

Research Article

# Domestic Debt Exchange Program Impact on Financial Sector Performance in a Digital Technology Era

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## Abstract

Governments economic recovery policy such as domestic debt exchange program (DDEP) significantly influences the patronage of digital financial products, and services in developing economies. This often led to a weakening of financial institutions' capital and overall performance. Using dual analysis, this study applies both qualitative and quantitative approaches to analyze the impacts of DDEP through the Lense of digital financial technology applications by financial institutions and conducted both regression and data envelopment analysis. Using the smartPLS model, paths were created to identify and analyze key impacting factors. A bootstrapping of 333 samples was carried out using selected financial institutions in a DDE implemented economy, weighing each case, where  $t = 1.96$  significant value was taken and a  $p$ -value  $< 0.05$  was also considered to be statistically significant. The study assumed that an efficient DEA is achieved if the DMUO has an ideal solution of  $\mu^*$ ,  $v^*$  in model two and  $\mu^* > 0$  and  $v^* > 0$  and includes a  $\Theta^*$ ,  $\lambda^*$ ,  $\lambda^*$  ideal solution. The study found that DDEP can have 15 negative impacts on financial institutions' performance. Also, most financial institutions were found to be inefficient in applying technology to mitigate the negative effects DDEP. Further, despite the introduction of advanced technology financial, the study results showed that nonperforming loans increased between 25% to 35% within twelve months of introducing the DDE, meaning financial institutions are unable to collect both principal and interest on loans by capitalizing technology on during the DDE program. Also, the sector collectively can suffer a sharp increase in impairment loss on financial assets by over 92% during DDE program. In addition, DDEP can caused between 48.5% to 5.68% sharp decline to return on assets.

## Keywords

Domestic Debt Exchange, Digital Financial Technology, Financial Performance, Financial Institutions, Economies

## 1. Introduction

Digital technology has dominated the financial sector, forcing various economic units to undergo continuous digital transformation [5]. The positive impacts of financial institutions using digital technology include the ability to offer new

services and reduce operating costs

Digital technology also enables businesses to gain a competitive advantage, improve operational efficiency, and enhance service delivery [52]. A recent review of the impact of

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digital technology on the finance sector shows that digital technology helps to improve customers' and employees' management, saves time and money and allows businesses to focus on core activities and work efficiently [35]. The above studies demonstrate that digital technology can help financial institutions overcome operational challenges and achieve profitability. However, this study presumes that the full potential of using digital technology has not been adequately explored by financial institutions that find themselves operating in debt exchange programs. The authors believe that a lack of comprehensive understanding of 'digital technology' may prevent financial institutions from fully capitalizing on its opportunities. Digital technology—the process of transforming businesses through technology was first introduced by [40]. Accordingly, digital transformation entails the process of transforming business sectors, such as banking, through various stages of digitization processes such as the digital documentation process, the introduction of new digital platforms, and the introduction of electronic banking products and services [19]. The importance of digital technology products, such as e-banking, to the banking sector by linking them to their geographical location and the benefits thereof, such as lower operating costs, improved customer service, and increased profitability [60].

It is important to note that the significance of digital technology products such as e-banking cannot be overemphasized, as it allows customers to perform various transactions from a secure website [5]. Although electronic banking (e-banking) services are widely considered most beneficial to promoting financial inclusion in developed countries due to high internet penetration, financial institutions in developing economies such as Ghana may not wholly push for e-banking services due to internet connectivity challenges in certain parts of the country [38]. Most financial institutions, especially commercial banks and selected microfinance institutions in developing economies like Ghana, have embraced digital technology by integrating ebanking into their business processes [8]. However, since the Ghanaian government unveiled the Domestic Debt Restructure plan in 2022, this study has noted shifts in Ghana's use of digital financial services and products. Notwithstanding the improved terms for creditors following protracted delays and adjustments. Other scholars have also predicted that the capital of Ghanaian financial institutions will continue to decline sharply because of the domestic debt restructuring. It has also been demonstrated through study that it would be challenging for financial institutions and other non-banking organizations to raise enough money to lend to the Ghanaian government [9].

One economic policy that impacts financial institutions performance is domestic debt exchange program (DDEP). In Ghana, this policy became a topical issue in the banking sector in late 2021 and was fully implemented in 2022. Since its implementation in 2022, the DDEP has affected most financial institutions performance and businesses in terms of access to funding and in deciding which financial institutions

products to invest their surplus funds in, despite the innovations digital technology has brought into the financial sector of Ghana [25]. Like many economies, Ghana was hit hard by the COVID19 pandemic [22]. The main economic recovery measure intended to stimulate economic growth by the government of Ghana is the introduction of the DDEP in 2022 as a measure to curtail the country's domestic debt. The program requires all holders of government securities to choose the option of exchanging their bonds for longer-term bonds with a growing interest rate or not. This policy, the government also explained, is needed to aid in reducing the government's debt servicing costs and improving its debt sustainability [31]. However, since its implementation, the DDEP non deliberate consequences of financial institutions in Ghana amid concern and speculation by customers and business owners about the future of financial institutions in the coming years in Ghana. As a result, most business owners in Ghana have significantly reduced their daily transactions with financial institutions [48]. One factor that has been identified as a major contributor to negatively impacting bank profitability is the DDEP. Like most developing economies, including Ghana was severely affected by the COVID-19 pandemic [21]. This had an influence on the country's economy, especially the financial sector, and led to the implementation of the domestic debt exchange program in 2022. The DDEP, as an economic recovery policy, requires all holders of government securities to choose between exchanging their bonds for longer term bonds with increasing interest rates. This policy has had a significant impact on the performance of financial institutions and businesses' access to funding. Although, digital technology has brought innovations to the financial sector but the introduction of DDEP in countries such as Ghana has also led to concerns and speculations among bank customers, particularly business owners, about the future of financial institutions in Ghana. As a result, many business owners in Ghana have significantly reduced their daily digital financial transactions, with the DDEP being a key factor negatively affecting bank profitability [46]. Also, regulatory requirements and changes can affect capital adequacy, risk management practices, and operations. Therefore, financial institutions must continually adapt to external factors by adopting appropriate digital technology to stay ahead of crises and build resilience. This study examines the impact of electronic banking on the performance of financial institutions during Ghana's domestic debt restructuring, aiming to provide strategies for leveraging digital technology to maintain profitability.

