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Impacts of Organizational Forms, Stock Performance and Foreign Ownership on Bank Efficiency in Jordan: A Panel Study Approach

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Abstract

Empirical evidence to date indicates that largest inefficiencies in banking do not result from market or regulatory distortions but results directly from managerial inefficiency, which is sub-optimal utilization of factor inputs by bank management. Scale inefficiency is also considered a form of managerial inefficiency since it involves the choice of inefficient output level in terms of cost minimization. Using a non-parametric methodology, this paper analyzes managerial and scale efficiencies in the Jordanian banking sector over the period 1996-2001.The results indicate that the typical Jordanian bank could obtain significant (input and cost) savings should they catch up with the best practice banks (as much as 40%). Most of the managerial inefficiency is due to scale inefficiency (output related) rather than pure technical inefficiency (input related). We also found that majorities of banks in Jordan experience increasing returns to scale in their operations. Apparently, significant economies of scale are available, could the Jordanian banks expand their operations by either internal or external growth.

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Keywords: Bank; Efficiency; MENA Region; Jordan; DEA

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1. Introduction

The purpose of this study is to analyze the X-inefficiency of banking firms operating in an emerging market, by drawing particularly on the Jordanian experience. Like some other Arab countries in the region, Jordan has embarked on important economic and social reforms to promote efficient financial markets and institutions for a genuine and enduring economic growth. According to Darrat and Hajj (2002) and Omran and Bolbol (2003), Jordan is among the four MENA countries that have devoted utmost attention to the efficient operation of their financial system in recent years.[1] Evidently, the 2001 Annual Report of the Central Bank of Jordan (CBJ) underscores this political goal by stating, "the CBJ places more emphasis on enhancing the efficiency and competitiveness of the banking system". In this framework, this study is to investigate how efficient the Jordanian banks are, what determines their efficiencies and whether there are positive trends in the efficiency of the banking sector as the country launches on financial reforms to reorient its economy and promote competition in the financial sector.

The theory of the firm assumes that managers (agents) are hired by stockholders (principals) to maximize banks' profits and owners' wealth by operating in the most efficient way possible. However, internal or external factors may cause bank managers to deviate from this objective. In fact, evidence to date from different country studies (e.g.; Aly et al., 1990 for the U.S. banks, Fukuyama, 1993 for the Japanese banks, and Isik and Hassan, 2002a for the Turkish banks) showed that major source of X-inefficiency in banking is technical and management related (internal) rather than allocative and regulation related (external). Apparently, bank managers operate relatively efficiently with respect to the optimal combination of inputs, yet they are not as efficient in transforming bank inputs into outputs. In perfectly competitive and contestable markets, inefficiently run banks would face hardship to survive and eventually be either absorbed or driven from the market by efficient ones. Evidently, some empirical studies found that management quality was the predominant cause of operating

[1] The other three Middle East and Noth Africa (MENA) countries mentioned by Darrat and Hajj (2002) are Egypt, Tunisia and Saudi Arabia. Omran and Bolbol (2003) classify Jordan as one of the reforming countries in the MENA in addition to Egypt, Morocco and Tunisia.

inefficiency and eventual failure in financial institutions (e.g; Cebenoyan et al., 1993; Barr, Seiford and Siems, 1994; Hermalin and Wallace, 1994; Wheelock and Wilson, 1995). Thus, the type of X-inefficiency we consider in this study is *managerial inefficiency* (ME), which refers to underutilization of bank resources by bank management. Examination of managerial inefficiency concerns banking supervisors and policy makers because banks' safety and soundness is dependent upon the quality of management. As a matter of fact, management quality is one of the five components of the so-called CAMEL (Capital, Assets, Management, Earnings, and leverage) rating in the bank examination process in some countries. Peristiani (1996) and DeYoung (1998) found that the management quality score (M), measured as part of this CAMEL analysis, has a significant negative relationship with the X-inefficiency of the U.S. banks. It was also observed that well-managed banks utilize their resources more efficiently than poorly managed banks, thereby producing higher amounts of outputs per inputs. In a competitive environment, capital markets penalize an under-performing bank by depressing its share price and subjecting it to takeover.

X-inefficiency is a measure of how close an observed bank is to an estimated "best-practice" frontier. Overall X-inefficiency resulting from sub-optimal use of inputs is decomposed into allocative and technical inefficiency in the literature. *Allocative inefficiency* occurs when inputs are combined in sub-optimal proportions given their prices. *Technical inefficiency* arises in cases where more of each input is used than should be required to produce a given level of output. Regulation is typically given as a major source of allocative inefficiency, while technical inefficiency is attributed to lack of strong competitive pressures, which allow bank managers to continue with less than optimal performance. Because it relies solely on the *amounts* of inputs and outputs in its calculation and does not involve *factor prices*, which are mostly market or regulation driven, technical inefficiency is entirely under the control of bank management and thus results directly from management laxity and errors (Leibenstein, 1966, 1978). Therefore, in this study, we coin the term technical inefficiency to describe managerial inefficiency in banking. In fact, some earlier researchers used technical X-inefficiencies as proxies for management quality. For instance, Barr, Seiford and Siems (1994) and Wheelock and Wilson (1995) make the explicit assumption that technical X-inefficiency is a good measure of management quality in bank failure studies.

Managerial inefficiency consists of two mutually exclusive and exhaustive components: pure technical inefficiency (PTE) and scale inefficiency (SE). *Pure technical inefficiency* is defined as managerial inefficiency devoid of scale effects. When the scale issues are dismantled, ME and PTE scores are the same, as the difference between them refers to scale inefficiency. Thus, PTE refers to proportional reduction in input usage that can be obtained if the bank operates on the efficient frontier. As it results directly from management errors, it is considered one form of managerial inefficiency. *Scale inefficiency* refers to non-optimal choice of production scale in terms of cost control. A scale efficient firm will produce where there are constant returns to scale (CRS). Thus, when there are increasing returns to scale (IRS), efficiency gains could be obtained by expanding production levels. If decreasing returns to scale (DRS) exist, efficiency gains could be achieved by reducing production levels. As it involves the choice of an inefficient level by management, scale inefficiency is also considered a form of managerial inefficiency. Thus, total managerial in-efficiency includes both pure technical inefficiency and scale inefficiency; that is, inefficient level of both inputs and outputs.

There is a virtual consensus in the finance literature that differences in X-efficiency among financial institutions exceed inefficiencies attributable to incorrect scale or scope of output (Berger and Humphrey, 1991). The empirical evidence from advanced markets indicates that X-inefficiencies arising from managerial errors after controlling for environmental factors account for on the order of 20% of total banking costs, while scale and scope inefficiencies usually account for less than 5% of costs. We found that managerial inefficiencies in the Jordanian banking are as high as 40% and scale inefficiencies are as high as 26% (under production model), both of which are substantially greater than those observed in more efficient markets. Overall results indicate that scale problems, which were persistent over prolonged period of time in the Jordanian banking, are responsible for most of the managerial sub-performance in the sector. Underperformance of the Jordanian banks may be also attributed to the underdevelopment of capital markets and corporate control mechanisms, which could discipline managers by the threat of takeover and to lack of sufficient competition in the banking market, which would force banks to streamline their operations or face disappearance.

The rest of the study is structured as follows. Section 2 provides a snapshot review of the MENA banking efficiency studies and discusses the motivation of the study. Section 3 overviews the Jordanian banking sector and economy. Section 4 discusses the methodology utilized in

constructing managerial efficiency and productivity growth measures. While section 5 elaborates the data and definition of bank inputs and outputs, section 6 presents the first stage analysis of the empirical results. Section 7 dwells on the correlates of efficiency and section 8 concludes.

2. Literature review and motivation of the study

The literature on the efficiency of financial institutions, especially for industrialized countries, is voluminous and well documented in some survey studies (for example, see Berger et al., 1993 and Berger and Humphrey, 1997 for overall efficiency issues and see Berger and Mester, 1997 and Isik and Hassan (2003) for the correlates of efficiency in the US and Turkish markets, respectively). As regards to the Middle East and North Africa (MENA) region, the efficiency literature contains a scant number of empirical studies that exclusively focus on the banking systems of the region. Al-Faraj et al. (1993), utilizing a non-parametric approach, DEA, study the operational efficiency of *branch offices* of a Saudi bank and report 87% overall efficiency for those branches. Employing a stochastic frontier approach, SFA, both Chaffai (1993) and Chaffai (1997) examine the productive efficiency of banks operating in Tunisia. These studies find that Tunisian banks exhibit a cost efficiency score ranging from 61% to 65%. While the former Tunisian study is basically related to general level of efficiency in the banking system, the latter is primarily focused on methodological issues. A recent study by Darrat et al. (2002), using a DEA methodology and a sample of eight banks, examine the banking efficiency and productivity in the Kuwaiti banking sector. They report that on average Kuwaiti banks demonstrate 68% cost efficiency, and 28% productivity growth over the period 1994-1997. They suggest that input waste could be reduced by 47%, were Kuwaiti banks operating on the efficient frontier.

The current study is important because first and foremost, there is no empirical study, to the best of our knowledge, which addresses managerial and scale efficiency issues of the Jordanian banks *per se.* Thus, this paper will complement and extend the international banking efficiency literature, which is substantially skewed towards the banks of developed countries (Berger and Humphrey, 1997; Berger et al., 1998; Isik and Hassan, 2000a,b; Yildirim and Philippatos, 2003). Second, like in many emerging markets, banks in Jordan are the dominant financial institution, as they control most of the financial flows and possess most of the financial

assets in the economy. Moreover, many non-bank financial institutions in Jordan, like in other emerging economies, are also affiliates of banks. Thus, competition in banking market is somewhat constrained. Inefficient usage of resources stemming from weak competitive pressures may result in higher operating costs for banks and thus more expensive bank services and higher loan prices. This will raise costs of funding for all economic units and will eventually make many public and private projects unfeasible ventures (by making their internal rate of return (IRR) fall below the hurdle rate). Thus, the study of how efficiently those banks are operating is also important for the government and industrial firms, as banks are in effect the only external source of funds for public and private investments in the country. Third, one of the cardinal missions of bank regulators is to ensure the efficient functioning of the banking system along with its safety and soundness. The first step in this endeavor is to determine the level of efficiency in the banking system. Hence, this study may also help regulators in Jordan in their efforts to improve the overall performance of the banking sector and determine the causes of non-optimal behavior observed among banks. Finally, this study is to provide some highlights about the potential correlates (determinants) of efficiency, which may benefit bank managers in Jordan. They could utilize the results of this study to identify the efficiency ranks of their bank, compare it with those of close rivals and look for ways to improve their efficiency status. By the revelation of the identity of the most efficient banks, this study provides a "model" for the managers of poorly performing banks. By the same token, the results may also help regulators foster overall managerial performance of the banking sector by identifying the "best practices" and "worst practices" associated with the most and least efficient banks and then encouraging the former practices while discouraging the latter among banks.

Furthermore, this paper has also some important research implications. Studies from different regulatory environments and market structures may help us conceive the impact of these differences on bank performance. For instance, the Jordanian banking market is highly concentrated as compared to those of advanced economies. The three-bank concentration ratio is 91% for Jordan whereas it is 19% for the US, 22% for Japan, 41% for France, 45% for Germany and 56% for the U.K. The Jordan's concentration ratio is also higher when compared to those of other emerging markets, such as 59% for Tunisia, 64% for Bangladesh, 65% for Egypt, 69% for Peru, 74% for Pakistan and 87% for Uruguay (Demirguc-Kunt and Levine, 1999). In some cases, the recent finance literature reports that there is a negative association between market

concentration and bank performance (Berger and Mester, 1997; Berger et al., 1998 and DeYoung et al. 1998). The *quiet life theory* suggests that the lower the intensity of environmental pressures, the lower is the effort expended by managers to derive the maximal output from a given amount of inputs (Berger and Hannan, 1998). Thus, it is possible that banks of concentrated markets become less motivated to operate efficiently, as they do not face strong competition from new banks and non-bank financial institutions. Moreover, the lack of developed money and capital markets also provides comfort for banks of emerging countries, as "disintermediation" from depositors and borrowers has not threatened their business yet to the extent that it did in developed markets. Therefore, other things being held constant, comparisons of banking efficiency in Jordan vis-à-vis in less concentrated markets may let us understand the dynamics between market concentration and efficiency.

3. A brief overview of the Jordanian economy and financial sector

There have been significant changes in the economic policies of Jordan in the wake of the 1988-89 crisis, when the Jordanian Dinar (JD) suffered two major devaluations and total debt of the country reached alarming 196% of GDP. Faced with serious default risk on its commitments, Jordan turned to the International Monetary Fund (IMF) to restructure its debt. In return, it has signed a stabilization program with the IMF and a structural adjustment program with the World Bank. The major goals of these programs were to boost state revenues while reducing state expenditures by implementing long-term policies such as privatizing state economic enterprises, introducing new taxes, freezing public sector salaries and lifting state subsidies, etc. However, the Iraq's invasion of Kuwait in 1990 and following Gulf War I in 1991 have substantially interrupted the implementation of these plans. Jordan first had to deal with a massive influx of Jordanian returnees from Kuwait and then had to cope with the loss of its biggest trade partner due to the trade embargos established on Iraq by the United Nations (UN). These adverse developments eventually caused another debt service problem for Jordan. As a result, Jordan had to sign another structural adjustment program (SAP) in December 1995 with the IMF and World Bank, which enabled it to reschedule debt payments and write off some of its bilateral debt. When the second SAP expired in February 1999 and the IMF approved another one, a three-year

SAP, in April 1999. Like the earlier ones, the new SAP also aimed at reducing the state's influence in the economy by fostering market forces and promoting the private sector.

