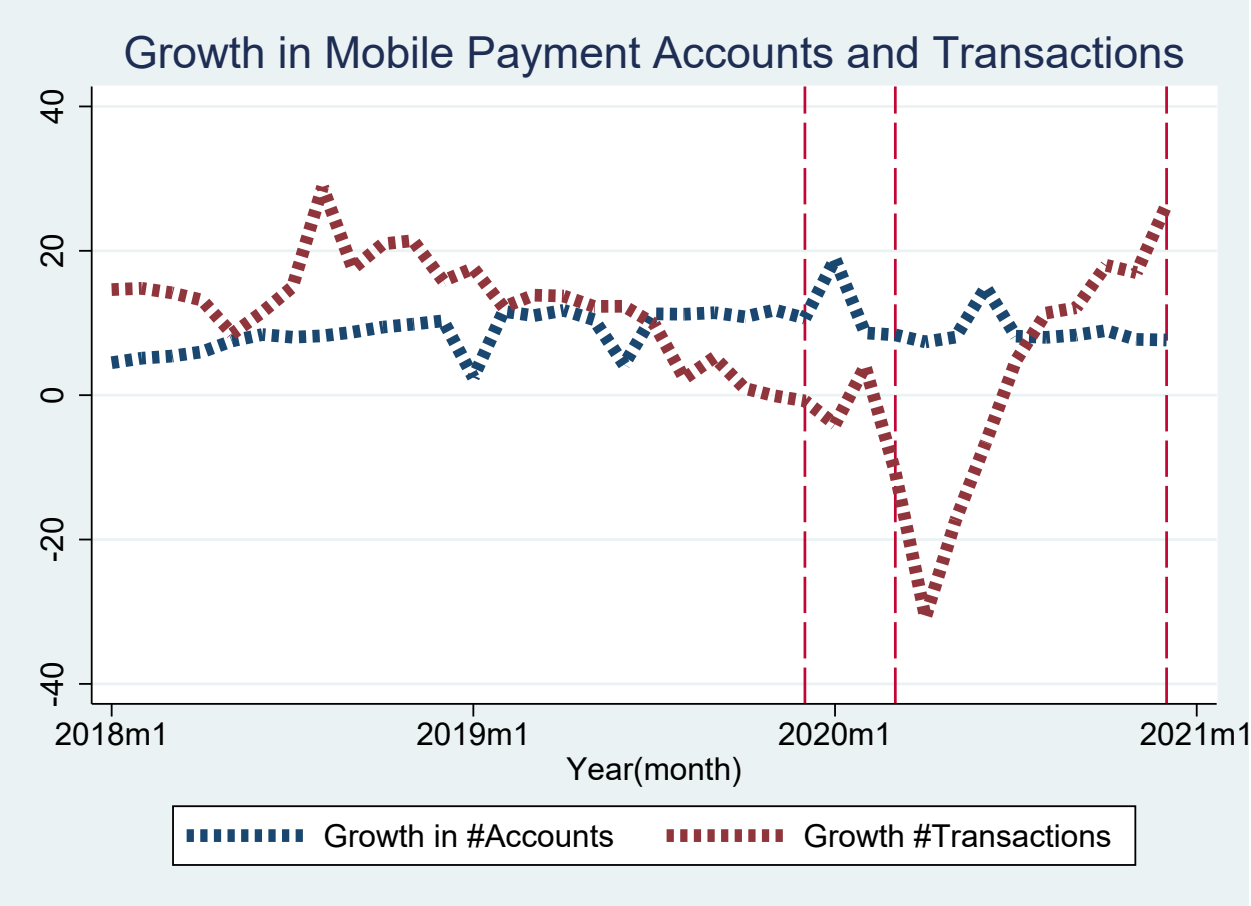


Figure 5: ***Mobile Banking***

Figure 5: This figure illustrates the effects of the Covid-19 pandemic on the growth in mobile banking accounts and growth in Mobile banking transactions.