## 2. The Problem Statement

One could describe the financial sector's adoption of digital financial technology as marred by a poor start. Many financial institutions in the past avoided electronic banking mainly because they did not see the advantages it offered. Rather, some were of the view that the average cost of doing business with an institution using digital technology was the same as a

face-to-face transaction [32]. Also, the adoption of digital technology services by some financial institutions is merely focused on satisfying their customers' needs instead of profitability [7]. However, studies on the US community financial institutions, Turkish financial institutions, and financial institutions in developing economies have shown that the adoption of digital technology, particularly ebanking, has positively impacted bank profitability and created opportunities for introducing new products and improved services [32, 15, 51]. On the other hand, further studies have revealed that there are many challenges confronting the adaptation of digital technology in the banking sector. A study by Dietrich and [57] on the profitability of Jordanian financial institutions revealed that digital technology's negative impact on the financial performance of financial institutions was significant [41] also discovered that the Internet's presence negatively impacted the profitability of private financial institutions and their subcategories. Further, digital technology has also created an avenue for the banking sector to become more competitive. This situation has caused customers to become more discerning, demanding, and sophisticated. Additionally, the complexity of customer behavior has created some form of pressure on financial institutions to always want to meet customers' needs and expectations by investing heavily in technology and infrastructure to offer a wide range of digital products and services without considering the impact on profitability [10]. Also, technological advancement has caused huge disruption in the banking sector, leaving financial institutions with no option but to adopt this radical shift to sustain and thrive, because the absence of digital technology is so critical and can lead to poor decisions, failure, and render financial institutions irrelevant for not being able to meet banking customer expectations [29].

Also, government policies such as the suspension of payments on some external debts and launching of Domestic Debt Exchange Program (DDP) after being locked out of the international financial market leave financial institutions with no option but to sign up and deal with the uncertainties associated with signing up for the bonds, including a decision on how much impairment losses should be recognized and the possible liquidity challenges that may be associated with the exchanges. The Ghanaian banking sector continues to experience a bruising setback since the introduction of the DDP. The sector's financial institutions have reported a decline of 15.7% in the ratio of broad liquid assets to total deposits, an increase of 3.7% in the industry's Non-Performing Loan (NPL) ratio, and a 6.5% decline in the capital adequacy ratio, adjusted for regulatory reliefs, compared to 2021 [46, 22, 2].

These numerous obstacles listed above that financial institutions must contend with, in addition to adverse government economic policies like DDEP, are what led to the undertaking of this study to assess how digital technology affects financial institutions performance under a domestic debt exchange scheme. The study seeks to answer the following questions: What impact does digital technology have on fi-

ancial institutions' performance during the economic recovery? How does technology influence a bank's ability to participate? What effect does the domestic debt exchange program have on the performance of businesses and financial institutions? This study will undoubtedly contribute to the understanding of the true effects of DDEP on financial institutions, specifically in Ghana, as well as the influence of digital technology on financial institutions and companies during a period of DDEP.

## 3. Relevant Literature

### 3.1. Digital Technology in the Financial Sector

The advancement of Information and Communication Technology (ICT) has been accepted as the cause of a paradigm shift in most aspects of human life. In addition, technology has become a daily, unavoidable necessity needed in all aspects of the business environment and society, including virtual transactions and collaboration for smart homework, automation services, and digitalization of transactions and responses, and data analytics. Over the past twenty years almost every industry sector, particularly the banking sector, has undergone constant transformation by incorporating technology. Most importantly, digitalization has impacted many sectors by presenting fresh business prospects, innovation, and challenges as well [44]. Also, the banking sector is actively experiencing the influx of new technology each day. The sector can also be described as having successfully embraced digitization, particularly the widespread adoption of digital banking and electronic banking (E-banking) over traditional banking methods [44]. Undoubtedly, digitalization in banking is critical to Promoting effective 'know your customer' practices, improving communications, and increasing financial institutions' ability to meet customer needs [37]. Also, effective digital transformation begins with identifying the digital clients and their behaviors, choices, preferences, dislikes and likes, level of digital technology literacy, and expectations [55]. However, the attitudes of consumers have the biggest effect on digital banking products [3]. Affirming this, some authors explored the factors that influence the adoption of internet banking and discovered that perceived ease of use and attitude have a significant impact on bank consumer acceptance of digital technology [6]. These findings, in a way, prompted the need to establish the real impact of digital technology on the profitability of financial institutions. Accordingly, the return on asset (ROA) have been used to measure financial profitability performance, the result showed that while digital banking products and services may lead to higher profits in the long run, they do not guarantee the same level of returns in the short term due to the high implementation costs. Other studies also showed that the impact of digital technology on bank performance may be measured through a combination of skills and innovation. Using the case of financial institutions in Cameroon, it was noted that various

physical characteristics such as marital status, age, and education have a significant effect on a bank's customers and a consequential impact on profitability [13, 14].

On the other hand, an assessment of the effects of digital technology impact on the profitability of Jordanian financial institutions revealed that technology's negative impact on the financial performance of financial institutions was significant. Also, a significant link between profitability and the offering of digital banking products and services by Indian financial institutions, and on Nigerian financial institutions have been conducted after the introduction of digital technology. The studies discovered that electronic banking harmed bank profitability in the early stages of adoption after analysis of eight financial institutions annual financial statements [12, 27, 45]. However, some scholars applied different dimension to analyze the digital technology (DT) impact on bank performance by focusing on the various challenges that users face when using DT in terms of privacy, security, and internet connectivity. The results showed that the lack of internet access makes people reluctant to adopt the technology [50]. Also, fear of losing money and the lack of education of bank customers affect the impact of DT on bank profitability. It is important to note that all these studies used survey and/or ROA methods to assess the impact of digital technology on bank performance [17]. However, none of these studies were conducted during the period of the government's domestic debt exchange program, and none of the studies reviewed used dual analysis based on digital technology.

### 3.2. Domestic Debt Exchange Program - Implication for Financial Institutions

In recent times, the financial sector of most economies has actively tested and embraced the advancement of digital technology. Considered one of the industries that have successfully embraced digitization, the banking sector is dominated by the widespread adoption of digital banking products and services over traditional banking methods. However, the recent digital envelopment and some government economic recovery policies in the banking sector after the COVID-19 pandemic have caused much and potentially disruptive disruptions in the banking industry, which is considered one of the most established and fundamental sectors of the economy [42]. A major government economic recovery policy after the pandemic that has had a direct impact on financial institutions digital transformation and profitability in the case of Ghana is the introduction of the Domestic Debt Exchange Program (DDEP) of the government. Like many developing countries, Ghana, after the pandemic, is facing debt sustainability and debt servicing challenges, causing the government to default on its debt obligations, which prompted the launch of a domestic debt exchange program in an effort to arrest the problem. Under the policy, financial institutions that tend to invest heavily in government products, such as bonds, were presented with a limited option to surrender current bonds in

exchange for new bonds issued at new rates and maturities [53]. Signing up for the DDEP can have several unfavourable effects on individual bondholders and pensioners who hold these government products through investing in bank products, which in one way or another may require bank customers to utilize bank digital services. There are three common risks that financial institutions and individual bondholders face under a DDEP, including the high risk associated with the new debt instrument, low returns on investments, and decreased confidence in the government's ability to meet its obligations, which have huge negative implication on the patronage of financial institutions products and services [20]. Ghana's economic performance in the past has long been held up as a model for economic growth and political stability. However, the recent economic tumble of Ghana has surprised many, with the government blaming Ghana's economic woes on the pandemic and the Russia-Ukraine war. On the other hand, some economic analysts and experts, as well as a section of the Ghanaian people, have attributed Ghana's economic troubles to overspending on the part of the government [20]. It is a well-established fact that the implementation of DDEP comes with lots of unintended, unfavourable economic implications for businesses, particularly financial institutions [2].