Although patchy in the beginning, the Jordanian government had shown a strong commitment to restructure its economy. In March 1997, a maximum limit of 49% on the size of foreign direct investment and stock purchases was eliminated. Between 1997 and 2000, Jordan has privatized partly or wholly some of its key state enterprises such as the Jordan Cements Factory, the Jordan Telecommunication Company, the Aqaba Railways Line and public transport and duty free markets.[2] In 2000, Jordan acceded to the World Trade Organization (WTO), which brought about extensive legislative and regulatory reforms regarding customs and tariffs, patent, copyright and trademark legislations (Mahdi, 2001). The same year, Jordan and the United States signed a Free Trade Area (FTA) agreement that eliminates trade barriers between the two countries within the following 10 years. Jordan is the fourth country to have such agreement with the USA after Israel, Mexico and Canada (Kanaan, 2001).

In contrast to other Arab countries, whose economies are mostly oil-based, Jordan has a relatively well-diversified economy and well-developed services industry. For example, as of 2001, aggregate output of services accounts for 72% of GDP, with finance, real estate and business services alone accounting for 21% of GDP. The monetization ratio, M2 to GDP, which indicates the relative size, or the dept, of the financial market in a country, is greater in Jordan (112%) than the rest of the Arabic countries except for Lebanon (127%). This implies that Jordan has a relatively large monetary sector relative to the size of its economy. Moreover, although relatively small in absolute terms ($US 5.8 billion), the Amman Stock Exchange comes first with respect to capitalization to GDP ratio (about 80%) among the equity markets in the MENA region (Darrat and Haj, 2002; Eltony, 2003)[3].

[Insert Figure1 around here]

The Central Bank of Jordan (CBJ) regulates and supervises the banking system in Jordan.[4] As Figure 1 shows, as of the end of 2001, the Jordanian banking sector is made up of 9 local commercial banks, 2 Islamic banks, 7 investment banks and 5 foreign banks. Jordan financial sector also includes 76 authorized money-changers, which facilitate private transfers

[2] Partial privatization of the Royal Jordanian Airlines is also underway.
[3] However, the long-run mobilization ratio, M1/M2, which indicates the importance of long-term banking and the degree of sophistication in the market, is relatively low with respect to the other Arab countries (about 30%).
[4] The supervision of CBJ has generally been vigorous, with attention focused on bank lending policies and provisioning. A new banking law passed in 2000 strengthened supervision even further, while also clarifying procedures for the licensing of new banks (CBJ reports).

from expatriate Jordanian workers and foreign workers in Jordan. In addition, there are 5 specialized credit firms in the system engaged in agricultural credit, housing, rural and urban development and industry. The Jordan Loan Guarantee Corporation provides guarantees to cover bank loans in support of small and medium-sized local industries. The Jordan Secondary Mortgage Refinance Company, established in 1996, refinances medium- and long-term housing loans extended by the banks. In order to boost the confidence in the banking system, Jordan has also passed new laws for the establishment of a depositors' insurance company. As mentioned, the financial industry in Jordan is extremely concentrated. Evidently, the Arab Bank, with about 60% of all assets, dominates the sector. However, the Housing Bank has made significant efforts in recent years to develop as an effective competitor to the Arab Bank. To this end, it has strengthened its capital structure by increasing it to JDl00 million (US$140 million) in 1999.

The three different groups of *domestic* banks operating in Jordan, commercial banks, investment banks and Islamic banks are subject to similar regulatory and market conditions and operate under the universal banking principle. *Commercial banks* practice all banking businesses; *investment banks* practice all financial, investment and commercial activities in addition to the brokerage services at the Amman Stock Exchange; *Islamic banks* practice all banking, financing and investment businesses on non-usury basis under the Islamic Shariah (Law). Unlike commercial or investment banks, Islamic banks do not engage in a fixed or predetermined rate of return on financial transactions. Islamic Shariah allows participating in the profit-loss of a business, but prohibits from taking or giving any kind of fixed interest on business. In this framework, Islamic banks developed or adopted a variety of interest-free mechanisms such as equity participation, profit and loss sharing, leasing and so forth. They also manage wide-ranging portfolios of equities of companies, whose business activities are in accordance with Islamic rules. Thus, Islamic banks are essentially an equity-based system, where equity capital is provided by the depositors who receive no fixed interest on their funds but a dividend out of the bank's profit (Hassan, 1999).

4. Measurement of managerial efficiency in banking

In order to measure X-efficiencies of production units, researchers tend to utilize one of the two competing methods in the literature, 1) *parametric frontier approach* (pioneered by

Aigner et al., 1977; Meeusen and van den Broeck, 1977) or 2) *nonparametric frontier approach* (pioneered by Charnes et al., 1978; Banker et al., 1984). Both of these sophisticated techniques attempt to "benchmark" the relative performance of production units but differ from each other mainly due to their underlying assumptions. Unlike the parametric approach, the non-parametric approach puts relatively little structure on the specification of the banking technology (frontier) and thus it is relatively immune from the specification errors. In addition, the latter approach does not make any assumption regarding the structures and distributions of inefficiency and error term, thus it deems all deviations from the frontier as inefficiency. Whereas, the parametric approach assumes that part of deviations is due to pure luck or data problems and part of the deviations is due to managerial errors. Furthermore, non-parametric frontiers are estimated using a mathematical linear programming, thus they work well with small samples. Whereas, parametric frontiers are estimated using econometric techniques, thus they require relatively larger sample size to estimate the unbiased coefficients of the model variables such as inputs, outputs, input or output prices, environmental factors and inefficiency and error terms (Aly et al., 1990; Evanoff and Israilevich, 1991; Avkiran, 1999; Sathye, 2002; Darrat et al., 2002; Isik and Hassan, 2002a).

Although our sample contains the *universe* of banking firms in Jordan, our population size is relatively small. We have 18 banks per year over the six-year study period (108 raw observations overall). The intent of this study is to focus on the input usage efficiency of banks in order to see whether the Jordanian banks are rationing their inputs given the hard economic conditions the country has been facing since the Gulf War I, and the recent political instabilities in the region. Therefore, we opt to use a non-parametric frontier approach, *input-orientated* DEA technique, to measure the efficiency and productivity scores of the Jordanian banks. The DEA linear programming model estimates a non-stochastic envelopment frontier over the data points such that all observed points lie on or below the frontier. Thus the frontier represents the set of best-practice observations for which no other decision making unit or linear combination of units employs as little or less of every input without changing the output quantities (input-orientated efficiency frontier) or produces as much or more of every output without altering the input quantities used (output-orientated efficiency frontier).

As briefly discussed before, *managerial efficiency (ME)* measures whether a bank employs the minimum amount of inputs to produce a given amount outputs, or equivalently

whether a bank produces the maximum level of outputs given the fixed amount of inputs, as compared to banks operating on the efficient frontier. *"Pure" technical efficiency (PTE)* indicates a proportional reduction in input usage if inputs are not wasted given the current production level that may be scale inefficient. *Scale efficiency (SE)* refers to a proportional reduction in input usage if the bank can attain the optimum production level where there are constant returns to scale (CRS). For the least and the most efficient units in the sample, the efficiency measures take values between 0 (0%) and 1 (100%), respectively. Obviously, efficiency measures do not take negative values, as banks cannot waste more than 100% of their factor inputs. [5]

[Insert Figure 2 around here]

Figure 2 illustrates the decomposition of *ME* for one input (*L*) and one output (*y*) case by means of *CRS* and *VRS* frontiers. Under both assumptions, the firm that operates at point *f* is managerially inefficient. Under the *CRS*, managerial inefficiency is measured by the distance *mf*, while under the *VRS*, managerial inefficiency would only be *sf*. The difference between these two measures, *ms*, is attributed to scale inefficiency, which simply indicates that the firm *f* can produce its current level of output with fewer inputs if it attains *CRS*. The *CRS* frontier is represented by *0n*, and it simply depicts the optimal level of output that can be obtained for given input levels. In other words, the *CRS* frontier shows what is attainable and what is unattainable with the given technology, and thus the firms either lie on or below it. The constituents of overall managerial efficiency (*ME*), *PTE* and *SE*, for the firm *f* can also be expressed in ratio form: $PTE = ks / kf$, and $SE = km / ks$. The managerial efficiency of the firm *f* is thus simply the product of *PTE* and *SE*: $ME = PTE \times SE = (ks / kf) \times (km / ks) = km / kf$.

The DEA linear programming model, as a member of nonparametric frontier family, estimates a non-stochastic envelopment frontier over the data points such that all observed points lie on or below the frontier. Thus the frontier represents the set of best-practice observations for which no other unit or linear combination of units employs as little or less of every input without changing the output quantities (input-orientated efficiency frontier) or produces as much or more of every output without altering the input quantities used (output-orientated efficiency frontier). To formulate the linear programming problem with the DEA to calculate each efficiency measure, let us assume that there *N* banks, each producing *O* different outputs employing *I*

[5]Since the DEA is standard by now, we refer the interested readers in further discussion to more technical studies on the efficiency techniques and their applications. For complete discussion on the DEA and other frontier techniques, please see Bauer et al. (1998).

different inputs. Also, assume that x_i represents the amount of input employed and y_i represents the amount of output produced by the i-th bank. Thus, the data of all banks in the sample are represented by the $O \times N$ output matrix, Y, and $I \times N$ input matrix, X. Since there are N banks, the linear programming problem is solved N times, once for each bank in the sample. To simplify the problem, let's consider that these N banks operate under the *CRS* and employ two inputs (Capital, K and, Labor, L) to produce single output. The formal problem for *ME* can conveniently be expressed as follows:

$$Min_{ME,w} \; ME_i$$

$$s.t.$$

$$Y \,.\, w_i \geq y_i$$

$$X \,.\, w_i \leq ME_i \,.\, x_i$$

$$w_i \geq 0 \qquad (1)$$

where ME_i, is a scalar and represents managerial efficiency measure (index) for the i-th bank. w_i is the $1 \times N$ vector of intensity weights defining the linear combination of efficient banks to be compared with the i-th bank. The inequality ($Y \,.\, w_i \geq y_i$) implies that the observed outputs must be less or equal to a linear combination of outputs of the banks forming the efficient frontier. The inequality ($X \,.\, w_i \leq TE \,.\, x_i$) assures that the use of inputs at the linear combination of the efficient banks must be less or equal to the use of inputs of the i-th bank. The formulation will mandate that $ME_i \leq 1$. According to Farrel (1957), an index value of 1 (100%) refers to a point on the frontier and thus to a technically efficient bank.

The CRS assumption will be incorrect if all banks are not operating at an optimal scale. In this case, the CRS specification will bias the estimation of ME by confounding scale effects. But, the substitution of the CRS assumption with the variable returns to scale (VRS) brings about the estimation of pure technical efficiency (PTE), i.e., ME devoid of the scale effects. This can be achieved by adding a convexity constraint $(N_1 \,.\, w_i = 1)$ to equation (1), which allows VRS as demonstrated below:

$$Min_{ME,w} \; ME_i$$

$$s.t.$$

$$Y \,.\, w_i \geq y_i$$

$$X \,.\, w_i \leq ME_i \,.\, x_i$$

$N_1 \cdot w_i = 1$

$w_i \geq 0$ (2)

where N_1 is an $1 \times N$ vector of ones. The VRS frontier obtained this way envelops the data more tightly than the CRS frontier and thus generates scores that are greater than or equal to those obtained from the CRS frontier.

If there appears a difference between the *CRS ME* and the *VRS ME (i.e., PTE)* for a specific bank, this means that the bank has scale inefficiency. The scale inefficiency for the bank, thus, can be computed from the difference between the *CRS ME* and the *VRS ME*. Since, *ME(CRS) = ME(VRS)*SE*, where *ME(CRS) = ME*, and *ME(VRS) = PTE*, then, *SE = ME / PTE*. With this *SE* specification, however, it is not clear whether the bank is operating in area of IRS (increasing returns to scale) or DRS (decreasing returns to scale). To determine this, an additional DEA problem is run to construct a frontier that allows for only non-increasing returns to scale (Non-IRS), such as *0mtuv* in Figure 2. This can be accomplished by substituting the constraint $(N_1 \cdot w_i = 1)$ in (2) with $(N_1 \cdot w_i \leq 1)$ as demonstrated below:

$Min_{ME,w} \; ME_i$

s.t.

$Y \cdot w_i \geq y_i$

$X \cdot w_i \leq ME_i \cdot x_i$

$N_1 \cdot w_i \leq 1$

$w_i \geq 0$ (3)

The type of scale inefficiencies (IRS or DRS) for a specific bank can be determined as follows:

If VRS ME ≠ Non-IRS ME, then the bank is operating at IRS,

If VRS ME = Non-IRS ME, then the bank is operating at DRS

5. Data and definition of bank production variables

One reason for the lack of adequate number of empirical analyses on the banks of emerging markets in general and the MENA region in particular is the availability of data at the micro (firm) level. Most of the time, such data are considered confidential and typically proprietary. Therefore, even if made available, emerging market data are usually aggregate; i.e., not detailed, inhibiting a comprehensive analysis of institutions/sectors under study. However, as

the economies open up, money and capital markets develop and integration of financial markets constantly evolves across the globe, demand for information disclosure by public and investment companies also increases. Because of public and diverse ownership structures of many banks, such data have been available for Jordan through many sources recently.[6]

The data used in this study span the period 1996 to 2001 and come from the Amman Stock Exchange (ASE) databases and the Central Bank of Jordan (CBJ). Our panel data encompass rich information about the national Jordanian banks originating from their balance sheets, profit and loss statements, ownership and board structures as well as company shares. We have 18 domestic banks per year operating over the period under study, making up 90 raw observations overall.[7] Because homogeneity of operations is essential in efficiency analysis, our study excludes foreign owned banks, which constitute very small portion of the sector.

In order to specify bank production variables, we should first decide on the nature of banking technology: what factors of production (inputs) banks employ and what products and services (outputs) they generate? Prior researchers following the *asset*, *user cost* and *value-added* methods to assign financial goods to input and output vectors all agree that loans and other major earning assets of banks, such as investment securities, should count as bank outputs. However, they generally disagree on whether deposits should count as bank inputs or outputs. The source of disagreement is concerning the fact that deposits carry the typical features of both inputs and outputs. Deposits are like inputs because they are costly to collect (due to associated interest payments and overhead costs). Furthermore, deposits are in effect the major "raw material" that is transformed into earning assets in the financial production process. However, deposits are also like outputs because they provide a significant amount of liquidity, safekeeping and payments to depositors (Clark, 1988; Aly et al., 1990; Berger and Humphrey, 1997).

