Operational Efficiency in Islamic Banking:
The Sudanese Experience

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Abstract

In this paper, we estimate the operational efficiency in 17 Sudanese (Islamic) banks between 1990-2000. We adopt the stochastic cost frontier approach. Our findings show that Islamic banks do not create inefficiency *per se*. Furthermore, although the average efficiency is almost stable between 1990-2000, there are wide efficiency differences across Sudanese banks. Despite the small size of the foreign banks, they are more efficient than state-owned and joint-ownership banks. Sudanese banks are not ready yet to confront the globalisation challenges.

We also examine the sources of inefficiency by estimating a second stage inefficiency regression. Several interesting findings emerged. First, the increase in the level of foreign and private shares in Sudanese banks should enhance the cost efficiency in the banking sector. Second, in order to improve efficiency, Sudanese banks should increase their (low) paid-up capital ratio but not through merger and acquisition activities. Third, Sudanese banks have an advantage in *murabaha* and *musharaka* modes of finance which are not fully utilised yet. Fourth, Sudanese banks should implement serious programmes for human capital development in order to reduce the current level of cost inefficiency.

1.   Introduction:

Modern Islamic banking is relatively a recent development of the financial industry as the first Islamic bank was opened in Egypt in 1963. Islamic banking activities have grown rapidly after 1975 as a result of the oil price boom which brought a huge amount of capital inflows to the GCC countries and therefore increased the demand from Muslim investors for ways to invest without going against *Shariah*. In the 1970s Islamic financial institutions focused on trade-related finance and leasing operations. In the 1990s, a number of new Islamic investment funds have been launched to manage wide-ranging portfolio of shares in companies whose activities are compatible with Islamic principles and many commercial banks started Islamic banking operations. The Banker (2000) reports that there are over 113 Islamic banks and Islamic investment institutions managing over $147 bn of assets worldwide.

Islamic banks have good prospects and are expected to expand further as the Muslim population is estimated at 1.2 bn worldwide and Islamic financial institutions have not yet sufficiently benefited from their potential in assets creation. Islamic financial markets are still underdeveloped and serious challenges facing them. Islamic banks need to pay more attention to their asset and liability composition, acquire the necessary expertise in financial engineering, and cooperate in establishing settlement mechanisms and rating agencies. Principal among such problems that Islamic banks should give greater attention to is to reorient their size and operations for higher efficiency in order to face intense competition with conventional banks.

The issue of how efficiency in banking can be enhanced is important at the micro and macroeconomic levels since efficiency has important policy implications. At bank management level, financial institutions used to enjoy local oligopolies and therefore make rewarding profits, but such advantages are shrinking due to growth in competition. At the macroeconomic level, bank efficiency is a socially optimal target since it reduces the average cost of financial transactions and therefore enhances the society's welfare. To our knowledge, efficiency in Islamic banking has not been the

focus of previous empirical studies. This is a result of lack of accessible micro data on Islamic banks.[1]

Sudan is one of very few countries with its financial system built completely on Islamic principles. The main objectives of the study are twofold: First, to measure the efficiency of the Islamic banks in Sudan using the stochastic cost frontier analysis. Second, to provide constructive recommendations to Sudanese policy-makers and bank management on strategic issues such as the viability of banking consolidation and the performance of foreign banks *vis-a-vis* domestic banks. The study also examines how the ownership differences (government/private), deposit mix, assets composition, earning risk, quality of labour force affect the performance of Sudanese Islamic banks. These objectives can be achieved by estimating two models. The first model is used to measure the inefficiency index, while the source of inefficiency scores is explained by estimating the second model.

The rest of the paper is organized as follows: Section 2 highlights the importance of banking efficiency and introduces the different concepts of efficiency. Section 3 highlights the recent development of the Sudanese economy and examines the main characteristics of the banking sector in the 1990s. The discussion of the different frontier techniques and the specification of our two models are provided in Section 4. Section 5 is devoted to data sources and description. The results and policy implications are reported in Section 6. Finally, Section 7 concludes.

2.   Efficiency in the banking sector:

The study of banking efficiency is quite important for the following reasons: First; the financial sector is a major player in modern economies, as a producer of financial services and as an employer. The value-added of the financial sector as a share of GDP has grown considerably over the last three decades. Banking system fulfil essential functions in intermediating between savers and investors, financing private sector trade and investment, and helping to ensure that the economy's financial

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[1] Bashir (1999) argues that the lack of data on Islamic banks is due to the following reasons: First; most of the Islamic financial institutions operate in underdeveloped markets. Second; Islamic banks are not obliged to disclose periodic information. Third; the lack of information agencies specialized in Islamic financial institutions.

resources are allocated effectively. The banking system must be sound and efficient in order to effectively play its role. Furthermore, well-functioning banking system increases the effectiveness of macroeconomic policy by providing a channel for monetary policy signals.

Second; financial markets have become increasingly globalised. The growth of international financial activities has been more rapid than the growth of domestic markets and access to international capital markets for developing and transition countries has grown rapidly. Technological progress, the development of new financial instruments and liberalization have increased the potential for further growth of the financial sector both domestically and internationally. A key challenge facing the financial sector especially in developing countries is to respond to the recent wave of globalisation and the move towards global financial markets. Domestic banks have to work side by side with foreign banks. Less efficient banks with high operating costs are likely to suffer from international competition.

Third; the measurement of financial efficiency is also important to all parties that participate in the banking industry. Assessing bank's performance through measuring efficiency helps bank management to improve managerial performance. It assists investor in making investment decisions whether to participate in financial activities. Regulators are also interested in banking efficiency since the performance of the banking sector has significant impact on other parts of the economy. The recent experience of Western Europe shows that achieving a greater efficiency is one motivation for the recent rapid changes in the structure of the banking industry (Altunbas et al, 1996).

The efficiency of conventional banks especially in the US has been studied extensively in the banking literature. Earlier studies mainly focused on the issues of scale and scope efficiencies. Scale efficiency of a firm refers to the relationship between the level of output and the average cost and it indicates how far is the level of output from the optimal scale of production where the production cost would be minimised. Scope efficiency refers to the relationship between average cost and the production of joint products. Scope efficiency is measured to examine whether it is

optimal to produce all the products as opposed to specialising in one or more of them. More recently, research on banking efficiency has focused on the issue of operational efficiency (x-efficiency). The concept of x-efficiency was introduced by Leibenstein (1966) who noted that organisations do not work as effectively as they could for a various reasons. X-inefficiency refers to the deviations from the production efficient frontier that represents the maximum attainable output for a given level of input, it reflects the managerial ability to control costs and maximize revenues (Al-Jarhi, 2001; Kwan and Eisenbeis, 1996). X-inefficiency includes both technical and allocative inefficiencies of individual firms. Technical inefficiency reflects the loss of profits from choosing a poor production plan while allocative inefficiency reflects the loss of profits from failing to meet the production plan (Al-Jarhi, 2001).

In a survey article, Berger et al (1993) indicate that there is a virtual consensus that x-inefficiency are larger than scale and scope inefficiencies in the banking industry. The survey shows that x-inefficiency account for approximately 20 percent or more of banking costs while both scale and scope inefficiencies account for less than 5 percent.

3.   The Sudanese Economy and Recent Development of Islamic banks in Sudan:

Sudan is the largest country in Africa with a land area of 2.5 million square kilometers, of which 12 percent is agricultural, 18 percent forest, the remainder is mainly desert. The Sudanese economy is classified as underdeveloped, it depends on the production of raw materials and primary commodities. Agriculture is the backbone of the Sudanese economy, contributing 48 percent of the GDP, giving employment to 65 percent of the population and providing the country with about 80 percent of the export earnings.[2] In addition, the agriculture sector is the source of raw materials to the processing factories in Sudan which contribute around 17 percent of the GDP. Heavy dependence on the agricultural sector has conditioned economic growth to erratic climate conditions and to the volatility of primary commodity markets.

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[2] These ratios refer to 1999 figures.

Table (1): Banking Finance to Different Sectors (1989-2000)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Agriculture	7%	11%	27%	34%	35%	29%	25%	27%	30%	33%	30.40%	22%
Industry	25.50%	22.90%	19.70%	13.70%	15.70%	18.30%	18.50%	18.80%	17.50%	18.80%	14.70%	10.50%
Exports	34.80%	28.20%	18.30%	17.20%	21.90%	22.20%	27.20%	19.60%	20.20%	17.10%	17.20%	21%
Imports	3.20%	2.90%	2%	1.10%	0.80%	1%	8.50%	5%	2.10%	0.70%	3.10%	1%
Domestic trade	6.50%	10.20%	13.80%	11.60%	6%	5.60%	2.90%	3.60%	4.20%	4.30%	5.80%	10%
Other sectors	23.20%	24.90%	19.60%	22.30%	20.20%	23.60%	18.80%	26.50%	25.95%	25.80%	28.80%	34%
Total finance	495	767	1403	3311	5273	10073	14140	33950	41556	47383	48732	79224

Source: Bank of Sudan
Note:Total finance is in million dinar.

