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Measuring the Impact of Monetary Policy on the Efficiency of Sudanese Islamic Banks

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Abstract

This study explores the influence of monetary policy on the efficiency of Sudanese Islamic Banks. It aims to determine the impact of monetary policy on bank efficiency, identify influential aspects, and provide recommendations for policy adjustments. The research uses both qualitative and quantitative methods, collecting primary data through surveys and interviews with bank executives and policymakers, and secondary data from bank financial reports and central bank policy documents. The findings reveal a significant relationship between monetary policy and bank efficiency, with specific aspects such as interest rate controls and reserve requirements having the most substantial impact. Different types of Islamic banks, such as commercial banks, were affected differently by monetary policy, with changes in policy over time having both positive and negative effects on bank efficiency. These findings contribute to the existing knowledge on the interplay between monetary policy and bank efficiency, particularly in the context of Islamic banking in Sudan. However, the study's limitations, including a focus on a single country and reliance on self-reported data, may limit its generalizability. Future research could expand this study by considering other countries or using alternative data sources.

Introduction

Islamic banking differs from traditional interest-based banking systems in that it places a strong focus on risk- and profit-sharing. Particularly in the area of monetary policy, this novel approach offers both benefits and challenges (Molyneux *et al.,* 2005). Islamic banking is important in Sudan, where economic complexity is still present (Kettell, 2011). It functions according to Islamic principles, which include risk-sharing and interest-free transactions (El-Gamal, 2006).

Even though Islamic banks play a significant role in Sudan's economy, little is known about how monetary policy affects these institutions. Although the effects of monetary policy on conventional banks have been thoroughly studied, little is known about how it affects Islamic banks in Sudan. This disparity emphasises how crucial it is to investigate how monetary policy measures affect Islamic banks' productivity and operations in the Sudanese setting.

This study utilises previously published works by academics including Savon and Yousfi (2023); Yungucu and Saiti (2016); Ponziani and Mariyanti (2020); Panorama (2017); Ali, Zulkhibri & Kishwar (2022); Shah and Rashid (2019); and Rashid, Hassan & Shah (2020) in order to close this gap. In order to provide light on the potential and problems faced by Islamic banks in Sudan in response to monetary policy frameworks, this study will perform a thorough analysis of the country's Islamic banking industry, including a review of pertinent data and trends.

In the end, it is anticipated that the research's conclusions will offer insightful information to financial industry practitioners and legislators. These realizations can guide the creation of more functional regulatory frameworks and assistance programs catered to the unique requirements of Sudan's Islamic banking industry. This research advances the nation's larger goals for economic development by strengthening the stability and effectiveness of the financial sector.

Sample of the Study

Regarding the Islamic banks operating in Sudan, the researcher determined the specimen of the study using (3) banks: Alkartom Islamic Bank, Islamic Co-operation, and Alshmali Islamic Bank. These specimens were examined according to the strength of their capital base, deposits, and loans, which the Central Bank of Sudan considers as first-ranked banks for the previous years. Banks included in this study represent (Ebersold & Glass, 2015).

Selected Data

In measuring the impact of monetary policy on the efficiency of Sudanese Islamic banks, this paper adopts two approaches to determine bank input and output. The intermediation approach considers bank liabilities as inputs and assets as outputs. On the other hand, the production approach focuses on physical entities such as labor and capital as inputs, with deposits serving as a measure of production. For this study (Berger & Udell, 2006), three outputs and three inputs were selected using the intermediation approach. The outputs encompass total loans, other earning assets, and total assets, while the inputs consist of the number of employees (LAB), fixed assets, and total deposits. Data for the study were collected from two primary sources: The Bank Scope International Bank Database for domestic banks and the audited annual reports for foreign banks, along with some missed variables for domestic banks. It is worth noting that all financial data are presented in terms of Sudan Gnih (in millions) (Al-Ayed & Al-Tit, 2021).