As a matter of fact, the selection of inputs and outputs in practice is most of the time dependent upon the researcher's interest and view of banks and sometimes upon the availability of data. For example, macroeconomists and monetarists who are concerned with economy-wide issues tend to view banks as the producers of both deposits and loans, whereas others see banks as the producers of loans using deposits as raw materials (Benston et al., 1982). In fact, the former view is similar to the production approach, while the latter is similar to the intermediation

[6] For example, Global Vintage and BankScope databases also provide some information on the Jordanian banks. However, these sources are not as rich as the Amman Stock Exchange database as they do not cover all of the banks operating in Jordan.
[7] Because one bank, namely Jordan Gulf Bank, had a negative worth over the period 1996-1999 and another bank, namely Islamic International Bank, was not existent between 1996 and 1997, overall number of observation declines to the net 84 observations.

approach, the two main approaches in the literature competing with each other in defining banking technology. The production approach considers deposits as *outputs* since it sees banks as firms producing services for customers such as performing transactions and processing loan applications. As such process requires only physical inputs such as labor and capital, input vector (and thus total costs) should be exclusive of deposits (and related expenses). However, the intermediation approach considers deposits as *inputs* since it views banks as the conduit of funds between depositors and borrowers. Banks employ labor, capital and deposits in their intermediation function. Thus, the input vector (and total costs) should include deposits (and related expenses in addition to operation costs).

Because the choice of inputs and outputs in efficiency models may affect the estimation of efficiency measures, in this study, we first treat deposits as an input and then as an output. We call the first treatment as *production model* and the second treatment as *intermediation model*, as they are analogous to the production and intermediation approaches discussed above.[8] Under the production model, we specify banks as multi-product firms producing deposits and loan services by employing two major factors of production, labor and capital. Under the intermediation model, we define banks as financial intermediaries that convert deposits by means of labor and capital into primary and secondary financial assets (various loans and investment portfolios). Following this policy, we aim to control for the impact of different definitions of banking technology on the qualitative results. In other words, this procedure will serve us as a robustness check that will show whether this aspect of model specification is of importance to the outcome. In addition, it will allow us to compare our results with other international studies that had used the same dual procedure, such as Favero and Papi (1995) and Hunter and Timme (1995).

Accordingly, for the production model, the input vector includes 1) labor and 2) capital, while the output vector includes 1) credits, 2) investment securities and 3) deposits. For the intermediation model, the input vector entails 1) labor, 2) capital and 3) deposits, whereas the output vector entails 1) credits and 2) investment securities. *Labor* input is measured by the number of full-time employees on the payroll. *Capital* input is approximated by the book value of bank capital. *Deposits* are measured by all types of loanable funds (the sum of demand and time deposits). *Credits* include all types of lending activities (both commercial/industrial credits

[8] It should be noted that this analogy is less than perfect, particularly for the production approach, where inputs are measured by physical units and outputs are measured by the number and type of transactions or documents processed over a given time period (but in practice proprietary nature of such flow variables might necessitate the usage of stock variables for outputs instead: such as the number of deposit or loan accounts serviced).

and individual loans). *Investment securities* contain other earning assets of banks such as marketable (public and private) securities. All bank variables are in annual terms expressed in the Jordanian Dinar (JD), except for labor, which is measured by the number of workers. Our definition of intermediation model is compatible with that of Darrat et al. (2002) who study banking efficiency in Kuwait.[9]

[Insert Table 1 around here]

Table 1 compares a number of efficiency studies that use the DEA methodology in terms of sample size and number of inputs and outputs. According to Evanoff and Israilevich (1991), Darrat et al. (2002) and Isik and Hassan (2002a, 2003), the DEA works well with small samples. In any event, the DEA sample size should be large enough to discern between decision-making units given the number of both inputs and outputs. It is known that a large number of inputs and outputs inhibit the discrimination power of the DEA among units, resulting in overestimation of efficiency. Thus, according to Soterious and Zenios (1998) and Dyson et al. (1998), the rule of thumb for the sufficient sample size to prevent this bias is that sample size should exceed the product of the number of inputs and outputs. According to a more conservative view by Nunamaker (1985), sample size should be at least three times greater than the sum of the number of inputs and outputs. The sample size in this study (18) compares favorably with most of the other small samples in the DEA literature and exceeds the critical sample size demanded by both conservative and non-conservative criterion.[10]

[Insert Table 2 around here]

Table 2 displays the summary statistics for the inputs and outputs of the Jordanian bank sector. All variables are five-year averages of bank inputs and outputs classified according to both production (Panel 1) and intermediation models (Panel 2). As can be seen, banks in our sample demonstrate a great deal of variation in terms of inputs and outputs, perhaps implying the wide discrepancies in scale, nature of business and operational strategies of sample banks.[11] In order to account for heterogeneous business operations among banks such as additional overhead

[9] In some studies, bank capital is represented by the book value of fixed assets. However, following Mukherjee et al. (2001), we define it as the book value of bank equity because it let us take into account the risk preferences of banks. For labor metric, we are not able to make distinction between administrative and non-administrative employees, as the available data does not allow such treatment. Investment securities contain all types of liquid financial assets other than very short-term loans.

[10] Table 1 extends the relevant table in Avkiran (1999).

[11] The sample in this study encompasses all types of banks operating in the Jordanian banking sector. Because of rather small sample size, we did not discriminate between different forms of banks in the sector. This procedure conforms to the sample structure in Altunbas et al. (1994), who study all types of banks operating in Turkish market, public, private and foreign development and investment banks and commercial banks. However, unlike them, we normalized the variables by the number of branch offices as it may be necessary to account for the differences in the underlying technologies for commercial and investment banks or commercial banks that are in reality investment banks in disguise.

costs that may result from operating large branch networks, we normalized all production variables by the number of branch offices. This treatment is in accordance with Berger and Mester (1997) and Denizer et al. (2000).

As the table indicates, the number of workers is 62,936 and 5,978 for the smallest and typical and largest bank in the Jordanian banking sector, respectively. The typical branch office in Jordan (with 26 employees per branch) is less crowded than that in Kuwait (39 per branch) but more crowded than that in Turkey (22 per branch). Speculatively, this difference could be a product of variations in operational efficiency in respective banking sectors or simply could be an artifact of geographical and regulatory characteristics in these countries. Kuwait has less usable land than both Jordan and Turkey. Harsh terrain in rural areas may lead to high population density in main cities and thus more employees per branch to cater their financial needs. Another interesting observation is that the sum of credits and investments in Jordan is almost equal to the volume of total deposits. This implies that the major source of funding in Jordan is deposit collection, which is a typical characteristic of a traditional banking system. Thus, the lesser use of other means of funds may imply the underdevelopment of money and capital markets in the country. In addition, it appears that asset portfolios of Jordanian banks are markedly skewed towards liquid financial assets; i.e., investment securities. As Jordanian banks are facing risky business environment in recent years, they may be reluctant to engage heavily in loan markets, as business credits are more costly to originate, maintain and monitor and thus more likely default than investment securities.

6. First stage analysis of empirical results

Instead of estimating a common frontier across time, we construct six separate annual efficiency frontiers, one for each year under study, to account for the changes in the macro-economy and marketplace over time. Constructing an annual frontier specific to each year is more flexible and thus more appropriate than estimating a single multiyear frontier for the banks in sample (DeYoung and Hasan, 1998; Isik and Hassan, 2002a).

6.1. Managerial efficiency in general

Table 3 displays the annual means of the efficiency measures of the Jordanian banks over the period 1996-2001, along with other descriptive statistics: standard deviation, median, minimum and maximum observations. The results are based on a common frontier that is estimated including all types of domestic banking firms in Jordan. Panel 1 reports the relevant statistics based on the production approach, whereas Panel 2 reports them based on the intermediation approach. Under *the production model*, Panel 1 of Table 3, the grand averages of managerial efficiency (ME), pure managerial efficiency (PTE) and scale efficiency (SE) over the study period are 71.45%, 89.66% and 79.67%, respectively. The above results suggest that average managerial, pure managerial and scale inefficiencies (i.e., average dispersions of banks from the best-practice banks) are 39.96%, 11.53% and 25.52%, respectively.[12] If Jordanian banks were *both* pure managerial and scale efficient, they would use about 40% less resources to produce the same amount of outputs during this period.

Because ME score is a composite of both PTE and SE scores, the relative sizes of these indexes provide evidence as to the source of overall managerial inefficiency. The components of ME indicate that most of the managerial inefficiency is resulting from scale inefficiency (output related) rather than pure technical inefficiency (input related). Because the choice of optimum production level is to a great extent under management discretion, the underperformance of Jordanian banks with respect to the frontier banks, which are operating under similar conditions, can be mainly attributed to internal problems and "poor" management practices. *Under the intermediation model*, Panel 2 of Table 3, the Jordanian banks showed 89.00% ME, 96.64% PTE and 92.12% SE on average over the 1996-2001 period. These results, as well, confirm the dominance of scale inefficiency (8.55%) to pure technical inefficiency (3.48%) in driving the total managerial inefficiency (12.36%) in Jordanian banking.

[Insert Table 3 around here]

According to the production (intermediation) model, overall managerial efficiency (ME) measure increases from 68.75% (86.79%) in 1996 to 73.55% (90.46%) in 2001.[13] There appears to be a slight upward shift in the relative efficiency of the Jordanian banks after 1997. The efficiency measures tend to level off afterwards, however, while there is a slight improvement in 2001 with respect to the previous years. Clearly, the Jordanian banks do not exhibit marked

[12] The association between efficiency (Eff) and inefficiency (Ineff) is Ineff = (1-Eff)/Eff. Thus, 71.45% managerial efficiency corresponds to 39.96% inefficiency rather than 28.55% (please see Berger and Mester, 1997 and Isik and Hassan, 2002).

[13] While pure technical efficiency (PTE) either remains constant or slightly falls, scale efficiency (SE) tends to improve between 1996-2001 according to the both models.

changes in performance over this time period. According to Mahdi (2001), economic growth in real terms was usually lower than population growth after the mid-1990s in Jordan, implying that per capita growth was negative, thus there was little improvement in the level of living. The demand for banking services is closely related to the level of economic growth. As societies become wealthier, their demand for most goods and services including financial products tends to increase, which boosts outputs of banks in relation to inputs and enhances their efficiency. Thus, the economic stagnation during the study period may be partly responsible for the lack of large variations in the efficiency scores of the sector over time. In a multivariate regression setting, we will investigate this issue more closely (in order to see whether the differences in the mean efficiency levels of the Jordanian banks across time are statistically significant).

6.2. Comparison of efficiency scores estimated under production and intermediation models

It is apparent that averages of our efficiency measures under the intermediation model are invariably greater than those under the production model. This is somewhat in contradiction with the findings of other studies (Favero and Pappi, 1995 and Hunter and Timme, 1995). Unlike us, these investigations find that efficiency is higher when deposits are specified as output (under production model). However, the important point for inferences regarding bank performance is whether efficiency rankings, rather than efficiency levels, of decision making units are preserved under the two models. According to the former study that used a similar frontier technique (non-parametric DEA), the Spearman rank correlation between two specifications was 0.77 on average, while according to the latter study that used a different technique (parametric DFA), the rank correlation was 0.16.

[Insert Table 4 around here]

Table 4 reports the Spearman rank and Pearson regular correlation coefficients between our pooled efficiency measures calculated under the production (P) and intermediation (I) models. The rank correlations (under the two specifications) are 0.83 for ME-P & ME-I, 0.66 for PTE-P & PTE-I and 0.90 for SE-P & SE-I, all of which are statistically significant at the 1% level. The results from the Pearson regular coefficients also provide comparable results. Obviously, higher correlations imply that our efficiency results are fairly robust against different

representations of banking technology, thus similar conclusions could be expected from the analyses of both models.

6.3. Managerial efficiency by banking groups

As mentioned, there are there major forms of banks in our sample: commercial banks, investment banks and Islamic banks. Investigation of managerial efficiency among these different forms of banks is critical for regulators, current owners and potential investors. Although these groups operate under the same environment, they may exhibit variations in operational performance due to differences in their managerial skills and practices, natures of business, and government patronage. In order to examine which type of banks demonstrates better managerial performance, we contrasted all types of banks in our sample against the same benchmark (i.e., the common frontier that was constructed using the pooled data). Table 5 displays the mean efficiencies of different banking forms operating in Jordan for the period 1996-2001 (Panel 1 for commercial banks, Panel 2 for other banks - investment and Islamic).

[Insert Table 5 around here]

While there is no consistent pattern in the cases of investment and Islamic banks, commercial banks demonstrate increasing efficiency over time. Under the production model, overall managerial, pure technical and scale efficiency scores are 80.53%, 91.99%, 86.72% for commercial banks, 62.06 %, 89.32%, 71.15% for investment banks, 64.52%, 79.38%, 79.33% for Islamic banks, respectively. Whereas, under the intermediation model, overall ME, PTE and SE scores are 94.75%, 97.43%, 97.16% for commercial banks, 83.47%, 98.03%, 85.30% for investment banks, 82.92%, 87.00%, 94.82% for Islamic banks, respectively. It is apparent that under both approaches, the most managerially efficient form is commercial banks. Investment banks dominate Islamic banks in terms of pure technical efficiency under both approaches, whereas the opposite is true in terms of scale efficiency. The results also clearly indicate that scale inefficiency is the main cause of overall managerial inefficiency in all forms of banks. However, scale inefficiency problems seem to be more acute in investment and Islamic banks than in commercial banks.

As mentioned, our study excludes all foreign banks operating in Jordan because of their small market share, different technologies, missions and regulations. Domestic banks in our

sample are all depository financial institutions. They differ from each other mainly in terms of banking services they specialize in. In fact, banking authorities in Jordan as well as in Qatar and the UAE classify Islamic banks as commercial banks. Moreover, in recent years, many countries in the region have brought or bringing Islamic financial institutions under the same supervision and regulation as imposed on conventional commercial banks (Eltony, 2003).

