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The Impact of Financial Technology on Banking Sector: Evidence from Egypt

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Abstract :

Purpose: *Financial technology is now critical for each firm to ease and simplify commercial transactions. The purpose of this study is to examine the efficiency of the banks in Egypt after the spread of FinTech.*
Design/Methodology/Approach: *The shortage of studies in this field in Egypt is presented as the paper's concern. Financial statement data were used for a period from 2014-2020 from the CBE Egyptian bank with Fintech collaborations. Three alternative models with different input-output combinations were developed, based on production, profitability, and intermediation dimensions to evaluate the banks' efficiency using DEA technique.*
Findings: *The results revealed that the Egyptian banks' efficiency does not relatively improved by introducing the financial technology except for deposits and total loans.*
Research implications: *This study contributes to the literature on the adoption status of Fintech services in Egypt and its impact on the banks' efficiency. Egyptian banks need to find more innovative ways to accelerates the transforming of the Egyptian society into a non-monetary society.*
Originality/value: *This study holds significance as it provides the empirical evidence for insufficient improving Egyptian banks' efficiency by introducing the financial technology except for deposits and total loans and the necessity to rushes the renovating of the Egyptian society into a non-monetary society as a part of the Egypt's 2030 Sustainable Development Plan.*

Keywords: *FinTech, banking efficiency, DEA*

JEL codes: *G20, G23.*

Paper type: *Research article.*

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1. Introduction

Banks are trying hard to provide easier, faster, more comfortable, secure services and to convey the modern technology age, but on the other hand, they are facing several challenges, especially with the development of financial technology companies that have forced banks to keep pace with technology. Financial technology, abbreviated as FinTech, is an invention that intends to contest with established financial approaches in the supply of financial services. The first word (fin) indicates finance, and the second word (tech) implies technology. It is a novel industry that employs technology to advance financial activities by depending on much more intense use of information technology. Furthermore, it made the financial transactions too simple, as you can with one click convert money or open a checking account, bank certificate, or depositing a check etc., (Leong and Sung, 2018).

FinTech's advantages concern all users of financial services; it has an impact on the economy because of its effect on GDP and financial inclusion. It boosts the gross domestic product (GDP) of digitalized economies by giving individuals and small, medium, and big companies suitable entrees to a variety of financial products and services (as well as credit facilities), which can increase total consumption and ultimately GDP levels. Digital finance has the potential to promote economic stability and financial intermediation for both clients and the economy. In banks, FinTech is interested in connecting the IT department with the financial department to enhance the system’s infrastructure and programming capabilities, the development of FinTech business models around technology and software to be flexible to any business needs without affording huge costs and preparatory work as well.

FinTech considers as the main banking tool to achieve a high level of financial inclusion (Anwar *et al.,* 2020). According to the World Bank in 2014, only about 12% of Egyptians and 14% of adults had a bank account in Egypt, one of the world's lowest penetration rates, while the mobile penetration rate of 102% and 33,9% of internet users, which proven that FinTech is the great development that banks need to improve its services, efficiency and increasing the inclusion (Nabil, 2019; Demirguc-Kunt *et al.,* 2018).

Big data is likewise an area where tech firms can greatly support banks and Firms, resulting in a critical aspect of personalization and an overall better quality of customer experiences. And now by the flood of FinTech startups in the market and its competitor with bank's institutions, banks need to evolve into digitization. FinTech applications have had an impact on the financial industry, resulting in the following changes:

Lending/Loan: Mobile phones can now be used all across the world to apply for loans. Customers can get credit reports at any time of year without revealing their

credit scores. The backend of the entire lending sector is now significantly more open as a result of this. In addition, he stated Digital Payments, in which customers use mobile wallets as an alternative to credit cards. People can transmit money without using traditional banks and handle payments more cost-effectively with digital banking. Google Wallet and Apple Pay are two of the most well-known digital wallets.

According to Mroczkowska (2020) there was more than one FinTech application. First, trading online apps have enabled everyone with internet access to invest in the market, analyze risk immediately, and spread expertise inside the online platform itself. Banking for Individuals customers might now govern their finances through the internet. Banks and start-ups in this field are evolving online wallets and profiles to follow services, resulting in an improved and faster user experience that enhances the digitalization of the world. Second, digital solutions are being used by InsurTech insurance businesses to improve client experience. Users can sign up for new services and submit claims directly from the app at any time. without consuming time that they had to go through previously. Third, Personal wealth management is a category of FinTech applications that focuses on improving the wealth management procedures of enterprises and individuals. Fourth, Blockchain technology has become an important part of today's financial scene. This cutting-edge technology provides a transparent method of tracking financial transactions throughout their full existence. Fifth, the Financial Conduct Authority (FCA) established RegTech (Regulatory applications) in 2015. Innovative solutions are used in this industry to improve compliance and give secure, cost-effective services. Its goal is to standardize and improve regulatory processes' transparency, as well as to automate features like risk management, transaction monitoring, and regulatory reporting to some extent.

