International Journal of
Finance
(IJF)

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CARI Journals

International Journal of Finance
ISSN 2520-0852 (Online)
Vol. 8, Issue No. 5, pp 27 - 45, 2023
www.carijournals.org

Online Banking and Technical Efficiency of Commercial Banks in Kenya

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Accepted: 4th Sept 2023 Received in Revised Form: 10th Oct 2023 Published: 17th Oct 2023

Abstract

Purpose: The financial sector is being revolutionized as a direct result of technological progress, with banks and other financial institutions embracing new technologies to better serve their customers online. Technological developments in the financial sector are simplifying access to financial services. The study set out to dissect the effects of Fintech on Kenya's commercial banking sector. The general objective was to establish the effect of online banking on technical efficiency of commercial banks in Kenya. The study was anchored on Theory of Constraint-Induced Innovation.

Methodology: The entire study relied on collecting empirical data and evaluating hypothesis in a positivist way. A causal-comparative research design was used in this research. The study targeted population of Seventeen Kenyan commercial banks from the first and second tiers. The analysis relied on secondary sources of information. The gathered quantitative data was analyzed using both descriptive and inferential statistics. Numbers, medians, and standard deviations were used to characterize the data, and frequency distributions were used to determine the sample size. Models for analyzing correlations and regressions are inferential statistics. STATA was used for the data analysis.

Findings: The study established that online banking has a positive and significant effect on technical efficiency of commercial banks in Kenya.

Unique Contribution to Theory, Policy and Practice: The research showed that commercial banks in Kenya could benefit from investing more in their online banking systems to boost their technological efficiency.

Key Words: *Online Banking, Technical Efficiency, and Commercial Banks*

Background to the Study

Technology is slowly but surely reshaping the financial industry (Hurni, Palmié, & Miehé, 2020). Financial institutions are increasingly relying on financial technology (FinTech) platforms in an effort to provide customers with cutting-edge products and services. Traditional financial institutions, especially banks, are threatened by the rise of FinTech, which has been attributed to technological digitalization (Gerlach & Lutz, 2021). As a result of technological

advancements, the financial sector has seen dramatic changes in service delivery, making previously inaccessible services readily available to consumers (Chanias, Myers, & Hess, 2019). Fiat currency is being replaced by digital currency, traditional banks are being replaced by mobile, online banking, digital payment systems, and e-finance. Constant advancements are slowly but surely altering the financial industry (Risman, Mulyana, Silvatika, & Sulaeman, 2021). New digital trends are largely responsible for the dramatic rise in demand for FinTech services (Abbasi & Weigand, 2017), as well as for the radical transformation of financial institutions that has accompanied it (Beloke & AP, 2021; Khanboubi, Boulmakoul & Tabaa, 2019). While the incorporation of technology into banking is nothing new, the rapid expansion of Fintech over the past decade has caught the attention of many. Over the next decade, technology developments and shifting consumer tastes are expected to significantly alter bank operations (Koch & Siering, 2017). Because of this, the way services and products are sold, as well as customer interactions and satisfaction, may need to be rethought. Sub-Saharan Africa has made great strides in financial development over the past two decades, but fintech has the ability to speed up and enhance those advances (Thaker, 2019). Fintech's most notable impact has been the improvement of banking sector efficiency through the elimination of informational inequalities. Through financial intermediation and the most efficient allocation of financial resources, economic growth is facilitated by an efficient banking sector (KBA, 2021).

Technology employed in the back offices of banks and other financial institutions is known as "FinTech" (Chauhan, Akhtar, & Gupta, 2022). The meaning of the term has evolved greatly since then. There are now a variety of consumer-facing applications that it supports. Numerous programs have been affected by FinTech for banking, and the way in which customers gain access to their financial information has been completely transformed (Suryawati & Nurdana, 2021). It has far-reaching implications, affecting everything from online payment platforms to the financial and insurance industries. FinTech's far-reaching effects are both an opportunity and a danger for legacy of financial institutions like banks (Achugamonu, 2020). Customers in today's digital era are less interested in using services offered by the conventional financial services sector in favor of those that are both convenient and secure (Gerlach & Lutz, 2021). Perhaps this is why FinTech is gaining traction and shaking up the banking and financial services industries. Banks and other financial institutions have been quick to embrace FinTech finance technology in response to its increasing popularity and the growing number of services it enables, such as online banking.

Financial technology companies, or fintechs, provide numerous technological services with the goals of improving efficiency, speed, and ease. According to experts, the payments industry is the most developed part of the financial technology sector as a whole (Douglas & Janos, 2020). The financial services industry has seen the effects of fintech on several fronts. By streamlining processes, proposing algorithms to aid in decision making, and using AI to oversee investment portfolios, it has helped digital financial services for customers (Bagudu, Khan, & Roslan, 2017). It has also influenced the banking sector through innovations such as the ability to keep track of one's finances and the speed with which transactions can be completed due to

circulation ledger technological advances, and the use of digital currencies (KPMG, 2020). For the financial institutions that fall under its purview, the Central Bank establishes a regulatory, legal structure and issues prudential rules (CBK, 2020). It issues licenses to financial institutions and conducts regulatory oversight to make sure they follow the rules. The Central Bank of Kenya (CBK) issues regulations and guidelines that banks in Kenya must follow (CBK, 2020). Banking institutions, the people and businesses with whom they deal with benefit from the increased openness made possible by this regulatory framework. Because of the critical role banks play in the national (and worldwide) economy, it is crucial that regulatory bodies keep a tight rein on the industry's standard procedures (CBK, 2020).