Methodology

Data Envelopment Analysis (DEA) is a non-parametric technique that has been extensively used to evaluate the efficiency of banks. In this study, DEA is employed to assess the technical efficiency of Sudanese Islamic banks operating from 1997 to 2008. The study adopts a constant return to scale (CRS) model, assuming that the banks are used in a competitive environment where outputs are proportional to inputs (Coelli *et al*., 2005). The DEA model calculates a

technical efficiency score for each bank, ranging from 0 to 1, with a score of 1 indicating total efficiency and a score of 0 indicating complete inefficiency (Jiang & He, 2018).

$$M\ in\theta = \theta CRS - yit + Xn$$
$$j=1$$
$$\lambda j\ yir \geq 0,\ r = 1,\ ...,\ M\text{------------------ (1)}$$
such that
$$\theta\ xis - Xn$$
$$i=1$$
$$\lambda j\ yir \geq 0,\ s = 1,\ ...,\ K,\ \lambda i \geq 0,\ j = 1,\ N\text{--------------------- (2)}$$
$$\lambda i \geq 0,\ i = 1,\ ...,\ N$$

Whereas: θ Measurement unit of efficiency (scalar) λ = is (N X 1) vector of cons

Results and Discussion

This section presents the outcomes and insights derived from the efficiency analysis. It begins by presenting the mean values, standard Deviations, and correlation coefficients of the input and output variables employed in the analysis. Subsequently, it delves into the results and discussion of the efficiency analysis conducted using the intermediary approach.

Table 1 shows the data summary and its statistical descriptions of the Islamic banks in Sudan for all input and output variables used in this study.

The mean total assets of the banks have increased from SDG 9696 million in 1997 to SDG 1336.67 million in 2008. However, there has been a decline in deposits and funds from SDG 5278.67 million in 1997 to SDG 954.73 million in 2008. Total loans have increased from SDG 577.17 million in 1997 to SDG 610.92 million in 2008. Also mentioned is that labor costs have increased from SDG 52.36 million in 1997 to SDG 184.20 million in 2008. This increase may be due to both normal salary raises and an increase in more highly skilled banking experts. Furthermore, stated that almost all of the variables indicate a relative increase in standard Deviations. In particular, variables such as total assets and deposits indicate high coefficients of variation. This suggests that the data points for these variables are more spread out from the mean, indicating a higher level of variability or uncertainty in the data.

Overall, it appears that the Islamic banks in Sudan have experienced some changes and fluctuations in their financial performance over the period of study.

Table 1: Descriptive Statistics of Input and Output Data

DMU	Summary Statistic	Labor	Fixed Capital	Deposits and Funds	Total Assets	Total Loans	Other Earning Assets
Alkartom	Mean	22.47	4459.60	40074.78	62381.53	31457.10	8479.90
	Standard Deviation	13.47	29620884.05	32415.93	56543.27	36211.21	6761.65
Islamic co-prative-Dve	Mean	10.25	15.53	192.34	273.23	116.04	48.41
	Standard Deviation	7.62	10.33	175.46	237.42	107.08	108.22
Alshmali	Mean	389.52	751.00	7402.15	11768.64	3243.21	4074.46
	Standard Deviation	165.53	534.06	4247.02	6243.39	2201.10	2139.89
Descriptive Statistics of Input and Output Data for All Banks in Every Year							
1997	Mean	52.36	363.23	5278.67	9696.80	577.17	2631.80
	Standard Deviation	82.35	514.04	7471.23	13375.85	974.13	3851.95
1998	Mean	60.19	407.07	7576.40	12406.23	1495.07	3564.80
	Standard Deviation	92.89	572.83	9797.68	15354.78	2553.07	4327.69
1999	Mean	81.39	449.40	8531.50	12792.07	3107.03	5617.83
	Standard Deviation	126.02	531.73	11662.73	16626.14	3432.27	6072.09
2000	Mean	113.63	644.23	13867.33	18022.37	5984.57	7466.27
	Standard Deviation	171.66	553.56	17898.22	21705.73	6996.41	8959.78
2001	Mean	120.51	650.30	15619.47	20313.83	9115.83	5314.27
	Standard Deviation	188.62	565.57	19051.79	24319.24	12756.06	6225.65
2002	Mean	158.72	753.97	17730.57	23406.93	10083.13	6849.13
	Standard Deviation	256.44	693.80	21729.46	27710.80	13440.51	7983.56
2003	Mean	234.59	3519.40	20345.97	31719.33	15776.83	6435.17
	Standard Deviation	382.12	5391.31	25760.22	41326.25	22510.56	6872.77
2004	Mean	172.44	3602.90	26432.43	39193.97	22800.93	6422.93
	Standard Deviation	267.04	5152.63	37628.73	54372.25	35487.64	7580.63
2005	Mean	196.77	5093.50	34279.53	57532.90	30743.63	1801.96
	Standard Deviation	299.78	7563.98	51385.19	85633.46	48911.38	2993.14
2006	Mean	174.88	4997.90	37002.60	66470.80	37550.43	2620.33
	Standard Deviation	255.27	7389.22	52838.04	97020.98	60206.21	4229.66
2007	Mean	182.73	51.67	781.00	1184.77	490.83	253.40
	Standard Deviation	248.92	48.45	727.02	971.59	506.34	91.33
2008	Mean	184.20	132.78	954.73	1336.67	555.07	281.37
	Standard Deviation	247.79	185.13	998.69	1288.61	610.92	91.96