Egyptian banks cooperate with the Central Bank of Egypt and the regulatory bodies to achieve economic growth to transform the Egyptian society into a non-monetary society where technical expertise is shared to provide financial services to people who do not deal with banks to enhance financial inclusion in Egypt. Financial inclusion in Egypt need more bank branches in every place for easy access to customers in all parts of Egypt, and consequently, the ATMs to provide financial services and products at an affordable cost, to reduce poverty, achieve economic growth, and financial illiteracy (sustainability report 2019 'CIB')[2].

The goal of this research is to find out how financial technology affects Egyptian banks' efficiency. We aim as well to introduce innovative ways to encourage investors to invest in FinTech start-ups to increase the number of FinTech firms in Egypt to improve the efficiency of banks and understand the challenges that face FinTech spread. Therefore, the study is seeking answers to the following questions:

[2] *https://ir.cibeg.com/en/sustainability-reports.*

Q1: How has FinTech affected the banking industry in Egypt?
Q2: What are the best practices to make banking more efficient?
Q3: What are the finest ways for financial technology to reach all segments of society?

The remainder of this research is organized as follows. The literature review and hypotheses development are discussed in the second section. The research methodology is discussed in section 3. The results will be presented in section 4 after that the conclusion and discussion are addressed in section 5.

2. Literature Review and Research Hypotheses

Parameshwar *et al.* (2019) stated that Fintech practices are causing disruptions in traditional financial institutions, according to the report. Based on the likelihood or significance of GDP growth, Nepal, Malaysia, India, Indonesia, Thailand, the Philippines, and Vietnam are among the nations represented in the sample. World Bank statistics (2015-2017), as well as other important websites such as the Global FinTech Report (2013-2017), World FinTech Reports (2017), and PWC Global FinTech survey, were used to compile relevant data (2017). FinTech services such as mobile money accounts, utility bill payment, and using mobile and internet to contact financial institutions were found to be helpful. Supporters of FinTech businesses, such as venture capitalists and private equity, have a favorable impact on Asian countries' GDP.

Wonglimpiyarat (2017) explore FinTech and its dynamic transitions in the banking industry. The study introduced a systemic innovation model which can be used as a dynamic tool to track the growth and design of the technology development and diffusion. The research confers the newest financial innovation of PromptPay FinTech – the e-payment system in Thailand as well. The case study approach has been used to examine the systemic innovation characteristics of FinTech-based innovations. Interviews with five main commercial banks in the financial services industry of Thailand have been conducted. The findings illustrated the systemic characteristics of FinTech-based innovations in the banking industry, both on a global scale and in Thailand's case. The investigates have shown that systemic characteristics of the innovation process are the outcome of interactions between the complexity of the innovation and the capabilities of innovators in handling the innovation.

Panjwani and Shili (2020), tested the influence of financial technology on the growth of the Islamic banking sector in the modern world. The sample taken for this study is the Islamic banking sector in the contemporary world for the period 2014 to 2018. The results showed that financial technology appears to play a key role in the empowerment of people who do not have access to financial services, resulting in immediate and sustained interest for people, the planet, and wealth. The financial sector's fast change has affected people all across the world. The rapid digitalization

prompted a significant increase in the use of technology in the banking business, particularly in the Islamic banking sector. This study investigates how financial technology advances motivate financing efforts to improve the quality of Islamic banking sector services in today's world, as well as the new concept of digital Islamic banking.

Drasch *et al.* (2018) clarify the effect of digital transformation in the financial sector, and the cooperation between banks and financial companies, the sample used in this research is based on the literature, 136 real-world cases, and 12 experts with Bank executives and industry experts in financial technology were executed. Findings point to 13 parameters for organizing and defining bank-fintech collaboration. Furthermore, the empirical investigation enables the detection of prevalent cooperative behaviors. good consideration must be given to the effect of cooperation between banks and financial companies, as it may result in some security risks for banks, and that study made some proposals, such as making a classification scheme for workers to evaluate joint efforts in the interaction of banks with companies.

Baber (2020) investigated the effect of FinTech applications and crowdfunding on customer retention at Islamic banks in Malaysia and the United Arab Emirates, the sample for this study was drawn from 535 customers from selected Malaysian and UAE banks. Cronbach's alpha was used to test the consistency of all FinTech, crowdfunding, and customer retention elements. The Kaiser–Meyer–Olkin (KMO) is used to see if the data set was suitable for factor analysis. The results have shown that there is no relevant relation between financing applications of FinTech and customer retention in the selected banks, but other variables such as crowdfunding, payments, advisory services, and compliance have a positive effect on retaining customers of Islamic banks in the selected countries.