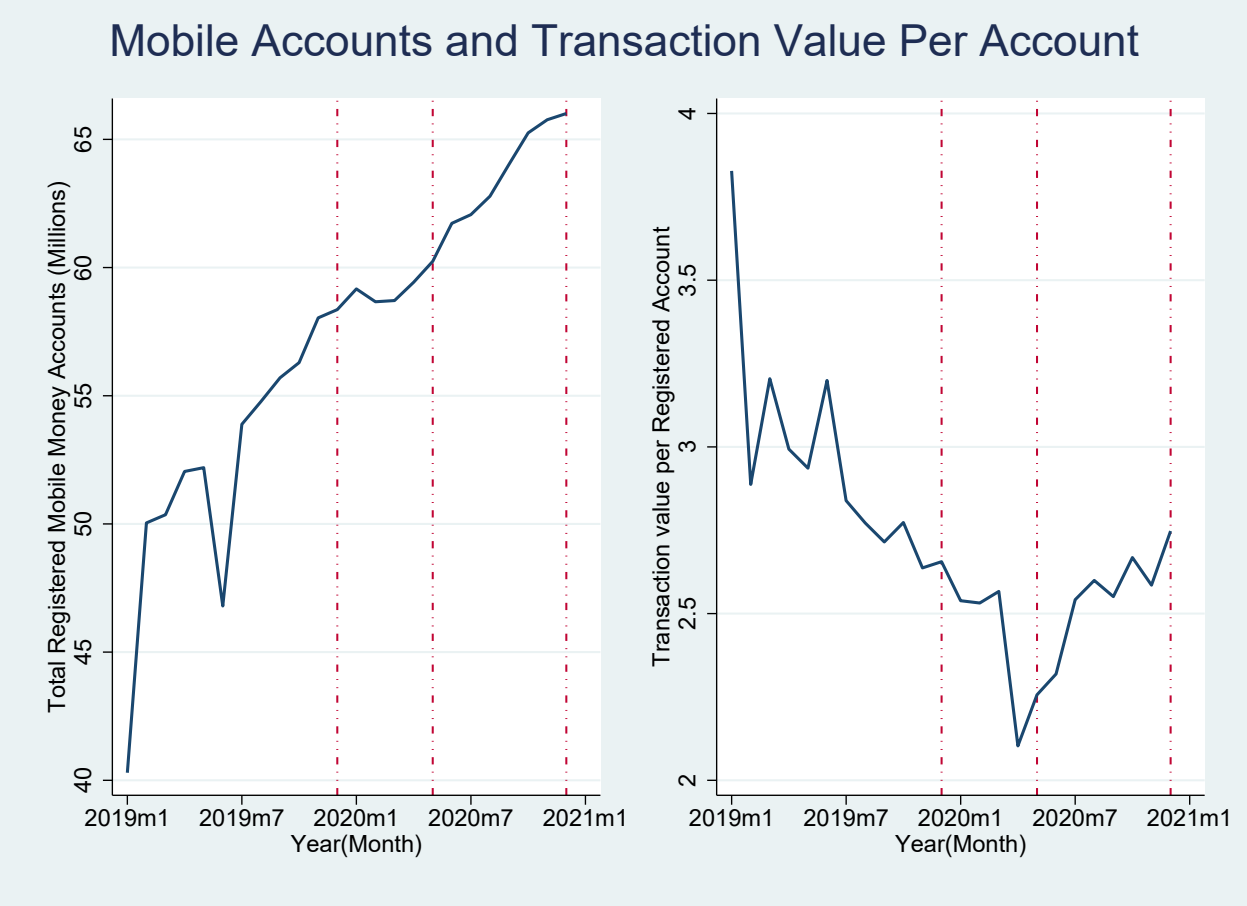


Figure 6: ***Mobile Banking***

Figure 6: These figures represent the effects of the Covid-19 pandemic on mobile banking transaction accounts and transaction value per account.