Table 2: Correlation of Input and Output Variables

Every Bank Separated Through the Period 1997-2008	State	Total Assets	Total Loans	Other Earning Assets
	Labor	-0.315	-0.394	0.002
	Fixed capital	1.000	0.998	0.942
	Deposits and funds	1.000	0.997	0.947
Every Year Separate for All Banks 1997-2008	Labor	0.427	0.524	-0.121
	Fixed capital	0.578	0.961	0.029
	Deposits and funds	0.988	0.975	0.243

The strong correlation between deposits and funds with total assets, total loans, and other earning assets implies that these variables play a significant role in determining efficiency in the asset intermediation process, given that these assets represent a substantial share of total assets.

As Avkiran (1999) suggests, correlation coefficients between input and output variables can be used to assess the appropriateness of these variables. The observed high correlation coefficients between input and output variables, as reported in Zhou, Liu & Liu (2020) corroborate the selection of these variables for the efficiency analysis.

Efficiency Scores

A Sudanese Islamic bank is considered efficient if it can generate a relatively high volume of income from its assets and liabilities while utilizing a given level of capital (Coelli *et al*., 2005). A bank that exhibits both pure efficiency and scale efficiency can produce a relatively high volume of income from its services and intermediation operations with the given level of inputs. These three aspects of efficiency are measured and compared to assess the performance of Sudanese Islamic banks. Figures 1, 2, and 3 illustrate the estimated mean efficiency scores for each year within the study period. Tables 3 and Appendix 1 present overall means and the Mann-Whitney Test scores, which evaluate the statistical significance of differences in estimated efficiency between different types of banks. These figures and tables aim to demonstrate variations in efficiency among different types of Sudanese Islamic banks (Deyoung, 1997).

The estimated mean efficiency scores, calculated for each year, offer a clearer picture of the banks' efficiency over time. All types of Sudanese Islamic banks experienced a decline in efficiency during the first half of the study period (1997-2002). However, during the second half of the study period, all banks showed a slight improvement in efficiency. This upward trend aligns with the implementation of financial reforms within the Sudanese banking sector. The pattern observed in overall average efficiency scores suggests that the positive impact of financial sector reforms on efficiency may not be realized in the short term but rather over a longer period. (Colwell & Davis, 1992).

Table 3: Descriptive Statistics - Efficiency Scores

Banks	Technical Efficiency	Pur-technical Efficiency	Scale Efficiency
All banks	0.899	0.935	0.962
Standard Deviation	0.039	0.047	0.040
Alkartom bank	0.959	0.960	0.999
Standard Deviation	0.084	0.084	0.003
Islamic co-op bank	0.833	0.910	0.918
St.dev	0.088	0.082	0.082
Alshmali bank	0.906	0.934	0.970
Standard Deviation	0.096	0.001	0.056

Table 3 provides a summary of the descriptive statistics and statistical tests of significance for all banks included in the study. The results reveal a notable degree of inefficiency among the Sudanese Islamic banks under consideration (Hassan, 2005). This implies that the same level of output could have been produced using a substantially smaller amount of inputs. On average, the findings suggest that banks could have operated with only 99.2% of the resources they actually utilized to achieve the same level of output. In other words, the average bank has wasted 2.17% of its inputs, indicating a potential cost savings of 3.2% without compromising output levels (Bacha *et al.,* 2011).