Wang *et al.* (2021) FinTech's possible impact on the banking industry was investigated from 2009 to 2018, 113 Chinese banks were sampled, there are 18 national banks (six state-owned big banks and twelve joint-stock banks), 72 urban commercial banks, and 72 rural commercial banks (a total of 72). 23 TFP was used to assess bank competitiveness, the DEA Malmquist technique was used to calculate TFP, SYS-GMM, and DFF-GMM were used to enhance the results. FinTech development has a favorable impact on earnings, financial innovation, and risk management, according to the findings. Commercial banks can improve their performance by implementing financial technology.

Wang *et al.* (2021) tested the influence of FinTech development on banks risk-taking on a database of 320 banks in China and found that the FinTech development reduces banks risk-taking especially in banks with low efficiency, and the banks with more shadow banking business are available mostly for the negative impact of FinTech. They suggest cooperation between banks and FinTech to reduce risk-taking

and recommend more researches in different countries to enable more generalization of the results.

Cheng and Qu (2020) clarified how financial technology banks affect credit risk in China, the sample taken for this study is 60 commercial banks in China from 2008 to 2017 as that Financial technology banks reduce the risk of credit for Chinese commercial banks, and financial technology banks are the least risky among the traditional state-owned banks, and the development of Internet technology is higher on AI technology and blockchain.

Hu *et al.* (2019) through empirical research, examine the primary elements that influence the selection of FinTech services, as well as user behavioral goals in China. To examine how consumers, embrace Fintech services, the authors present an improved technology acceptance model (TAM) that integrates user innovativeness, government support, brand image, and perceived risk as drivers of trust. A questionnaire was sent to the clients of the Hefei Science and Technology Rural Commercial Bank and got 387 qualified replies. The results show that there was confidence between users of financial technology, but there were some risks such as Internet risks, social risks, and others. Furthermore, users' views toward Fintech adoption are unaffected by perceived ease of use or perceived risks.

Ntwiga (2020) investigated the influence of FinTech on banks' collaboration by measuring the technical efficiency in the Kenyan banking sector. The sample taken for this study is five banks for the period from 2009-2018 in Kenyan. The results showed a positive relationship between financial technology and banks efficiency, as financial technology helped to increase technical efficiency on a large scale. The results showed that the period before the use of technology was suffering from a lack of efficiency and high productivity.

Li *et al.* (2017) indicated the ability of FinTech on digital banking. The sample taken for the study is 47 incumbent US retail banks from 2010 to 2016. ROA-ROE is the measurement of FinTech on digital banks. The results indicate a positive relationship exists between the growth in FinTech funding or deals and the concurrent stock returns of incumbent retail banks. Although these results suggest complementarity between FinTech and traditional banking, the results at the banking industry level are not statistically significant, and that the coefficient signs for about one-third of the banks are negative, but not statistically significant. Since the FinTech industry is young and our sample period is short, they stated that they cannot exclude that their findings are spurious.

Siek and Sutanto (2019) explained the influences of fintech on the conventional banking industry in Indonesia and that FinTech can be a great competitor for banks especially in payment gateway and peer-to-peer (P2P) services that affect traditional financial business. To expose a range of value propositions that dominantly impact the adoption of fintech or banking products, this study looked at several crucial and

practical criteria, such as customer satisfaction, net promotion score, promotion, ease of use, etc. The results demonstrate that the banks have been disrupted by the payment fintech since the appearance of fintech companies in around 2015. Furthermore, fintech startups have digital strategies for approving a customer-centric mindset and developing a product that provides high customer satisfaction. P2P fintech, on the other hand, does not now pose a serious threat to banks, since clients place a higher priority on security.

Butt and Khan (2019) looked into the strategic factors that go into finding Fin-Tech investment targets, as well as the problems that banks experience during implementation. They investigated the challenges that banking sectors face when it comes to investing in Fin-Tech. This study employed a convenience-based sample case study technique with five banks in Pakistan. Field notes, recordings, and transcriptions of interviews with branch managers are among the most important data sources. The findings revealed that Fin-Tech is in early stages in banking sector of Pakistan and Pakistan prefers to outsource financial activities to Fin-Tech firms for a variety of reasons, including high quality, new technology, software maintenance, and a competitive market edge.

In Pakistan, there are several difficulties with Fin-Tech implementation. One of the main causes is consumer acceptance, which means that customers in Pakistan are hesitant to adopt financial innovations due to low literacy and high poverty rates, and as a result, they are uninformed of the latest Fin-Tech products. People prefer to visit branches for their banking transactions rather than using financial technology to secure the privacy and security of their transactions, which is a major issue. Pakistan is said to need to upgrade its FinTech infrastructure. The government must also devote more resources to resolving these issues.