Technical Efficiency of Commercial banks

Efficiency is a relative phrase that can be determined by contrasting the actual ratio of outputs to inputs with the optimal ratio (Fried, Lovell, & Schmidt, 2008). Selecting the input set from the optimal input set is a measure of technical efficiency (Tutulmaz, 2014). It's the capacity to select an input mix that minimizes costs, given a range of relative input prices and a set of feasible technologies (Onour & Abdalla, 2010). To be allocatively efficient, a decision-making unit must use a combination of inputs that results in the lowest possible cost, and vice versa. Conversely, if increasing output necessitates decreasing another output or increasing another input, then the production is not technically efficient. One key indicator of a bank's success is the effectiveness with which it uses its resources (Vu & Turnell, 2010). An efficient bank, rather than increasing its worth to shareholders through the abuse of its dominant position in the market, could do it through more ethical means. The likelihood of failure is diminished by a banking industry that is stable, profitable, and efficient. To assess the influence of Fintech on Kenya's banking industry, The study used Data Envelopment Assessment (DEA) on Kenyan banks' technical efficiency. The DEA model was used to derive expected efficiency scores for technical effectiveness (TE), pure technical effectiveness (PTE), and scale effectiveness (SE). Banks have more sway over inputs to the DEA model's input-orientation and intermediation dimension. Reducing inputs as much as feasible while maintaining output levels is the goal of input-orientation (Banker, Charnes, & Cooper, 1984).

Statement of the Problem

The technical efficiency of financial institutions has played a significant role in promoting access financial services as well as financial soundness of the commercial banks which is an integral component of the financial system (Kamau, 2011; Nasieku, 2014). However the evolution of online banking has increased competition in the banking industry, thus creating a considerable interest in its efficiency. Given that there is increase in competition in the industry, there has been considerable interest in their efficiency. Despite the growth in digital technology between 2020 and 2021, technical efficiency still indicates stagnation only increasing marginally from 0.735 to 0.756%, thus fintech has failed to make significant contribution to growth in efficiency of commercial banks. This reflects ongoing disparities in Fintech use across numerous groups, including age, education, sex, income, employment, and the rural-urban divide (CBK, 2021). Furthermore, concerns about safety continue to be raised about

Fintech's widespread adoption. The protection of users' personal and financial information is the primary concern for any Fintech (KBA, 2021). Many researchers have examined Fintech and the technical efficacy of the financial sector. Ntwiga's (2020) research examined the impact of fintech on technical efficiency in Kenya's banking industry and found a positive correlation. Data Envelopment Analysis was utilized to quantify the impact of Fintech and technical efficiency in the banking sector, whereas the previous study measured technical efficiency before and after the introduction of Fintech. Despite the theoretical link between fintech and technical efficiency the nature of this relationship in context of the Kenyan banking industry still remains an issue of empirical investigation and therefore the motivation of the current study.

Several studies have been conducted on Fintech and technical efficiency in the financial market.

The study by Alemu (2016) evaluated the technical efficiency of commercial banks in Ethiopia and established an insignificant relationship. However, the study did not expound on Fintech thus creating a research gap. Thalassinos and Le (2022) study on Fintech transformation on performance of banks and found that the digital transformation has a positive impact on the performance of commercial banks. Noteworthy the banking industry context in Ethiopia is significantly different from the Kenyan banking industry. However, the study adopted performance while the current study adopted a technical efficiency thus creating a conceptual gap. Ngalyuka (2021) study on relationship between Fintech utilization and fraud losses in banks in Kenya found that Fintech had led to a significant increase in fraud. The study focused on administrative issues from Fintech in commercial banks thus creating a contextual gap. The study by Ntwiga (2020) assessed technical efficiency in the Sacco's with the influence of fintech and established a positive relationship, whereas the study used Sacco's and Pre-Post Fintech period to measure the technical efficiency while the current study used commercial banks and a Data Envelopment Analysis technique to estimate the effect of Fintech and efficiency in the banking sector. This study therefore sought to bridge the gap by establishing the effect of online banking and technical efficiency of Kenya commercial banks in Kenya.

Research Hypothesis

H_{01}; Online banking has no discernible effect on commercial banks' technological efficiency in Kenya.

Theoretical Review

Theory of Constraint-Induced Innovation

In 1983, Silber put forth his hypothesis of constraint-induced financial innovation. The notion proposes that increasing profits should be a financial institution's overarching goal whenever possible. As stated by Silber (1983), financial institutions' ability to operate profitably and sustainably is hindered by several constraints. The theory of constraint-induced invention is novel and indicative since it examined financial innovation from a microeconomics perspective, but with an excessive focus on "innovation in adversity." Therefore, it fails to

provide a satisfactory explanation for the phenomenon of financial innovation within the context of broadening financial liberalism. This concept helped shed light on how the efficiency gains from service efficiency brought about by financial breakthroughs influenced by the bottom line of businesses. According to the constraint-induced financial innovation theory proposed by Silber and developed by (DeYoung, Lang, & Nolle, 2007), the fundamental motivator for implementing a digital strategy is the incentive for improving a firm's income. There are a few disadvantages, including strategy and other external restraints. For instance, a company's internal management and leadership style might have a significant impact on its ability to maximize its own benefits. According to this notion, businesses use technology to break free of the shackles of variable factors like taxes, regulations, and operating costs. The theory also implies that firms increase their returns on capital by using financial technology to address financial challenges that diminish a company's earning potential (Peake, Cooper, Fitzgerald, & Muske, 2017). However, this still suggests that innovations are commercially driven by a desire to mitigate the risks that financial institutions face.