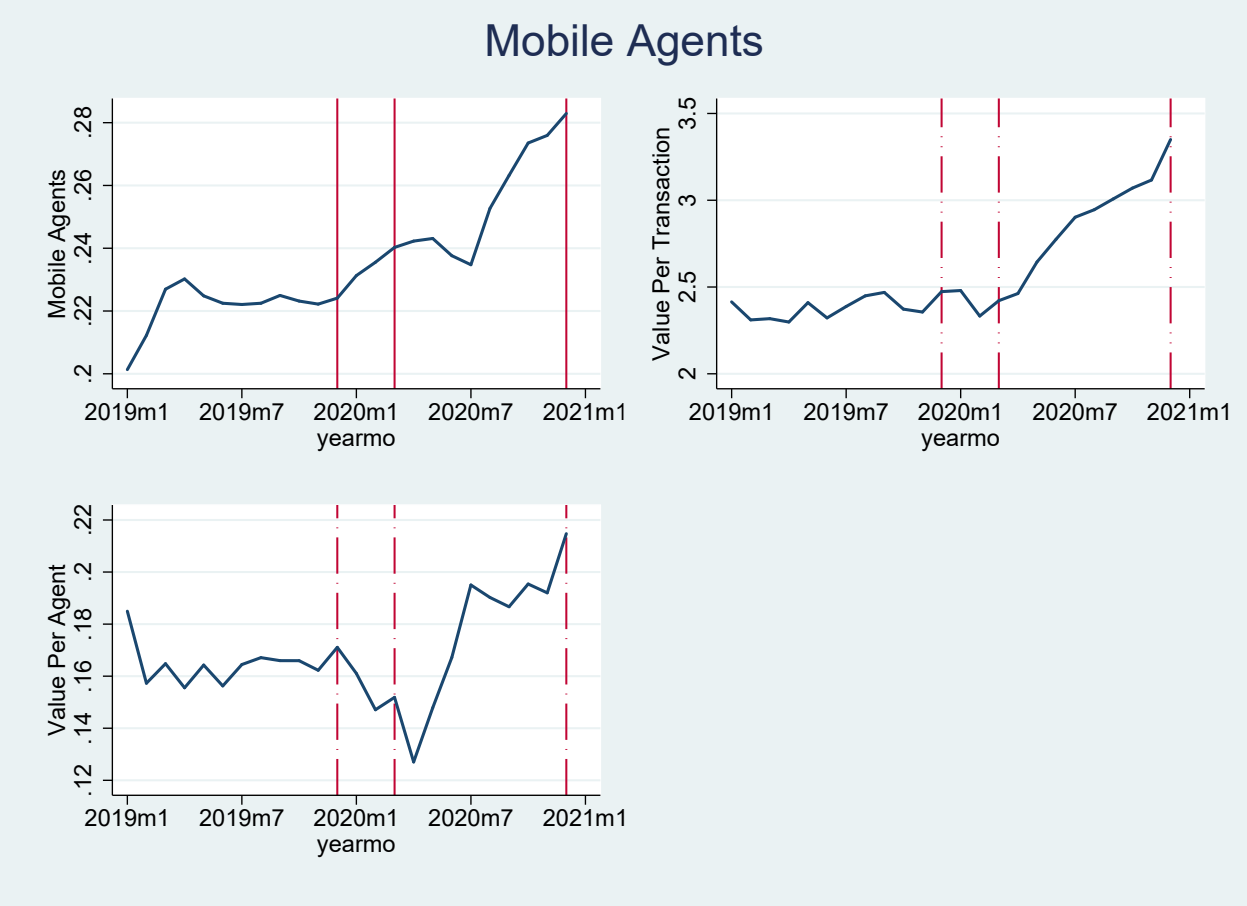


Figure 7: ***Mobile Banking***

Figure 7: These figures represents the effects of the Covid-19 pandemic on mobile banking value-per-transaction and the evolution of mobile banking agents.

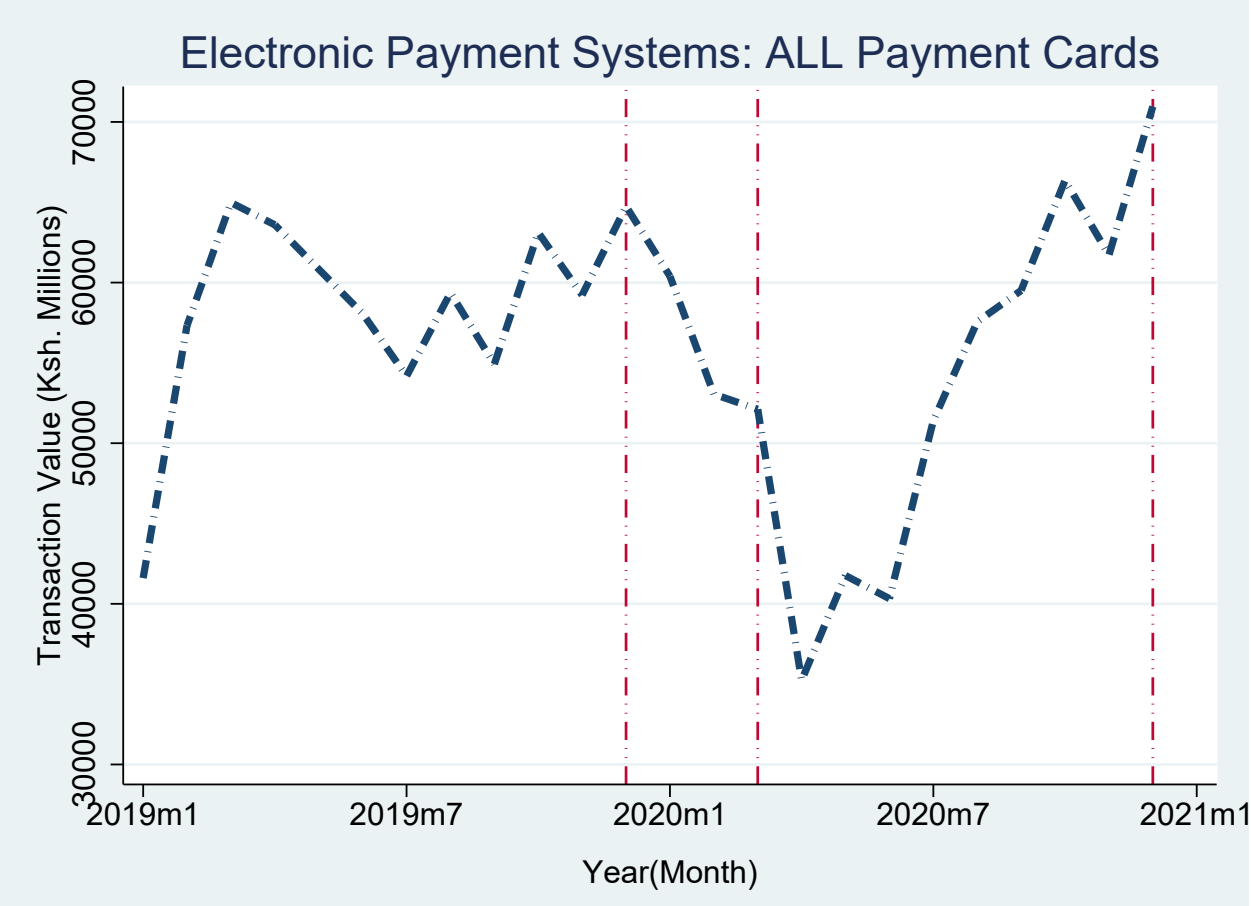


Figure 8: ***Payments Cards***

Figure 8: This figure illustrates the evolution of electronic payment cards transactions and the effects of Covid-19 on total transaction value