Although these three organizational forms operate in a similar environment, the common frontier results may be challenged on the grounds that these banks have different sizes, organizational structures, operational strategies and service specializations and thus, they may not share a common technology. Taking this view into account, we split the pooled sample into two sub-samples - commercial banks and other (depository) banks. Separate production frontiers are then constructed for each sample.[14] The three efficiency measures, ME, PTE and SE, are then estimated for each separate group. The results for the mean values of efficiency scores calculated relative to the separate frontiers are summarized in Appendix 1. Because separate frontiers either coincide with or lie inside of the common frontier, separate frontier measures are greater than common frontier measures (see Aly et al., 1990; Elyasiani and Mehdian, 1992; Isik and Hassan, 2002a for further discussion and proof). However, horizontally (cross-sectional) or vertically (time series), separate frontier results summarized in Appendix 1 are exactly in accordance with the common frontier results summarized in Table 5: Commercial banks dominate other banks (both investment and Islamic) in terms of managerial and scale efficiency and efficiencies of commercial banks tend to rise over time. Also, for all forms of banks, scale inefficiency remains the main source of managerial inefficiency.

Because results under common and separate frontiers are comfortably in line with each other and pooling augments the reliability of estimates in cases where the number of observations on each group is inadequate – like in the category of Islamic banks, we continue the rest of our analysis with the efficiency measures estimated relative to common frontier. The readers should beware that the above analyses are based on "raw" efficiency scores. In other words, other factors that may be also responsible for the efficiency variations across these organizational forms are not controlled for. Also, whether the efficiency differentials between

[14] The reason for combining investment banks and Islamic banks into one sample is two fold. First, the number of Islamic banks is too small to calculate a specific frontier for this group. Second, because Islamic banks usually become partners in the firms they finance and they manage large portfolios of common stock, they look more like investment banks than commercial banks.

these organizational forms are statistically significant is not answered yet. In a multivariate setting, we will try to address these issues in section 7.

6.4. Returns to scale in the Jordanian banking sector

Because scale inefficiency appears to be the major problem driving overall managerial inefficiency in the Jordanian banks, it is worthwhile to focus on their returns to scale. The law of diminishing returns indicates what happens to output when a bank changes only one input, say labor or capital, and holds all other input constant. Whereas, *returns to scale (RTS)* tell us what happens to a bank's output if it changes *all* inputs. Thus, we define *RTS* as the increases in output that result from increasing all inputs by the same percentage. Obviously, there are three possible cases: 1) *increasing returns to scale (IRS)* occur when 1% increase in inputs produces more than 1% increase in outputs; 2) *constant returns to scale (CRS)* occur when 1% increase in inputs results in exactly 1% increase in outputs; and 3) *decreasing returns to scale (DRS)* happen when 1% increase in inputs leads to less than 1% increase in outputs.

CRS occur in cases where banks double their outputs by replicating their current technology (original production process). IRS take place in cases where increased output enables banks to increase the division of labor and equipment or to use of more specialized labor and capital. In these circumstances, bank employees specialize in a small number of tasks at which they become highly proficient. DRS happen in all production and service technologies at some output rate, especially at a very large one. The larger the production and service levels of banks, the more complex is their management and organizational structure. Too large banking organizations have greater number of layers in the management and they face substantial costs in monitoring and controlling of large operations and marketing processes.

Because a bank's cost curves are determined by its technology, whether a bank faces IRS, CRS or DRS influences its long run costs. *Economies of scale* are present when, as output increases, long run average cost decreases. Whereas, *diseconomies of scale* are present, as output increases, long run average cost increases. Both IRS and DRS represent non-optimal output levels, thus scale inefficiencies. As discussed, ME = PTE * SE, where ME refers to the frontier efficiency that is measured under the constant returns to scale (CRS) assumption, where banks are assumed to have no scale inefficiencies. Accordingly, ME indicates proportional reduction in

input usage that could be achieved if banks were operating on the production frontier rather than at their inefficient locations. PTE is the frontier efficiency that is measured under the variable returns to scale (VRS) assumption, where banks are allowed to have scale inefficiencies. Unlike PTE that is input related, scale efficiency (SE) is output related and refers to input savings that could be attained if the banks were operating at the optimal scale (CRS), where there are neither increasing returns to scale (IRS) nor decreasing returns to scale (DRS). Thus, the difference between the ME and PTE scores refers to the cost of operating at an incorrect scale, either at the DRS or IRS portion of the long-run average cost curve.

[Insert Table 6 around here]

Table 6 displays trends in the returns to scale of the Jordanian banks (both in the industry and sub-group levels) according to both production and intermediation models (Appendix 2 presents the scale trends for individual banks in detail). As it appears, the great majorities of Jordanian banks experience increasing returns to scale (IRS) in their operations. Under production (intermediation) model, of the Jordanian banks, 70% (52%) showed IRS, 29% (43%) CRS and only 1% (5%) DRS in their production technologies between 1996 and 2001. Strikingly, there were no banks in many years under study that suffered from excessive scale, DRS, (between 1996-99 under the production model and in 1998, 1999 and 2001 under the intermediation model). As for subgroups, all types of banking organizations, be they commercial, investment or Islamic, exhibit mostly IRS in their operations under the both models. Of these banking forms, commercial banks are the banks that have more scale efficient operations, as they are the group with the highest percentage of CRS. Interestingly, almost no Islamic bank or investment bank demonstrates DRS throughout the study period.

It is clear that most of the Jordanian banks are facing substantial scale problems, especially due to increasing returns to scale. One implication is that for most Jordanian banks, increases in outputs would result in less than proportional increases in inputs (and costs). Hence, those banks with the IRS could achieve significant cost savings and efficiency gains by increasing the scale of their operations. In other words, substantial gains could be obtained from altering scale via internal growth or consolidation in the sector. As a matter of fact, in a perfectly competitive and contestable market, scale inefficient banks should be absorbed by efficient ones to exploit cost advantages. Thus, those banks that experience IRS should either eliminate their scale inefficiency or be ready to become a prime target for acquiring banks, which can “create

value" from underperforming banks by streamlining their operations and eliminating their redundancies and inefficiencies (Evanoff and Israilevich, 1991; Cummins et al., 1999).

The results from Table 6 indicate that scale inefficiency problems in the Jordanian banking sector persisted over a prolonged period of time. One implication is that the financial markets in Jordan are not efficient enough to eliminate such non-optimal behavior. There may be some regulatory or market specific characteristics that somehow inhibit the utilization of scale economies by curbing internal or external growth of the Jordanian banks. In fact, the close inspection of the financial system in Jordan reveals some clues for the persistence of scale inefficiencies in this less than perfect market. It appears that external growth of banks is constrained by corporate control and governance issues surrounding the traditional Jordanian financial system. As a matter of fact, the Central Bank of Jordan (CBJ) has been persistently trying to consolidate the banking industry by offering incentives to smaller institutions to merge with one another or larger ones. However, such efforts have not been particularly successful, as Jordanian banks have a strong tradition of family ownership and owners are reluctant to cede control to larger institutions (Annual Report of the CBJ, 1999). It seems that lack of wide spread stock ownership somewhat impedes transfer of ownership in these closely held firms. In addition, it is evident that inexistence of effective competition allows inefficient banks to continue with slackened efficiency and still remain in business.

On the other hand, there may be some other factors involved in the continuity of such inefficient banking behavior. The limited demand from the Jordanian residents and companies for financial services and products (i.e., the sophistication of financial markets) may be impeding the internal growth of these scale inefficient banks. As Eltony (2003) reports, the long-run mobilization ratio, M1/M2, which indicates the importance of long-term banking and the degree of sophistication in the market, is relatively low in Jordan (about 30%) with respect to the other Arab countries (74% in Morocco, 66% in Syria and 43% in Tunisia). Darrat and Hajj (2002) also indicate that the ratio of demand deposits to the narrow money stock (M1), which is another proxy that measures the degree of sophistication in a financial market, is very low for Jordan (35%) as compared to other Arab countries (e.g.; about 60 % in both Saudi Arabia and Tunisia). Such low ratios are the indicators of limited access to financial institutions and limited intensity of banking transactions. They also imply that cash is still the dominant instrument of payment services rather bank deposits in this country (by almost two-to-one margin). Alternatively, public

in Jordan appear to be unfamiliar with the available financial institutions and their services. As discussed above, such limited demand for financial services may be partly resulting from sluggish economic growth in Jordan. Economic theory suggests that as income rises, the demand for most goods and services including financial products rises. However, as reported by Mahdi (2001), the standard of living in Jordan (as indicated by the growth rate of GDP per capita) was deteriorating or stagnant at best in recent years (-1.32%, -0.43%, -0.44%, 0.02%. 0.81%, respectively, between 1996 and 2000). For Jordan, long-term trends in economic prosperity are also relatively poor. While average of annual growth rate of real GDP between 1970-1999 was 6.59% for Saudi Arabia and 4.35% for Tunisia, it was only 1.68% for Jordan (Darrat and Hajj, 2002). Furthermore, over the past years, banking activity in Jordan has been substantially constrained by the conservatism of the banks, which have tended to prefer the short-term risks of trade finance and property development to longer-term industrial ventures. Thus, passive management and low risk policies may be serving as another strong impediment for internal growth. In conclusion, it is clear that while internal or external growth would generate cost savings and increased efficiencies for the Jordanian banks, utilizing such opportunities appear to be challenging due to the characteristics of the local financial market.

6.5. Efficiency rankings of the Jordanian banks

Table 7 identifies the best practice and worst practice banks in the Jordanian banking system according to the six-year averages of their efficiency scores. The 'Group Rank' column shows the efficiency orders of banks within their specialization group (commercial, investment and Islamic), whereas the 'Sector Rank' column shows the efficiency orders of banks within the entire banking industry. According to the *production model*, the most efficient banks in the Jordanian banking sector are Arab Bank, Cairo Amman Bank and Jordan Gulf Bank (all of which are fully ME as compared to other sample banks), while the least efficient bank is Beit Al-Mal Saving and Investment for Housing (which has 19.83% ME score). These most managerially efficient banks are also the most pure technical and scale efficient banks in the sector, indicating that these banks are competent both in minimizing the input usage per output and in choosing the optimum production scale in terms of cost control. Expressively, the great majority of managerial inefficiency in the worst practice bank stems from scale inefficiency. The

results in Appendix 2 indicate that Beit Al-Mal Saving and Investment for Housing exhibits increasing returns to scale (IRS) in every year under study according to both production and intermediation models. This suggests that this firm is suffering excessively from underproduction and could reap substantial economies of scale if it could grow. According to Cummins et al. (1999), these types of firms are ideal for mergers and acquisitions, as the combined firm with increased size could benefit from economies of scale opportunities present in the incumbent.

As for sub-groups, the most managerially efficient *commercial banks* are Arab Bank, Cairo Amman Bank and Jordan Gulf Bank (100%) while the least efficient commercial bank is the Housing Bank for Trade & Finance (57.33%). The best practice *investment bank* in terms of managerial efficiency is the Jordan Investment & Finance Bank (95.86%) whereas the least efficient investment bank is the Beit Al-Mal Saving and Investment for Housing (19.83%). In *Islamic banks* group, Jordan Islamic Bank for Finance and Investment manifests a clear dominance over Islamic International Bank with respect to managerial efficiency (81.42% versus 39.18%). The least inefficient banks in each group suffer mostly from scale related problems rather than technical problems, emphasizing the importance of scale inefficiency in the Jordanian banking. According to the *intermediation model*, the same efficiency orders are well preserved for the worst and best practice banks both in the industry and sub-group levels. Again, the preservation of efficiency rankings under both models reinforces the robustness of our efficiency scores against different representations of banking technology (different specifications of inputs and outputs) in Jordan.

7. Second stage analysis of empirical results

There are many non-mutually exclusive explanations of what determines the level of managerial efficiency in an individual bank. In this section, in the light of recent advances in corporate finance and financial institutions literature, we will try to determine the potential correlates of managerial efficiency, which are at least partially exogenous and may explain some of the efficiency differences that remain after controlling for time and individual effects. In order to check robustness of the results, as also we did when estimating managerial efficiency (such as using alternative specifications of banking technology, e.g.; production and intermediation models, or using alternative specifications of production frontier, e.g.; common and group

specific frontiers), we will also employ a few alternative specifications of the explanatory variables. The statistical relationship found, however, need not imply causality. Causality may run from efficiency to the characteristics investigated rather than the other way around. For example, efficient banks may have larger market share because more efficient banks may compete more effectively, earn more profits, accumulate more capital and then become larger. Alternatively, having larger size and in turn a higher market share and power may lead to greater operating efficiency. Therefore, our second stage analysis results can only help to identify certain characteristics that are more prevalent in efficient banks rather than to determine the factors that may lead to greater efficiency in banks.

We constructed the following three models (or their variations) to determine the potential correlates of efficiency in the Jordanian banks:

$$ME_{it} = a + b_1 Stability_{it} + b_2 Organizati\,on_{it} + b_3 Ownership\ \&\ Control_{it} + b_4 Market_{it} + b_5 Stock_{it} + b_6 Other_{it} + \varepsilon_{it} \quad (4)$$

$$PTE_{it} = a + b_1 Stability_{it} + b_2 Organizati\,on_{it} + b_3 Ownership\ \&\ Control_{it} + b_4 Market_{it} + b_5 Stock_{it} + b_6 Other_{it} + \varepsilon_{it} \quad (5)$$

$$SE_{it} = a + b_1 Stability_{it} + b_2 Organizati\,on_{it} + b_3 Ownership\ \&\ Control_{it} + b_4 Market_{it} + b_5 Stock_{it} + b_6 Other_{it} + \varepsilon_{it} \quad (6)$$

In the models, *i* stands for the *i*'th bank and *t* for the *t*'th time period. The left hand side (LHS) variables are dependent variables, i.e., the three efficiency scores estimated in the first stage: managerial efficiency (ME), pure technical efficiency (PTE) and scale efficiency (SE). The right hand side (RHS) variables are the exogenous bank characteristics being investigated, which are grouped into six wide categories. The overall means (μ) and standard deviations (σ) of the RHS variables over 1996-2001 are shown in the parentheses.