Table (2): Contributions of the Economic Sectors to GDP

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Agriculture	28.7%	33.9%	40%	38%	41.1%	43%	45%	47.6%	48.7%	49.8%	46.4%
Industry, Manuf. & Mining	9.4%	9.7%	9%	9.4%	7.6%	6.7%	7.4%	8.3%	8.1%	9.1%	15%
Electricity & Water	2.3%	2.1%	2.3%	2.3%	2.6%	2%	2%	1.9%	1.8%	1.8%	1.7%
Construction	5.8%	5.3%	5.2%	5.8%	5.6%	5.5%	5%	4.9%	5.1%	4.9%	4.7%
Govt. Services	11.7%	10.3%	7.8%	11.7%	7.6%	8.4%	7.5%	5.9%	6.5%	6.2%	5.8%
Other Services	42.1%	38.7%	35.7%	42.2%	35.5%	34.4%	33.1%	31.3%	29.8%	28.2%	26.4%

Source: Ministry of Finance and National Economy and Bank of Sudan.

In the 1980s, the Sudanese economic problems have been aggravated by the increase of foreign debts, the depreciation of the Sudanese pound against foreign currencies, the decline of the agricultural export revenues especially the main cash crops, and the surge in oil prices which led to high inflation. Furthermore, the outbreak of the civil war in 1983 had worsened the economic conditions. The successive governments adopted various policies to contain the economic crisis. During the 1980s, Sudan used to receive foreign assistance between $800 million to $1 billion a year in the form of loans, grants, and aid. But due to the economic and political situation, external finance dried up in the beginning of 1990s.

The current Sudanese government has taken office in 1989 and engaged in economic reforms and liberalization policies since 1990. Reforms started with a three-year economic recovery programme (1990-93) aimed at getting the economy out of stagnation where the agriculture sector was given priority. Despite the available resources, the performance of the agriculture sector is below its potential. Drought, the lack of investment in technology, the civil war and the widespread urban migration have hindered the agriculture sector from reaching its potential.

The Sudanese government used an expansionary monetary policy in order to boost the agricultural sector. All direct taxes on agricultural products were eliminated in order to enhance the competitiveness of the Sudan's agricultural exports. Banks were instructed to direct 50 percent of their finance to the agriculture sector. Table (1) shows that banking finance to the agricultural sector has increased from 7 percent of total finance to 35 percent in 1993 and then declined to 22 percent in 2000. The increase in finance to the agricultural sector was at the expense of the industry and export sectors. Banking finance to industry diminished from 25.5 percent in 1989 to 10.5 percent in 2000. On the other hand, exports share of total banking finance went down from 34.8 percent in 1989 to 21 percent in 2000. As a result, the contribution of the agriculture sector to GDP has substantially increased. Table (2) shows that agricultural sector production as a percentage of GDP has increased from 28.7 percent in 1990 to 46.4 percent in 2000. The improvement in the performance of the agriculture sector is sustainable where agricultural contribution to GDP is above 40 percent since 1994. On the other hand, the contribution of the industry, manufacturing and mining sector to GDP was almost steady during the 1990s.

Due to the expansionary monetary policy and increase in government spending, the level of investment as a percentage of GDP has remarkably improved from 9 percent in 1990 to over 31 percent in 1997. Table (3) shows that the investment rate steadily increased in the first five years of the 1990s then it fluctuated between 16 to 31 percent since 1995. On the other hand, the Sudanese financial sector was not able to mobilize adequate domestic savings whereby savings as a percentage of GDP remained very low in the 1990s, compared to its counterparts in developing and developed countries. Table (3) shows that saving rate never exceeded 17 percent and has an average of 11 percent between 1990-97. Table (3) also reveals that the resource gap (between investment and saving) is getting wider over time which means that the financial sector is not playing its role in the development process.[3]

Table (3): Macroeconomic indicators

	Growth Rate	Inflation	ER	Investment/GDP	Saving/GDP
1990	-5.5	67.4	98	9.3	8
1991	7.5	122.5	277.8	13.4	9.5
1992	6.6	119.2	297.5	17.3	13.9
1993	4.6	101.2	60.9	19.8	11.8
1994	1	115.9	84	23.5	11.7
1995	6	68.9	109.5	16.1	11.3
1996	5.9	130.4	74.2	21.8	13.9
1997	6.3	47.2	17.9	17.8	5.8
1998	6.4	17	37.6	31.7	16.5
1999	7.6	16.1	8.4	…	…
2000	5.8	8.1	0.1	…	…
2001	6.7	7.4	…	…	…

Source: Bank of Sudan, Central Bureau of Statistics and Kireyev (2001).
Notes:
1. All numbers are in percentage.
2. ER = Nominal Exchange Rate Depreciation

Although the expansionary policies transformed the economy from stagnation to revival and expansion, the inflationary pressure has increased since 1992 because of the increase in money supply, deterioration in the exchange rate and therefore the increase in the cost of production. The average annual inflation rate estimated at 104

percent in 1990-97. Therefore, the Sudanese government adopted tight fiscal and monetary policies in order to control liquidity, money supply, and budget deficit. Thus, tighter money supply by the Bank of Sudan (BOS) has constrained finance to investment. Budget deficit was reduced from 3.8 percent in 1996 to only 0.5 percent of GDP due to cut in government spending. Annual inflation was brought down to 8 percent in 2000 where excess liquidity in the market created in the period of high inflation was absorbed through two instruments: Government Musharaka Certificates (*GMC*) and Central Bank Musharaka Certificates (*CMC*).

Sudan got a significant boost when its oil exports began in 1998, turning a $300 million annual bill for petroleum products into a source of revenue that could earn $1.2 billion. The petroleum sector is attracting large foreign direct investment, with both China and Malaysia investing over $1 billion each. Overall, the Sudanese economic fundamentals have improved and during most of the 1990s the Sudanese economic performance was strong. The average GDP growth of Sudan stood at 4.7 percent in 1990-2000, in contrast to 1.2 percent in 1985-1990. In fact, over the past six years, with an average of 6.5 percent, the Sudanese GDP growth is among the highest rates in developing countries.

But Sudan is still confronting some serious economic problems. Foreign debt still stands at $24 billion, a huge figure for Sudan that has a GDP of $8 billion. Furthermore, the civil war costs $1 million a day. Inadequate infrastructure is a major obstacle to the development of the Sudanese economy. Domestic production depends heavily on imported capital and intermediate goods, while the main source of foreign currency is a handful of primary agricultural exports such as cotton and Arabic gum.

The Banking Sector in Sudan

Bank of Sudan was established in 1960 to supervise the banking sector that had a few branches of foreign banks. In 1972, one Sudanese bank was established then the government nationalized the banking sector. The first Islamic bank (Faisal Islamic Bank) was established in 1977. The major shift for the banking sector took place in 1983 when a decision was made to conform all financial transactions to Islamic

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[3] The recent literature on finance and growth shows that higher growth rate can be achieved through

principles. Since 1983 several Islamic banks entered the Sudanese market, e.g. Tadamoun Islamic Bank, Sudanese Islamic Bank, Albaraka Bank, but it has been quite difficult to transform all financial operations in the economy at once. In fact, the serious financial changes took place since 1992 in line with the effort to stabilize the economy and accelerate growth. Since 1992 the financial sector is built entirely on Islamic principles and any financial transaction that is not compatible to *Shariah* is not allowed.

The institutional structure of the banking sector was stable in the 1990s. Table (1A) shows that the total number of banks was in the range of 25-29 in the 1990s where two insolvent banks have been liquidated, three (public) banks have been merged into Khartoum Bank to form the largest bank in Sudan, and in 1993 the merger of El-Nilein Bank and the Industrial Development Bank created the second largest bank. Currently, the Sudanese banking system consists of two investment banks, four specialized banks, and 17 commercial banks (3 foreign, 7 state-owned, and 7 jointly owned banks). As in several developing countries, the Sudanese financial sector is dominated by a few banks. For instance, the largest two banks (Omdurman Bank and Bank of Khartoum) are government-owned banks with a 25 percent market share. Three banks hold 45 percent of the total banking deposits while 60 percent of the total assets is held by six banks. In fact, the seven commercial banks owned by the state have more than 50 percent market share (see Table 2A).