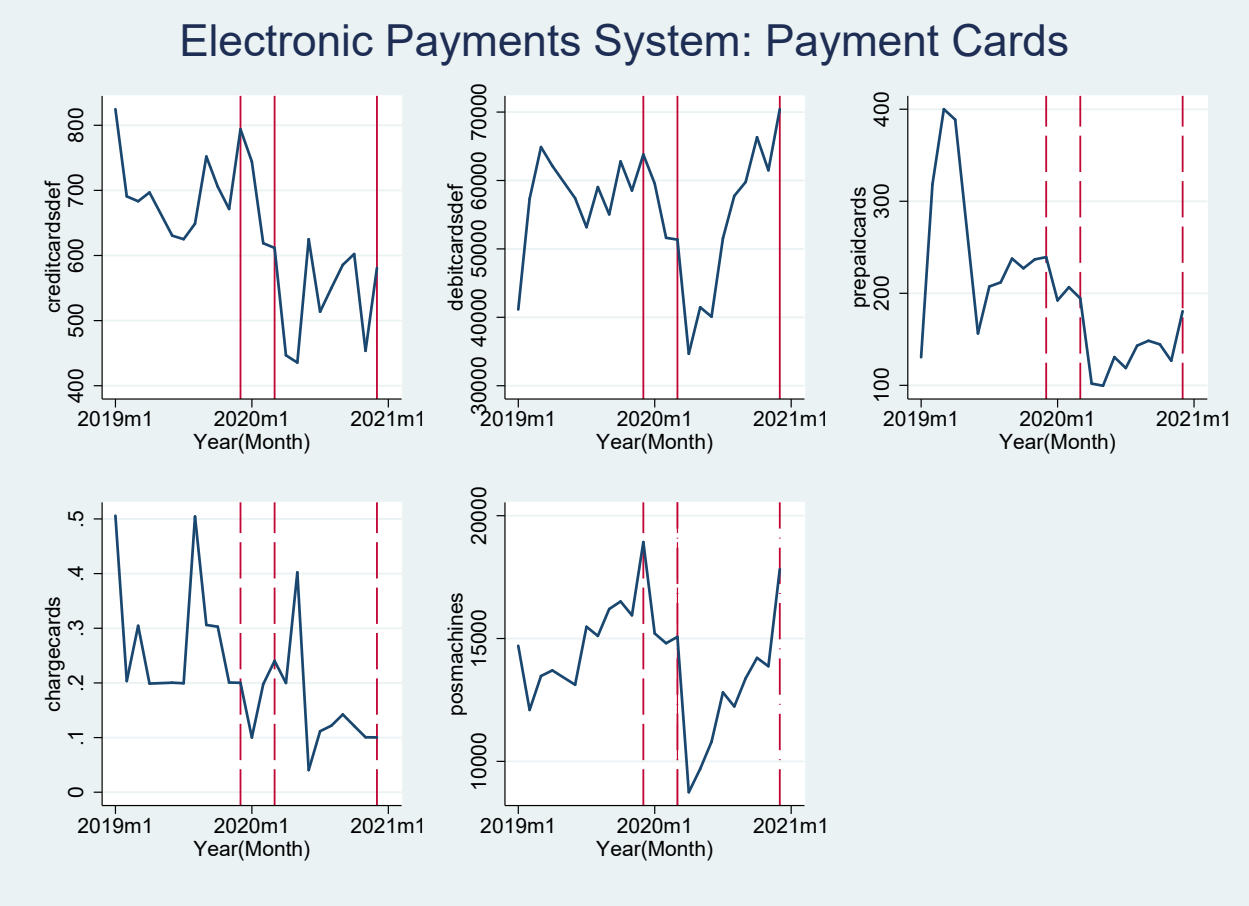


Figure 9: ***Payments Cards***

Figure 9: These figures illustrate the effects of the Covid-19 pandemic on different electronic payment systems.