Pu *et al.* (2021) illustrated the interaction between banks industry and FinTech in Lithuania by collecting annual reports from Lithuanian banks during 2003-2019 and analyzing the FinTech sector by SWOT & PESTEL analysis. Regression analysis results reveal that FinTech companies improve banks' efficiency especially in payment services and increase customer satisfaction and FinTech affects economic growth by financial inclusion.

Yang *et al.* (2017) the researchers in 2015 looked at whether Fintech adoption contributed to the Taiwan banking industry's productivity increase. The study estimates the 25 specified sample banks using the preferred Cost Malmquist Index from 2010 to 2015 to evaluate such a potential influence. The empirical conclusion reveals that throughout the observed period of 2010-2015, there was favorable evidence to support Fintech adoption as a possible contributor to the Taiwan banking industry's perspective expansion of competitiveness.

Wong and Ho (2020) looked into the influence of FinTech innovations on the Hong Kong banking industry. For this study 45 banks in Hong Kong were chosen as a

sample for the period 2017-2019. The measurement of financial technology is the percentage of a bank's financial services and operations that have already integrated FinTech innovations, while the metrics of banks are cumulative changes in their cost-to-income ratio and return on assets.

According to the study results, incumbent banks that perceive Fintech as a complement and enabling technology that helps them increase efficiency and satisfy the need for underserved consumers outnumber those who regard it as a risk and a substitute for their present operations by a wide margin. Given the widespread interest in and rising acceptance of Fintech by banks, the effect of Fintech is becoming more apparent, with most institutions formerly believing themselves to be immune now realizing that they may not be. Most incumbent banks have taken a pragmatic approach and have made demonstrable steps to incorporate Fintech into their business processes.

Gohary (2019) clarified that e-government in Egypt needs FinTech companies to improve and facilitate its services. The sample was a questionnaire for 400 respondents that indicate that 70% of respondents found difficulties in using the website, shortage in employee's efficiency, poor services and transactions in the system, and the slow internet speed so, the study suggests cooperation with FinTech to solve the problems and awareness campaign to increase trust as 30% of the respondents didn't use e-government. The findings found that bank accounts with e-government did not influence any of the dimensions of the enabling service, whereas the remaining components affect some aspects but not others.

The author tried to explore the FinTec impact on banks efficiency in the countries included in the literature summarized in the following Table 1:

Table 1. *FinTec impact on banks efficiency in the countries included in the literature*

Author	**Country**	**Results**
Wang et al. (2021)	China	FinTech development has a favorable impact on earnings, financial innovation, and risk management.
Hu, Z. et al. (2019)	China	There was confidence between users of financial technology, but there were some risks such as Internet risks, social risks, and others.
Cheng, M., & Qu, Y. (2020).	China	• Financial technology banks reduce the risk of credit for Chinese commercial banks • Financial technology banks are the least risky among the traditional state-owned banks • The development of Internet technology is higher on AI technology and blockchain.
Wang, et al. (2021)	China	FinTech development reduces banks' risk-taking especially in banks with low efficiency.
Ntwiga, D. B. (2020	Kenya	a positive relationship between financial technology and banks efficiency

Li, Y., et al (2017)	US	• FinTec impact on banks efficiency in the countries included in the literature
Pu, et al (2021)	Lithuania	FinTec impact on banks efficiency in the countries included in the literature
Yang, Y. L., et al. (2017).	Taiwan	Fintech adoption has a possible contributor to the Taiwan banking industry's perspective expansion of competitiveness.
Wong. J & Kelvin Ho, (2020)	Hong Kong	Fintech as a complement and enabling technology that helps them increase efficiency and satisfy the need for underserved consumers outnumber those who regard it as a risk and a substitute for their present operations by a wide margin.
Siek, M., & Sutanto, A. (2019)	Indonesia	• Banks have been disrupted by the payment fintech since the appearance of fintech companies in around 2015. • Fintech start-ups have digital strategies on approving a customer-centric mindset and developing a product that provides high customer satisfaction.
Butt, S., & Khan, Z. A. (2019).		• Fin-Tech is in early stages in banking sector of Pakistan and Pakistan prefers to outsource financial activities to Fin-Tech firms for a variety of reasons, including high quality, new technology, software maintenance, and a competitive market edge. • In Pakistan, there are several difficulties with Fin-Tech implementation. One of the main causes is consumer acceptance where people prefer to visit branches for their banking transactions rather than using financial technology to secure the privacy and security of their transactions.
Panjwani. K & Shili. N, (2020)	contemporary world	Financial technology appears to play a key role in the empowerment of people who do not have access to financial services.
Baber (2019)	Malaysia and the United Arab Emirates	• No relevant relation between financing applications of FinTech and customer retention in the selected banks • Other variables such as crowdfunding, payments, advisory services, and compliance have a positive effect on retaining customers of Islamic banks in the selected countries.
Gohary, E. E. (2019)	Egypt	• 70% of respondents found difficulties in using the website, shortage in employee's efficiency, poor services and transactions in the system, and the slow internet speed • bank accounts with e-government did not influence any of the dimensions of the enabling service

Source: *Own study.*

Banks are trying to join the era of modern technology, but they face many challenges, especially with the appearance of financial technology companies that forced banks to keep pace with technology, and therefore, banks put their banking operations as the development of financing operations. Although financial

technology faces several problems, the first of which is not being widely used by citizens. This is due to the lack of awareness among individuals. Therefore, officials should spread awareness among citizens, given that the government is taking serious steps towards financial inclusion. Also, the government must put in place appropriate measures that help to fair competition between innovators.