There has not been major changes in the distribution of bank branches in Sudan over the 1990s. Table (3A) reports that 50 percent of bank branches network is concentrated in the capital (Khartoum) and the Middle region where 35 percent of the population live.

The Sudanese banks are very small by international standards whereby the total amount of deposits in the entire banking system is around $500 million since 1995. The average capital and total assets of a Sudanese bank is $3.5 million and $24 million, respectively (Kireyev, 2001). The deposits structure of the Sudanese banks differs from most Islamic banks. In Sudan, total deposits are dominated by demand

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higher level of savings, investment, and efficiency of investment.

deposits with a share of over 70 percent. On the other hand, saving and investment deposits remain relatively small. Kireyev (2001) argues that this phenomenon is a reflection of the cash nature of the Sudanese economy where individuals prefer to have instant access to their funds. One also may argue that this phenomenon reflects the failure of the banking sector to offer investment opportunities to suit potential depositors. In addition, because inflation rates were much higher than any profits that banks may distribute to depositors in the 1990s, individuals invested heavily in properties. Even banks used to invest in the property sector till 1995 when BOS prevented such practice.

The main indicators of financial deepening show that the banking sector is characterized by financial desintermediation between 1992-1997. Table (4) shows that banking finance (in real terms) has declined by 46 percent in 1990-2000. The growth rate of banking finance to private and public sectors were –82% and –20%, respectively, over the 1990s. Because of the depositors loss of confidence in the banking system, total deposits witnessed a huge drop in its real value. In 2000, Sudanese banks had only 4 percent of the total deposits they used to possess in 1990. Even foreign deposits deteriorated by 45 percent in the 1990s. Total deposits as a percentage of GDP is very low by any standard. The ratio was in the range of 6-11 percent, compared to 65 and 97 percent in Egypt and Jordan, respectively. Investment deposits has never exceeded 2 percent of GDP in the 1990s. The average finance to economic sectors as a percentage of GDP was less than 3 percent in 1991-2001.

The private deposit base was weakened when the government imposed limits on deposits withdrawal in 1991. As a result, currency in circulation outside banks has increased and confidence in the banking system has been lost. The currency circulated outside banks as a percentage of currency circulated inside the banking system is always above 90 percent since 1990. For example, the currency outside the banking sector was 92 percent in 1995, 91 percent in 1996 and 1997, and 95 percent in 1998 and 1999 (Haroun, 2001).

Table (4): Financial Indicators

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Index in real terms						(1997=100)					
Banking finance	229	231	178	167	123	125	96	100	105	102	132
to government	229	188	178	164	140	131	100	100	105	129	130
to private sector	591	299	257	179	122	107	113	100	104	88	108
to public enterprises	690	349	301	208	124	112	116	100	136	271	552
Total deposits	2161	1093	817	416	295	184	116	100	114	117	138
Total deposits/GDP	1.50%	7.40%	11.00%	9.50%	9.90%	10.10%	6.60%	6.10%	6.00%	5.90%	6.60%
Investment deposits/GDP	0.20%	2.10%	1.10%	2.20%	0.83%	0.47%	0.48%	0.62%	0.70%	0.80%	1.10%
banking finance/GDP	9.20%	3.30%	3.50%	2.8%	5.30%	2.60%	3.20%	2.40%	2.00%	1.80%	2.70%

Sources: The first half of the table was taken from Kireyev (2001). The second half of the table was provided by the Research & Statistics Department, BOS.

The assets composition of the Sudanese banks also contrasts with other Islamic banks. In Sudan, banking finance to economic sectors constitutes a small fraction of total assets. Sudanese banks maintain a large proportion of their resources in liquid assets since short-term deposits dominate the liabilities side of the banking balance sheet. Haroun (2001) reports that banking finance to economic sectors as a percentage of total assets accounts for 14, 21, 17.5, 14.4 and 11.5 percent in 1995-99, respectively. Sudanese banks are mainly engaged in non-fund financial services whereby off-balance sheet transactions generate 46 percent of the banking income, compared to 37 percent from banking finance to economic activities (Haroun, 2001). Several banks extract almost 70 percent of their net profits from administration fees and charges imposed on customers (Kireyev, 2001).

Table (5): Finance Composition (according to the Modes of Finance)

	Murabaha	Musharaka	Mudaraba	Salam	Others	Total
1990	70.70%	13.30%	1.30%	13.30%	1.30%	100.00%
1991	72.50%	12.50%	1.30%	12.50%	1.30%	100.00%
1992	67.30%	11.10%	1.60%	18.6	1.30%	100.00%
1994	40.80%	40.40%	2.90%	7.10%	8.70%	100.00%
1995	54.40%	35.10%	2.70%	3.90%	3.90%	100.00%
1996	53.00%	32.00%	2.00%	4.00%	9.00%	100.00%
1997	52.00%	22.60%	5.40%	8.40%	11.60%	100.00%
1998	54.30%	21.10%	6.10%	6.50%	12.00%	100.00%
1999	49.10%	30.80%	4.10%	5.00%	11.00%	100.00%
2000	34.20%	42.60%	3.70%	3.30%	16.40%	100.00%
2001	39.50%	31.00%	6.20%	5.00%	18.30%	100.00%

Source: Bank of Sudan

Table (5) shows that the Sudanese banks prefer *murabaha* over other types of Islamic modes of finance. Almost half of the banking finance was in the mode of *murabaha* contracts in the 1990s. *Musharaka* is also a popular form of finance among Sudanese banks with an average share of 29 percent of total finance in the 1990s. Due to the increase in non-performing loans in agriculture, banking finance through *salam*

contracts has declined from 13.3 percent of total banking finance in 1990 to 5 percent in 2001. Other modes of finance constitute a small fraction of total finance.

In 2000, banks' excess reserves at the BOS reached 50 percent of the banking finance whereby the Sudanese banks prefer to accumulate reserves rather than providing finance to private sector.[4] Kireyev (2001) points out that finance to private sector (in real terms) was shrinking annually by 16 percent between 1991-93, 1.5 percent between 1994-96, and 6 percent in 1997-99. Overall, finance to the private sector has declined by 23 percent in 1990-99. Among other reasons, Kireyev argues that the decline in banking finance in the 1990s is due to the fact that Sudanese banks do not have much access to lines of credit from abroad, inefficiency of the banks and the excessive BOS intervention. The capital and deposit bases are not sufficient for increasing finance. Banks consider the risk of extending finance to all sectors, other than trade, high. The cost of borrowing remains high in Sudan. For instance, the *murabaha* real rate of return was in the range 9.7-16.7 percent in 2000. In addition, Sudanese banks prefer to buy GMC with higher rate of return compared to financing private sector.

Haroun (2001) points out that the profits of the banks are very low compared to international standards where the ratio of total expenses to total revenues exceeds 55 percent in all Sudanese banks apart from the foreign ones. For example, the ratio of total expenses to total revenues has reached 98 percent in public and joint banks in 1997. Total expenses have exceeded total revenues by 30 percent in government banks in 1999. Haroun (2001) argues that low efficiency in assets management, high ratio of non-performing loans, and low productivity of labour are the main hurdles to increase operating revenues in Sudanese banks. In addition, the high total expenses is due to the absence of good governance, high staff and administration cost, small size of Sudanese banks, and the slow process of introducing modern technology to banking operations. The average staff and administration costs in the Sudanese banks is 9 percent of total assets and it reaches 20 percent in some banks (Kireyev, 2001).

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[4] Indirect monetary policy becomes less effective when banks hold high level of excess reserves.

Non-performing loans as a percentage of total banking finance is quite high in Sudanese banks. For instance, Abdullah et al (2000) show that according to the BOS publications the non-performing loans ratio was 44 percent in 31/7/1998. The non-performing ratio was 24 percent in 1999 and 16 percent in 2000 (BOS, 2000)[5]. The non-performing loans ratio is higher in public banks compared to the joint banks. For example, in 2000 the non-performing loans ratio was 28 percent in public banks and 17 percent in joint banks (Haroun, 2001).[6] It is worth noting that foreign banks did not record non-performing loans because they mainly engage in non-funding financial services and finance only trade transactions with low risk of default. Abdullah et al (2000) examined the non-performing loans for 1994-1998. They conclude that among the Islamic modes of finance, *Murabaha* is the main contributor to non-performing loans. The exports sector has the highest non-performing loans as a percentage of total non-performing loans (38 percent). Furthermore, 28 percent of the non-performing loans is due to defaults in the agricultural sector. There are several reasons behind the increase in non-performing loans: First; the absence of the price mechanism to allocate finance among different sectors and projects led bankers to use other and less efficient measures to screen potential investments. Second; banks do not have sufficient information on customers and investment opportunities. Third; the performance of the main economic sectors (agricultural and industry) are vulnerable to several external factors such as drought and change in foreign prices.