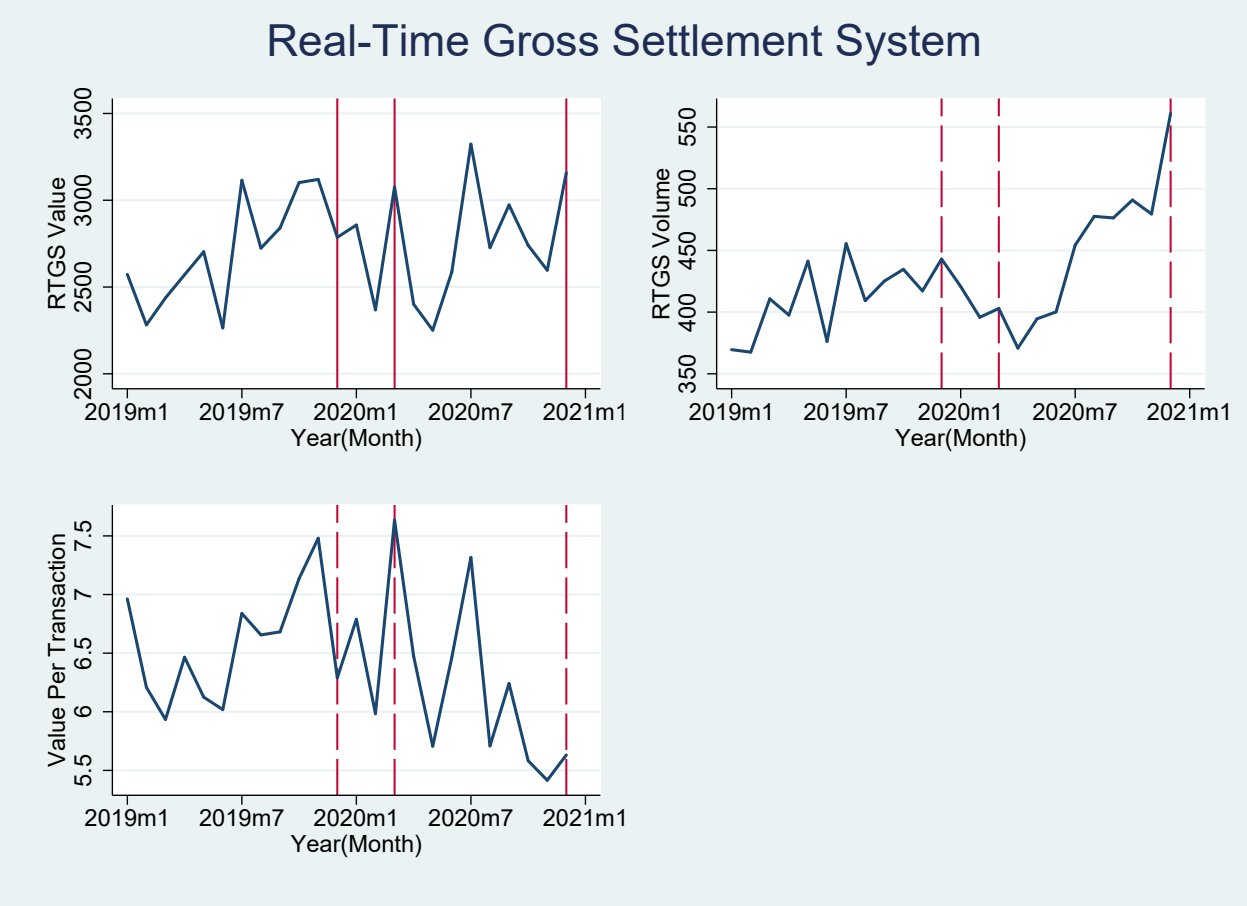


Figure 10: ***Real-Time Gross Settlement System***

Figure 10: These figures represent the time-series evolution of total value and volumes of RTGS and the effects of the Covid-19 pandemic on usage of RTGS.