Empirical studies have shown that Ghana is not the first country to implement DDEP since economies like Russia, Argentina, and Turkey have all implemented DDEP in the past [20]. In 1998, after announcing an international package of emergency financing and economic reforms, Russia was forced to devalue its currency, the ruble. This was later followed by a declaration to restructure all domestic debt obligations falling due at the end of 1999 and a ninety-day suspension on the repayment of private external debt to support local commercial financial institutions. A few weeks later, the Central Bank of Russia (CBR) floated the ruble. Causing the exchange rate to reach 21 rubles to one dollar, that is, over three times, compared to the previous 6.29 rubles to the dollar that had prevailed in the past [33, 18]. Also, Argentina in 2005 was recorded as having the biggest suspension of payments in history, and then again in 2010, a debt restructuring policy was introduced by the government to exchange old bonds for new ones, and all debt repayments amounting to \$80 billion went to private creditors and the Paris Club. amounting to \$6.5 billion were suspended [49]. In addition, Argentina has swapped \$21.66 billion in domestic debt, amounting to around 64% of loans due to mature in June 2023, to ease the fears of a debt default as the economy falters. Again, the DDED sees all old debt exchanged for new bonds that will mature in 2024 and 2025, in aid of helping to guarantee the sustainability of the Treasury debt. Between financial institutions, insurers, and companies, around \$17 billion was exchanged [54]. This is another clear indication of the impact of DDEP on financial institutions, which digital technology may not be able to overcome. The major debt restructurings in Turkey date back to the early 2000s, when large Turkish

financial institutions, through the so-called "Istanbul approach," were able to negotiate with other creditors without following formal processes and succeeded in implementing a debt-restricting policy. Then again, in 2018, the legislatures in Turkey sought to prevent the uncertainty surrounding the debt restructuring process and enacted a regulation on restructuring debts in the financial sector, where companies' creditors can approve a scheme with a majority in number and 75% by value of each affected creditor class. The Turkish DDEP is known as the "Konkordato principle," where a company's indebtedness can be restructured by asking for an amendment, extension, or haircut from creditors to help the company avoid bankruptcy [56].

Similarly, the Ghana government launched Ghana's Domestic Debt Exchange Programme (DDEP) on December 5, 2022, and extended an invitation for the voluntary exchange of 137 billion Ghana Cedis (\$12.12 billion) of bonds and domestic notes, including E.S.L.A. and Daakye bonds, for a new bond package to be issued. The new exchange excludes bonds, notes, and Treasury bills in total held by individuals [53]. To address the impact of the DDEP on the finance sector, stress tests were conducted by the Finance Ministry to estimate the potential impact of the program on financial institutions, insurance firms, regulated pension schemes, specialized deposit-taking institutions (SDIs), collective investment schemes, asset managers, and pension fund trustees that could result from their participation in the DDEP. Some of the steps that were taken by the Finance Ministry of Ghana to ensure forbearance on liquidity and solvency were to temporarily reduce regulatory liquidity and capital requirements for schemes and firms that voluntarily participate in the program. As well as the suspension of any new rules that will have negative consequences for the liquidity of participating firms and schemes. Ghana's financial stability is hoped to be achieved through the DDEP, which the Finance Ministry projected was going to generate a target size of GHs 15 billion (\$1.33 billion) each year for Ghana and its development partners [24].

Available information has shown that most financial institutions in Ghana recorded losses on their 2022 financial statements. The report of the 2022 financial statement has been met with concern and speculation about the future of these financial institutions in the years to come [2]. However, despite these challenges, there is some hope for these financial institutions for the 2023–2025 financial year because the government has shown a strong commitment to addressing the issues facing the banking sector. Additionally, available indicators have shown that the Ghanaian economy is recovering from the COVID-19 pandemic impacts. Further, some financial institutions in Ghana are already taking steps to address their financial challenges, including technology application, diversifying their portfolios to reduce their risk, and limiting their investments in government securities [46].

## 4. Methodology

Many scholars have established the positive impacts of technology on bank profitability. Using a survey, some of the scholars assessed digital transformation strategy impact in the banking sector by evaluating the acceptance rate of e-services. The study results showed that digital transformation is a continuous process that affects both the external and internal environments of bank operations [4, 35]. Also, for commercial financial institutions, digital transformation is a tendency and an obligation and is the only way to achieve sustainable development. It also helps to achieve improved efficiency and promotes enhanced performance in commercial financial institutions [61]. In addition, using a survey it was noted that the benefits of digital transformation for financial institutions are numerous. However, the implementation needs to be well-planned and executed [59]. Furthermore, digital technology is found can significantly improve bank profitability, business loans, deposits, and the efficiency of income acquisition. That is, digital transformation has specific effects on financial institutions' operating performance [61].

However, despite the huge contributions of digital technology to the banking sector, the banking sector continues to face many challenges that limit their ability to fully take advantage of the complete opportunities that technology offers. One of such challenges is the government's DDEP, which appears to limit the ability of technology to improve financial institutions performance. In the case of Ghanaian financial institutions, the banking sector can be considered to have fully embraced digital technology. Additionally, the introduction of a DDEP by the government in 2022 has negatively affected the performance of most financial institutions. Also, from the 2022 financial statements published, almost all financial institutions in Ghana recorded losses [43]. However, among other strategies, financial institutions in Ghana can deal with the threats associated with the introduction of the Ghanaian DDEP by utilizing digital transformation. That is, leveraging technology to increase efficiency, improve customer service, and reduce costs. Noting that digital transformation enhances the development of new products and services. In addition, investing in advanced technologies like artificial intelligence, blockchain, and other digital platforms assist to deal with the low customer trust in the banking sector which is linked to the uncertainties associated with the DDEP of the Ghanaian government, financial institutions in Ghana can learn from the DBS Bank in Singapore, which has been recognized as the World's Best Bank for its digital transformation initiatives that helped the DDEP bank reduce costs, improve customer satisfaction, and drive growth [47]. PwC Ghana's 2023 Banking Survey Report on Post-DDEP, which assessed the recovery strategies of Ghanaian financial institutions, revealed that digital technology continues to positively impact bank profitability. The report attributes profitability and 31% growth in the total income generated by the industry to interest income, trading income, fee, and commission income, the increased

volume of international transactions, and the uptake of digital services by customers. The PwC survey report clearly shows the need to further analyze the impact of technology on the banking sector to enable financial institutions to fully take advantage of digital technology during unfavourable economic conditions like DDEP.