Since 1999 the BOS has pursued a tight policy in dealing with non-performing loans. Banks should report on their non-performing loans to the BOS on a monthly basis and penalties are imposed on noncompliant banks.[7]

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[5] Haroun (2001) argues that despite collaterals, such as storing commodities through the bank, are provided against finance, banks are not able to liquidate the collaterals.

[6] The increase in non-performing loans as a percentage of total finance in the late 1990s was mainly due to the decline of the overall finance activities. Also the high level of non-performing loans is due to the tight definition that the BOS use of such loans whereby an overdue loan by one month is considered as non-performing.

[7] If non-performing loans do not exceed 10 percent of a bank's finance, the BOS encourages the management of the bank to take corrective actions. For banks which have non-performing loans above 10 percent, the BOS request the bank to prepare a debt recovery plan which should be approved by the BOS. The bank must implement the recovery plan within a month of the approval, otherwise penalties are imposed.

Banks' paid-up capital has considerably deteriorated as a percentage of total assets. Sudanese banks had a narrow capital base over the 1990s and the capital adequacy ratio was always below the international norm of 8 percent. In 1994, the BOS required that all banks should comply with the 8 percent risk-weighted capital requirement within three years. In 1996, only 13 banks out of 28 met the capital requirement. In 2000, out of 26 banks 9 still undercapitalised (Haroun, 2001). The BOS encouraged undercapitalized banks to merge through voluntary bilateral agreements, alternatively banks have to increase their paid-up capital to SD 3 billion by end of 2002.[8]

Since the mid-1990s there has been apparent progress in bank supervision and regulations. The BOS has begun to reduce financial restrictions and liberalise the banking system and banks have been engaged in inter-bank market activities. Uniform accounting principles for all financial institutions in Sudan have been introduced in 1998. Key items of the banks' balance sheets are monitored by the BOS. Banks have to submit specific information to the BOS on a daily, weekly, monthly, quarterly, and annual basis. Finance ceiling for agriculture went down to 30 percent in 1998. Since 1999 no minimum finance is required for the agriculture sector, financial institutions are free to allocate finance to different sectors of the economy without BOS intervention. The profit margins on *murabaha* issued by the BOS are indicative and banks are free to set their own margins.[9]

4. Methodology and Model Specifications:

The efficiency in financial institutions can be estimated using either parametric methods (such as stochastic frontier analysis, thick frontier approach, and distribution-free approach) or non-parametric techniques (such as data envelopment analysis and free disposable hull analysis). A major drawback of the non-parametric methods is that they generally ignore prices. Therefore, non-parametric techniques fail

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[8] Banks are requested to increase their paid-up capital to SD 1 billion by end of 2000, to SD 2 billion by end of 2001 and SD 3 billion by end of 2002.

[9] Despite, the profit margins of the m*urabaha* contracts issued by the BOS are not binding, banks feel obliged not to drift away from these margins.

to capture the allocative inefficiency in misresponding to relative prices in choosing inputs and outputs. In other words, non-parametric procedures account only for technical inefficiency. In addition, non-parametric techniques do not allow for measurement error and other external variables that may temporarily affect outcomes, assuming that random error is equal to zero (Berger and Mester, 1997).[10] On the other hand, parametric procedures are more developed and avoid some of the problems associated with the non-parametric techniques. For instance, the stochastic frontier techniques not only allow for an error term but also distinguish between firm-specific effects and random noise. [11]

To measure the x-efficiency of banking firms, we use the frontier analysis proposed by Farrell (1957). Accounting information on inputs and outputs can be used to formulate cost frontier and estimate x-efficiency. Under the cost frontier analysis, the lowest cost -cost frontier- using the most efficient mix of productive inputs is determined. Individual bank inefficiency index is measured by estimating the deviation of costs from the cost frontier. The inefficiency index represents both allocative inefficiencies from failing to react optimally to relative prices of inputs, and technical inefficiencies resulting from employing excessive amount of inputs to produce outputs.

When the cost frontier analysis is used, one of the main hurdles that may be faced is to define bank's production function. The banking literature introduces two approaches to define costs, inputs, and outputs of a financial institution: The intermediation approach and the production approach (Humphrey, 1985). The main difference between the two approaches lies on how deposits are treated. Although the intermediation approach considers deposits as an input to the production of loans, the production approach treats deposits as an output since deposits significantly contributes to the creation of profits (Resti, 1997). Furthermore, the two approaches adopt different definition of cost. The intermediation approach takes into account both

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[10] In this case if random error exists, measured efficiency may be biased with random deviations from the true efficiency frontier.

[11] For more details see Bauer (1990), Greene (1993), and Berger and Humphrey (1997).

operating and financial costs, while the production approach considers only operating cost. Another difference between the two approaches is that the intermediation approach measures bank's inputs and outputs by the currency value of accounts, while the production approach measures outputs by physical quantities (number of deposit and loan accounts). Berger and Humphrey (1997) argue that although there is no perfect approach, the intermediation approach may be more appropriate to evaluate financial institutions since this approach takes into account financial expenses, which often accounts for one-half to two-third of total cost. Following the recent empirical literature and bearing in mind the difficulty of obtaining data on the number of bank's accounts, we adopt the intermediation approach to the analysis of bank production.

We use the stochastic cost frontier methodology that is developed by Aigner *et al* (1977) and later by Jondrow *et al* (1982). In this method, a banking firm's observed total cost is modeled to deviate from the cost-efficient frontier due to random noise and x-inefficiency. The single-equation stochastic cost function model can be given as:

$$TC_n = f(Q_i, P_j) + \varepsilon_n \qquad (1)$$

where TC_n is total cost, n is the number of banks, Q_i is a vector of outputs, and P_j is an input price vector. In our model, total cost, TC, includes both financial and operating cost where financial cost is defined as total distributed profits to depositors. We use three input prices: P_1 is the unit cost of capital to the bank, P_2 is the unit cost of funds, and P_3 is the unit cost of labour. Due to data constraints, three output variables are included: investment in *Murabaha*, *Q1*, investment in other Islamic modes of finance (such as *leasing, musharaka, istisna'a*), *Q2*, and off-balance sheet transactions, *Q3*.

In equation (1), ε is a two-component error term of the form:

$$\varepsilon_n = \mu_n + \delta_n \qquad (2)$$

where μ_n is a random uncontrollable factor. It is assumed that μ_n is independently and normally distributed with zero mean and σ_μ standard deviation, i.e., $N(0, \sigma^2_\mu)$. δ_n is the controllable component of ε_n which is assumed to account for inefficiency in production. The term δ_n is independently distributed of μ_n and has a half-normal distribution since inefficiency raises costs.[12]

To get estimates of the x-inefficiencies, δ_n , a standard translog cost function[13] incorporating a two component error structure is estimated using a maximum likelihood procedure (see Cebenoyan *et al*, 1993, Karapakis *et al*, 1994):

$$InTC = \alpha_0 + \sum_{i=1}^{3} \alpha_i InQ_i + \sum_{j=1}^{3} \beta_j InP_j + \frac{1}{2}\sum_{i=1}^{3} \sum_{k=1}^{3} \gamma_{ik} InQ_i InQ_k + \frac{1}{2}\sum_{j=1}^{3} \sum_{h=1}^{3} \theta_{jh} InP_j InP_h$$

$$+ \sum_{i=1}^{3} \sum_{j=1}^{3} \varphi_{ij} InQ_i InP_j + \varepsilon \qquad (3)$$

The maximum likelihood procedure involves three steps. The first step involves obtaining OLS estimates of Equation (3). The OLS estimates are unbiased expect the estimate of the α_0. Second, the OLS estimates are used to obtain the starting values. The estimates corresponding to the largest log-likelihood value in the second step are used as starting values in the iterative maximization procedure in the third step. Jondrow et al (1982) have shown that x-inefficiency (in logarithm) of firm *n* can be calculated by using the distribution of the inefficiency term δ_n conditional on ε_n , i.e., $E(\delta_n/\varepsilon_n)$. The mean of this conditional distribution for the half normal model is shown as:

$$E(\delta/\varepsilon) = \left[\frac{\sigma\lambda}{1+\lambda^2}\right] \left[\frac{\phi\left(\frac{\varepsilon_i\lambda}{\sigma}\right)}{\psi\left(\frac{\varepsilon_i\lambda}{\sigma}\right)} + \frac{\varepsilon i\lambda}{\sigma}\right]$$

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[12] The assumption of half-normality has brought some criticism and several alternatives have been suggested. Cowing et al (1983) and Greene (1990) argue that empirical evidence shows distributional assumptions do not have much impact on the efficiency estimates.