A) *Stability variables* involve dummy variables for the six years under study: 1.Yr96 (μ:0.16; σ:0.37), excluded from the regressions as the base case; 2.Yr97 (μ:0.16; σ:0.37); 3.Yr98 (μ:0.17; σ:0.38); 4.Yr99 (μ:0.17; σ:0.38); 5.Yr00 (μ:0.18; σ:0.38); and 6.Yr01 (μ:0.17; σ:0.38).

B) *Organizational variables* include three dummy variables for the three banking forms in the sample: 1.Commercial banks, ComBank, (μ:0.5; σ:0.5), excluded

from the regressions as the base case; 2. Investment banks, InvBank, (μ:0.41; σ:0.49); and 3. Islamic banks, IslBank, (μ:0.1; σ:0.3). Definitions of these organizational forms were provided before in section 3.

C) *Ownership and control variables* contain five variables: one dummy variable and four real variables: 1. Ceo-Chair (μ:0.29 ; σ:0.45), whether the general manager of the bank is also chairman or vice chairman of the bank board (if they are the same, Ceo-Chair=1, otherwise 0); 2. %ForOwn (μ:0.34; σ:0.25), the proportion of stock owned by foreigners (non-Jordanians); 3. %PubOwn (μ:0.12; σ:0.13), the proportion of stock owned by the state or state affiliated institutions; 4. %InstOwn (μ:0.52; σ:0.24), the proportion of stock owned by other institutions (non-individuals); and 5. %OwnCon (μ:0.43; σ:0.21), the proportion of stock owned by the three largest shareholders.

D) *Market variables* entail two variables, 1. LoanShare (μ:0.06; σ:0.15), the market share of the bank in loan markets; and 2. %ForBrn (μ:0.1; σ:0.18), the proportion of foreign branches of the bank in total number of branches.

E) *Stock performance variables* encompass five variables: 1. Earning/Share (μ:1.02; σ:3.59), net income divided by total number of outstanding shares; 2. Price/Earning (μ:23.51; σ:58.73), price per share divided by net income per share; 3. MV/BV (μ:0.99; σ:0.64), market value of shares divided by book value of bank equity; 4. DivYield (μ:0.45; σ:1.18), percentage dividend yield; and 5. DivPayout (μ:0.37; σ:0.49), dividend payout ratio, what percentage of net profits are paid to owners.

F) *Other variables* are the other bank traits that serve as control variables: 1. Age (μ:23.37; σ:16.85), the age of the bank in the relevant year; 2. Loans/TA (μ:0.43; σ:0.14), the fraction of loans in total assets; 3. Deposits/TL (μ:0.75; σ:0.21), the fraction of bank deposits in total liabilities; 4. Equity/TA (μ:0.13; σ:0.09), equity ratio that indicates what fraction of bank assets is provided by owners; 5. LogTA (μ:8.50; σ:0.62), size of the bank as measured by the log of total bank assets.

In order to account for variations in size across banks, we calculate a consistent estimate of the covariance matrix that allows for heteroscedasticity in the data. However, as a result of

this treatment, the coefficients themselves do not change; only their standard deviations change (White, 1980). Because incorporating an endogenous factor in a multiple regression can bias the coefficients even on the exogenous factors, following Berger and Mester (1997), we ran single variable (univariate) regressions to check the robustness of the multivariate regressions results. In fact, due to causality issues discussed above, efficiency estimates are sometimes tested for correlation with certain variables to underscore the fact that causation may run in both directions (Mester, 1994). Univariate regressions include only one bank characteristic at a time in addition to a constant term and thus their coefficients are proportional to correlation coefficients. Univariate regressions may also serve better in empirical settings, where the number of observations are limited and degrees of freedom are of concern. However, in univariate regressions, both the efficiency score and the variable investigated may be related to a third omitted factor, which may lead to spurious relationships between variables. Because both specifications have their prons and cons, Table 8 reports both multivariate (MultiVar) and univariate (UniVar) regression coefficients for the models 4 to 6 (under production and intermediation models). Due to the degrees of freedom concerns, we ran more parsimonious versions of the above models and reported the results in Appendix 3 (for production approach) and Appendix 4 (for intermediation approach).[15] The complete model results (Table 8) and more parsimonious models' results (Appendix 3 and 4) are quite similar. Thus, we continue our analysis with the results of complete model (Table 8). The asterisks *, **, and *** refer to statistical significance at 10%, 5% and 1% levels, respectively.[16] Model statistics for multivariate regressions such as R-square, F-value and Durbin-Watson (DW) are also given in the table.

Our panel data contain observations from different time periods (1996 to 2001) and different forms of banks (commercial, investment and Islamic banks). The question is, when data pooled, if the parameters of the model stay the same across time and bank groups. In cases where banks use different production technologies, have different sizes, face different regulatory regimes, operate in different time periods, or possess different organizational forms, one could specify more complicated and realistic (panel data) models, such as fixed effects model (FEM) or random effects model (REM), rather than a single cross-section or time series model (Baltagi, 1995; Matyas and Sevestre, 1996). In FEM, variation across groups or time is captured in simple shifts of the regression function (i.e., change in intercepts). Thus, FEM is simply a linear

[15] In both cases, each variable category is regressed alone only other bank traits serving as control variables.
[16] To preserve space, we do not report t-statistics of the coefficients. However, they are available from authors upon request.

regression model where the intercept terms vary over the individual units or groups. In REM, the variation across groups changes all of the slopes of the conditional mean function and the model superimposes a distribution of coefficient vectors. Thus, REM allows each bank (group) to have its own parameters. Because our data is unbalanced panel data, we ran both two factor fixed and random effect models in order to control for possible time and group effects. In doing so, we also wished to check the robustness of the classical regression results presented in Table 8. The results along with model statistics (adjusted R, Chi-Square for the Langrage Multiplier (LM) test, and Chi-Square for the Hausman test) are reported in Appendix 5. Apparently, both FEM and REM regression results are similar to each other in terms of statistical significance and sign of coefficients. However, we applied some formal tests to check whether the individual or group effects should be treated as fixed or random. The Breusch and Pagan's LM statistics is used for testing panel data models (FEM or REM) against the classical regression (Table 8) model. Large values of the LM argue in favor of panel models. The Hausman's chi-squared statistics is used for testing FEM against REM. Large values of chi-squared argue in favor of FEM. In our case, while the Hausman test results support REM against FEM, the LM results argue in favor of the classical regression model against both FEM and REM. Therefore, in our analyses below, we took the classical multivariate regressions (Table 8) as reference.[17]

Because the developments in the macroeconomy and marketplace may exert influence on managerial performance, with ***stability variables***, we would like to investigate whether there are marked changes in efficiency across time. All years are compared to the basis year 1996, which is excluded from the regressions to prevent perfect collinearity. The overall results from multivariate and univariate regressions under production and intermediation models indicate that mean efficiency scores (ME, PTE and SE) of 2001 are generally greater than those of the basis year as well as the subsequent years. This efficiency differential is also statistically significant in the majorities of regressions. The efficiency results are probably mimicking the positive changes in the general economic environment of the country in 2001. According to the CBJ reports, during 2001, GDP at constant market prices expanded by 4.2%, significantly greater than the population growth of 2.8%. The decline of domestic interest rates during the period may have also contributed to this positive outcome in efficiency, by boosting the production of banking

[17] Because Hausman test suggests REM against FEM, although both of them are rejected in favor of classical regression with no group effects, we incorporated binary variables to account for time and group effects in our pooled data regressions.

services and products. Also, the boom of the Amman Stock Exchange (ASE) in 2001 may have fostered the brokerage services of the banks as the ASE index rose by about 30% and the volume of share trading increased by 130% in 2001 with respect to 2000. Furthermore, the positive echoes of the accession of Jordan to the WTO and signing of the free trade agreement between Jordan and the U.S. in the preceding year may have played some role in this consequence.

Organizational variables include dummies for commercial, investment and Islamic banks. Commercial banks are the basis group, thus they are not included in the regressions. Overall results confirm the earlier casual observations we made in section 6.3: commercial banks are significantly superior to other two forms in terms of almost all efficiency measures. Moreover, investment banks in regard to efficiency generally dominate Islamic banks. The superiority of commercial banks to other forms of banks may be explained with their expertise and experience in banking accumulated over the years, as commercial banks are relatively established banks. Moreover, relatively larger size of commercial banks may allow them to reduce per unit costs substantially if the long-run average cost curve for banks in Jordan has the typical U-shape. Moreover, commercial banks may have respectively more diversified asset portfolio, which may reduce their overall risk and cost of funds. Such cost and risk structure may permit them to raise and intermediate more funds, leading to greater input-output transformation in these banks and hence higher observed efficiency for them. With retail banking structure, they may also market and cross sell more products to their clients than other banks, thereby boosting their production per units of labor and capital and hence efficiency.

Ownership and control variables are factors related to the structures of management-board as well as stock ownership. Bank ownership, control and governance issues are linked to X-efficiency by means of the agency cost theory in the finance literature. Unless monitored effectively, bank managers can deviate from firm value maximization goal, which is closely connected to efficiency, and they can pursue their own interests to the detriment of shareholders. Fama and Jensen (1993) suggest that separation of decision management from decision control is one way to alleviate such possible agency problems. Thus, the conflict of interest between managers and owners may exacerbate when the CEO of the bank is also the chairperson of the board of directors because decision making and decision control powers are consolidated in one person's hand. Evidently, Pi and Timme (1993) for the U.S. commercial banks and Isik and Hassan (2002a,b and 2003) for the Turkish commercial banks showed that X-efficiency is

significantly lower if these two key corporate persons are the same.[18] In the Jordanian banking case, our results in Table 8 indicate that CEO-Chairman affiliation has significant negative relation with the PTE score, supporting the agency theory. However, such affiliation seems to have strong opposite effects in cases of ME and SE. It should be noted that PTE refers to pure managerial performance if scale effects are dismantled. In section 6, we found that scale inefficiency is the predominant driver of managerial sub-performance in Jordan. Thus, lack of negative relationship between Ceo-Chair variable and ME can be attributed mainly to the scale effects, which may not be totally under management control due to the reasons discussed before.

Other variables in this category are related to the *stock ownership* structure. In advanced markets, domestic banks were found to be more efficient than foreign banks (Hasan and Hunter, 1996; Mahajan et al.; 1996; Chang et al.; 1998; DeYoung and Nolle, 1996 for the U.S. banks and Berger et al., 2000 for the European banks; Sathye, 2001 for the Australian banks). These studies advocate that foreign banks may have traded between market share and efficiency as they usually financed their rapid expansion in a new market with expensive purchased funds. On the contrary, in emerging markets, foreign banks were found to be more efficient than domestic banks. For instance, Bhattacharya et al. (1997), Srivasttava (1999) for the Indian banks, Hasan and Marton (2000) for the Hungarian banks and Isik and Hassan (2002a,b and 2003) for the Turkish banks report that foreign banks are more cost efficient than their domestic peers. These studies attribute the superior efficiency of foreign banks to their better technology, management structure, scale and scope economies, and home government support, among other things. Our results suggest that as the percentage of foreign ownership (%ForOwn) increases, the degree of efficiency generally decreases. The association is also significantly negative in most of the instances. However, these results are not directly comparable with those of the earlier foreign bank efficiency studies, as they looked at the performance of foreign banks, which are predominantly owned by foreign investors, vis-à-vis that of domestic banks, which are predominantly owned by domestic investors. The banks in our sample are all domestic banks, which are prevalently owned by locals. Thus, direct comparison between foreign and domestic banks is precluded. However, the results of this study suggest that at low levels of foreign ownership, domestic banks with higher foreign involvement are less efficient. Foreign ownership may be indeed

[18] Topuz et al. (2003) also report that CEO-Chairman affiliation is negatively related to the cost, allocative and scale efficiencies supporting the agency cost theory in the case of the U..S. REITs.

positively associated with X-efficiency in developing markets, as the results from other emerging market studies imply. Our results may simply mean that for foreign ownership, which usually has better technology and managerial experience in emerging market settings, there may be needed much greater proportional ownership stake to exert more power on operational decisions. In addition, further investigation shows that most of the foreign investors in banks of Jordan are coming from neighboring Arab countries. As Isik and Hassan (200a) and Berger et al. (2000) posit, the origins of foreign owners may be important because not all of them are coming from financially more developed markets.

The state ownership variable (%PubOwn) has the largest (negative) coefficient among the ownership variables. The relationship is mostly statistically significant at 1% level, as well. The results indicate that as the state ownership rises, domestic bank efficiencies tend to go down. This finding is in line with that of Isik and Hassan (2002a,b), who showed that state banks in Turkey operate less efficiently than their private counterparts. It may be that state involvement imposes goals on banks, which are more related to social and political welfare than efficiency of operations. Or lack of takeover threat or incentive mechanisms in state structures may allow management to care less on input savings and enjoy quite life (Altunbas et al, 2001; Isik and Hassan, 2003). We also looked at the link between institutional ownership and efficiency. Individuals as small investors usually do not have enough incentives to monitor management actions due to disproportionate expenses and free-riding issues. However, because they usually have higher stake in question, institutional investors have both the clout and the interest in controlling management closely (Berger and Mester, 1997). Thus, one could expect that the greater the institutional ownership, the greater the efficiency. However, our results are mixed at best in regard to this association, as they do not reveal any clear picture. It may be that the variable %InstOwn we use is not a good measure of institutional power because it is defined as the sum of the fractions of shares owned by non-individuals. Thus, the ratio indicates neither voting power nor degree of representation in the bank board. [19] If the institutions we consider have small proportion of stock (thus less representation in the board) or if they are somehow affiliated with the bank, they may not apply the desired pressure on management to become more efficient. Another relevant question is whether widely held or closely held banks are more efficient. Hannan and Mavinga (1980) found that in the absence of competition, widely held

[19] Unfortunately, we do not have the data on the proportion of stock owned by the board members to iterate our study in this direction.

banks made significantly higher expenditures on equipment and physical plant than closely held banks. Thus, one can expect that due to the existence of monitoring problems, widely held banks may suffer from lower efficiency. We wanted to investigate this issue by means of the variable %OwnCon, defined as the proportion of the stock owned by the largest three shareholders. Our results suggest that as ownership concentration rises, efficiency tends to decline significantly, implying that closely held banks are less efficient. Closely held banks in Jordan are family structures, where professional management notion is not strong, inefficiencies are tolerated and influence and disciplines of outsiders on management are limited.