Several researchers (Wang *et al.*, 2021; Hu *et al.*, 2019; Cheng and Qu, 2020; Cheng, Qu, 2020; Ntwiga, 2020; Li *et al.*, 2017; Pu *et al.*, 2021; Yang, *et al.*, 2017; Wong and Ho, 2020; Siek and Sutanto, 2019) exposed that FinTech applications have a positive effect on the banking sector. Though some researchers (Baber, 2020; Gohary, 2019) revealed that FinTech services have a negative relationship with banks' efficiency as some challenges were facing the FinTech implementation. Four studies in China have reported the positive impact of financial technology on banks' efficiency, this indicates China's success to overcome the FinTech implementation challenges.

In Egypt, Gohary (2019) concluded that Egypt needs to improve its internet services first and increase citizens' awareness of FinTech and enhance confidence in its services. The following Research Hypo is elaborated on in the preceding discussion:

H1: *Financial technology has a positive impact on the efficiency of the banking sector, and it is divided into 3 sub-hypotheses:*

> ***H1a:*** *Financial technology has a positive impact on deposits and total loans.*
> ***H1b:*** *Financial technology has a positive impact on total loans and interest income.*
> ***H1c:*** *Financial technology has a positive impact on interest expenses and deposits.*

3. Research Methodology

The data source, data analysis methodologies, and the definition and measurement of variables are all discussed in this part. The analysis used financial statement data for a period of eight years (2014-2020) from the CBE Egyptian bank with Fintech collaborations. Where Egyptian Central Bank became a principal member of the AFI in July 2013. In 2015, financial inclusion was inserted in Egypt's 2030 Sustainable Development Plan, it becomes a national priority (Egypt SDS 2015). In this study, the Fintech periods are used to cover Fintech cooperation in the banking sector.

3.1 Data Envelopment Analysis

The DEA technique is used to assess efficiency ratings in this study which has two types, namely: constant return scale (CRS) and variable return scale (VRS), as either of the two types, can calculate the efficiency indicators, and in this research we used CRS, to measure the technical efficiency, There are two methods for calculating technical efficiency indicators, the first one from the input side "input-oriented

measures", and the second from the output side "output-oriented measures", And in this research, we used "output-oriented measures" and multi-stage DEA method which is more computationally demanding than the other two methods **(**Coelli, 1996).

The ability of a bank to maximize outputs from a particular set of inputs is referred to as TE, and it is linked to managerial decisions. The PTE is a measure of TE that shows managerial flaws in managing the bank's resources, or management performance. SE refers to the relationship between output and average cost, and hence to the size of the organization's operations or manufacturing scale, as well as the appropriate bank size Singh. D., and Fida, B.A. (2015).

The technical efficiency (TE) consists of overall TE calculated by the CRS, PTE calculated by the VRS, and scale efficiency (SE) calculated by the ratio of TE and PTE (Yilmaz and Gunes, 2015). A bank can operate under three different return to scale scenarios: constant return to scale, declining returns to scale, and growing returns to scale. If the output increases (decreases) more than the inputs, the organization is experiencing a rising (decreasing) return to scale. The bank faces the dilemma of undersizing (oversizing) to increase (decrease) returns to scale, resulting in operations below (above) the ideal size. If the output changes appropriately with the growth or reduction in inputs, the organization is scale efficient (Abel and Bara, 2017).

Intermediation, production, and profitability are the three primary methods or dimensions in the DEA model, which are specified by the model's input and output variables. Banks are viewed as intermediaries who route funds from surplus units to deficit units, collecting monies from depositors and turning them into loans, according to the intermediation theory.

The production method supposes that banks use resources and inputs such as capital and labor to produce deposits, loans, and services (Singh and Fida, 2015). Cost-related items such as staff expenses and non-interest expenses are used as inputs, and revenue-related items such as net interest income and non-interest income are used as outputs in the profitability method (Novickyte and Drozdz, 2018).

3.2 Variables Definition and Measurements

Table 1 shows the input and output variables for the DEA model utilizing the intermediation dimension: deposits, interest income, loans, and interest expenses. The DEA variables are used to determine the technical (CRS), pure technical (VRS), and scale efficiency (ratio of CRS and VRS) of the CBE with Fintech cooperation.