[13] The mathematical derivation of Equation (3) is explained in the appendix.

Where ɸ(.) and ψ(.) are the standard normal density function and standard normal distribution, respectively. An inefficiency measure (in percentage) can be calculated where, *INEFF*, is an exponential transformation of the raw estimate of δ_n.

$$INEFF = \exp(\delta) - 1 \qquad (4)$$

INEFF has a minimum value of zero for the most efficient bank in the sample and increase with inefficiency for the other banks with no upper bound.

The great advantage of maximum likelihood estimation is that under broad set of conditions, parameter estimators are consistent and asymptotically efficient. It should be noted that the estimation of α, β and other coefficients of equation (3) are of secondary interest, therefore, limited attention will be paid to the statistical properties of estimators (Greene, 1993).

Once the inefficiency index, *INEFF*, is estimated, we proceed to examine the sources of inefficiency. This is done through regressing the inefficiency measure on various bank and economic variables, as the following model shows:

$$INEFF = f(TA, TD, D1, D2, FIN, MUR, MUSH, OFM, IDTD,$$
$$W, MROF, MSOF, CA) \qquad (5)$$

There is a controversial debate on how the size of the bank affects its performance. Here, the size of the bank is measured by either total assets, *TA*, or total deposits. *TD*. It is also argued that the type of ownership (i.e. government, private, foreign, domestic) has an impact on operational efficiency. We use two dummies to capture the change in the banks' efficiency due to the type of ownership. D1 is 0 for government banks and 1 for private banks. We also distinguish between domestic and foreign banks with a dummy, D2, which is 1 for foreign banks and 0 for joint and local banks.

The impact of the assets management policy on efficiency is captured by several variables: the ratio of banking finance through the Islamic modes of finance to total assets, *FIN*, the ratio of *musharaka* to total assets, *MUSH*, *murabaha* over total assets, *MUR*, banking finance through other modes of finance (apart from *murabaha* and

musharaka) over total assets, *OFM*. The coefficients of these variables depend on the expertise of the bank staff and whether they are more oriented towards such activities.

We also examine the impact of the trade-off between *musharaka* finance and *murabaha finance*, on the one hand, and non-funding financial activities on the cost inefficiency. So we include two variables: *MROF*, *murabaha* over off-balance sheet transactions, and *MSOF*, *musharaka* over the off-balance sheet transactions.

The deposits mix may influence efficiency. It has been argued that a higher proportion of current deposits increase the level of efficiency since banks utilise more resources without incurring financial cost. The impact of the deposits mix is measured by the investment deposits over total deposit, *IDTD*.

Furthermore, efficiency is affected by the quality of labour force, the higher the quality of labour, the higher the level of efficiency a bank can achieve. The hypothesis is examined by including the average staff expenses, *W*, in the model. Here, we assume that better-paid workers are more skilful and therefore productive.

The variable *CA* is the ratio of total paid-up capital and investment deposits over total assets and is included to capture the impact of the difference in safety and soundness among banks on efficiency. Under the moral hazard hypothesis, banks with relatively low capital increase the riskiness of their loan portfolios which results in higher non-performing loans and thus higher cost inefficiency. Currently the debate on capital requirements is considerable in Sudan where all Sudanese banks must raise up their paid-up capital to SD 3bn by end of 2002.

5.   Data and Measurements:

With the permission of the BOS and the great assistance of the General Administration for Banking Supervision of the BOS, we started to collect data from all (26) Sudanese banks. Due to the limited amount of data that 5 banks have released and the inconsistency in the data provided by four other banks, we had to eliminate 9 banks from the study. Annual data were collected from 17 Sudanese banks for the period 1990-2000. Twelve banks have a complete time series of observations, while few observations were missing for five banks. So, we have 170 observations. The

market share of the 17 banks is greater than 90 percent. List of the banks is included in the appendix.

The unit cost of capital, P_1, is measured as the depreciation plus premises expenses over premises and fixed assets. The unit cost of fund, P_2, is defined as total distributed profits to depositors over investment deposits. The unit cost of labour, P_3, is measured as total wages and salaries over number of staff.

6.   Results:

Table (6a) reports the estimated cost inefficiency for the 17 Sudanese banks over the period 1990-2000. The average cost inefficiency for the whole sample is moderate where the average cost of the Sudanese banks is 13 percent higher than a fully efficient bank with the same level of outputs. On the other hand, the results show that the operational efficiency did not improve between 1990-2000. In fact, the inefficiency slightly deteriorated over the sample period from 11.08 percent to 11.65 percent. The average inefficiency has doubled between 1992-1993 then it decreased slowly in the second half of the 1990s.

The mean figures do not reflect the significant changes in the cost inefficiency within the individual banks. Table (6a) reports that the discrepancy among the individual banks is apparent, the cost inefficiency ranges from 0.08 percent for Bank No. 5 to 123.5 percent for Bank No. 7. All Sudanese banks witnessed a change in the operational efficiency between 1990-2000. The efficiency has improved only in 7 banks out of 17. Although the average cost inefficiency exceeds 30 percent in Bank No.7 and No. 15, both banks made a significant progress in enhancing their performance over the sample period. Bank No.7 has made a remarkable improvement after 1993 when the cost inefficiency decreased from 124 percent in 1993 to 14 percent in 2000. Bank No.15 was able to reduce cost inefficiency from 79 percent in 1994 to 34 percent in 2000. In the 1990s, both banks implemented major re-structuring programmes that led to a significant reduction in the number of employees and bank branches. On the other hand, management inefficiency increased in 10 Sudanese banks between 1990-2000. The deterioration in resource utilisation was significant in some banks. For example, cost inefficiency has a positive trend in Bank No.13, it increased from 4 percent in 1994, to 7.5 percent in 1997, and reached 14

percent in 2000, although Bank No. 13 has the fastest growth in total profits among the Sudanese banks.

Table (6a) : Cost Inefficiency (%)

Bank	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	15.06	12.66	9.88	15.39	19.42	17.32	17.21	18.08	15.85	15.18	12.58
2	2.76	4.14	5.44	18.73	11.79	10.70	11.12	8.43	8.57	8.25	8.76
3	4.09	3.02	4.16	11.44	12.85	8.70	12.11	10.44	10.76	8.56	7.64
4	8.12	10.75	9.83	12.46	22.41	15.57	11.00	15.05	18.00	15.98	15.55
5	0.08	0.54	0.73	0.47	0.59	0.26	0.39	0.46	0.40	0.73	0.56
6	1.66	2.03	3.49	1.61	1.89	2.14	2.84	1.66	2.75	2.76	3.81
7	48.78	42.52	24.05	123.52	24.14	39.28	32.20	25.65	21.69	13.85	14.18
8	11.20	10.20	11.57	15.23	20.81	25.13	21.74	15.73	18.96	18.28	17.64
9	6.11	12.68	23.83	19.05	22.54	20.14	13.84	11.62	11.83	9.88	8.52
10	1.01	0.55	0.60	0.50	0.59	0.69	0.56	0.42	0.97	1.20	1.30
11	13.30	6.96	3.40	3.60	4.76	3.63	3.32	3.89	4.79	5.31	5.85
12	20.77	36.61	19.23	21.00	39.53	23.42	21.24	53.32	22.32	29.60	25.20
13	--	--	--	--	3.58	5.91	6.18	7.49	4.65	11.99	13.64
14	--	--	--	--	27.34	13.36	15.22	16.08	19.35	12.80	15.41
15	--	--	--	--	78.86	16.63	24.04	27.86	25.76	21.17	33.58
16	--	--	--	19.89	18.27	10.64	13.35	17.12	21.09	13.61	13.60
17	--	--	0.98	0.39	0.49	0.58	0.84	0.52	0.39	0.24	0.24
Mean	**11.08**	**11.89**	**9.01**	**18.81**	**18.23**	**12.59**	**12.19**	**13.75**	**12.24**	**11.14**	**11.65**

Table (6b)