This highlights significant opportunities for enhancing pure technical efficiency by utilizing inputs more effectively. However, it is important to note that banks exhibit greater efficiency in resource utilization compared to overall efficiency. The average efficiency bank could only reach 89.9% of the expected technical efficiency, indicating that technical efficiency remains the primary area of concern. Similarly, the average bank could have achieved 96.2% of its potential scale efficiency, suggesting that there is room for improvement in scale efficiency by 0.04% (Berger, Molyneux & Wilson, 2020).
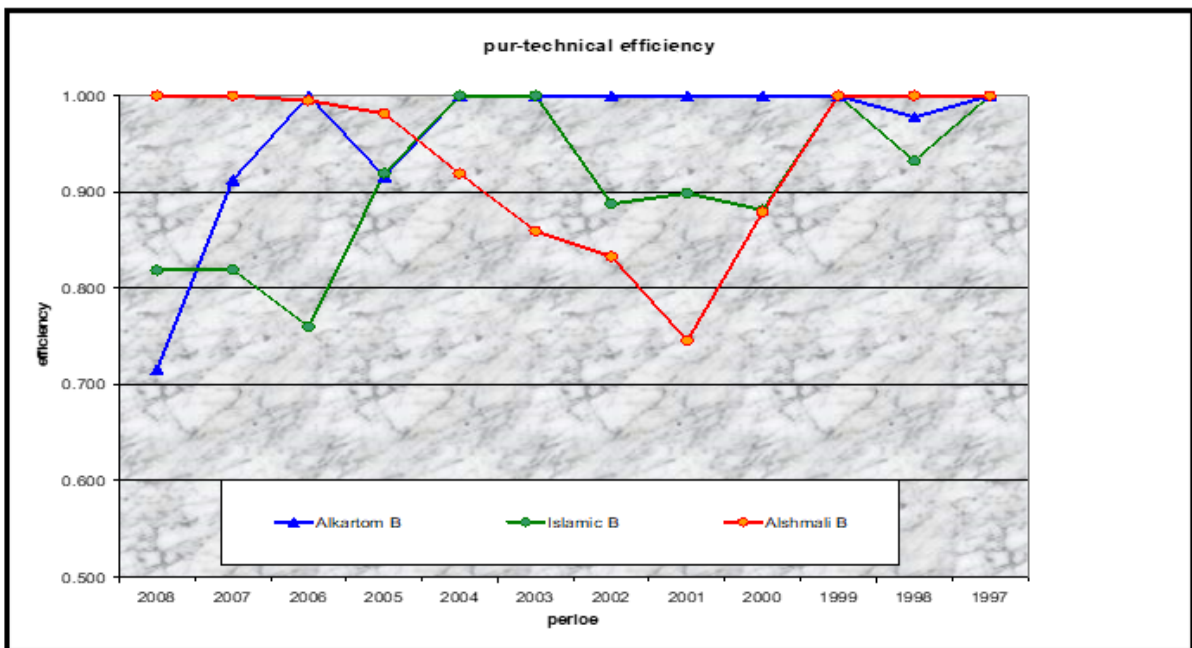
Figure 1: Average Technical Efficiency
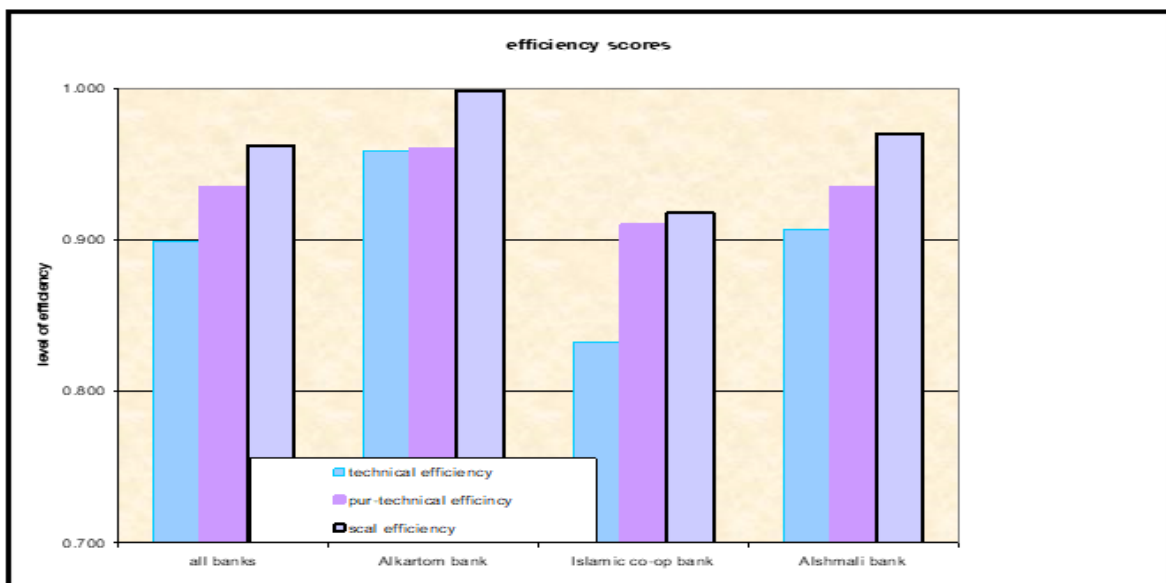
Sources: (Nwokocha & Iheriohanma 2012)
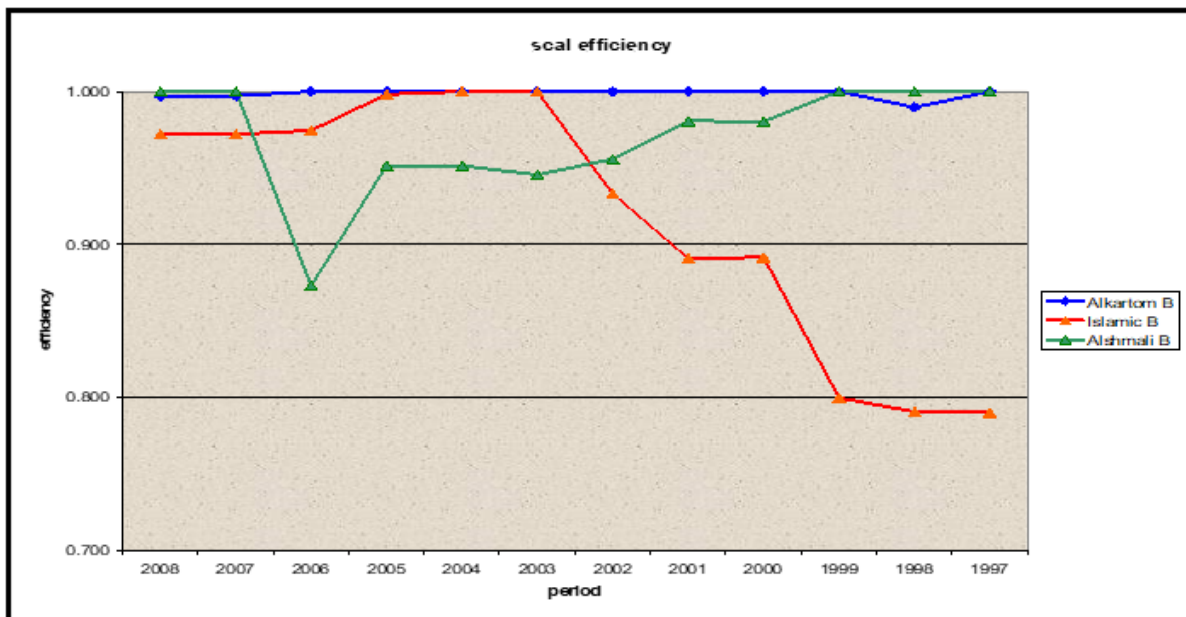
Figure 2: Technical Efficiency
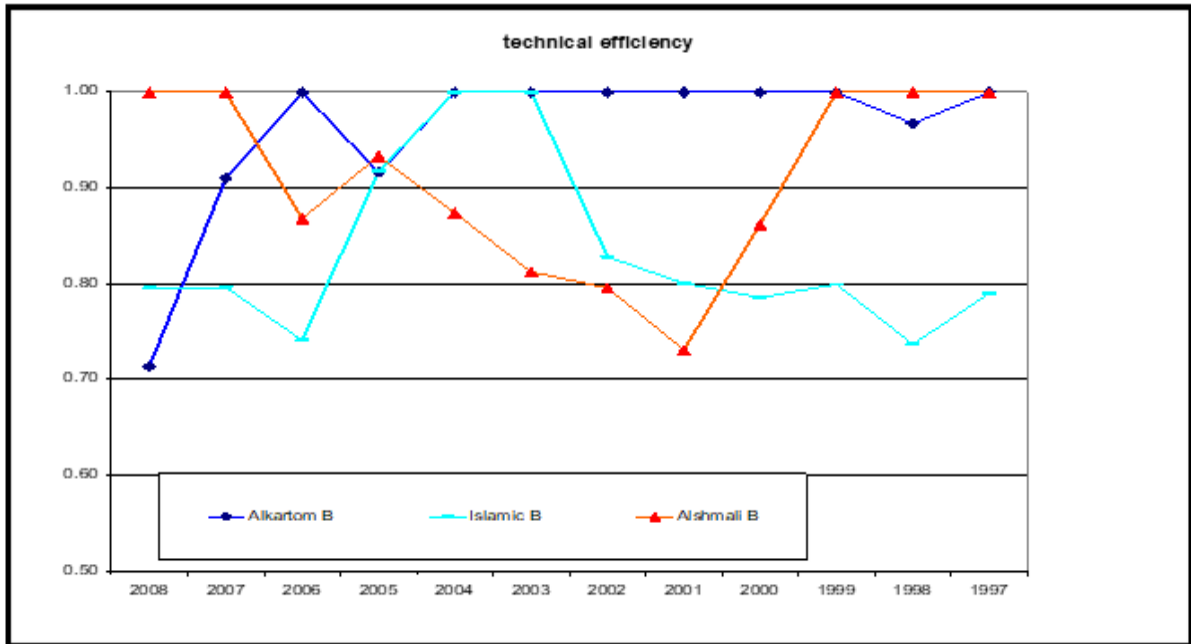
Sources: (Ondrey, 2020)