This hypothesis helps explain why commercial banks are constantly developing novel revenue streams to keep up with the market. According to the literature, businesses face both internal and external limitations, and innovations serve as a means of competing in the marketplace and boosting bottom-line results. According to research by Albliwi, Antony, and Lim (2015), financial related organizations work to reduce limits and barriers since they strengthen administration but reduce efficiency. The theory of constraint-induced innovation is representative since it is grounded in microeconomics. However, it places a premium on expansion in trying times while downplaying the significance of expanded development in liberal finance. Tufano (2009) argues that reducing interest rates on loans, cutting costs, and investing in startups are all ways in which individuals and businesses might innovate to overcome such challenges. Budgetary speculating demands were something that innovators set out to meet in a number of ways, including through the reduction of the need for deposits (because of low interest rates) and the promotion of expansion. Critics of the constraint-induced innovations in finance hypothesis include (Kithinji, 2017) and (Pirson & Lawrence, 2010), who argue that businesses have a broader social mission than simply maximizing profits. In addition to profit, the reason many businesses operate is to improve the lives of their communities by doing things like expanding access to banking services. Since this Fintech functions as a revenue stream to the bank, even those without bank accounts are able to obtain loans through their phones and online, and this is why the Constraint- Induced Financial Innovation hypothesis is linked with online banking. Because of this theory's significance, it is instrumental in seeking to establish the effect of online banking and the technical efficiency of Kenya's commercial banks.

Empirical Review

Online banking and technical efficiency of Commercial Banks.

The effects of online banking on China's commercial banks were studied by Dong et al. (2020). A static panel model and a model with dynamic panels were developed to experimentally

examine the impact of online banking on the revenue, safety, liquidity, expansion, and overall performance of commercial banks. The study's findings indicate that commercial banks' earnings, security, and growth benefit from the proliferation of online banking, although the banks' liquidity suffers as a result. The proliferation of Internet banking has also helped commercial financial institutions improve their technical efficiency. Further, the impact of online banking varies greatly depending on the type of commercial bank, with state-owned commercial banks feeling the least of the consequences and city commercial banks feeling the most. Researchers Islam, Kabir, Dovash, Nafee, and Saha (2019) looked into how the rise of online banking has affected the bottom lines of Bangladeshi financial institutions. All 30 of Bangladesh's publicly traded banks' annual reports were combed through for secondary data. The results showed that online banking institutions had greater ROA and ROE than those without. The results, however, were unremarkable. After the advent of internet banking, there was also a statistically significant drop in ROA and ROE. A lack of widespread client adoption of online banking may explain these findings, as may the initial investment in necessary infrastructure. Therefore, the return on the investment was not realized until much later, despite the reality that it was made well before widespread use of online banking became commonplace.

Online banking was studied by Olushola (2020) to determine its impact on the technical efficacy of banks in Nigeria. The results of a multiple regression analysis showed that the technical efficiency of Nigerian banks did not change much as a result of the introduction of e-banking. According to the findings, Nigerian banks' technological efficiency for handling deposits has not improved as a result of investments in electronic banking. According to the research, in order for electronic banking to be successful, there needs to be a strong promotion and awareness for customers to use the services. Ngungi (2020) looked at how the rise of online banking has affected the technical efficacy of Kenya's commercial banks. The researchers gathered information using a descriptive approach. The whole population of commercial banks in Kenya (all 39 of them) was counted. The technological efficiency of Kenya's commercial banks was shown to improve slightly due to the introduction of online banking. This is due to the fact that both customers and financial institutions gain from the improved efficiency of online banking. The study concludes that banks ought to motivate more customers to use online banking services because of their effectiveness in reducing costs for the bank and customers, increasing security and increasing accessibility.

Ali (2018) looked into how online banking has altered commercial banks' technical efficiency. The study analyzed technical effectiveness of Barclays Bank of Kenya over the six years from 2012 to 2017 using a descriptive research design. The availability of online banking only accounted for 35.0% of the variance in commercial banks' technological efficiency, according to the regression analysis. Findings also indicated that all measures of technical efficiency positively correlated with techniques used by online banks to mitigate risk. Furthermore, the regression results showed that differences in online banking risk management measures accounted for just 17.6% of the variance in commercial banks' return on efficiency. Finally, the results indicated that technological efficiency indicators were inversely related to the cost

of using an online bank. Fee and commission differences in online banking accounted for just 37.6% of the efficiency variance among commercial banks. According to the research, commercial banks' technological efficacy improves when they ensure the safety of their customers' online banking transactions and implement other measures to counteract the risks associated with it. Cheruiyot (2019) analyzed the impact of internet banking on the technical efficiency of Kenyan commercial banks using data collected from those institutions. In this study, internet use was measured through the use of online banking as a surrogate. Both the return on assets and the return on equity were used to evaluate performance. Accessibility to online banking has a minor but statistically significant effect on profitability, according to a multiple regression analysis.