	Mean	Median	Maximum	Minimum	St. Deviation
1	15.33	15.39	19.42	9.88	2.77
2	8.97	8.57	18.73	2.76	4.31
3	8.52	8.70	12.85	3.02	3.44
4	14.07	15.05	22.41	8.12	4.13
5	0.47	0.47	0.73	0.08	0.19
6	2.42	2.14	3.81	1.61	0.76
7	37.26	25.65	123.52	13.85	30.72
8	16.95	17.64	25.13	10.20	4.72
9	14.55	12.68	23.83	6.11	5.92
10	0.76	0.60	1.30	0.42	0.30
11	5.35	4.76	13.30	3.32	2.88
12	28.38	23.42	53.32	19.23	10.65
13	7.63	6.18	13.64	3.58	3.78
14	17.08	15.41	27.34	12.80	5.00
15	32.56	25.76	78.86	16.63	21.09
16	15.95	15.36	21.09	10.64	3.68
17	0.52	0.49	0.98	0.24	0.25

Table (6c)

	Mean	Maximum	Minimum	St. Deviation
Government banks	22.09	123.52	3.58	21.14
Joint ownership	12.46	25.13	3.02	5.91
Foreign	0.58	1.30	0.24	0.27

Over the sample period, Bank No.5, 17 and 10 are the most efficient banks with cost inefficiency less than 1 percent. There are three common characteristics among the three most efficient banks: First, they are foreign banks. Second, the three banks are small and their total market share is 4.2 percent in terms of total assets. Third, they invest too little in premises and fixed assets (relative to total assets) compared to other Sudanese banks. Furthermore, economic theory argues that foreign banks bring physical capital, techniques of production, managerial and marketing expertise, which can have positive externalities on the rest of the financial market.

There is management ineffectiveness in managing resources in joint-ownership and government banks compared to foreign banks. Table (6c) reports that the management inefficiency is quite high in government banks with 22 percent compared to 0.6 percent in foreign banks. Despite the small size of the three foreign banks, they are more efficient than other types of banks in Sudan. The cost inefficiency of foreign banks is quite low and stable over the sample period. Furthermore, the results show that the joint-ownership banks can avoid 12.5 percent of costs relative to best-practice bank.

We proceed to the second stage and regress the inefficiency index on various bank variables. Since the inefficiency index is bounded (between 0 - ∞) dependant variable, so the parameters of OLS regression will be biased as well as inconsistent. It is useful to use limited dependent variable models such as the Tobit or logit model. Here we use Tobit model and the results are reported in Table (7). Since the Tobit model deals with the probability of some event occurring, direct interpretation of the various coefficients in Table (8) is not easy.[14]

In Eqs (1) and (2) of Table (7), the coefficients on the variables, TA and TD, measuring total assets and total deposits, are found positive and significant at the 1 percent level. The larger the bank in terms of total assets and deposits, the less efficient is the bank. The relation between inefficiency and bank size is robust across all model specifications. These results are consistent with our earlier findings. Since

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[14] When Tobit model is used, although the natural log is taken for the dependent and explanatory variables, the estimated coefficients do not measure the elasticity.

the Sudanese economy is small and based on small and medium size enterprises rather than conglomerates, the cost of running a large bank may not be justified by the transactions that could be created. Our results imply that mergers and acquisitions among Sudanese banks should not be encouraged because such activities may lead to higher cost inefficiency. On the other hand, the Sudanese economy is currently undergoing through a major transformation with the significant increase in foreign direct investment and the discovery of oil. This in turn will create new and different demand for banking financing and services. Therefore, the BOS may encourage the emergence of few large (universal) banks in order to effectively deal with the fast changes of the Sudanese economy.

The coefficient on D1 is significantly negative in all regressions. This means that private banks exhibit higher level of management efficiency in Sudan compared to public banks. The results are supportive of the current view of selling-off one or more (large) public bank to the private sector since the privatisation of some state-owned banks would improve the operational management in the banking sector. Furthermore, the operational efficiency is positively affected by the level of foreign equity where the coefficient on D2 is negative and significant in all regressions except Eq (3). These results are consistent with Hao et al (2001) findings for the case of South Korea. Taking the main characteristics of the Sudanese banking system into account, it is not appropriate to open the Sudanese financial market to more foreign banks at this stage since many local banks with high operating costs are likely to suffer from international competition. Instead, it is advisable that the BOS allows foreign banks to take share in the readily available banks.

In Eqs (1) and (2), the coefficients estimate for, *FIN*, the ratio of banking finance through the Islamic modes of finance to total assets, are negative and significant at the 1 percent level. This implies that Sudanese banks can enhance their operational efficiency through the increase in banking finance relative to total assets. We then break down banking finance to its main components in order to find out which modes of finance can influence the cost inefficiency. From Eq (3), we find that Sudanese banks have a relative advantage in *murabaha* and *musharaka* finance over other modes of finance. The higher the *murabaha* and *musharaka* finance, the higher the cost efficiency in Sudanese banks. The coefficients on the variables MUSR and MUR,

measuring *musharaka* finance over total assets and *murabaha* finance over total assets, are found negative and significant at the 1 percent level. On the other hand, the coefficient on OFM, measuring the ratio of finance through other modes (apart from *murabaha* and *musharaka*) to total assets, is insignificant. The interpretation of such a result is that bank efficiency is not closely related to the other modes of finance. Such a result is due to the negligence of banks' management to fully explore the other modes of finance. Thus the values of other modes of finance become trivial in our sample and has no relation with the change in cost efficiency.

In Eqs (4) and (5), the coefficients of MROF and MSOF, measuring *murabaha* over off-balance sheet transactions and *musharaka* over off-balance sheet transactions, are insignificant which imply the positive impact of the rise in *murabaha* and *musharaka* finance may be offset when Sudanese banks reduce non-funding activities. Therefore, Sudanese banks do not have to increase banking finance at the expense of non-funding financial services. In order to improve the operational efficiency, Sudanese banks have to maintain the current level of non-funding financial transactions and to direct more resources towards *murabaha* and *musharaka* finance.

Table (7): Tobit Parameter Estimates of Inefficiency Model

	1		2		3		4		5	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	-10.69	(-1.26)	-13.59	(-1.98)**	-20.82	(-2.88)*	-6.66	-0.88	-7.25	(-0.97)
Total Assets	2.15	(2.25)*	---	---	---	---	---	---	---	---
Total Deposits	---	---	2.63	(3.31)*	3.03	(3.77)*	2.10	(2.43)*	2.16	(2.51)*
Banking finance / total assets	-2.49	(-5.24)*	-2.73	(-5.78)*	---	---	---	---	---	---
Investment Deposits / Total Deposits	0.89	(1.63)***	0.86	(1.68)**	0.46	(0.81)*	0.59	1.04	0.75	1.34
Average staff expense	-4.44	(-6.34)*	-4.79	(-7.62)*	-5.16	(-8.13)*	-4.41	(-6.42)*	-4.50	(-6.53)*
(Paid-up capital+ investment deposits) / total assets	-2.17	(-3.53)*	-1.98	(-3.59)*	-1.75	(-3.16)*	-2.59	(-4.30)*	-2.46	(-4.16)*
D1 (government =0; Private =1)	-12.40	(-7.52)*	-12.41	(-7.89)*	-10.62	(-6.25)*	-14.15	(-8.13)*	-13.75	(-7.78)*
D2 (domestic =0; foreign =1)	-10.91	(-3.73)*	-10.95	(-4.35)*	-2.53	(-0.98)	-5.00	(-1.93)**	-5.08	(-1.98)**
Musharaka / total assets	---	---	---	---	-1.16	(-3.33)*	---	---	---	---
Murabaha / total assets	---	---	---	---	-1.22	(-3.06)*	---	---	---	---
Other Modes of Finance / Total assets	---	---	---	---	0.06	(-0.23)	---	---	---	---
Murabaha / off-balance sheet transactions	---	---	---	---	---	---	-0.40	(-1.127)	---	---
Musharaka / off-balance sheet transactions	---	---	---	---	---	---	---	---	-0.58	(-1.59)

Note: *,**,*** mean 1%, 5%, and 10% levels of significance

The results support the moral hazard hypothesis. Our findings suggest a positive relationship between risk and inefficiency. More aggressive banks, engaged in greater amount of funding relative to paid-up capital, tend to be more inefficiently operated in Sudan. It is found that the coefficient on CA is always negative and significant at the 1 percent level. So, the BOS should encourage Sudanese banks to raise the current (low) capital ratio in order to improve cost efficiency in the banking sector.