A common characteristic of the literature reviewed above revealed that the authors used surveys and quantitative data to assess technology impacts on bank performance. Also, previous studies on technology and firms' performance have consistently used lots of quantitative measures, and these methods have been described as parametric methods. In this regard, non-parametric methods such as data envelopment analysis (DEA) models and the application of paths created in models have been identified as some of the best methods. This is because this method is suitable for the analysis of various factors and adequate to estimate the constructs of hidden variables to show the impacts of dependent and independent variables [48, 30]. Additionally, there are other effective methods that can be used to measure the performance of financial institutions. This includes the market valuation approach - where the prices and other relevant information generated by the market are used by financial institutions to determine the price of comparable instruments, and the income approach, where future cash flows or income streams are converted into a discounted amount [30].

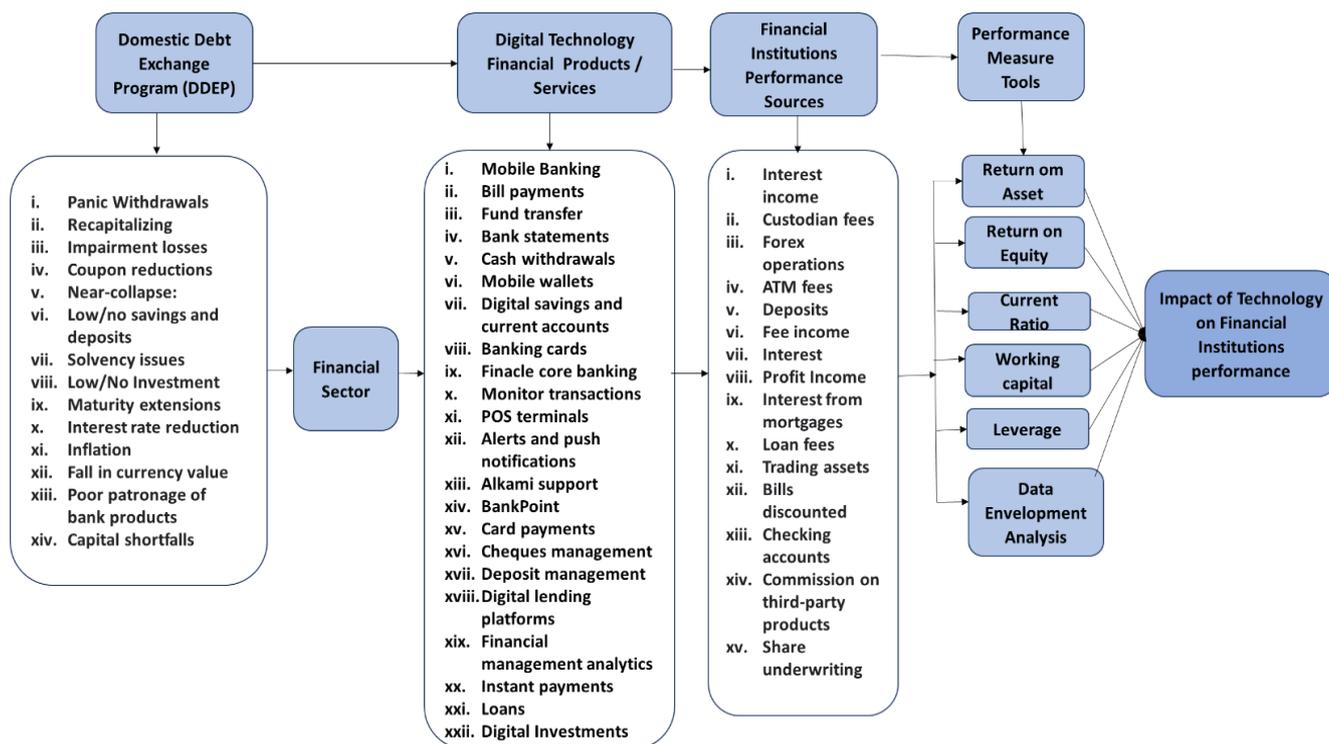
Considering the effectiveness and benefits of all the above methods, this study used both qualitative and quantitative research methods and the DEA method. A simple random sampling was used to select five major commercial financial institutions in Ghana. These financial institutions were selected because they share characteristics that are similar and represent the characteristics of other commercial financial institutions. The sample population consisted of 400 senior managers, junior managers, and junior staff of the five financial institutions. A survey was used for data collection, comprising both primary and secondary data from five major financial institutions in Ghana: Ecobank, Ghana Commercial Bank, Fidelity Bank, Absa Bank, and Consolidated Bank Ghana. The survey questionnaires were administered via email, face-to-face, phone, and video calls, out of which 333 members of the sample population responded to the survey questions. The collected data was analyzed in SPSS to provide a summary of the data. The study also applied the thematic analysis method to qualitative data to help identify key themes and patterns in the data. As part of the ethical considerations, the study chose this research method because it relates specifically to the research aim. Also, these methods were chosen because they will help the study overcome the challenge of using only qualitative methods to analyze financial institutions' performance in the DDE program. Also, respondents voluntarily participated and consented to give information to support the study. The study is conducted considering the safety and confidentiality of all participants.

## 5. Results and Discussions

### 5.1. Analysis of DDE Program and Digital Technology Impact on Financial Institutions

The digital transformation in the banking sector has had a tremendous impact on bank operations and profitability. With technological advancements, financial institutions can offer better opportunities and smarter products to their customers. The reality is that the impact of technology on the banking industry is multiple and can be attested to by all, judging from the speed at which financial institutions operate. The study, through a literature review, observed that the implications of DDEP on financial institutions in the current technology-driven financial sector are massive and intense. Using the SmartPLS model, the study has presented the DDEP implications for financial institutions in a model form, as shown in Figure 1 below. From Figure 1 of the study, the introduction of a DDEP can have fifteen negative impacts on the performance of financial institutions. Also, it became clear that, with the help of digital technology, financial institutions can leverage twenty digital technology products and services to overcome the negative impacts of DDEP.