Table 2. *DEA input, output variables ant its measurements for the intermediation dimension*

Model	Input variables & Measurements		Output variables & Measurements	
M1	Deposits (D)	Customers' deposits	Total Loans (TL)	
M2	Interest expenses (IE)	Cost of deposits	Deposits(D)	
M3	Total loans (TL)	Includes loans and facilities to customers and banks, loans and advanced to customers and banks.	Interest income (II)	Loan interest

Source: Own study.

4. Results

The data was examined using R software. Based on the three models in Table 2, the DEA model calculates the efficiency ratings for the CBE Fintech collaborating during the Fintech period. This section contains the DEA model's data analysis and findings, as well as its conclusions and debates. The DEA output-orientation is used to present the findings for each of the three models M1, M2, and M3.

4.1 Descriptive Statistics

The TE, SE, and PTE for the DEA models are presented in this segment. The statistics for the TE, PTE, and SE built on the mean, standard deviation, and return to scale are highlighted in this section as well.

Table 3. *Descriptive Statistics for the Efficiency Scores based on M1, M2, and M3*

Efficiency	Statistic	2014	2015	2016	2017	2018	2019	2020
M1								
TE	Mean	0.859	0.812	0.869	0.878	0.719	0.844	0.837
	[3]SD	0.167	0.160	0.132	0.130	0.190	0.167	0.142
PTE	Mean	0.889	0.879	0.910	0.905	0.866	0.882	0.882
	SD	0.176	0.180	0.141	0.142	0.181	0.170	0.140
SE	Mean	0.967	0.928	0.957	0.972	0.829	0.957	0.948
	SD	0.049	0.145	0.168	0.285	0.211	0.179	0.211
	RTS	**I**	**I**	**I**	**I**	**D**	**I**	**I**
M2								
TE	Mean	0.865	0.850	0.729	0.708	0.653	0.754	0.721
	SD	0.120	0.115	0.160	0.190	0.278	0.228	0.197
PTE	Mean	0.962	0.929	0.870	0.860	0.852	0.868	0.854
	SD	0.058	0.102	0.183	0.195	0.203	0.180	0.200
SE	Mean	0.902	0.914	0.851	0.835	0.785	0.879	0.858
	SD	0.130	0.049	0.145	0.168	0.285	0.211	0.179
	RTS	**D**	**D**	**D**	**D**	**D**	**I**	**I**
M3								
	Mean	0.888	0.954	0.887	0.935	0.863	0.927	0.855

[3] *Standard deviation*

TE	SD	0.078	0.050	0.089	0.053	0.107	0.060	0.139
PTE	Mean	0.950	0.969	0.959	0.978	0.948	0.989	0.979
	SD	0.068	0.053	0.091	0.038	0.072	0.016	0.047
SE	Mean	0.935	0.985	0.925	0.957	0.913	0.938	0.875
	SD	0.062	0.018	0.047	0.052	0.109	0.065	0.144
	RTS[4]	**D**	**I**	**D**	**D**	**D**	**D**	**D**

Source: *Own study.*

Table 3 shows that the first model (M1) exhibited declining returns to scale in 2018 and increasing returns to scale from 2014 to 2020, except for 2018. The second model (M2) exhibits growing returns to scale for two years and decreasing returns to scale for the remaining five years. The third model (M3) has growing returns to scale for one year and decreasing returns to scale for the remaining six years.

Overall, increasing returns to scale (IRS) express that the output increases by more than the proportional change in all inputs as happen in M1. decreasing returns to scale (DRS) express that the output increases by less than the relative change in all inputs as happen in M2 and M3. Model M1 has growing returns to scale in the Fintech period, therefore Fintech is valid for taking deposits and lending. During the Fintech period, the returns to scale of models M2 and M3 decreased.

Regarding the mean technical efficiencies, M1 (71.9 percent - 85.9%), M2 (65.3 percent - 86.5 percent), and M3 which have the highest mean technical efficiencies (85.5 percent - 95.4 percent). Relating to the pure technical efficiency scores, Model M1 (86.6 percent -91.0 percent), M2 (85.2 percent - 96.2 percent), and M3 (94.8 percent - 98.9 percent) which is the highest pure technical efficiency scores. In general, model M3 had a better performance in terms of efficiency scores for the eight years. Concerning the mean scale efficiencies, M1 (82.9 percent - 96.7 percent), M2 (78.5 percent - 91.4 percent), and M3 (87.5 percent - 98.5 percent) are the three models' scale efficiencies. For the eight years, Model M3) Total loans (TL) and Interest income (II)) exhibited greater mean scale efficiencies.