Market structure may be important in defining banking efficiency, as well. The Cournot model of oligopolistic behavior predicts that market power be positively related to profitability and efficiency, as banks with market power can charge higher prices, deter competition and transform more outputs per inputs (Berger 1995; Berger and Mester, 1997; Isik and Hassan, 2003). We use market share of the bank in loan markets (LoanShare) to represent market power (deposit market share of the bank is also used for robustness check). Our results, although mixed, mostly provide evidence in favor of market power, i.e., banks with greater market power seem to be more efficient. A related issue is the internationalization of banks, which may foster efficiency because of the exploitation of scale and scope economies or new banking techniques and concepts imported from other countries (Mahajan et al., 1996). Supporting this argument, Isik and Hassan 2002a provided some empirical evidence for the Turkish banks. To measure the degree of internationalization, we constructed the variable %ForBrn, which is the fraction of bank's foreign branches in its total branches (domestic and foreign). Our results indicate that as the fraction of foreign branches increases, so does the efficiency of banks. All types of efficiency, including scale efficiency, seem to be positively and significantly related to internationalization. This suggests that expansion to foreign markets benefits the Jordanian banks, as they predominantly experience increasing returns to scale in their operations.

The authors know of no study that links X-efficiency to ***stock performance*** in banking, especially in the emerging market case. We use the traditional stock performance measures such as earning per share ratio (Earning/Share), price earning ratio (Price/Earning), market to book value ratio (MV/BV), dividend yield ratio (DivYield) and dividend payout ratio (DivPayout). Our results overall indicate that managerial efficiency and its components are all positively associated with stock performance. Market to book value ratio appears to have the strongest

association. MV/BV ratio reflects the subjective judgment of thousands of stockholders and prospective investors about a firm's potential for future earnings and dividends. Thus, the positive relation between MV/BV and efficiency implies that efficient banks are associated with greater future financial outlook because these banks appear to record greater earnings per share, pay greater dividends and offer greater dividend yields.

We also explore the impacts of ***other bank traits*** on efficiency. Other characteristics include bank's age (Age), asset (Loans/TA) and liability (Deposits/TL) compositions, capitalization (Equity/TA) and bank size (logTA). If banking involves "learning by doing", we may expect that older banks are more efficient. Consistent with expectations, in the U.S. banking, Mester (1996) report that young banks tend to be inefficient. DeYoung and Hasan (1998) find that for young banks, it takes about nine years to catch up with the established banks with respect to efficiency. Univariate regression results of our study support these earlier papers. However, once other bank traits are taken into account as in the multivariate regressions, old banks lose their superiority. This is in line with the finding of Isik and Hassan (2003) for the Turkish banks. Our results also indicate that while concentration of assets on loans is positively linked to efficiency, concentration of liabilities on deposits is negatively related. This means that banks with large amount of deposits fail to convert them into loans and securities effectively, perhaps because of stagnant economy in the majorities of the 1990s, thus reducing their efficiency. Banks with greater fraction of loans appear to enjoy greater efficiency and productivity per unit of labor and capital. The Equity/TA ratio measures how well capitalized the banks are and how risky they are. Insolvency risk rises for banks with thinner capital cushion. The *moral hazard hypothesis* anticipates that with little stake to lose, owners of less capitalized firms tend to have less incentive to control and monitor management, exacerbating agency costs and thus increasing managerial inefficiency in banks. Empirical studies usually found that well capitalized firms are more efficient (Kwan, 1997; Berger and Mester, 1997). Our results indicate the opposite in Jordan. Because most of the banks in Jordan are closely held, where owners are strongly involved in management, agency issues may not be material. Moreover, to the extent that equity ratio reflects the degree of risk, the above result means that riskier firms tend to be more aggressive and produce more outputs per inputs, making them more efficient. As for size, X-inefficiency may decrease with bank size, if large banks are better able to attract astute managers, if large banks face greater pressure from shareholders, or because large banks tend to

operate in intensively banked, densely populated areas where competitive pressures may be greater. Because large banks can specialize more and reduce unit production costs, they may be operating at more efficient scale. Moreover, smaller banks may not be able to obtain enough capital and management ability to successfully operate in a complex environment that requires frequent technology updates. Consistent with these arguments, Aly et al. (1990) and Berger et al. (1993) reported a positive association between size and efficiency for the U.S. banks while Isik and Hassan (2002a) reported a negative association for the Turkish banks. Our results indicate that size, as measured by the log of gross total assets (LogTA), is significantly and positively related to efficiency in Jordan. This is consistent with our earlier finding that most of the X-inefficiencies in the Jordanian banking arise from insufficient scale of operations.

7.1. Fit of the correlates of efficiency models

The adjusted R^2 s in Table 8 show that our right hands side (explanatory) variables under the production model were jointly able to explain about 88% of the variations in ME, about 80% of the variations in PTE and about 86% of the variations in SE. The results under intermediation model also yield similar explanatory powers except for PTE, which has adjusted R^2 of 64%. The *F* test of each multiple regression, a measure of the overall significance of estimated regression as well as a test of significance of R^2, implies that the R^2s of the models are statistically different from zero (at least at 1% level). This indicates that not all slope coefficients of the explanatory variables are zero, meaning that our explanatory variables (jointly) have statistically significant explanatory power.[20] In addition, Durbin-Watson (DW) statistics do not imply any sign of muticolliniarity in our model variables.

8. Concluding remarks

[20] The existence of large number of statistically significant coefficients, despite the relatively small size of observations, also confirms the strength of the models. Researchers know that finding strong relations with large sample sizes is relatively easier in contrast to small samples. Our adjusted R^2s stand quite in contrast to those of the earlier correlates of efficiency studies. For example, for the U.S. banks, Berger and Mester (1997), using about 6,000 banks and 25 independent variables, which explained about 7% of the variance of cost efficiency and about 35% of the variance of standard and alternative profit efficiencies. For the Turkish banks, using 149 observations and 19 independent variables, Isik and Hassan (2003) explained about 50% of the difference in measured technical efficiency, 39% in pure technical efficiency and 57% in scale efficiency. The difference between these papers may be, among other things, a product of different efficiency estimation techniques, data samples, time periods, efficiency estimates, or simply specification of correlates.

Employing a non-parametric approach and using a data set that spans the period 1996-2001, we investigated managerial, pure technical and scale efficiencies of the depository banks (commercial, investment and Islamic) operating in Jordan. To the best of our knowledge, this is the first investigation that focuses specifically on the X-efficiency of the Jordanian banking sector. When estimating efficiency in the first stage, to account for time effects, we constructed year-specific production frontiers and to account for group effects, we normalized all inputs and outputs by the number of branch offices and calculated a separate frontier for each banking group. In addition, against specification errors, we used two alternative representations of banking technology, production model, where deposits are treated as bank output, and intermediation model, where deposits are considered as bank input.

Under production (intermediation) model, we found 71% (89%) managerial efficiency, 89% (96%) pure technical efficiency, and 79% (92%) scale efficiency for the Jordanian banks over the years under study.[21] The components of managerial efficiency under both models suggest that major source of X-inefficiency in the Jordanian banking sector is scale inefficiency, i.e., banks in Jordan are not operating at an optimal scale at which the per unit average production cost is minimized. Further investigation of returns to scale shows that majorities of the banks are experiencing increasing returns to scale. Moreover, our results from the correlates of efficiency analyses suggest that larger banks are more efficient, i.e., as banks tend to increase their asset size, they become more efficient. These findings imply that the Jordanian banks could obtain significant efficiency gains and input savings by increasing production of outputs.

While one way to exploit such economies of scale opportunities is through internal growth, the other is through external growth, i.e. mergers and acquisition (M&A). Because internal growth opportunities are limited and more time demanding given the sluggish economy, external growth through consolidation in the industry should be encouraged. The banking authorities in the region such as in Oman have already begun to stimulate mergers and acquisition among their banks to foster efficiency. Likewise, the Central Bank of Jordan should continue to encourage smaller banks to merge. Although resistance from family ownership structures may currently inhibit greater consolidation in the industry, the increased foreign competition as a result of the free trade agreement signed between Jordan and the US should eventually increase consolidation in the industry. This treaty allows the US bank holding

[21] Although efficiency scores are different in absolute terms, their rankings are very similar under both models.

companies to enter the Jordanian market through acquisition of an existing Jordanian bank. The cost efficiency and service quality of large US banks may also motivate the Jordanian banks to consolidate in order to increase their competitive viability.

In the second stage of our analysis, we investigated the correlates of efficiency to determine the characteristics of efficient banks. We used binary variables in the classical multivariate GLS regressions to account for size, group and time effects. We also employed more complicated panel data models such as fixed effects and random effects models that allow heterogeneity in the data. Overall results suggest that managerial efficiency was quite stable across time except for 2001, perhaps mimicking the revival of the Jordanian economy during this period. Among specialization groups, commercial banks dominate both investment and Islamic banks in terms of efficiency. We also found support for the agency theory in the case of pure technical efficiency as PTE score decreases significantly if decision-making and controlling roles reside in the same person. Our results also indicate that public and foreign ownership is negatively associated with efficiency. Managerial efficiency also declines with ownership concentration, perhaps implying that closely held and family owned businesses are not efficient structures. Internationalization of bank operations seems to benefit domestic banks in terms of operational efficiency, as banks may be able to exploit scale and scope economies with the expansion of operations to new markets. Likewise, increasing size, producing more loans as a fraction of total assets or expanding market share in the domestic market appear to be the main characteristics of more efficient firms, all of which again indicate that increasing scale of operations is one solution to eliminate underutilization of factor inputs in the Jordanian banking. Finally, our results suggest that efficiently run banks are highly regarded by the investors in the stock market as market to book value ratio is significantly correlated with greater efficiency.

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Appendix 1. Average efficiency of different forms of Jordanian banks calculated relative to *separate* frontiers

Models		**PRODUCTION MODEL**			**INTERMEDIATION MODEL**		
Type/Indices	**#**	**ME**	**PME**	**SE**	**ME**	**PME**	**SE**
Panel 1		%	%	%	%	%	%
All Banks							
1996	16	76.44	94.07	80.74	91.16	99.76	91.39
1997	16	72.86	92.94	79.05	93.19	98.88	94.15
1998	17	77.29	94.94	81.75	90.84	98.01	92.56
1999	17	78.80	94.60	82.89	91.41	97.96	93.30
2000	18	81.50	95.68	84.81	91.99	98.08	93.71
2001	17	83.51	99.44	83.86	93.06	99.79	93.27
Overall	101	78.71	95.37	82.43	92.02	98.75	93.14
Panel 2							
Commercial Banks							
1996	8	76.63	90.20	83.31	98.01	100.00	98.01
1997	8	71.36	94.31	76.43	98.66	100.00	98.66
1998	8	80.69	97.81	82.79	96.46	100.00	96.46
1999	8	84.99	99.98	85.00	98.99	100.00	98.99
2000	9	87.16	99.19	87.70	97.12	99.78	97.34
2001	9	85.30	99.24	85.90	97.89	99.61	98.28
Overall	50	81.45	97.04	83.75	97.80	99.89	97.91
Panel 3							
Other Banks							
1996	8	76.25	97.94	78.18	84.30	99.51	84.76
1997	8	74.35	91.58	81.68	87.73	97.76	89.64
1998	9	74.27	92.39	80.83	85.84	96.23	89.09
1999	9	75.66	90.42	82.92	85.63	96.37	88.99
2000	9	75.84	92.17	81.92	86.86	96.39	90.07
2001	8	81.50	99.66	81.56	87.64	100.00	87.64
Overall	61	76.14	93.80	81.18	86.58	97.68	88.65
Panel 3.a							
Investment Banks							
1996	7	72.86	97.64	75.06	82.06	99.44	82.59
1997	7	70.69	90.37	79.06	85.97	97.44	88.16
1998	7	72.04	92.97	78.30	86.86	98.36	88.37
1999	7	78.77	93.10	85.54	85.97	98.61	87.34
2000	7	78.00	94.66	83.23	88.37	99.30	89.07
2001	6	77.20	99.55	77.28	84.25	100.00	84.25
Overall	41	75.46	94.34	80.60	86.48	98.83	87.56
Panel 3.b							
Islamic Banks							
1996	1	100.00	100.00	100.00	100.00	100.00	100.00
1997	1	100.00	100.00	100.00	100.00	100.00	100.00
1998	2	82.05	90.35	89.70	82.30	88.80	91.60
1999	2	64.75	81.05	73.75	84.45	88.50	94.75
2000	2	68.30	83.45	77.35	81.55	86.20	93.55
2001	2	94.40	100.00	94.40	97.80	100.00	97.80
Overall	10	78.67	91.79	83.35	86.96	93.36	92.71

Appendix 2. Bank-level trends in the returns to scale (RTS) of the Jordanian banking sector (1996-2001)