The study results from Figure 1 show that DDEP exposes financial institutions to fourteen financial risks, including panic withdrawals and low or no savings: The uncertainties and misinterpretations that surround DDEP often lead depositors to withdraw their funds, even though they should not, due to the beliefs of depositors overestimating the probability that a bank run is underway [34]. Recapitalization issues: the study observed that one common feature associated with the introduction of DDEP is that financial institutions must increase their capital ratios to meet the new regulatory requirements. In most cases, financial institutions do this by either reducing assets or raising new equity capital. However, most financial institutions often use the first option due to the higher private costs of equity issuance [36]. Impairment losses - a market value, the country's external market, and liability variables are negatively related to the recognition option and may indicate that these exposure factors cause impairment losses [23]. Coupon reduction and maturity extensions - domestic debt restructurings possess a distinct feature that negatively imposes direct costs on the local financial system and potentially reduces the fiscal savings for the economy from the debt exchange. Also, new bonds are credited to the holder's securities account at the Central Securities Depository (CSD), from which their eligible bonds are tendered, and payments are deferred to a later date in the future [28]. Near-collapse and solvency - DDEP as one major factor that contributes to bank losses due to the negative impact it has on the bank's profitability position [2]. An estimated twenty-three (23) financial institutions in Ghana could lose about \$3.36 billion (GH¢41.3 billion) from the DDEP, which could adversely impact their solvency [11].

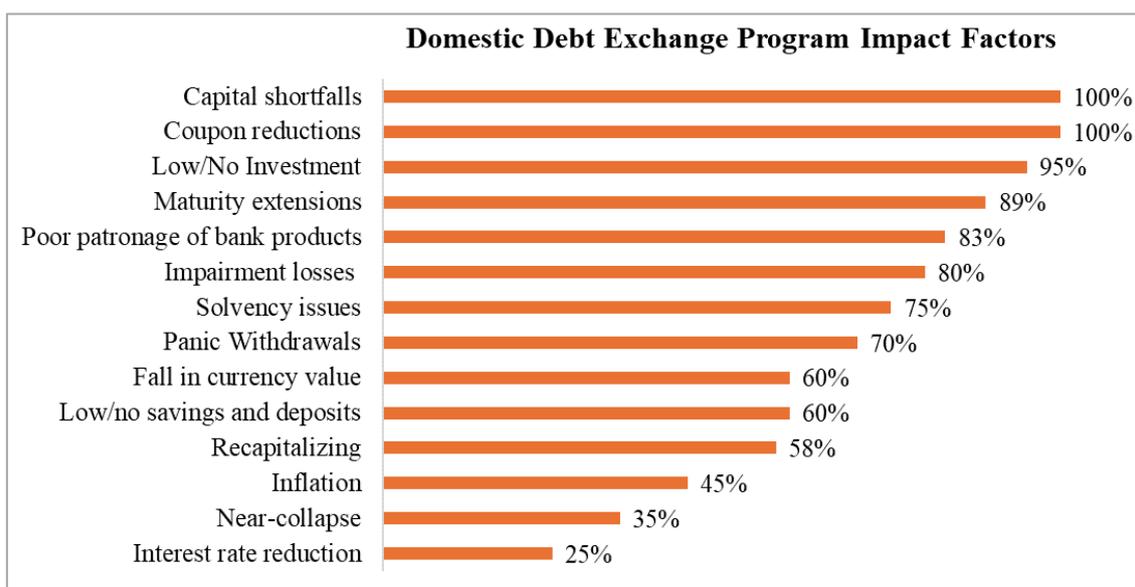


Sources: This Study

Figure 1. DDEP Impacts Versus Technology Impacts on Financial Institutions Model.

i. Statistical analysis

In response to the questionnaires of this study by selected financial institutions, the figure 2 below shows the extent of DDE impacts factors on financial institutions.



Source: this study

Figure 2. Domestic Debt Exchange Impact Factors.

Figure 1 above shows that 100% of financial institutions indicated that they suffered capital shortfalls and coupon reduc-

tions due to the implementation of DDE. Also, 95% and 89% of the respondents indicated that they experienced low or no new investment or maturity extension, respectively. A further 83%, 80%, 75%, and 70% of respondents also reported having suffered poor product patronage, impairment losses, solvency issues, and panic withdrawals, respectively. In addition, 60%, 58%, 45%, 35%, and 25% of the respondents indicated that they had suffered a fall in currency value, low savings, recapitalization challenges, inflation, a near-collapse, and an interest rate reduction because of the introduction of DDE. From Figure 2, this study observed that the seven critical impacts of DDE on financial institutions are coupon reductions, capital shortfalls, maturity extensions, low/no investment, solvency issues, im-

pairment losses, and poor patronage of bank products.

Also, the paths created in models are one of the best methods identified to be suitable for the analysis of various factors and adequate to estimate the constructs of hidden variables, and this supports the model developed in Figure 1, and this is affirmed in the studies of [48]. Further bootstrapping of 333 samples was carried out, weighing every 333 cases, where the  $t = 1.96$  significant value was taken and a  $p$ -value  $< 0.05$  was also considered to warrant the statistical significance of the SmartPLS model developed in Figure 1. Table 1 indicates the factors for the latent endogenous variables used, which were obtained from the observed item scores. Table 1 shows the correlation results with  $N = 333$ , where  $p < 0.00$ .

Table 1. Correlations results.

Variables	1	2	3	4	5	6	7	8
<i>Control</i>								
1 Financial Institutions Performance	0.71							
<i>Prognosticators</i>								
2 low/no investment	0.10	0.00						
3 Poor patronage of bank products	0.13	0.03	0.70					
4 Impairment losses	0.15	0.02	0.16	0.71				
5 Solvency issues,	0.18	0.01	0.19	0.75	0.77			
6 Maturity extensions	0.13	0.12	0.20	0.22	0.78	0.82		
7 Capital shortfalls	0.032	0.13	0.54	0.26	0.68	0.74	0.83	
8 Coupon reductions	0.042	-0.03	0.92	0.02	0.07	0.79	0.81	0.92

A significant statistic of the standardized factorial loadings was performed to assess the indicator's reliability. As a common rule, for an indicator to be accepted, the score in the measurement model used for evaluation should be from 0.70 and above, and any indicator with a score from 0.40 to 0.60 should be considered an outer loading and should be excluded [26]. This implies that compound reliability increases the alternative to Cronbach's alpha as a measure of the internal reliability of the developed model, and the score obtained is higher than 0.70. Table 1 shows that the results of the constructs of coupon reductions, capital shortfalls, maturity extensions, poor patronage of bank products, impairment losses, and solvency issues exceed the minimum requirements to be considered as factors that influence the performance of financial institutions during the implementation of DDE. The study sought further to establish why financial institutions consider the indicators above as critical factors that impact their performance in a DDE program using a threshold of 3.5. Table 2 below shows the mean and standard deviation indicators of the impact on financial institution performance.

Table 2. Mean and Standard Deviation.