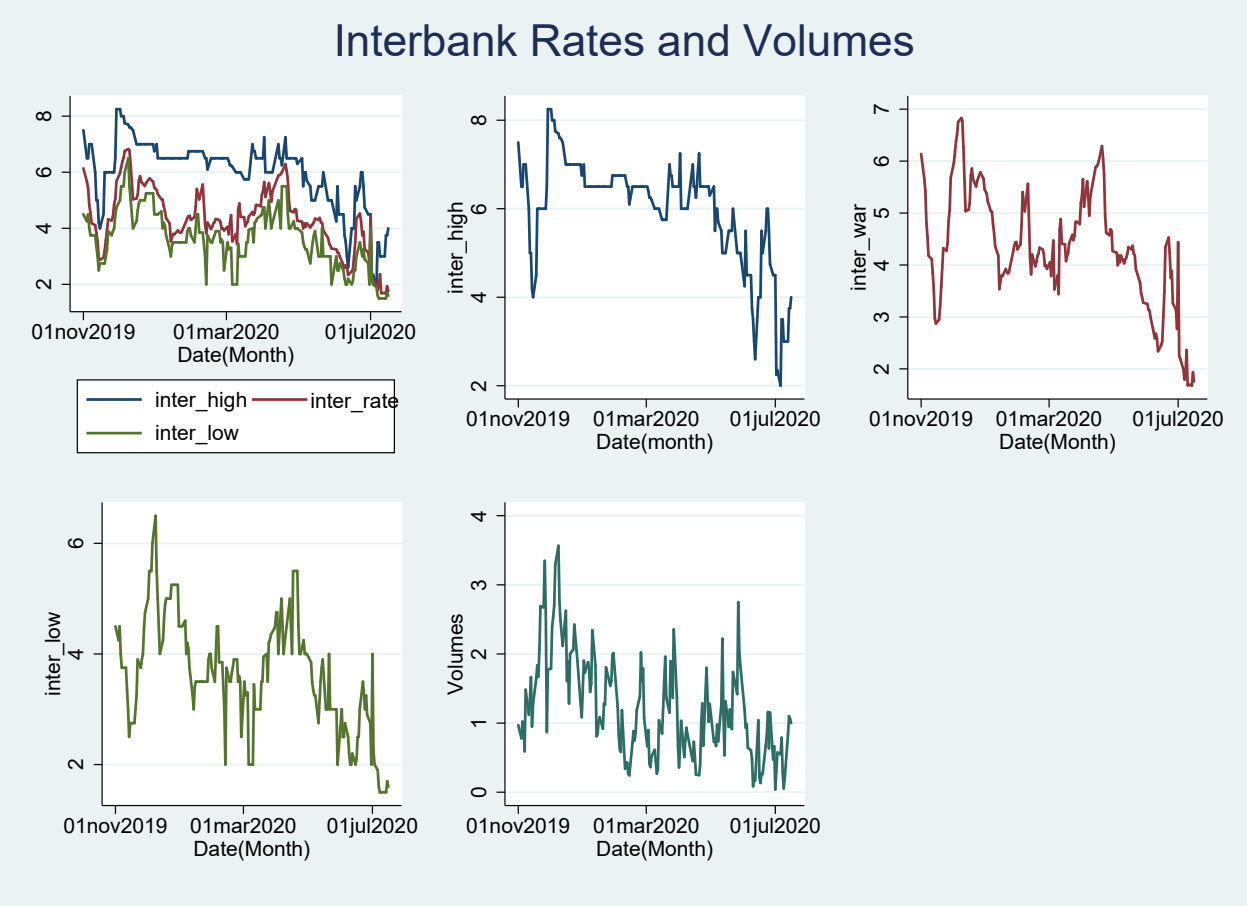


Figure 11: ***Real-Time Gross Settlement System***

Figure 11: These figures illustrate the time-series evolution of interbank rates and total interbank volumes.

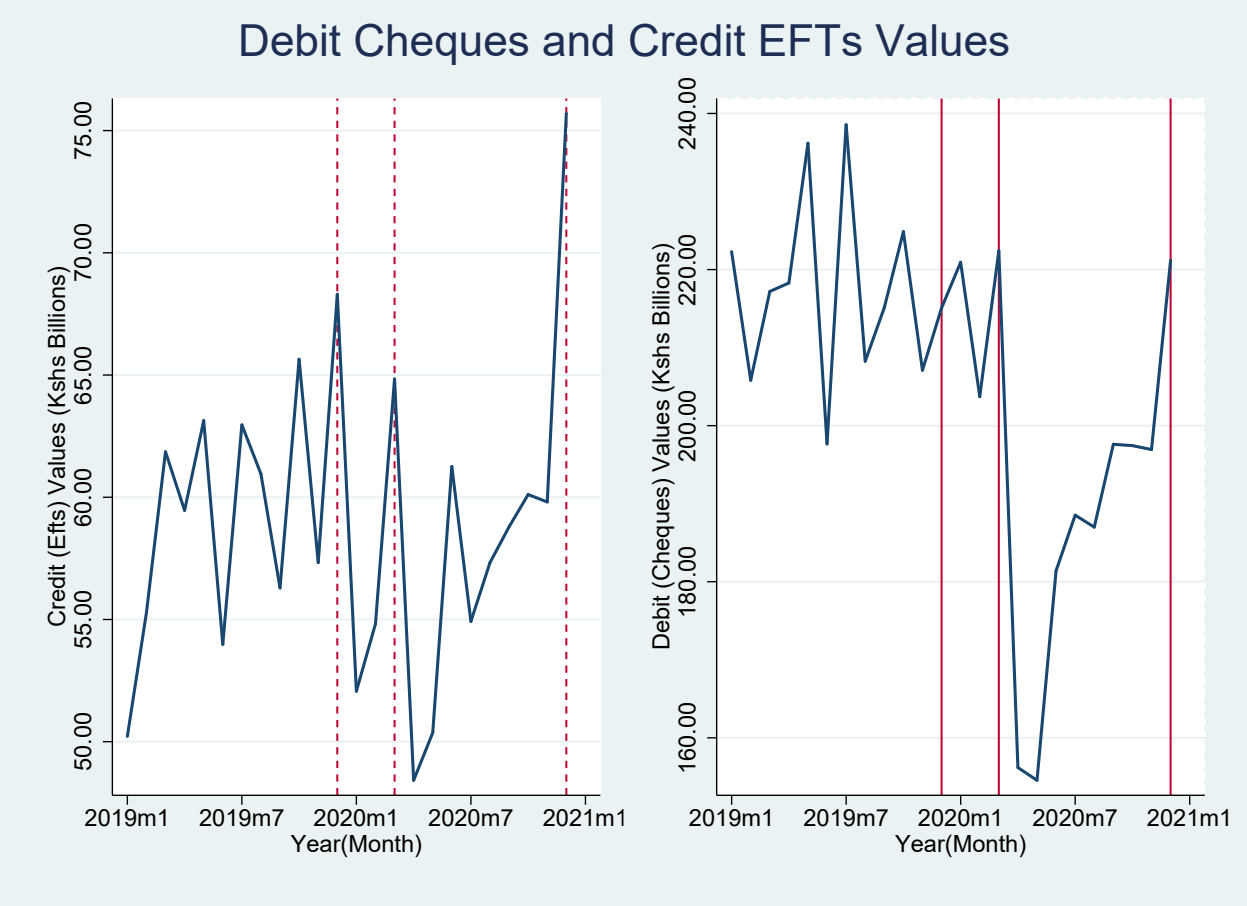


Figure 12: ***Debit Cheques and Credit EFTs Values***

Figure 12: These figures illustrate the time-series evolution and the effects of the Covid-19 pandemic on debit and credit electronic fund transfers.