Technical efficiency

Banking sector efficiency enhances economic growth by facilitating the transfer of funds and directing capital where it is needed most. To be technically efficient, a bank needs to generate a predetermined number of results while expending the minimum amount of resources. The financial institutions that are more efficient at what they do are better able to weather economic storms, boost growth, eliminate informational inequalities, and smooth out economic swings (Fried, Lovell, & Schmidt, 2008). Using Japanese data, Homma et al. (2018) examine the aforementioned assumptions to discover that Japanese banks expand in size, and this is consistent with the efficient organization hypothesis. According to the findings (Homma et al., 2018), market concentration reduces bank efficiency, which is consistent with the quiet life theory. However, Yin et al. (2019) discovered that smaller banks, in particular, had a negative link between the number of employees and efficiency. According to Rosman et al. (2019), larger banks are able to lower their input costs because of their dominant market position. Returns to scale from a more specialized workforce and economies of scale from spreading fixed costs across a larger volume of services have been hypothesized to explain the positive correlation between size and productivity (Hauner, 2020). The quiet-life argument, on the other hand, suggests that larger organizations tend to be less productive. Recent research (Al-Gasaymeh, 2016, epková, 2015, and Singh, and Fida, 2015) demonstrate no statistically significant relationship between bank size and TE. In essence, there can be different ways of looking at the question of whether or not size and TE are related.

Sharma (2018) investigates the link between productivity and financial success in the market. Conclusions Statistically significant correlation between operational efficiency and the market performance of Indian banks was confirmed. Additionally, banks with streamlined operations result in more money for their shareholders. In addition, Meles et al. (2016) discover that US banks' financial performance improves when their use of intellectual capital is optimized. Personnel effectiveness, a subcomponent of IC effectiveness, has also shown to have a greater effect on financial performance. Thus, the advancement of efficient methods of knowledge management, enabling banks to amass the resources necessary to adjust to a dynamic and ever-shifting market. In their 2020 study, Afsharian et al. analyze how efficiency influences the success of European banks that are open to the public. The findings corroborate the hypothesis

that technical efficiency is positively related to banks' overall success. Aguenaou et al. (2017) use the CAMEL framework to analyze the financial success of Moroccan banks between 2004 and 2014. The findings demonstrate that the efficiency of banks is positively associated to factors including capital sufficiency, asset quality, profits performance, and liquidity, but it is negatively related to management efficiency.

Adusei (2019) analyzed the factors that affect rural and community banks' technical effectiveness in Ghana. Using the binary logistic regression method and the data envelopment analysis assumption of a variable's return to scale, we have analyzed the data. Only 20 of the sampled rural and community banks met the criteria for technical efficiency. The binary logistic regression study shows that the technical efficiency of rural banks in Ghana is significantly influenced by factors like bank size, profitability, and quality of bank funding. Increasing a rural bank's profitability enhances its technical efficiency, whereas expanding the bank's size or improving its funding quality reduces the bank's technical efficiency. These findings suggest that many rural and community banks in Ghana have poor resource usage and that a rural bank's success in this area can be evaluated by looking at its size, profitability, and financing quality.

Kumar (2018) looked into how the technical efficiency of Indian public sector banks affected their bottom lines. If public sector banks are efficient, they can increase output by 1.13 times relative to the same inputs. Thirteen banks in the "lucky" and "underdog" quadrants of an efficiency-profitability matrix based on effectiveness ratings and Return on Assets (ROA) have a technical effectiveness score below the industry average.

Conceptual Framework

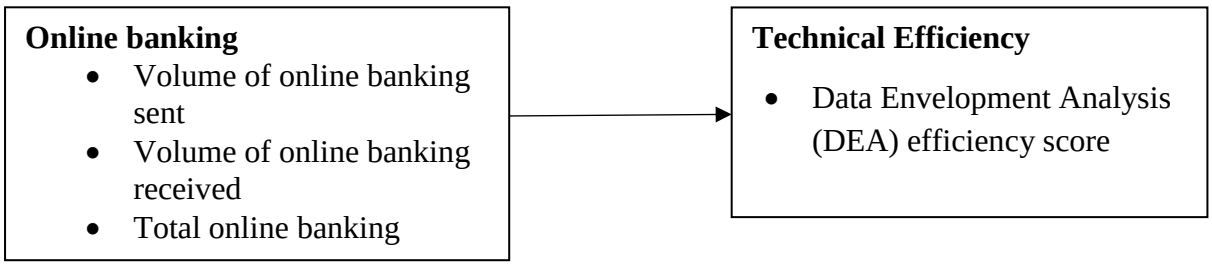

Figure 1: Conceptual Framework

Research Methodology

Research Philosophy

Research philosophies are approaches to studying society with the goal of providing an explanation based on the knowledge gained (Padilla-Daz, 2015). A study's critical assumptions and presuppositions can be traced back to the researcher's underlying research philosophy. Positive (or scientific), realist, and interpretivist phenomenology are the primary research philosophies (McLachlan & Garcia, 2015). Knowledge, according to positivist philosophy (Singh, 2015), is based solely on empirical data, with no room for theoretical speculation or

personal bias. The social entity is the starting point for the positivist philosophical approach. Knowledge, according to positivist thought, is based on hard data and objective reality, rather than on theoretical constructs or personal valuations (Alakwe, 2017). Distinction is highlighted by looking at how different things like prescriptions and leading research on individuals compare. Data collection and theoretical development form the basis of this study's methodology (Potrac, Smith, & Nelson, 2017). Therefore, positivism was used in this study because it is centered on collecting data and testing hypotheses. The results of the experiments validated the hypotheses and will be useful for future studies. Since positivism is founded on empirical evidence, the field of statistics arose to analyze it. This study is a deductive inquiry into the impact of online banking on the technical efficacy of commercial banks since the researcher examined the premise and established a conclusion. Many believe that the logical method is the only valid one for scientific research.