Indicators	Mean	Std. Deviation
Coupon reductions	1.58	.499
Poor patronage of bank products	1.66	.679
Impairment losses	4.64	.478
Solvency issues,	4.57	.498
Capital shortfalls	4.57	.498
Maturity extensions	1.23	.417
low/no investment	1.20	.410

A regression analysis was conducted using the forced entry method to assess the relative impacts of the DDE program and digital technology in assessing financial performance. Table 3

below presents the unstandardized (b) and standardized (beta) regression coefficients, the multiple correlation coefficients (R), adjusted R2, and the value of t and its associated p-value for each variable that entered the equation. The study results ap-

pear to show that DDE explains the huge variance in financial institution performance (beta = -.68, t = -5.871, p<0.001) and is a good predictor of financial institution performance.

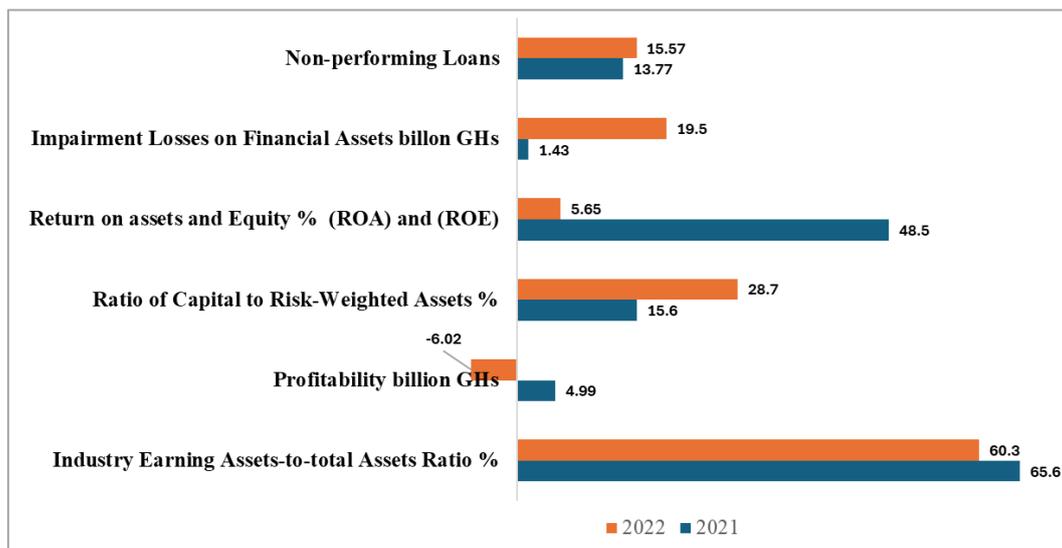
**Table 3.** Regression Analysis.

Variable	B	Beta	R	R <sup>2</sup>	T	Sig (t)
Constant	22.00				3.743	.003
DDE	-5.30	-.68	.		-5.871	.000
Digital Finance	-0.56	-.02			-0.125	.797
			.91	.80		

Source: this study

Analysis of the Collective Financial Sector Performance  
 Analysis of data collected from the financial sector shows that almost all the financial institutions in Ghana experienced

the negative impacts of DDE in their 2022 financial year. **Figure 4** below shows the collective industry performance of financial institutions in 2021 and 2022 (PwC 2023 Survey).



Source: This study

**Figure 3.** Collective industry performance in 2021 and 2022.

Analysis of **Figure 4** above shows that nonperforming loans increased from GHs13.77 billion to GHs15.57 billion within twelve months of introducing the DDE, compared to 2021 and 2022, indicating that financial institutions are unable to collect both principal and interest on loans during the DDE program. Also, the sector collectively suffered a sharp increase in impairment losses on financial assets, from GHs1.43 billion in 2021 to GHs 19.5 billion in 2022, indicating that the financial asset value of financial institutions could decline by over 92% of its value during the DDE program. Additionally, return on assets declined sharply from 48.5% in 2021 to a low of 5.68%

in 2022, signalling that the profitability of financial institutions was severely affected by DDE. Further, the ratio of capital to risk increased from 15.6% to 28.7%, an indication that the introduction of DDE exposes financial assets to more financial risk by increasing their present risk by over 83%. Unfortunately, the financial sector could not even maintain the old profitability; instead, profitability in the sector dropped from 4.99% in 2021 to -6% in 2022 after the Ghanaian government introduced DDE. This decline in profitability indicates that the introduction of DDE could adversely impact the profitability of the financial sector by 183%. Fur-

ther, earnings on the industry's assets to total assets declined from 65.6% in 2021 to 60.3% in 2022, indicating that the DDE program could cause financial institutions to experience an 8.8% decline in their assets to total asset earnings.

### 5.2. Assessing Digital Technology Impact on Financial Institutions in DDE Program

According to Dash et al., the application of DEA compared to other methods used to analyze technology impacts on firms' performance is the strongest technique. Also, many scholars have applied DEA to assess the impact of technology on firms' performance and suggested that the application of technology has a positive impact on firms' performance [16]. In this regard, the study applied a two-stage DEA model to empirically assess digital technology impacts on financial institutions during a DDEP [58]. This study uses a data set of 333

decision-making units (DMUs) and a digital technology product: electronic banking contributions (%EB) as an output in stage 1 and electronic banking commissions (EBC) as an output in stage II. To determine the efficiencies of each DMU (financial institution), the DEA algorithm with the package Rowbust DEA (Rdea) Version 1.2-5 in R Studio was applied, and codes in the R language were written. The R was used to generate the result of the efficiencies generated, analyzed, and presented. The DEA model shown in Figure 2 is constructed in the form of a case study using data from the PwC Ghana 2023 Banking Survey. Figure 2 below shows the two-stage DEA model for financial institutions performance efficiency aided by electronic banking products, which has been further developed based on DEA [39].

Figure 5 shows a two-stage DEA model for financial institutions performance efficiency aided by electronic banking products.