Our findings also suggest that banks with higher level of demand deposits enjoy higher level of efficiency. It is found that the coefficient on the variable IDTD, measuring the ratio of investment deposits to total deposits, is positive and significant in most regressions. Although the rise in demand deposits is desirable at the bank management level, such phenomenon may hinder the available fund for investment and therefore reduce economic growth at the national level. Regulators should encourage Sudanese banks to correct the current bias in the deposits structure.

With respect to the relationship between cost efficiency and human capital, the coefficient estimates for W, the average staff expenses, are negative and significant at the 1 percent level in all specifications. Thus, Sudanese banks can improve their cost efficiency by providing serious training and development programmes to current employees in order to enhance the quality of labour force. Our survey shows that the current level of expenditure on staff development and training courses does not exceed 0.1 percent of total assets in most Sudanese banks.

7.   Conclusions:

Banking industry is a vital part of the financial system and the examination of x-efficiency in Islamic banking should have important policy implications. We use the stochastic frontier approach to evaluate cost efficiency for 17 Sudanese banks over 1990-2000. Our findings show that Islamic banks *per se* do not create inefficiency. There are other (several) factors that cause operational inefficiency in the Sudanese Islamic banks. If those factors are taken care of, Islamic banks will operate efficiently.

We find that the overall operational inefficiency mean is moderate (13 percent) over the sample period. The overall inefficiency mean slightly increased (by 0.57 percent) between 1990-2000. At the individual bank level, there are significant management efficiency differences across the 17 Sudanese banks. The cost inefficiency ranges from 0.08 to 123.5 percent over the sample period. The cost inefficiency witnessed a change in all Sudanese banks. These changes were significant in at least 8 banks. On the other hand, while inefficiency has improved in 7 banks, 10 Sudanese banks have seen a deterioration in the cost efficiency.

The results also show that the efficiency differences across the three banking types are quite apparent and significant. Joint-ownership banks operate more efficiently than government banks in Sudan. Despite the small size of the 3 foreign banks working in Sudan, they are much more efficient than joint-ownership and state-owned banks. Our findings imply that Sudanese banks are not ready yet to integrate into the global financial markets. Globalisation and full liberalisation of the financial sector means the BOS will have to offer foreign banks the same treatment as local banks. Foreign banks will provide more comprehensive range of financial services than is currently available through domestic banks. Less efficient banks in the market with high operating costs are likely to suffer from international competition and may be rationed out.

We also use the Tobit procedure in order to examine the sources of management inefficiency in Sudanese banks. Our findings suggest the following:

- There is a negative relationship between the cost efficiency and the bank size. This implies that the BOS should not encourage merger and acquisition activities in the banking sector. Due to the small size of the Sudanese economy, large banks may not be able to create enough business to optimally utilise their resources and minimise costs.
- There is a negative relationship between the cost efficiency, on the one hand, and the level of domestic equity, and the level of government equity, on the other hand. These results are consistent with the earlier findings. The BOS can improve the operational efficiency in the banking sector by allowing foreign

banks to take share in the banks operating in the Sudanese market and by selling-off some state-owned banks to the private sector.

- The results suggest that the higher the capital adequacy ratio, the higher the cost efficiency in Sudanese banks. The BOS should encourage Sudanese banks to raise their (low) paid-up capital and meet Basel capital requirements. Sudanese banks should not increase their capital through merger and acquisition activities within the banking sector.

- With respect to assets management in Sudanese banks, our findings suggest a positive relationship between cost efficiency, on the one hand, and the ratio of *musharaka* to total assets and *murabaha* over total assets, on the other hand. These results suggest that Sudanese banks have advantage in managing *musharaka* and *murabaha* contracts. Sudanese banks can reduce cost inefficiency through higher *murabaha* and *musharaka* finance relative to total assets. Non-funding activities is the most important source of income for many Sudanese banks and a trade-off between *musharaka* and *murabaha* finance and non-funding financial services may have offsetting impact on cost efficiency.

- It is found that the higher the ratio of demand deposits, the greater the cost efficiency in the Sudanese banks. Currently, the deposit structure in the Sudanese banks is biased towards current deposits with a percentage of over 70 percent of total deposits. The deposit composition in the Sudanese banks drifts away from the standards of Islamic banks in other countries. The increase in the ratio of current deposits to total deposits means less financial resources available for long-term investment. Such phenomenon may have a negative impact on economic growth. Therefore, regulators should give serious attention to such phenomenon and discourage a rise in demand deposits at the expense of investment deposits, despite the positive impact that higher demand deposits may have on cost efficiency.

- There is a positive and significant relationship between cost efficiency and the average staff expenses. Higher quality of labour would improve the utilisation of resources in the Sudanese banks. Our recent survey shows that Sudanese banks spending on staff development and training is quite low. Human capital

development should be a priority for Sudanese bank management in order to reduce the current level of inefficiency.

Acknowledgement:

References:

Abdullah et al, (2000), "Non-performing loans in the Banking System because of evasion", *Banking and Financial Studies*, 4, 43-69.

Aigner, D., C.A. Knox Lovell and P. Schmidt, (1977), "Formulation and Estimation of Stochastic Frontier Production Function Models", *Journal of Econometrics*, 6, 21-37.

Al-Jarhi, M., (2001), "Globalisation and Islamic Banking and Finance: Challenges and Opportunities", Presented at the International Seminar on the Impact of Globalisation on the Islamic World: Issues and Challenges in the 21th Century, June 11-13, Kuala Lumpur.

Altunbas, Y., L. Evans and P. Molynoux, (1996), "Universal Banks, Ownership and Efficiency: A Stochastic Frontier Analysis of the German Banking Market", Working Paper, Department of Economics, University of Durham.

Bank of Sudan, Annual Report, Various issues.

Bauer, P.W., (1990), "Recent Development in the Econometric Estimation of Frontiers", *Journal of Econometrics*, 46, 39-56.

The Banker (2000),

Bashir, A., (1999), "Risk and Profitability Measures in Islamic Banks: The Case of Two Sudanese Banks, *Islamic Economic Studies*, 6, 1-24.

Berger, A. and D. Humphrey, (1997), "Efficiency of Financial Institutions: International Survey and Directions for Future Research", *European Journal of Operational Research*, 98, 175-212.

Berger, A. and L. Mester, (1997), "Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions?", *Journal of Banking and Finance*, 21, 895-947.

Berger, A. W.C. Hunter and S.G.Timme, (1993), "The Efficiency of Financial Institutions : A Review and Preview of Research Past, Present and Future, *Journal of Banking and Finance*, 17, 221-249.

Cebenoyan, A. and C.A. Register, (1993), "Banking Efficiency: Stochastic Cost Frontier Approach", Paper presented at the 19th Annual PMA Meeting, October 1989, Boston.

Cowing, T.G., D. Reifschneider and R.E. Stevenson, (1983), "A Comparison of Alternative Frontier Cost Function Specifications", In *Development in Econometric Analyses of productivity*, edited by Ali Dogramaci, Ch 4, Kluwer-Nijhoff.

Farrell, M.J., (1957), "The Measurement of Productive Efficiency", *Journal of Royal Statistical Society*, 120, 253-281.

Greene, W., (1990), "A Gamma-Distributed Stochastic Frontier Model", *Journal of Econometrics*, 46, 141-163.

Greene, W., (1993), "The Econometric Approach to Efficiency Analysis", In *the Measurement of Productive Efficiency: Techniques and Applications*, edited by Fried et al, Oxford: Oxford University Press.

Hao, J., W.C. Hunter and W.K. Yang, (2001), "Deregulation and Efficiency: The Case of Private Korean Banks", *Journal of Economics and Business*, 53, 237-254.

Haroun, N. S., (2001), "Performance of Sudanese Banking System: Current Challenges and Future Prospects", Presented at Seminar on Banking Sector in Arab Countries: Performance and Challenges, 19-20 Feb 2001, Kuwait. (in Arabic)

Humphrey, D.B., (1985), "Cost and Scale Economies in Bank Intermediation", In *Handbook for Banking Strategy*, edited by R. Aspinwall and R. Eisenbeis, New York: Wiley & Sons.

IMF, (2000), "Sudan: Staff Report for the 2000 Article IV Consultation and Fourth Review of the First Annual Programme under the Medium-term Staff Monitored Programme", IMF Staff Country Report No. 00/70.

Jondrow, J., C.A. Knox Lovell, I.S. Materov and P. Schmidt, (1982), "On Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model", *Journal of Econometrics*, 19, 233-238.

Karapakis,E.I, S. Miller and A.G. Noulas, (1994), "Short-run Cost Inefficiency of Commercial Banks: A Flexible Stochastic Frontier Approach", *Journal of Money, Credit and Banking*, 26, 875893.