Research Design

The term "research design" is defined as the "plan or structure" used to address the researcher's issues and inquiries (Malterud, Siersma, & Guassora, 2016). For this study, the researcher took a causal-comparative strategy. This is due to the fact that causal-comparative research designs aim to pinpoint the causes of variation in study outcomes (Rahi, 2017). Because it compared how different types of digital banking services affected the efficiency of commercial banks technically, this research lent itself well to a causal-comparative methodology. Multiple tests were performed on the study's variables to confirm or refute the hypothesis.

Population and Sampling

The study's population consists of all the entities that have enough in common to be either included or excluded. The 17 commercial banks in Kenya make up the number of the study's sample. The banks in Kenya are divided into two different size categories by the Central Bank: big (>5%) and medium (1%-5%) of market share index. Tier 1 and 2 banks were the analyzed unit from 2010 to 2021. To learn about a population as a whole by looking at a small subset of that group is known as sampling (Bryman & Bell, 2013). For the years 2010-2020, this research focused on 17 of Kenya's top and middle tier commercial banks. Since it is throughout these time periods that online banking has expanded and evolved, a causal-comparative approach provides the clearest picture.

Data Collection Methods

The study used secondary data for the analysis. The data was acquired from CBK reports and the banks' annual financial reports.

Data Analysis

According to Kothari (2012), data analysis consists of a series of interconnected procedures that are carried out to summarize the gathered data and arrange it so that it answers the research objectives. Data was scrubbed, modified, double-checked, and coded before analysis. The data was analyzed using both inferential and descriptive statistics. Data were described using

percentages, averages, and standard deviations, while the sample size was described using frequencies. Correlation and the panel regression model were used as methods of inference. STATA was used for the data analysis.

The impact of Fintech on commercial banks' technical efficiency in Kenya was determined using a panel regression model. This allowed for a more accurate assessment of the correlations between the study's dependent and independent variables. The model of regression was:

$Y = \beta_{01t} + \beta_{1it}X_{1it} + \varepsilon$

Where;

Y = Technical Efficiency

X_1 = Online Banking

β_0= Constant Term;

β_1= Beta coefficient

i= bank

t= time period

ε = Error Term.

Hypotheses was tested at a 0.05 significance level. A null hypothesis was rejected if the P-value >0.05 and not rejected if the P-value <0.05.

Ethical Considerations

The study's veracity was guaranteed by the researcher's strict adherence to ethical guidelines. When the researcher utilised the ideas and thoughts of other authors, they were properly cited. In addition, as will be shown in the following section, the researcher adhered to ethical principles.

Informed consent

A letter of permission detailing the study's scope and justification was provided to the researcher by the CUEA. Second, the study was sanctioned by Kenya's National Council for Science, Technology, and Innovation (NACOSTI). All required permissions have been obtained for this data collection.

Results

Descriptive Statistics

The descriptive statistical analysis of the data gathered for all variables from 2010 to 2021 is presented in this section. The use of descriptive statistics includes indicators of distribution (skewedness and kurtosis) as well as measures of central tendency, such as the mean and standard deviation, as well as measures of dispersion and minimum and maximum observations. Online banking (shillings) and technological efficiency (ratio) were used to offer descriptive data. The analysis helps make it possible to display and visualize raw data

meaningfully. The outcomes are shown in Table 1. The results shows that the median value of online banking volume was 151,501,077, indicating that this is the average number of online banking transactions. The data points are dispersed from the mean, and transaction volume varies to the tune of 74,376,283 standard deviations on average. There were at least 60,014,626 online banking transactions included in the dataset, indicating that a minimum value of this size existed. There are a total of 249,838,009 online banking transactions in the dataset, making the maximum value 249,838,009. If most transactions are concentrated towards the mean, as shown by a skewness value of -0.05, then the dataset is roughly symmetric. The data set is platykurtic, with a kurtosis of -1.87, meaning its peak is flatter than that of a normal distribution and its tails are narrower.

A mean volume of 79,602,325 indicates that this is the typical amount of money sent via internet banking in a given time frame. With a standard deviation of 42,989,598 we can see that the volume of online banking transactions received varies greatly, with certain values being far higher or lower than the mean. In this data set, the smallest amount of online banking received is represented by the number 4,325,213, and the biggest amount is represented by the number 187,674,337. There are more values on the left side of the distribution, and a lengthy tail toward the upper values, according to the skewness of 0.45, which indicates that the distribution of the volume of online banking handled is somewhat skewed to the right. Last but not least, a kurtosis of -0.67 suggests that the distribution is somewhat flat and contains fewer outliers than a normal distribution would, with fewer extreme values than predicted in the tails. The overall volume of online banking transactions has been calculated to be 231,116,678 (the mean of the data). Spreading out from the mean, as shown by the standard deviation value of 108,361,300. As far as the data goes, the lowest value we have is 90,404,233. However, the greatest value in the data is 379,568,198. A skewness of -0.05 implies a relatively symmetrical data distribution, with just a hint of left skew. This indicates that there are more observations to the right of the average than to the left. With a kurtosis of -1.85, the data appears to have a platykurtic shape, characterized by a more rounded peak and narrower tails than would be seen in a normal distribution. This suggests that there are fewer extreme values in the data compared to a normal distribution.