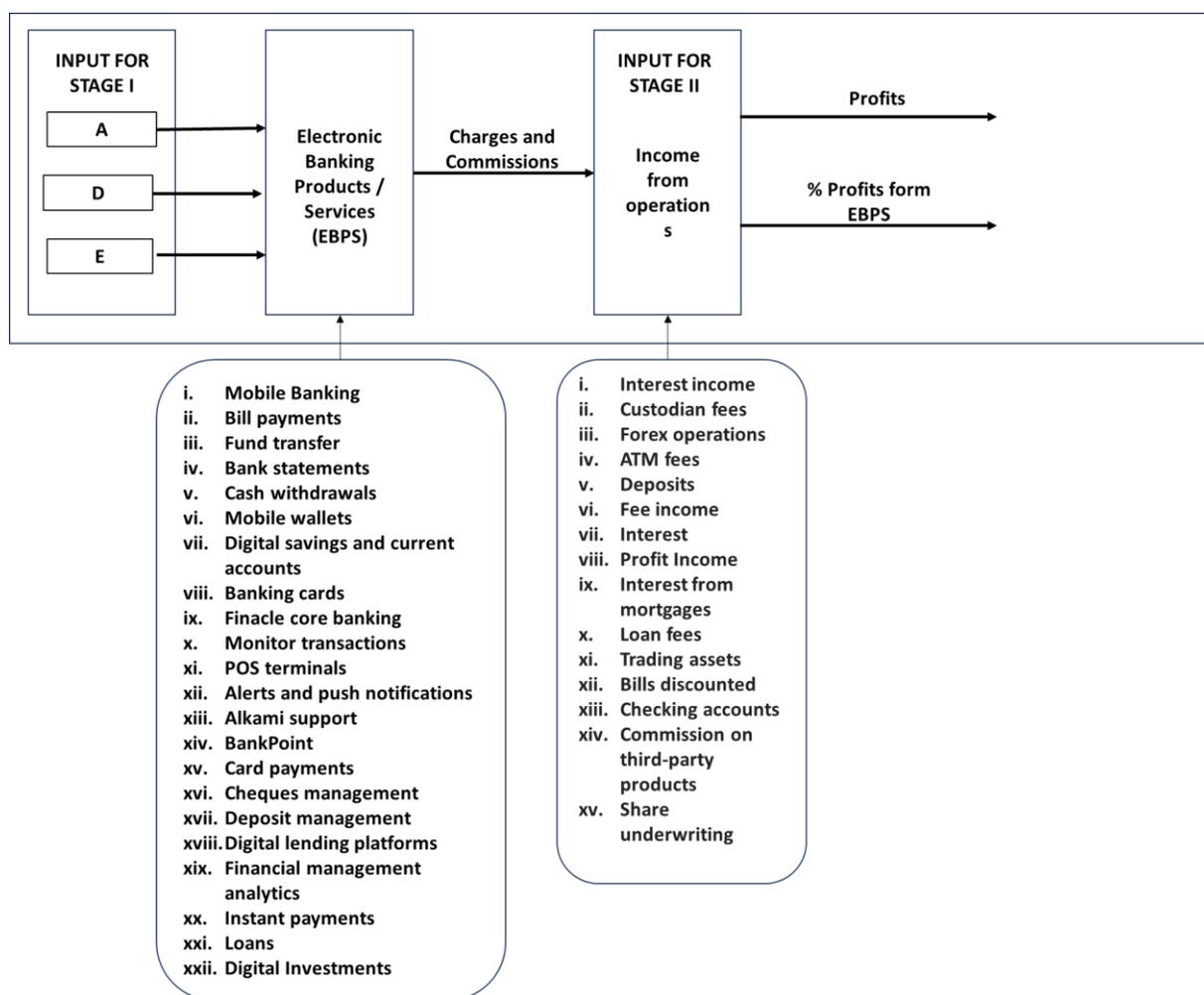


Figure 4. Two-stage DEA model for financial institutions performance efficiency.

Further, the study used the non-parametric method to produce a comparative ratio of weighted outputs to inputs for each DMU under consideration and presumed that there are n DMUs

that will be evaluated in this study's case of n=333, where each DMU consumes m different inputs. In the case of stage I this study considers the m different inputs as the losses associated

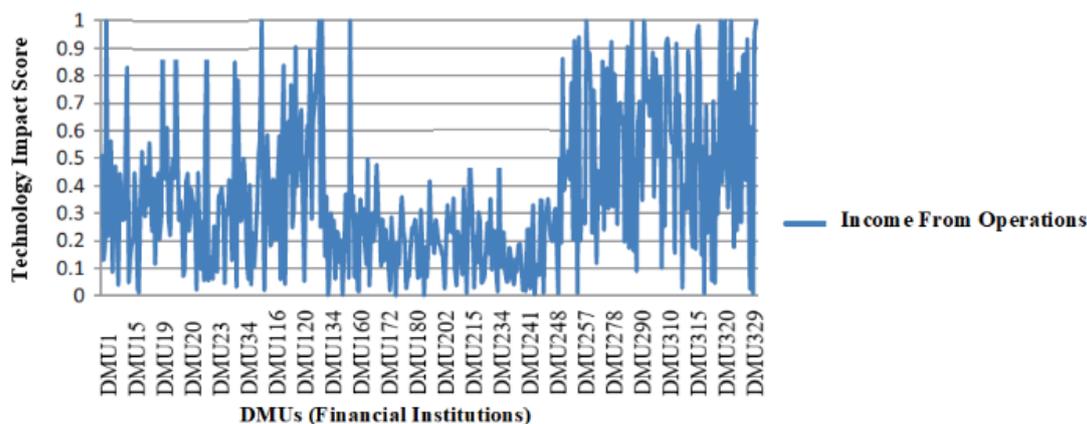
with the DDE program, electronic banking expenditure, and the bank’s assets to produce different outputs. Also, in stage II, the core input considered by this study is income from EBPS, which is also the main output of stage I. Further, at the complete stage, the entire profits made from the operations in stage II and the percentage profit from EBPS are the two main outputs. In the construction of the envelope model, the study assumed that the DMU<sub>j</sub> utilizes the amount  $x_{ij}$  of input  $i$  and produces the amount  $y_{rj}$  of output  $r$ . The study assumed that  $x_{ij} > 0$  and  $y_{rj} > 0$ . Based on this, the input efficiency of the DMU<sub>0</sub> is determined under the assumption of variable returns to scale (VRS) of a specific primal-dual linear.

The DMU<sub>0</sub> that will change onto the frontier, and it is defined by the envelopment surface of  $Z_0 = \theta - \epsilon \cdot \bar{T}S^+ - \epsilon \cdot \bar{T}S^-$

The efficient DMUs variable  $\mu$  determines the corresponding diminishing of all inputs in the sample used. Also, the study assumes that an efficient DEA is achieved as far as the DMU<sub>0</sub> has an ideal solution of  $\mu^*$ ,  $v^*$  in model two and  $\mu^* > 0$  and  $v^* > 0$  and includes a  $\Theta^*$ ,  $\lambda^*$  ideal solution. Financial institutions in Ghana that have been severely impacted by the Ghanaian government's DDE program and whose financial performance measures are grouped into inputs and outputs in the DEA model, which consists of various units, are under consideration in this study. The first stage (electronic banking products and services) of the model consists of electronic banking products that innovative technology has made it possible for financial institutions to offer to customers to promote deposits, investments, payment of charges, and commissions in Ghana cedis (GHs) as a measure from the DDE program, electronic banking expenditure, and the bank’s asset to produce a different. In the next stage, which is income from operations, financial institutions are able to generate enough income by offering innovative electronic products and services to strive during DDE programs and improve their performance. The application of the DEA model at stage I will assist stage II in forming financial institutions (DMU) to attain higher financial performance. The Ghanaian cedi values of the financial institutions are electronic banking expenditure,