The scale inefficiency due to the scale of operations are model M1 (2.1% - 17.1%), M2 (4.0%-21.5%) and M3 (1.5% - 12.5%). The inefficiency due to managerial decisions or PTE efficiency are model M1 (8.0%-13.4%), M2 (3.8%-18.1%) and M3 (1.1% - 9.2%). The main source of technical inefficiencies in the intermediation process is due to both the scale of operations (SE) and managerial decisions (PTE). Therefore, the CBE exhibited poor utilization of inputs, managerial inefficiencies, and not operating at an optimal scale.

The results revealed that regarding the first hypothesis: Financial technology has a positive impact on the efficiency of the banking sector, H1 has been partially rejected. As the results regarding the sub-hypotheses are: H1a: Financial technology has a positive impact on deposits and total loans. H1a has been accepted. H1b:

[4] *RTS - Returns to scale, IRS – increasing, DRS – decreasing.*

Financial technology has a positive impact on total loans and interest income. H1b has been rejected. H1c: Financial technology has a positive impact on interest expenses and deposits. H1c has been rejected.

5. Conclusion and Discussion

Financial technology is a relatively new technology that has become more important for businesses to streamline and speed up company processes and transactions. The purpose of this study and the first research question address the assessment of the effectiveness of Egypt's CBE bank following the adoption of FinTech.

After reviewing relevant literature, developing a data collection procedure, collecting and evaluating data to test study hypotheses, it was discovered that Egyptian banks cooperate with the Central Bank of Egypt and the regulatory bodies to achieve economic growth to transform the Egyptian society into a non-monetary society. Technical expertise is shared to provide financial services to people who do not deal with banks to enhance financial inclusion in Egypt. However, according to sustainability report, 2019 'CIB', Financial inclusion in Egypt need more bank branches in every place for easy access to customers in all parts of Egypt, and consequently, the ATMs to provide financial services and products at an affordable cost, to reduce poverty, achieve economic growth, and financial illiteracy**.**

The CBE's technical efficiency is influenced by the models chosen in this study, which are defined by input and output variables. The combination of input and output variables selected has a significant impact on assessing bank efficiency. According to the three models for the Fintech period, technical inefficiency is caused by a failure to operate at the most productive scale, managerial inefficiency, and inadequate input utilization.

Model M1 offers growing returns to scale during the fintech periods, therefore it's suitable for taking deposits and lending. During the Fintech period, the returns to scale of models M2 and M3 decreased. Further research can be done to observe the technical efficiency of particular banks to identify those with growing or diminishing returns to scale. This might offer more perceptions on managerial flaws in handling resources and the ideal scale of production.

This study is designed to find out whether there is a direct impact on Egyptian banks since the announcement of the expansion in the use of financial technology or not. To enable the ecosystem and establish a healthy atmosphere for startups and entrepreneurship, the association will continually contact regulators such as the Central Bank of Egypt, the Financial Regulatory Authority. This is on top of working with the government at all levels to promote the Fintech ecosystem in Egypt. The Egyptian government and the Central Bank of Egypt's initiatives to digitize payment systems and achieve financial inclusion goals have resulted in a

rapidly expanding number of Fintech businesses. These initiatives include establishing organizations that link all Fintech ecosystems such as:

1. *Egyptian FinTech Association:* it is a member of the Global Fintech Hubs Federation and is a non-profit, non-political organization based in Egypt started in 2019. It is a cross-industry project that aims to serve as a forum for all market participants and stakeholders in the FinTech ecosystem to collaborate. It will allow members to collaborate with a variety of stakeholders to develop answers to the industry's problems. The Association's mission is to grow Egypt's financial technology ("Fintech") business and to serve as a venue for the exchange of ideas, distribution of information, and collaboration among various players in Egypt's financial technology services industry and entrepreneurial ecosystem. It will foster cross-industry innovation and collaboration among banks, microfinance institutions, telecommunications companies, technology companies, insurance companies, venture capital firms, universities, consulting firms, law firms, R& D facilities, and any other key players who may emerge in the future.
2. *CBE FinTech Hub:* it is a digital platform that fosters and connects all Fintech ecosystem stakeholders, including Fintech startups, financial institutions, regulators, service providers, mentors, and investors, through innovation and technology coming to life in 2019**.** It is, first and foremost, a one-stop-shop for Fintech-driven companies, mentors, and financial institutions that is vital for cooperation and networking. Second, assist companies in obtaining funding by linking them to investors and Fintech pools of funds. Thirdly, a technology-enabled networking platform for all Fintech players. Fourthly, FinTech Sandbox access, which serves as a virtual regulatory area for FinTech businesses. Finally, it's a well-organized venue for FinTech events, workshops, training, and competitions.