The provided information under technical efficiency relates to banks' technical efficiency as measured by three metrics: variable return to scale efficiency (VRSE), constant return to scale efficiency (CRTE), and SCALE. The median VRSE score is 0.693, which indicates that banks are, on average, only using around 70% of their potential in their day-to-day operations. With a standard deviation of only 0.080, we can infer that most banks' VRSE values fall within a small band. Some banks are far less efficient than others, as shown by the least VRSE value of 0.510, and others are highly efficient, as shown by the maximum VRSE value of 0.820. When output is held constant, the mean CRTE value of 0.700 is slightly higher than the VRSE value of 0.650, showing that banks, on average, are slightly more efficient. As with VRSE, the standard deviation of 0.080 for CRTE suggests that there is not much in the way of diversity amongst different financial institutions. The range of CRTE values is also extremely small, with maximum and minimum values that are very close to those of VRSE. Finally, SCALE

indicates whether or not a financial institution is performing at its maximum potential. According to the median size value of 0.733, financial institutions are typically performing at about 73% of their potential size. There is more variance in scale between different banks, as indicated by the standard deviation value of 0.118, which is more than that of VRSE and CRTE. If a bank's SCALE score is below 0.500, it is running well below its optimal scale; if it is above 0.920, it is functioning extremely close to its optimal scale. It appears from the data that most banks are working at a comparable degree of technical efficiency, while there is considerable variation. Nonetheless, there is greater diversity in the amount to which banks are functioning at their optimal scale of manufacturing, with some banks operating considerably below or above this level.

Table 1 Descriptive Statistics

		Mean	Std. D	Minimum	Maximum	Skew	Kurts
Online Banking	Volume of online banking sent	151,501,077	74,376,283	60,014,626	249,838,009	-0.05	-1.87
	Volume of online banking received	79,602,325	42,989,598	4,325,213	187,674,337	0.45	-0.67
	Total online banking	231,116,678	108,361,300	90,404,233	379,568,198	-0.05	-1.85
Technical Efficiency	VRSE	0.693	0.080	0.510	0.820	-0.56	-0.41
	CRTE	0.700	0.780	0.520	0.820	-0.57	-0.40
	SCALE	0.733	0.118	0.500	0.920	-0.28	-0.94

Trend Analysis on Online Banking

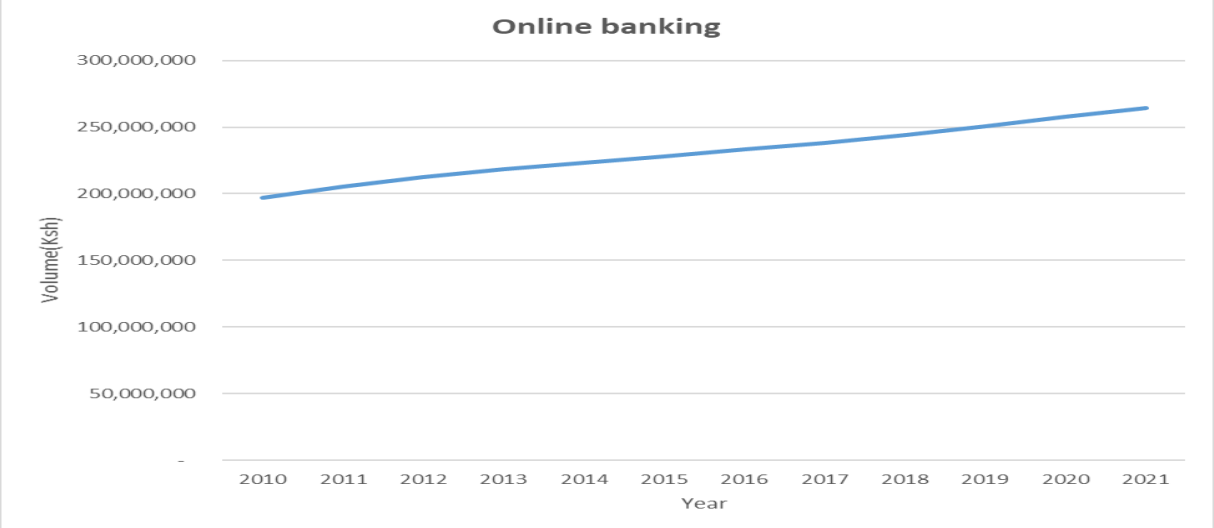

Figure 2: Trend Analysis on Online Banking

The offered trend analysis demonstrates the development of internet banking from 2010 to 2021. The results show a consistent upward trend in the popularity of internet banking throughout time. There were 197,258,351 users in 2010, but by 2021, that number had increased to 264,361,872, an increase of approximately 67 million. The number of people using online banks increased at a slow but steady rate between 2010 and 2015, by about 4.4 million year on average. However, the rate of expansion picked up from 2015 to 2021, with an annual rise of almost 6.4 million users. The convenience and efficacy of online banking services, together with the proliferation of online banking applications, have contributed to their meteoric rise in popularity. As more people make the switch to digital banking, the trend research predicts that the popularity of online banking will continue to rise.