Figure 3: Technical Efficiency

Sources: (DesJardins, Ahlburg, & McCall, 2016)

Figure 4: Technical Efficiency

Sources: (Tavares, 2002)

The present study investigates the trends in efficiency changes within the Sudanese Islamic banking industry during the post-deregulation period. It examines how different types of banks responded to the reform process. Efficiency scores and total factor productivity growth are estimated using the input-oriented data envelopment analysis (DEA) model. Two input and output specifications are employed to represent efficiency gains in intermediation. The primary limitation encountered in this study is the number of banks included in the sample. Therefore, efficiency scores are estimated based on year-moving averages for the local Sudanese Islamic banks. The analysis of mean estimated efficiency scores in both models, which utilized intermediation and asset approaches for the specification of input and output variables, revealed fluctuating trends, indicating both decreases and increases in estimated efficiency.

One potential effect of the monetary policy measures on Islamic banks' profitability is through changes in interest rates. As Islamic banks do not charge or pay interest, changes in interest rates may not have the same impact on their profitability as on conventional banks.

Another potential effect of the monetary policy measures on Islamic banks' financing activities is through changes in the money supply. As Islamic finance is based on risk-sharing, changes in the money supply may affect the availability of financing for Islamic banks and their ability to generate profits. For example, if the money supply is tight, Islamic banks may have difficulty finding suitable investment opportunities for their funds, which could reduce their profitability. In addition to the direct effects on profitability and financing activities, the monetary policy measures may also have affected Islamic banks' risk management practices. For example, changes in interest rates or the money supply may affect the creditworthiness of borrowers,

which could increase the risk of default. Islamic banks may have had to adjust their risk management practices in response to changes in monetary policy to ensure the quality of their loan portfolio.

Overall, the effects of monetary policy measures on the overall efficiency of Islamic banks in Sudan during the period from 1997 to 2008 are complex and multifaceted. While some of the measures may have had direct or indirect effects on Islamic banks' profitability and financing activities, other factors such as the regulatory environment, the competitive landscape, and macroeconomic conditions would also have played a role in determining their efficiency.