Kireyev, A., (2001), "Financial Reforms in Sudan: Streamlining Bank Intermediation", *IMF working Paper* No 53.

Kwan, S.H. and R.A. Eisenbeis, (1996), "An Analysis of Inefficiencies in Banking: A Stochastic Cost Frontier Approach", *FRBSF Economic Review*, 2, 16-26.

Leibenestein, H., (1966), "Allocative Efficiency Versus x-efficiency", *American Economic Review*, 56, 392-415.

Resti, A., (1997), "Evaluating the Cost-Efficiency of the Italian Banking System: What can be Learned from the Joint Application of Parametric Techniques", *Journal of Banking and Finance*, 21, 221-250.

Appendix

Table (1A): Institutional structure of the banking sector (1990-2000)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total number of banks	28	28	29	29	28	27	27	27	27	26	25
State-owned banks	5	5	4	4	4	2	2	2	2	2	2
Joint banks	12	12	14	16	16	17	17	17	17	16	16
Foreign+local capital	10	10	10	11	11	11	11	11	11	11	11
Government+private capital	2	2	4	5	5	6	6	6	6	5	5
Foreign banks	6	6	6	4	4	4	4	4	3	3	3
Specialized banks	4	4	4	4	3	3	3	3	3	3	3
Investment banks	1	1	1	1	1	1	1	1	2	2	1

Source: Kireyev (2001).

Table (2A): The Market Share of the Sudanese Banks

	Bank's Assets/Total banking Assets	Bank's Deposits/Total banking Deposits
Animal Resources Bank	5.10%	6.20%
Albaraka Bank	3.50%	3.40%
Sudanese French Bank	9.20%	12.20%
Bank of Khartoum	10.50%	13.60%
Elnilein Industrial Development Bank	9.20%	8.80%
Omdurman Bank	15.30%	19.90%
Tadamoun Islamic Bank	4.80%	6.60%
Farmer Commercial Bank	8.30%	6%
Sudanese Islamic Bank	3.20%	3.20%
Alshamal Bank	8.10%	3.80%
The Blue Nile Bank	0.70%	1.00%
The National Bank of Abu Dhabi	1.50%	0.60%
Sudanese Estate Bank	0.60%	0.60%
Faisal Islamic Bank	4.30%	3.80%
Elgharb Islamic Bank	1.10%	0.60%
Habib Bank	0.20%	0.20%
Islamic co-operative Development Bank	2.60%	2.40%
Ivory Bank	0.10%	0.10%
Mashreq Bank	2.50%	3.90%
National Bank of Sudan	1.90%	2.10%
Saudi Sudanese Bank	4.60%	6.20%
Savings & Social Development Bank	1.80%	4.10%
The Workers Bank	0.80%	0.90%

Source: Bank of Sudan

Note: the above figures are based on data for 2001.

Table (3A): The Distribution of the Banking Network in Sudan

	Khartoum	Middle	East	North	Kurdofan	Darfour	South	Total
1991	29.90%	21.20%	13.10%	14.60%	9.30%	8.10%	3.80%	100.00%
1992	26.60%	22.60%	15.00%	14.30%	10.30%	7.80%	3.50%	100.00%
1993	28.60%	22.00%	14.20%	12.50%	10.80%	9.10%	2.90%	100.00%
1994	28.10%	22.20%	14.50%	12.80%	10.10%	8.80%	3.50%	100.00%
1995	30.10%	22.40%	12.90%	13.00%	9.80%	8.20%	3.60%	100.00%
1996	32.20%	23.40%	14.40%	10.30%	9.20%	7.60%	2.90%	100.00%
1997	31.50%	22.80%	14.00%	12.20%	8.80%	7.40%	3.30%	100.00%
1998	31.80%	23.60%	13.20%	11.30%	9.10%	8.00%	3.00%	100.00%
1999	32.30%	23.20%	14.30%	12.30%	8.20%	6.80%	2.80%	100.00%
2000	33.40%	22.00%	13.70%	11.30%	9.20%	7.80%	2.50%	100.00%
2001	32.50%	23.80%	11.30%	10.80%	10.80%	7.30%	3.30%	100.00%

Source: Bank of Sudan

Table (4A): Maximum Likelihood Estimates of the Stochastic Cost Function

	Coeff.	Std.Err.	t-ratio	P-value
ONE	3.660	2.548	1.436	0.151
LQ1	0.025	0.273	0.090	0.928
LQ2	-0.037	0.198	-0.185	0.854
LQ3	0.143	0.215	0.663	0.507
LP1	0.074	0.622	0.118	0.906
LP2	-0.063	0.252	-0.251	0.802
LP3	0.945	0.260	3.638	0.000
LQ1P1	0.036	0.147	0.246	0.806
LQ1P3	-0.025	0.043	-0.574	0.566
LQ2P1	0.002	0.059	0.029	0.977
LQ2P3	-0.029	0.015	-1.886	0.059
LQ3P1	-0.028	0.067	-0.424	0.671
LQ3P2	0.016	0.045	0.355	0.723
LQ1Q3	0.006	0.037	0.156	0.876
$\lambda=\sigma/\sigma$	41.279	172.229	0.240	0.811
$\sigma= \sqrt{\sigma^2_\delta +\sigma^2_\mu}$	0.149	0.075	1.972	0.049

No. of observations	170
Adjusted R2 on OLS equation	0.88
Function converged at iteration	28

List Of Banks*

Albaraka Bank
Alshamal Bank
Animal Resources Bank
Bank of Khartoum
Elnilein Industrial Development Bank
Faisal Islamic Bank
Habib Bank
Islamic co-operative Development Bank
Mashreq Bank
Omdurman Bank
Saudi Sudanese Bank
Savings & Social Development Bank
Sudanese French Bank
Sudanese Islamic Bank
Tadamoun Islamic Bank
The Blue Nile Bank
The National Bank of Abu Dhabi

*Banks are listed in alphabetic order.

The Translog Cost Function

Suppose that production is characterized by a production function,

$$Y = f(\mathbf{x})$$

The solution to the problem of minimizing the cost of producing a specified output rate given a set of factor prices produces the cost-minimizing set of factor demands

$$x_i = x_I (Y, \mathbf{p})$$

The total cost of production is given by the cost function,

$$C = \sum_{i=1}^{M} p_i x_i (Y, \mathbf{p}) = C (Y, \mathbf{p})$$

If there are constant returns to scale, then it can be shown that

$$C = Yc(\mathbf{p})$$

or

$$\frac{C}{Y} = c(\mathbf{p})$$

where $c(\mathbf{p})$ is the unit or average cost function. The cost-minimizing factor demands are obtained by applying Shephard's (1970) lemma, which states that if $C(Y,\mathbf{p})$ gives the minimum total cost of production, then the cost-minimizing set of factor demands is given by

$$x_i^* = \frac{\partial C (Y, \mathbf{p})}{\partial p_i}$$

$$= \frac{Y \partial c (\mathbf{p})}{\partial p_i}$$

Alternatively, by differentiating logarithmically, we obtain the cost-minimizing factor cost shares:

$$s_i = \frac{\partial \log C(Y, \mathbf{p})}{\partial \log p_i}$$

$$= \frac{p_i x_i}{C}$$

With constant returns to scale, In C $(Y, \mathbf{p}) = \log Y + \log c(\mathbf{p})$, so

The transcendental logarithmic, or translog, function is the most frequently used flexible function in empirical work. By expanding $\log c(\mathbf{p})$ in a second-order Taylor series about the point $\log \mathbf{p} = \mathbf{0}$, we obtain

$$\log c \approx \beta_0 + \sum_{i=1}^{M} \left(\frac{\partial \log c}{\partial \log p_i}\right) \log p_i + \tfrac{1}{2} \sum_{i=1}^{M}\sum_{j=1}^{M} \left(\frac{\partial^2 \log c}{\partial \log p_i \, \partial \log p_j}\right) \log p_i \log p_j$$

where all derivatives are evaluated at the expansion point. If we identify these derivatives as coefficients and impose the symmetry of the cross-price derivatives, then the cost function becomes

$$\log c = \beta_0 + \beta_1 \log p_1 + \ldots + \beta_M \log p_M + \delta_{11} \left(\tfrac{1}{2} \log^2 p_1\right) + \delta_{12} \log p_1 \log p_2$$
$$+ \delta_{22} \left(\tfrac{1}{2} \log^2 p_2\right) + \ldots + \delta_{MM} \left(\tfrac{1}{2} \log^2 p_M\right).$$