Trend analysis for Technical Efficiency

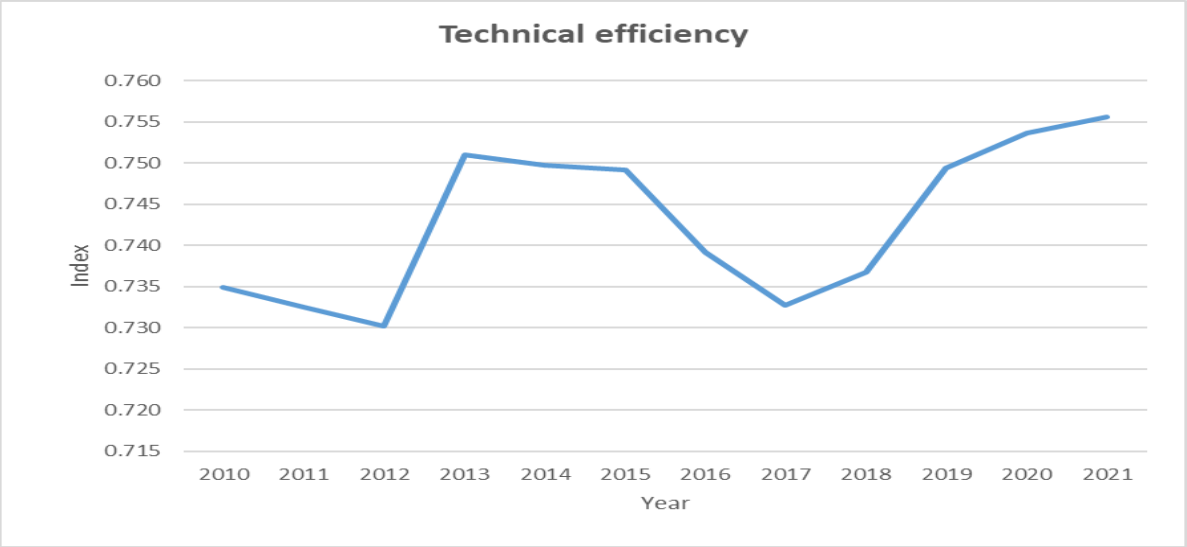

Figure 3: Trend Analysis on Technical Efficiency

The graph shows the technical effectiveness of Kenyan banks from 2010 to 2021 on a scale from 0 to 1, with 1 indicating the most efficient performance possible. The trend analysis indicates that the technical effectiveness of banks in Kenya has varied over time, but has improved steadily on the whole. Kenyan banks have a mean technical efficiency of about 0.744, with a standard deviation of about 0.010. Banks in Kenya saw a gradual deterioration in their technical efficiency from 2010 to 2012, with that number falling from 0.735 to 0.730. The technical effectiveness increased dramatically in 2013, reaching 0.751, and then remained constant for the following two years, at 0.750 and 0.749, respectively. Technical efficiency dropped to 0.739 in 2016 and continued its slow fall to 0.733 in 2017. In 2018, however, things turned around as the technical effectiveness rose to 0.737. The level of technical efficiency has increased steadily from 2019 to 2021, rising to 0.749 in 2019, 0.754 in 2020, and 0.756 in 2021. There appears to have been some variation in the technical effectiveness of Kenyan banks over the years, with efficiency dropping between 2010 and 2012 and then rising again between 2013 and 2018. Banks in Kenya are getting more technically efficient over the course of 2019–2021,

a trend that bodes well for the country as a whole. This development bodes well for Kenya's economy as a whole, as it indicates that the country's banking system is evolving toward a more viable and effective model.

Correlation Analysis

The researchers looked for a connection between the variables by conducting a correlation analysis. Pearson's correlation was used to determine the mean score for each independent variable. A statistically significant correlation has a p-value of less than or equal to 0.05. However, a correlation that has a p-value of more than 0.05 is not considered to be statistically important (Statistics Solution, 2018). There is a positive correlation between the two variables when both are growing, and a negative correlation when both are shrinking. Table 2 shows the outcomes of the correlation study.

Table 2: Correlation Results

	Technical Efficiency	Online Banking
Technical Efficiency	1.000	
Online Banking	0.687	1.000
	0.000	

The results shows that there is a favorable and statistically significant relationship between using online banking and technological efficiency (r= 0.687*, p=0.000<0.05). This indicated a strong connection between using the internet to do banking and being technically efficient (68.5%). The strong positive association between the two variables indicates that high levels of technical efficiency are typically reflected in online banking.

Regression Analysis

Using regression analysis, the study looked for a statistically significant relationship between independent and dependent variables. Online banking was used as independent variable while Technical Efficiency was taken as the dependent variable. The results are shown in Table 3.

Table 3 Regression Outputs

Technical Efficiency	Coef.	Std. Err.	z	P>|z|
Online Banking	0.0218	0.0055	3.9800	0.000
_cons	0.1512	0.0492	3.0700	0.002
F-statistic	238.63			
Prob > chi2	0.000			
Rsquared	0.6297			

The results shows existence of a positive and statistically significant effect of online banking on technical efficacy of commercial banks in Kenya (=0.0218, p=0.000).