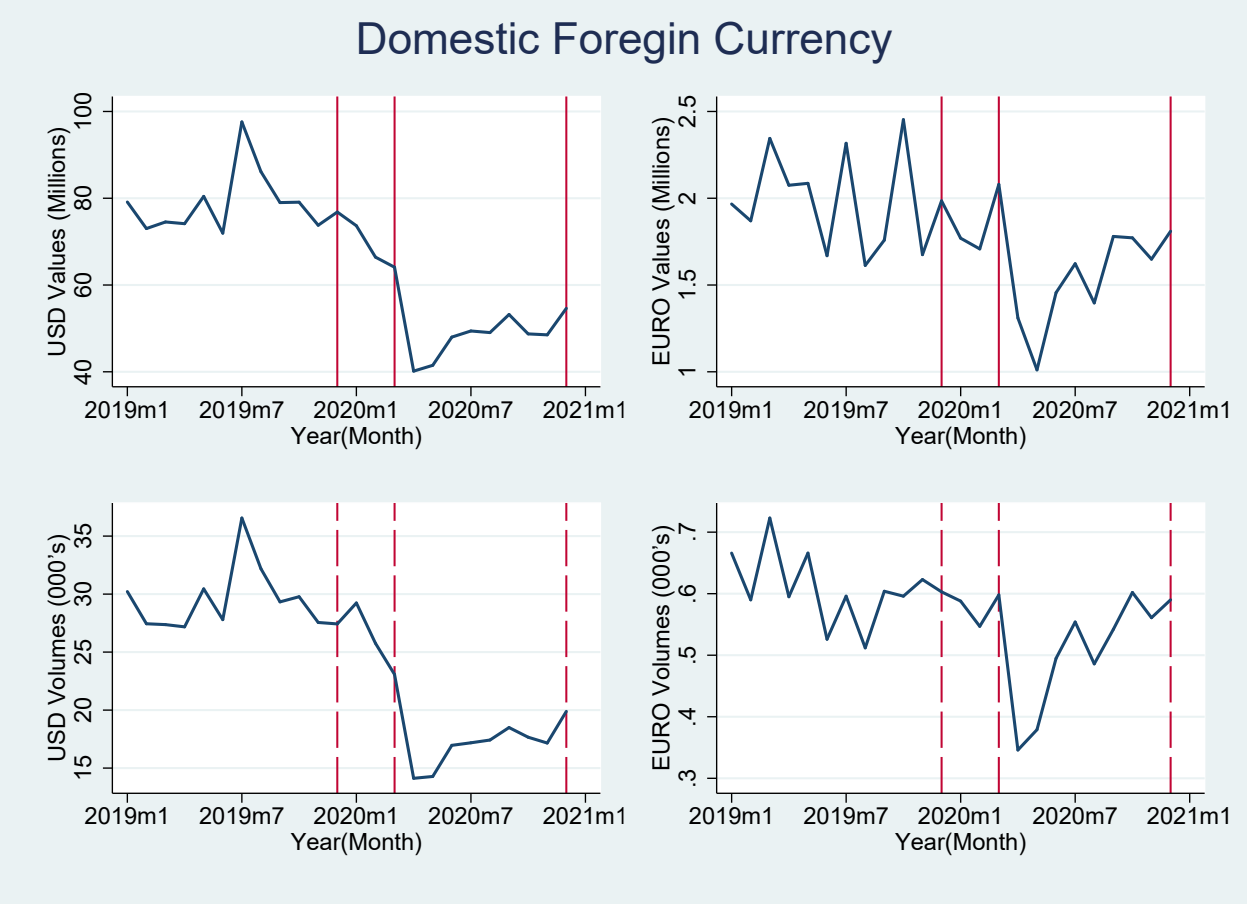


Figure 13: ***Domestic Foreign Currency Cheques- Transaction Values***

Figure 13: These figures illustrate the time-series evolution of the transaction **values** of the domestic foreign dominated currency cheques processed through the automated clearing house (ACH).

TABLE 1 : Summary Statistics

This table presents the descriptive statistics for our sample. The sample period is from January 2010 to May 2020. Mobile payments include all FinTech and Digital related transactions. DFCC(USD) and DFCC(EURO) are domestic foreign currency in U.S. dollars and Euros respectively; all values are in millions USD or EURO. KEPSS/RTGS is Kenya electronic payment settlement system/Real-time Gross Settlement; all values are in millions Ksh. EFTs are electronic fund transfers; all values are in billions Ksh.All electronic payment cards values are in millions Ksh. Mobile payments are in billion shillings. All values are seasonally adjusted.