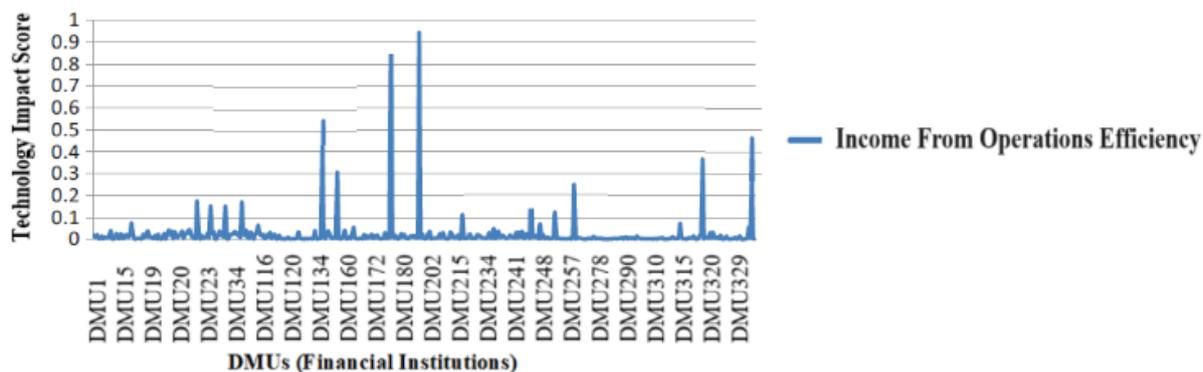
fixed assets, operations costs, and profits generated from charges and commissions. The percentage of income from operations was obtained from the various DMUs. Specifically, the 2022 financial statements of financial institutions were used, and the income from operations of various financial institutions was a dual operation contained in two core value-added activities, as shown in Figure 4.

The study also considered that the main technologies used by financial institutions are automated teller machines (ATMs), computers and software installed for operational purposes, the internet, and mobile phones used to provide products and services, collect deposits, charges, and commissions, and use them for the institution's investment through electronic means. Financial institutions financial performance and profit were measured after all the various deductions, including tax and bad loans, given out in stage II. The impact of each DMU at each stage was analyzed using an impact score of 1 unit, or 100%. For each selected financial institution's use of technology to collect charges and commissions from customers, only 15 (4.5%) were successful. Also, out of the 100% units, 82% felt the impact of technology in generating income from operations. Additionally, 34 (10.2%) institutions also had a score between 80% and 99% on technology impact on their operations income; 23 (6.9%) also had a score between 50 and 79; 20 (6.0%) had a score between 60 and 70; and 19 (5.7%) had a score between 50 and 59; and finally, 252 (75.68%) had a technology impact score below 50%. The 75.68% of financial institutions that scored below 50% suggest that most financial institutions, particularly Ghanaian financial institutions, are not able to utilize technology to avert the negative impacts of the DDE program on their operations. To address this hurdle, financial institutions must become abreast of modern technology and adopt a proactive and adaptive approach to help them foster a culture of risk awareness, rigorous strategic planning, and continuous learning to curtail similar situations in the future [46]. Figure 5 below shows financial institutions ability to use modern technology to increase revenue from charges and commissions, and Figure 6 shows the efficiency of the usage of technology to generate revenue.



Source: this study

Figure 5. Financial institutions use technology to generate revenue.



Source: this study

**Figure 6.** Efficiency in the Usage of Technology to Generate Revenue.

This study starts the interpretation of figure 6 above with an explanation of the acceptable score. Practically, it is complex to have units attain a 100% performance score in the financial sector through technology applications. In this regard, the Central Bank of Ghana normally uses between 80% and above in grading the financial institution's system in terms of its performance [1]. In this regard, this study also interrogates the results of figures 5 and 6 concerning assessing financial institutions performance and efficiency in using technology to generate revenue in a period of DDE program, which should be between 0.8% and above. For financial institutions ability to use technology to generate revenue, only DMU172 and DMU180 were efficient in the application of digital financial technology to improve revenue performance during the initial stage of the DDE program, with scores between 80% and 100%. These results indicate that about 98% of financial institutions considered in this study were not efficient in using technology to improve revenue generation under a DDE program since its introduction by the Ghanaian government. This also confirms reports that most financial institutions in Ghana recorded losses on their 2022 financial statements. The report of the 2022 financial statement has been met with concern and speculation about the future of these financial institutions in the years to come [8, 46]. This has led many financial institutions, particularly those considered in this study, to face many financial challenges because of the introduction of the DDE program [43]. The overall efficiencies in the entire financial sector's operations show that most financial institutions had scores between 50% and 65%. Although most financial institutions did not achieve higher efficiency in improving revenue, they still enjoyed higher overall efficiency in general operations using digital financial technology applications.

## 6. Conclusions

This study identified that DDEP can have fifteen negative impacts on financial institution performance including panic withdrawals, solvency issues, recapitalization, coupon reduc-

tion, maturity extensions, uncertainties, and misinterpretations as the most challenging for financial institutions. It is important to note that most studies affirm the conclusions of this study [35, 34, 28]. However, with the application of appropriate digital financial technology, financial institutions can leverage the twenty opportunities offered by digital technology identified by this study to overcome the negative impacts of DDEP. Financial institutions severely impacted by the DDEP program should strive to achieve 80% and above efficiency based on this study's DEA standard measure in the application of digital technology to improve their financial performance. Also, financial institutions that scored below 50% in digital financial technology suggest that those institutions, particularly Ghanaian financial institutions, are not able to utilize technology to avert the negative impacts of DDEP on their financial performance. According to the DEA analysis, many of the financial institutions considered in this study were inefficient in applying technology to avert the negative impact of DDEP on their financial performance because they had a score of 50% or less. To address this hurdle, this study posits that financial institutions must act proactively, develop an adaptive approach, and become abreast of modern technology to foster a culture of risk awareness, rigorous strategic planning, and continuous learning. Although most financial institutions were inefficient in using digital financial technology to improve their financial performance, the overall efficiency in terms of general operations using digital financial technology was very efficient and high. This indicates that digital financial technology had significant positive impacts on the overall performance of financial institutions in DDEP economy. Therefore, leveraging digital financial technology to drive revenue is the way forward to improve the financial performance of the financial sector during a DDEP.

## Abbreviations

DDEP Domestic Debt Exchange Program

## Data Availability Statement

The data is available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare no conflicts of interest.

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## Research Fields

**Joseph Asare:** finance, economics, taxation, banking operations

**Jones Adjei Ntiamoah:** taxation, economics, finance

**George Oppong Ampong:** banking operations, finance, economics

**Peter Arhenful:** Accounting, finance, taxation, economics