Discussion of Results

Finding out how Kenyan commercial banks fared technically and how their customers reacted to internet banking was the first goal. The overall volume of online banking transactions has been calculated to be 231,116,678 (the mean of the data). The data is dispersed relatively far from the mean, as evidenced by the standard deviation value of 108,361,300. The results of the correlation between online banking and technological efficiency showed a favorable and statistically significant relationship (r= 0.687*, p=0.000.05). This indicated a strong connection between using the internet to do banking and being technically efficient (68.5%). The strong positive association between the two variables indicates that high levels of technical efficiency are typically reflected in online banking. Online banking and technical efficiency were found to have a favorable and statistically significant relationship (=0.0218, p=0.000). We reject the null hypothesis that internet banking has no meaningful influence on the technical effectiveness of commercial banks in Kenya since the p-value of 0.000 is less than the threshold 0.05. According to Dong, et al. (2020), who studied the effects of online banking on Chinese financial institutions, the expansion of this channel has a positive effect on the profitability, security, and growth of financial institutions, but a negative effect on their liquidity. Also, commercial banks have been able to boost their overall technical efficiency because to the rise of online banking.

This confirms the findings of Olushola (2020), who also studied the effects of e-banking on Nigerian banks and found no statistically significant influence on technical efficiency. All technological efficiency measures revealed favorable relationships with online banking safety strategies, which is consistent with the findings of Ali (2018). Furthermore, the regression results showed that differences in online banking risk management measures accounted for just 17.6% of the variance in commercial banks' return on efficiency. Based on the findings of a multiple regression analysis, Cheruiyot's (2019) research found a marginally significant correlation between Internet banking profitability and availability. In contrast, Islam, Kabir, Dovash, Nafee, and Saha (2019) found no statistically significant effect of increased use of online banking on bank profitability in Bangladesh. According to Ngungi's (2020) research, online banking has a small but favorable impact on the technological efficiency of Kenya's commercial banks. This is due to the fact that internet banking is more cost-effective for businesses as a whole, generates more commission income, requires fewer employees, and improves service for customers.

Interpretation of Results

The overall volume of online banking transactions has been calculated to be 231,116,678 (the mean of the data). The data is dispersed relatively far from the mean, as evidenced by the standard deviation value of 108,361,300. The results of the correlation between online banking and technological efficiency showed a favorable and statistically significant relationship (r= 0.687*, p=0.000.05). This indicated a strong connection between using the internet to do banking and being technically efficient (68.5%). The strong positive association between the two variables indicates that high levels of technical efficiency are typically reflected in online banking. Online banking and technical efficiency were found to have a favorable and

statistically significant relationship (=0.0218, p=0.000). We reject the null hypothesis that internet banking has no meaningful influence on the technical effectiveness of commercial banks in Kenya since the p-value of 0.000 is less than the threshold 0.05. The increased efficiency and effectiveness of banking operations is a direct result of the widespread adoption of electronic banking technologies including, internet banking platforms, and electronic fund transfers. Banks can improve their efficiency and effectiveness by offering online banking services. With online banking, users may safely and easily handle a wide range of banking needs without making trips to banks. Customers and banks alike can benefit from the time and money savings that come from reduced face-to-face contact and paperwork. In order to handle transactions more quickly and precisely, banks can benefit from the automation of mundane operations using online platforms, which can boost operational efficiency. In addition, online banking systems typically employ cutting-edge technology and stringent security procedures to guard account holders' private data. A boost in clients' trust and confidence in using online banking services can result from this. With more people using online banking, financial institutions might potentially increase their customer base without significantly increasing their infrastructure. Customers in rural or economically depressed areas also benefit from the convenience of internet banking. Those who may not have easy access to conventional banking institutions may benefit greatly from this expanded availability. Banks can increase their market share and overall profitability by broadening their customer base.

Conclusion

The results provide convincing evidence that using an online banking service has a major impact on the technical effectiveness of Kenya's commercial banks. Online banking appears to significantly correlate with commercial banks' increased technical efficiency, as evidenced by the rejection of the null hypothesis. This finding hints that commercial banks in Kenya gain some significant operational efficiency and productivity from adopting and using internet banking services. To conduct financial transactions, view account details, and engage with banking services, clients can use a wide range of digital platforms and services that make use of the internet. Given the positive impact of online banking on technical efficiency, it stands to reason that commercial banks in Kenya should benefit from the incorporation of digital platforms and services. Banks can enhance efficiency, lower transaction costs, provide better customer service, and broaden access to financial services by adopting online banking solutions like internet banking portals, and digital payment systems.

Recommendations

According to the findings, commercial banks in Kenya could improve their technical efficiency by putting more resources into their online banking platforms. Creating trustworthy and safe online banking services is a crucial part of this process, as is enhancing connectivity and connectivity speeds. Financial institutions need to educate their clients on how to make the most of online banking in order to improve their consumers' digital literacy. Customers can be encouraged to take advantage of online banking capabilities by holding workshops, training programs, and educational campaigns. Commercial banks should keep their online banking

systems up-to-date and upgraded on a regular basis to ensure continued technical efficacy. The banking experience can be improved by adding new features, tightening security, and coordinating with complementary technologies.

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