	Mean	**Std. Dev**	**25^{th}**	**75^{th}**
Mobile Payments	220.892	101.149	130.69	308.893
Payment Cards	38,230.4	9,208.249	33,775.5	40778
Debit Cards	37,362.56	9,136.743	3,2955.5	39850
POS Machines	8,057.774	3,434.965	5,366	9,851.5
Credit Cards	771.016	374.491	461.5	1021.5
Prepaid Cards	96.498	68.226	50.974	117.9
Charge Cards	0.353	0.238	0.2	0.46
DFCC(USD)	98.526	23.951	78.07 1	119.756
DFCC(EURO)	2.878	1.032	1.982	3.559
Debit Cheques	198.568	25.919	179.788	218.282
Credit (EFTS)	42.817	11.380	33.099	50.672
KEPSS/RTGS	2,140,643	460085.2	1801550	243251

TABLE 2: Univariate Analysis:Electronic Payments Systems:

Initially Shock of the Covid-19 pandemic on Consumers' adoption of Payment Systems

This table presents univariate tests for electronic payment systems in Kenya. The Table focuses on the initial effect of the covid-19 pandemic on consumers' adoption of payment systems. Our window of the Covid-19 pandemic is from December 2019 to May 2020.

	2019 Dec	**2020 May**	Δ %	Δ{3-4} %	Δ{Dec19-20Q1} %
Mobile Payments	382.93	357.37	**-6.68**	**-15.51**	**-6.98**
Payment Cards	64,750	41,761	**-35.50**	**-32.38**	**-22.47**
Debit Cards	63,719	41,229	**-35.30**	**- 32.38**	**-22.44**
POS Machines	18,903	9,639	**-49.01**	**-41.86**	**-28.63**
Credit Cards	793	433	**-45.39**	**-15.38**	**-26.84**
Prepaid Cards	239	99	**-58.58**	**-43.18**	**-47.49**
Charge Cards	0.2	0.4	**50.00**	**-38.33**	**-16.67**
DFCC(USD)	76.83	41.49	**-45.99**	**-45.83**	**-37.3**
DFCC(EURO)	1.985	1.011	**-49.07**	**-36.87**	**-37.02**
Debit Cheques	215.08	154.56	**-28.14**	**-6.99**	**-29.77**
Credit (EFTS)	68.30	50.37	**-26.25**	**-2.94**	**-25.32**
KEPSS/RTGS	2,786.59	2,251.403	**-19.21**	**8.52**	**-21.97**
KEPSS_Vol	443026	394549	**-10.94**	**2.91**	**-7.97**

TABLE 3: Univariate Analysis: Electronic Payments Systems:
The Effect of the Covid-19 pandemic on Consumers' Adoption and use of FinTech {Mobile and Digital Banking}: Intermediate to Long Term Effect

This table presents univariate tests for electronic payment systems in Kenya. Our window of the Covid-19 pandemic is from December 2019 to May 2020. This Table documents a significant decline in almost all forms of electronic payments with some positive results in mobile and related digital platforms banking.

	1	2	3	4	5	6
Year(Quarter)	**20Q1-19Q1**	**20Q2-19Q2**	**20Q3-19Q3**	**20Q4-19Q4**	**20Q4-20Q1**	**YOY**
Change	Δ	Δ	Δ	Δ	Δ	Δ
Mobile Values	2.0981%	-1.3034%	27.8816%	**49.7982%**	**53.9669%**	**19.9684%**
Mobile Agents	10.3898%	6.2931%	12.1168%	**24.3366%**	**19.5652%**	**13.4022%**
Mobile Accounts	25.4828%	16.7334%	14.9160%	**14.0933%**	**14.5596%**	**18.2987%**
Payment Cards	1.0029%	-55.5435%	0.0089%	**6.3867%**	**20.4241%**	**-7.3449%**
Debit Cards	1.2883%	-55.5663%	0.3902%	**6.9116%**	**21.1158%**	**-7.0552%**
Credit Cards	-8.6294%	-33.2665%	-19.0833%	**-24.7570%**	**-16.3359%**	**-19.2437%**
POS Machines	13.9176%	-38.7642%	-18.4277%	**-10.8006%**	**1.0229%**	**-11.1574%**
Prepaid Cards	-28.7978%	-148.6364%	-37.9415%	**-35.8569%**	**-17.4940%**	**-40.8727%**
Charge Cards	-45.9946%	6.1033%	-63.0631%	**-54.2649%**	**-21.9922%**	**-43.3703%**
RTGS	13.8517%	-4.1428%	3.9547%	**-5.6882%**	**2.6587%**	**1.6638%**
DFCC(USD)	-9.9194%	-74.7171%	-42.2774%	**-33.8775%**	**-23.0790%**	**-32.5972%**
DFCC(Euro)	-10.0791%	-54.3288%	-15.6265%	**-14.3986%**	**-5.3040%**	**-18.6635%**
Credit etfs	2.6100%	-10.3340%	-5.0860%	**2.2725%**	**14.2852%**	**-2.3747%**
Debit etfs	0.2715%	-32.5060%	-13.4157%	**-4.8678%**	**-4.8815%**	**-10.6863%**