	1996	1997	1998	1999	2000	2001	All
Panel 1: Production Model							
Commercial Banks (#)	8	8	8	8	9	9	Mostly
Arab Bank	crs	crs	crs	crs	crs	crs	crs
Arab Banking Corporation / Jordan	irs	irs	irs	irs	irs	irs	irs
Bank of Jordan	irs	irs	irs	irs	irs	irs	irs
Cairo Amman Bank	crs	crs	crs	crs	crs	crs	crs
Export & Finance Bank	irs	irs	irs	crs	crs	crs	irs/crs
Jordan Gulf Bank	-	-	-	-	crs	crs	crs
Jordan Kuwait Bank	irs	irs	irs	irs	irs	irs	irs
Jordan National Bank	irs	irs	irs	crs	drs	crs	irs
The Housing Bank for Trade & Finance	irs	irs	irs	irs	irs	irs	irs
Investment Banks (#)	7	7	7	7	7	6	
Arab Jordan Investment Bank	irs	irs	irs	crs	irs	irs	irs
Beit Al-Mal Saving & Investment for Housing	irs	irs	irs	irs	irs	irs	irs
Industrial Development Bank	crs	crs	crs	irs	irs	irs	irs/crs
Jordan Investment & Finance Bank	irs	crs	crs	crs	crs	-	crs
Middle East Investment Bank	irs	irs	irs	irs	irs	irs	irs
Philadelphia Investment Bank	irs	irs	irs	irs	irs	irs	irs
Union Bank for Savings & Investment	irs	irs	irs	irs	irs	irs	irs
Islamic Banks (#)	1	1	2	2	2	2	
Islamic International Bank	-	-	irs	irs	irs	irs	irs
Jordan Islamic Bank for Finance & Investment	crs	irs	crs	irs	irs	irs	irs
Panel 2: Intermediation Model							
Commercial Banks (#)	8	8	8	8	9	9	Mostly
Arab Bank	crs	crs	crs	crs	crs	crs	crs
Arab Banking Corporation / Jordan	irs	irs	irs	irs	irs	irs	irs
Bank of Jordan	irs	irs	irs	crs	irs	irs	irs
Cairo Amman Bank	crs	crs	crs	crs	crs	crs	crs
Export & Finance Bank	drs	drs	crs	crs	crs	crs	crs
Jordan Gulf Bank	-	-	-	-	crs	crs	crs
Jordan Kuwait Bank	irs	irs	irs	irs	crs	irs	irs
Jordan National Bank	irs	irs	crs	crs	drs	crs	crs
The Housing Bank for Trade & Finance	irs	irs	irs	irs	irs	irs	irs
Investment Banks (#)	7	7	7	7	7	6	
Arab Jordan Investment Bank	crs	crs	crs	crs	drs	crs	crs
Beit Al-Mal Saving & Investment for Housing	irs	irs	irs	irs	irs	irs	irs
Industrial Development Bank	crs	crs	crs	crs	crs	crs	crs
Jordan Investment & Finance Bank	irs	crs	crs	crs	crs	-	crs
Middle East Investment Bank	irs	irs	irs	irs	crs	irs	irs
Philadelphia Investment Bank	irs	irs	irs	irs	irs	irs	irs
Union Bank for Savings & Investment	irs	irs	irs	irs	drs	irs	irs
Islamic Banks (#)	1	1	2	2	2	2	
Islamic International Bank	-	-	irs	irs	irs	irs	irs
Jordan Islamic Bank for Finance & Investment	crs	crs	crs	crs	irs	irs	crs

Appendix 3. Alternative specification of the correlates of efficiency in the Jordanian banking sector- under the production model

	Stability Model			Organization Model			Ownership & Control Model			Market Structure Model			Stock Performance Model		
	ME	PME	SE	ME	PME	SE	ME	PME	SE				ME	PME	SE
Constant	-0.363	1.456***	-0.563	-0.746	1.326***	-0.818	-1.441***	1.252***	-1.420***	-0.777	1.887***	-1.331**	-0.200	1.507***	-0.536
Stability															
Yr97	-0.035	-0.044	-0.011												
Yr98	0.022	-0.002	0.005												
Yr99	0.052	0.005	0.029												
Yr00	0.016	0.001	0.006												
Yr01	0.093**	-0.003	0.078												
Organization															
InvBank				0.038	-0.033	0.051									
IslBank				-0.042	-0.104***	0.020									
Ownership & Control															
Ceo-Chair							-0.042	-0.167***	0.106***						
%ForOwn							-0.229***	0.167***	-0.335***						
%PubOwn							-0.426***	-0.122**	-0.367***						
%InstOwn							0.137*	-0.121	0.273**						
%OwnCon							-0.321***	-0.169**	-0.297***						
Market Structure															
LoanShare										-0.797***	0.415**	-1.172***			
%ForBrn										0.872***	-0.042	0.967***			
Stock Performance															
Earning/Share													-0.004	0.008**	-0.010
Price/Earning													-0.001	-0.001***	0.000
MV/BV													0.063***	-0.016	0.079***
DivYield													0.000	-0.008	0.008
DivPayout													0.030	0.037***	-0.006
OtherVars.															
Age	-0.001	0.003**	-0.003	-0.001	0.002	-0.002	-0.004**	0.003**	-0.006***	-0.004**	0.002	-0.005**	0.001	0.002	-0.001
Loans/TA	0.453***	0.279**	0.266	0.489***	0.249**	0.324**	0.470***	0.168**	0.369**	0.546***	0.277**	0.369**	0.429**	0.316**	0.122
Deposits/TL	-0.470***	0.107	-0.513***	-0.353**	0.095	-0.390**	-0.305**	0.083	-0.309*	-0.435***	0.078	-0.464***	-0.429**	-0.063	-0.436**
Equity/TA	-1.997***	-0.303	-1.696***	-1.750***	-0.184	-1.523***	-1.564***	-0.036	-1.406***	-1.629***	-0.492**	-1.181***	-1.895***	-0.858*	-1.374***
LogTA	0.176***	-0.092**	0.223***	0.207***	-0.071	0.235***	0.315***	-0.049	0.319***	0.218***	-0.137***	0.302***	0.143	-0.073*	0.205**
Model Stats															
R-Square	0.684	0.160	0.570	0.668	0.195	0.564	0.800	0.543	0.742	0.694	0.217	0.619	0.606	0.289	0.479
F-Value	19.524***	2.241**	11.944***	26.748***	3.423***	17.163***	36.098***	8.544***	25.889***	30.071***	4.167***	21.614***	11.866***	3.132***	7.091***
DW	2.374	1.929	2.441	2.264	1.739	2.328	2.163	2.174	1.827	2.288	1.996	2.530	2.319	1.845	2.574

Appendix 4. Alternative specifications of the correlates of managerial efficiency in the Jordanian banking sector – under the intermediation model

	Stability Model			Organization Model			Ownership & Control Model			Market Structure Model			Stock Performance Model		
	ME	PME	SE	ME	PME	SE	ME	PME	SE	ME	PME	SE	ME	PME	SE
Constant	0.035	1.416***	-0.394	-0.654	1.210	-0.809**	-0.221	1.464***	-0.653*	-0.652*	1.516***	-0.912**	0.233	1.414***	-0.167
Stability															
Yr97	0.011	-0.013	0.020												
Yr98	0.034	-0.007	0.038												
Yr99	0.045	-0.011	0.052*												
Yr00	-0.005	-0.017	0.015												
Yr01	0.146***	0.008	0.142***												
Organization															
InvBank				0.077***	0.012	0.068***									
IslBank				-0.061*	-0.079***	0.014									
Ownership & Control															
Ceo-Chair							0.018	-0.032***	0.060***						
%ForOwn							-0.143***	0.068***	-0.200***						
%PubOwn							-0.136	0.001	-0.120*						
%InstOwn							0.210**	-0.067**	0.228***						
%OwnCon							-0.172*	-0.094***	-0.029						
Market Structure															
LoanShare										-0.675***	0.023	-0.587***			
%ForBrn										0.645***	0.094	0.341**			
Stock Performance															
Earning/Share													-0.007*	0.003*	-0.010***
Price/Earning													0.000	0.000	0.000
MV/BV													0.068***	0.019**	0.049**
DivYield													0.023***	0.009***	0.013
DivPayout													-0.002	-0.001	0.001
Other Vars.															
Age	-0.004***	0.002**	-0.006***	-0.005***	0.001**	-0.006***	-0.003*	0.002***	-0.006***	-0.007***	0.001	-0.006***	0.000	0.001	-0.001
Loans/TA	0.054	-0.005	0.007	0.210*	0.061	0.135	0.227*	0.035	0.169*	0.259**	0.033	0.140	0.078	-0.045	0.082
Deposits/TL	-0.631***	-0.084	-0.594***	-0.399***	-0.020	-0.392***	-0.244*	-0.042	-0.307**	-0.512***	-0.059	-0.398***	-0.274**	-0.110**	-0.195
Equity/TA	-1.900***	-0.300***	-1.649***	-1.535***	-0.203**	-1.384***	-1.334***	-0.191***	-1.444***	-1.665***	-0.291**	-1.135***	-1.041**	-0.374***	-0.708
LogTA	0.190***	-0.044**	0.244***	0.240***	-0.030*	0.265***	0.174***	-0.051***	0.236***	0.256***	-0.061***	0.277***	0.107**	-0.040**	0.151***
Model Stats															
R-Square	0.689	0.243	0.692	0.663	0.431	0.644	0.621	0.543	0.728	0.735	0.217	0.619	0.523	0.321	0.492
F-Value	15.116***	3.734***	14.61***	23.448***	10.059***	20.855***	17.503***	8.779***	21.533***	24.118***	5.741***	24.532***	11.347***	3.445***	10.504***
DW	1.817	2.136	2.121	1.714	2.212	1.765	1.500	2.121	1.309	1.766	1.996	2.530	2.081	2.113	2.001

Appendix 5. Correlates of managerial efficiency in the Jordanian banking sector – Fixed effects and random effect models

	Panel 1: PRODUCTION MODEL						Panel 2: INTERMEDIATION MODEL					
	Fixed Effects Model (FEM)			Random Effects Model (REM)			Fixed Effects Model (FEM)			Random Effects Model (REM)		
	ME	PME	SE	ME	PME	SE	ME	PME	SE	ME	PME	SE
Constant	-1250.15	-1245.54	-1250.49	-1243.96*	-1240.12*	-1244.27*	-1249.36	-1245.98	-1249.16	-1242.85*	-1240.14*	-1243.02*
Ownership & Control V.												
Ceo-Chair	15.36	15.15	15.55	48.37	48.20	48.54	15.45	15.35	15.46	48.45	48.37	48.47
%ForOwn	266.64*	267.11*	266.52*	279.45**	279.95**	279.32**	266.79*	267.03*	266.76*	279.58**	279.84**	279.56**
%PubOwn	-250.29	-249.57	-250.31	-286.03*	-285.49*	-286.03*	-250.07	-249.63	-249.98	-285.74*	-285.45*	-285.73*
%InstOwn	133.49	133.16	133.51	96.15	95.83	96.20	133.52	133.15	133.59	96.18	95.84	96.26
%OwnCon	-46.16	-45.96	-46.04	-43.75	-43.59	-43.64	-46.04	-45.90	-45.98	-43.61	-43.52	-43.57
Market Structure Var.												
LoanShare	-1111.30***	-1111.10***	-1111.43***	-1055.29***	-1055.08***	-1055.41***	-1111.37***	-1111.27***	-1111.37***	-1055.33***	-1055.26***	-1055.32***
%ForBrn	661.16*	661.27*	661.06*	578.87*	578.82*	578.80*	661.05*	661.16*	661.09*	578.82*	578.84*	578.77*
Stock Performance Var.												
Earning/Share	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Price/Earning	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13
MV/BV	0.48***	0.48***	0.48***	0.48***	0.48***	0.48***	0.48***	0.48***	0.48***	0.48***	0.48***	0.48***
DivYield	-0.12	-0.12	-0.12	-0.16	-0.16	-0.16	-0.12	-0.12	-0.12	-0.16	-0.16	-0.16
DivPayout	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Other Var.												
Age	1.55	1.56	1.55	0.75	0.75	0.74	1.55	1.56	1.55	0.75	0.75	0.75
Loans/TA	-326.92*	-327.25*	-327.07***	-341.82**	-342.16**	-341.97**	-327.05*	-327.42*	-327.07*	-341.93**	-342.29**	-341.98**
Deposits/TL	-58.48	-58.20	-58.59	-129.40	-129.23	-129.48	-58.43	-58.36	-58.36	-129.34	-129.31	-129.31
Equity/TA	1366.57***	1366.99***	1366.89***	1387.39***	1387.81***	1387.68***	1366.82***	1367.41***	1366.80***	1387.61***	1388.18***	1387.60***
LogTA	128.47	127.89	128.54	138.19	137.72	138.25	128.38	127.98	128.35	138.05	137.74	138.07
Model Stats												
R-Square	0.526	0.526	0.526	0.628	0.628	0.628	0.526	0.526	0.526	0.628	0.628	0.628
LM (FEM/REM vs CR)				3.09	3.08	3.08				3.08	3.08	3.08
Hausman (FEM vs REM)				0.06	0.06	0.06				0.06	0.06	0.06

Table 1. The DEA studies that use small sample in the finance literature [3]

Studies	Sample size	Inputs*Outputs [1]	3*(Inputs+Outputs) [2]
Current paper			
Production model	18	2 * 3 = 6	3 * (2 + 3) = 15
Intermediation model	18	3 * 2 = 6	3 * (3 + 2) = 15
Darrat et al. (2002)	8	3 * 2 = 6	3 * (3 + 2) = 15
Canhoto and Dermine (forth.)	20	2 * 4 = 8	3 * (2 + 4) = 18
Sathye (2001)	29	3 * 2 = 6	3 * (3 + 2) = 15
Avkiran (1999)	16-19	2 * 2 = 4	3 * (2 + 2) = 12
Haag and Jaska (1995)	14	3 * 4 = 12	3 * (3 + 4) = 21
Giokas (1991)	17	3 * 3 = 9	3 * (3 + 3) = 18
Vassiloglou and Giokas (1990)	20	4 * 4 = 16	3 * (4 + 4) = 24
Oral and Yolalan (1990)	20	5 * 4 = 20	3 * (5 + 4) = 27

1. For Soteriou and Zenios (1998) and Dyson et al. (1998), the rule of thumb for the appropriate sample size for the DEA to be able to discriminate between units is that the sample size should exceed the product of the number of inputs and outputs. **2**. To Nunamaker (1985), the rule of thumb for the DEA sample size is that sample size should be at least three times greater than the sum of the number of inputs and outputs. **3**. This table extends a similar table provided by Avkiran (1999).