During the period from 1997 to 2008, the Central Bank of Sudan (CBOS) implemented various monetary policy measures to regulate the supply of money and credit in the economy. Some of the specific monetary policy actions taken during this period include:

Open Market Operations: The CBOS also used open market operations to influence the supply of money in the economy. Open market operations involve the purchase or sale of government securities by the central bank in the open market. By buying government securities, the CBOS injected money into the economy, while selling government securities removed money from the economy.

Interest Rate Policy: The CBOS used interest rates as a tool to influence the cost of credit and the supply of money in the economy. In 1997, the CBOS introduced a new monetary policy framework that included a benchmark interest rate known as the discount rate. The discount rate was used to signal the CBOS's stance on monetary policy and to guide commercial bank lending rates.

Foreign Exchange Policy: The CBOS also implemented policies to manage the exchange rate of the Sudanese pound. During this period, Sudan was subject to economic sanctions, which made it difficult to access foreign currency. The CBOS implemented various measures to manage the availability and exchange rate of foreign currency, including the use of a managed float exchange rate regime and restrictions on foreign currency transactions.

Reserve Requirement Policy: The CBOS also used reserve requirements to regulate the amount of money that commercial banks could lend. Reserve requirements are the amount of funds that banks are required to hold as reserves with the central bank. By adjusting reserve requirements, the CBOS could increase or decrease the amount of money that banks had available to lend. Overall, the specific monetary policy actions taken during the period from 1997 to 2008 were aimed at regulating the supply of money and credit in the economy, managing the exchange rate, and promoting economic stability. These actions would have affected the profitability and financing activates of Sudanese Islamic banks, as Pell as their overall efficiency.

Conclusion

The results of the study, which used Model DEA, confirm this. High accuracy in the results of measuring banking efficiency used in Sudanese banks during the study phase. The results demonstrate a notable correlation between monetary policy and bank efficiency, particularly in connection to interest rate regulations and reserve requirements, which exert the greatest influence. Various categories of Islamic banks, including commercial banks, experienced distinct impacts from monetary policy, with the evolution of policy over time resulting in both favorable and unfavorable consequences for bank efficiency. These findings enhance the current understanding of how monetary policy and bank efficiency interact, specifically in the context of Islamic banking in Sudan. The inclusion of a specific country and the use of data that is self-reported may restrict its applicability to a broader context. Future investigations could enhance this study by examining additional nations or utilizing different data sources.

Conflict of Interest

The authors declare that they have no conflict of interests.

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Appendix 1: Estimated Efficiency scores (Mean)

DMU	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	Average
	TECHNICAL EFFICIENCY												
Alkartom Bank	0.714	0.910	1.000	0.916	1.000	1.000	1.000	1.000	1.000	1.000	0.967	1.000	0.959
Islamic B	0.796	0.797	0.741	0.918	1.000	1.000	0.828	0.801	0.786	0.800	0.737	0.790	0.833
Alshmali Bank	1.000	1.000	0.868	0.934	0.874	0.812	0.796	0.731	0.862	1.000	1.000	1.000	0.906
average	0.836	0.902	0.870	0.923	0.958	0.937	0.875	0.844	0.883	0.933	0.902	0.930	0.899
	PUR-TECHNICAL EFFICIENCY												
Alkartom Bank	0.716	0.913	1.000	0.916	1.000	1.000	1.000	1.000	1.000	1.000	0.978	1.000	0.960
Islamic Bank	0.819	0.819	0.760	0.920	1.000	1.000	0.888	0.899	0.881	1.000	0.932	1.000	0.910
Alshmali Bank	1.000	1.000	0.995	0.981	0.919	0.859	0.833	0.746	0.879	1.000	1.000	1.000	0.934
average	0.845	0.911	0.918	0.939	0.973	0.953	0.907	0.881	0.920	1.000	0.970	1.000	0.935
	SCALE EFFICIENCY												
Alkartom Bank	0.997	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.990	1.000	0.999
Islamic Bank	0.972	0.972	0.975	0.998	1.000	1.000	0.933	0.891	0.892	0.800	0.790	0.790	0.918
Alshmali B	1.000	1.000	0.873	0.952	0.951	0.945	0.956	0.981	0.980	1.000	1.000	1.000	0.970
Average	0.990	0.990	0.949	0.983	0.984	0.982	0.963	0.957	0.957	0.933	0.927	0.930	0.962