According to Adam (2021), in the Egyptian financial market, banks are the most important service providers. They control the majority of the market's financial assets and flows. According to the Central Bank of Egypt's annual report for the fiscal year 2017–2018, the number of functioning banks has increased to 39, with over 2,800 branches across Egypt. With 133,651 mobile payment agents, sixteen of these banks provide full-service e-banking and mobile financial services. Thirty-two of Egypt's 39 banks provide online banking services, with 1.4 million registered accounts and transaction volumes of EGP 128 million EGP (about $7 million). Furthermore, 2,800 federal agencies issued 4.5 million payroll cards and seven million pension cards.

However, the research results revealed that the CBE still exhibited poor utilization of inputs, managerial inefficiencies, and not operating at an optimal scale. Therefore, the second research question addresses the best practices to

make the Egyptian banks more efficient. Egypt government exert huge effort to grow Fintech services and make it available to each individual un the society. Payment services, mobile cash, and smart wallets are the most developed sectors in the Egyptian Fintech startups. Savings and investments, insurance, financial management, crowdfunding, and blockchain are among the other industries covered by Egyptian Fintech. It grows each day. For example:

- *Payment service providers:* Fintech startups let banked and unbanked clients transfer money, payphone, and other utility bills, and use a variety of other payment methods. Fawry is one of Egypt's most well-known Fintech startups that offers payment services. T-Pay Mobile, PayMe, PayMob, and Vapulus are some of Egypt's other digital payments Fintech startups.
- *Micro-savings:* 7aweshly is a service that allows unbanked clients to save little amounts of cash. Feloosy helps consumers save money for a certain investment. MoneyFellows allows users to safely form money circles and classifies them based on their income and other characteristics.
- *Mobile wallets:* licensed banks can provide mobile wallets, taking cash deposits in return for creating electronic money, according to the Central Bank of Egypt's new laws for cashless payments via Mobiles, which were released in 2016. Cash-in/cash-out, person-to-person (P2P), international money transfers (IMT), ATM cash-in/cash-out, person-to-merchant (P2M), merchant-to-merchant (M2M), virtual card number (VCN), and account value load (AVL) from bank to wallet accounts are all covered by the new regulations.
- *Micro-Insurance:* Carsurance is an Egyptian Fintech company that provides insurance quotes.

The study aims as well to introduce innovative ways to encourage investors to invest in FinTech start-ups to increase the number of FinTech firms in Egypt to improve the efficiency of banks and understand the challenges that face FinTech spread. This is the third research question that addresses the best ways for financial technology to spread all over the social sectors.

The researcher develops the following recommendations based on the findings and conclusion which may mature financial technology in Egypt and make greater use of it.

1. Transferring ATMs to work without cards through the "long-range communication" technology, which allows customers to withdraw cash from their balances using digital wallets or the bank's application by bringing the phone closer to the ATM screen to withdraw cash without the need to enter a card or password to verify the identity of the customers.
2. Providing mini-seminars in a simple way across bank websites for customers, especially for elderly people who face problems in using technology, to explain how to properly use the electronic services of banks.

3. Find Monetization Opportunities with Blockchain (DLT) technology is appointed for certain financial services because it is digital and cryptographically sealed, designed to be distributed, and synchronized across networks. Furthermore, it is unchallengeable, which means that once a transaction has been agreed upon and recorded, it cannot be modified.
4. Getting benefit from the international experience: Monzo British Virtual Bank the first British virtual bank operates without a traditional banking infrastructure such as the presence of the main entity and a group of branches, and it also obtained a license from the Central Bank, a feature that saves a large proportion of costs, which helped to provide accounts with high-interest rates and loans with lower interest rates from banks. Fully working like mortgages and loans, prepaid visa activation, with an app that helps you control spending by sorting.
5. Considering the successful experience in the other countries such as Germany which designed the first automatic teller machine that enables the person to withdraw gold bars in 2009. The machine requires the customer to enter cash or credit cards, to obtain small pieces of gold-bearing the GL "Galleries Lafayette" logo with size and value equal to the amount deposited in the device, or exchange cash for 24. The machine also allows the customer to choose the weight and model of gold he wants to buy.
6. Investment in Artificial Intelligence: The most influential trend is a technology where AI-based on distributed and shared data set as it is used for dynamic and psychological customer segmentation. The combination of predictive and cognitive capabilities is a trend that includes technology partners as we have noted in the cases of Watson from IBM and Alpha Go from Google. Early movers who collaborate with tech companies will change into a system. Adopting another generation of quantum computing.

This research offers practical implications on the management of technology where banks can learn the lessons of the systemic nature/characteristics of FinTech-based innovations, as well as the dynamics of the banking industry to pursue appropriate strategies in market competition (the ways the banks manage technological complexities and the use of technology strategy to improve its competitive position in the banking sector) to follow Egypt's 2030 Sustainable Development Plan.
The research has some limitations including that DEA has weaknesses like measurement errors of the input or output which lead to some differences in the results. In addition, The DEA method does not measure absolute proficiency**.**

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