Table 2. Descriptive statistics of the bank inputs and outputs for the Jordanian banks (in Jordanian Dinar)[1]

	Mean	Standard Error	Minimum	Maximum
Panel 1: Production Model				
BANK INPUTS				
LABOR	942	1,406	62	6,195
CAPITAL	91,053,571	208,626,482	1,814,152	1,167,932,000
BANK OUTPUTS				
DEPOSITS	955,429,174	2,556,514,870	329,866	12,974,819,000
CREDITS	454,435,497	1,127,728,381	719,719	5,235,743,000
INVESTMENTS	618,951,324	1,668,593,679	294,080	8,916,139,000
Panel 2: Intermediation Model				
BANK INPUTS				
LABOR	942	1,406	62	6,195
CAPITAL	91,053,571	208,626,482	1,814,152	1,167,932,000
DEPOSITS	955,429,174	2,556,514,870	329,866	12,974,819,000
BANK OUTPUTS				
CREDITS	454,435,497	1,127,728,381	719,719	5,235,743,000
INVESTMENTS	618,951,324	1,668,593,679	294,080	8,916,139,000

1. The *production model* specifies banks as multi-product firms producing deposit and loan services by employing two major factors of production, labor and capital. The *intermediation model* defines banks as financial intermediaries that convert deposits by means of labor and capital into primary and secondary financial assets (various loans and investment portfolios). *Labor* is measured by the number of full-time employees on the payroll. *Capital* is proxied by the book value of financial capital. *Deposits* are measured by all types of loanable funds (the sum of demand and time deposits). *Credits* include both commercial/industrial credits and individual loans. *Investment securities* contain other earning assets of banks such as marketable public and private securities. All bank variables are in annual terms expressed in the Jordanian Dinar, except for labor, which is measured by the number of workers.

Table 3. Summary statistics of the efficiency measures of the Jordanian banking sector (1996-2001)

	1996	1997	1998	1999	2000	2001	All
Panel 1: Production Model							
Managerial Efficiency (ME)							
Mean	**68.75**	**68.54**	**72.92**	**72.17**	**72.37**	**73.55**	**71.45**
Std Dev	27.42	21.87	23.19	26.91	25.90	26.28	24.80
Median	68.50	65.60	72.90	72.50	74.35	73.70	72.50
Minimum	9.60	36.20	39.90	11.70	11.10	10.50	9.60
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Pure Managerial Efficiency (PME)							
Mean	**89.35**	**87.18**	**91.06**	**90.05**	**89.22**	**90.95**	**89.66**
Std Dev	17.79	12.67	10.61	13.51	14.08	10.13	13.06
Median	97.95	89.95	94.90	96.10	98.45	94.50	95.70
Minimum	34.60	61.60	64.50	62.10	65.10	68.80	34.60
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Scale Efficiency (SE)							
Mean	**76.76**	**79.26**	**79.89**	**79.75**	**81.18**	**80.89**	**79.67**
Std Dev	23.69	22.25	21.90	25.66	24.62	25.75	23.49
Median	79.25	85.00	91.80	93.60	89.30	91.50	85.90
Minimum	9.60	36.20	39.90	11.70	11.10	10.80	9.60
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Panel 2: Intermediation Model							
Managerial Efficiency (ME)							
Mean	**86.79**	**89.21**	**89.91**	**89.11**	**88.44**	**90.46**	**89.00**
Std Dev	20.81	12.37	13.26	19.49	19.99	22.58	18.10
Median	92.95	93.20	98.50	97.20	98.20	97.00	96.40
Minimum	15.30	64.40	62.60	22.00	19.40	5.20	5.20
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Pure Managerial Efficiency (PME)							
Mean	**97.66**	**96.80**	**96.85**	**96.24**	**95.12**	**97.35**	**96.64**
Std Dev	3.24	4.39	6.11	6.64	8.18	4.33	5.71
Median	99.20	100.00	100.00	100.00	100.00	100.00	100.00
Minimum	90.80	89.70	77.00	77.00	72.40	87.20	72.40
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Scale Efficiency (SE)							
Mean	**88.93**	**92.07**	**92.67**	**92.68**	**93.04**	**93.05**	**92.12**
Std Dev	20.87	11.19	11.13	19.00	18.93	22.78	17.54
Median	94.90	97.70	98.50	100.00	99.75	99.70	99.10
Minimum	15.30	64.40	64.70	22.00	19.40	5.20	5.20
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00
# Of Observations	**16**	**16**	**17**	**17**	**18**	**17**	**101**

Table 4. The correlation between the efficiency measures under intermediation (I) and production (P) models

	PRODUCTION MODEL			INTERMEDIATION MODEL	
	ME-P	PME-P	SE-P	ME-i	PME-I
Spearman (rank)					
PME-P	0.5146				
SE-P	0.9206	0.2979			
ME-I	**0.8311**	0.2998	0.8762		
PME-I	0.4892	**0.6623**	0.4517	0.6129	
SE-I	0.7898	0.1839	**0.8984**	0.9386	0.4480
Pearson (regular)					
PME-P	0.4447				
SE-P	0.8932	0.0075			
ME-I	**0.7958**	0.0118	0.8785		
PME-I	0.4343	**0.5565**	0.2635	0.3123	
SE-I	0.6920	-0.1775	**0.8393**	0.9488	-0.0024

Table 5. Average efficiency of different forms of Jordanian banks calculated relative to *common* frontier

Models		PRODUCTION MODEL			INTERMEDIATION MODEL		
Type/Indices	#	ME	PME	SE	ME	PME	SE
Panel 1		%	%	%	%	%	%
Commercial Banks							
1996	8	74.04	87.00	83.53	91.94	96.88	94.81
1997	8	70.93	86.01	82.39	91.34	96.01	94.99
1998	8	79.89	92.20	86.34	95.30	97.90	97.24
1999	8	84.96	95.36	88.26	96.66	97.99	98.58
2000	9	86.71	95.89	89.73	95.60	97.40	98.08
2001	9	85.30	94.67	89.37	97.26	98.30	98.94
Overall	50	80.53	91.99	86.72	94.75	97.43	97.16
Panel 2							
Other Banks							
1996	8	63.46	91.70	69.99	81.65	98.44	83.05
1997	8	66.16	88.34	76.13	87.08	97.59	89.15
1998	9	66.72	90.06	74.17	85.11	95.91	88.61
1999	9	60.80	85.33	72.18	82.40	94.68	87.44
2000	9	58.02	82.54	72.62	81.28	92.84	88.01
2001	8	60.34	86.76	71.35	82.81	96.28	86.43
Overall	61	62.54	87.37	72.75	83.36	95.87	87.17
Panel 2.a							
Investment Banks							
1996	7	58.24	90.51	65.70	79.03	98.21	80.63
1997	7	64.07	89.19	73.00	85.23	97.24	87.60
1998	7	64.77	90.36	72.44	86.20	98.03	88.01
1999	7	64.51	90.44	73.16	83.99	98.61	85.36
2000	7	60.29	86.24	73.04	84.09	97.60	86.46
2001	6	60.20	89.13	69.28	82.08	98.57	83.50
Overall	41	62.06	89.32	71.15	83.47	98.03	85.30
Panel 2.b							
Islamic Banks							
1996	1	100.00	100.00	100.00	100.00	100.00	100.00
1997	1	80.80	82.40	98.00	100.00	100.00	100.00
1998	2	73.55	89.00	80.20	81.30	88.50	90.70
1999	2	47.80	67.45	68.75	76.85	80.90	94.75
2000	2	50.10	69.60	71.15	71.45	76.20	93.45
2001	2	60.75	79.65	77.55	85.00	89.40	95.20
Overall	10	64.52	79.38	79.33	82.92	87.00	94.82

Table 6. Returns to scale (RTS) in the Jordanian banking sector (1996-2001)

	1996	1997	1998	1999	2000	2001	*All*
Panel 1: Production Model	**%**	**%**	**%**	**%**	**%**	**%**	*%*
All Banks							
IRS	75	75	71	65	67	71	*70*
CRS	25	25	29	35	28	29	*29*
DRS	0	0	0	0	6	0	*1*
Commercial Banks							
IRS	75	75	75	50	44	44	*60*
CRS	25	25	25	50	44	56	*38*
DRS	0	0	0	0	11	0	*2*
Investment Banks							
IRS	86	71	71	71	86	100	*81*
CRS	14	29	29	29	14	0	*19*
DRS	0	0	0	0	0	0	*0*
Islamic Banks							
IRS	0	100	50	100	100	100	*80*
CRS	100	0	50	0	0	0	*20*
DRS	0	0	0	0	0	0	*0*
Panel 2: Intermediation Model	**%**	**%**	**%**	**%**	**%**	**%**	*%*
All Banks							
IRS	63	56	53	47	39	59	*52*
CRS	31	38	47	53	44	41	*43*
DRS	6	6	0	0	17	0	*5*
Commercial Banks							
IRS	62	62	50	38	25	28	*48*
CRS	25	25	50	62	62	62	*46*
DRS	13	13	0	0	13	0	*6*
Investment Banks							
IRS	71	57	57	57	28.5	67	*56*
CRS	29	43	43	43	43	33	*39*
DRS	0	0	0	0	28.5	0	*5*
Islamic Banks							
IRS	0	0	50	50	100	100	*60*
CRS	100	100	50	50	0	0	*40*
DRS	0	0	0	0	0	0	*0*

Table 7. The overall ranks and means of managerial efficiency of the Jordanian banks (1996-2001) [1]

Name	ME %	Group Rank	Sector Rank	PME %	Group Rank	Sector Rank	SE %	Group Rank	Sector Rank
Model 1: Production Model									
Commercial Banks									
Arab Bank	100.00	**1**	**1**	100.00	**1**	**1**	100.00	**1**	**1**
Arab Banking Corporation / Jordan	68.62	6	9	91.62	3	6	74.88	6	11
Bank of Jordan	77.38	3	5	89.28	6	9	86.43	4	8
Cairo Amman Bank	100.00	**1**	**1**	100.00	**1**	**1**	100.00	**1**	**1**
Export & Finance Bank	76.75	4	6	79.25	**7**	12	93.90	2	6
Jordan Gulf Bank	100.00	**1**	**1**	100.00	**1**	**1**	100.00	**1**	**1**
Jordan Kuwait Bank	70.88	5	8	91.15	4	7	77.62	5	10
Jordan National Bank	86.80	2	3	92.50	2	5	93.10	3	7
The Housing Bank for Trade & Finance	57.33	**7**	12	89.47	5	8	63.40	**7**	**13**
Investment Banks									
Arab Jordan Investment Bank	71.25	3	7	74.08	6	13	96.05	2	4
Beit Al-Mal Saving & Investment for Housing	19.83	**7**	**15**	99.57	2	3	19.88	**7**	**16**
Industrial Development Bank	84.37	2	4	88.50	5	10	94.37	3	5
Jordan Investment & Finance Bank	95.86	**1**	2	99.66	**1**	2	96.14	**1**	3
Middle East Investment Bank	46.68	6	13	98.47	3	3	47.43	6	15
Philadelphia Investment Bank	64.48	4	10	96.83	4	4	66.18	5	12
Union Bank for Savings & Investment	57.57	5	11	69.83	**7**	**15**	82.15	4	9
Islamic Banks									
Islamic International Bank	39.18	**2**	14	73.03	**2**	14	52.75	**2**	14
Jordan Islamic Bank for Finance & Investment	81.42	**1**	5	83.62	**1**	11	97.05	**1**	2
Model 2: Intermediation Model									
Commercial Banks									
Arab Bank	100.00	**1**	**1**	100.00	**1**	**1**	100.00	**1**	**1**
Arab Banking Corporation / Jordan	86.62	**7**	12	93.42	**7**	10	92.68	7	11
Bank of Jordan	94.82	4	6	96.83	5	8	97.93	4	8
Cairo Amman Bank	100.00	**1**	**1**	100.00	**1**	**1**	100.00	**1**	**1**
Export & Finance Bank	97.37	2	4	98.47	2	4	98.82	2	5
Jordan Gulf Bank	100.00	**1**	**1**	100.00	**1**	**1**	100.00	**1**	**1**
Jordan Kuwait Bank	92.85	6	7	97.23	4	6	95.43	5	9
Jordan National Bank	96.65	3	5	98.42	3	5	98.20	3	7
The Housing Bank for Trade & Finance	87.97	5	11	94.22	6	9	93.28	6	10
Investment Banks									
Arab Jordan Investment Bank	99.58	2	2	99.67	3	3	99.92	2	3
Beit Al-Mal Saving & Investment for Housing	31.83	**7**	**15**	100.00	**1**	**1**	31.83	**7**	**15**
Industrial Development Bank	100.00	**1**	1	100.00	**1**	**1**	100.00	1	**1**
Jordan Investment & Finance Bank	98.62	3	3	99.68	2	2	98.92	3	4
Middle East Investment Bank	88.13	5	10	100.00	**1**	**1**	88.13	5	12
Philadelphia Investment Bank	79.65	6	13	96.85	4	7	82.03	6	14
Union Bank for Savings & Investment	88.98	4	9	90.30	**5**	12	98.55	4	6
Islamic Banks									
Islamic International Bank	69.38	**2**	14	79.50	**2**	**13**	87.13	**2**	13
Jordan Islamic Bank for Finance & Investment	91.95	**1**	8	92.00	**1**	11	99.95	**1**	2

1.All efficiency scores and ranks for the banks are based on 6-year grand averages (1996-2001), except for three banks, which had some missing variables or were inexistent in the relevant period. 2. The efficiency scores of Islamic International Bank are based on the period 1997-2001. 3. The efficiency scores of Jordanian Gulf Bank are based on the period 2000-2001. This bank had negative newt worth during the 1996-1999 period, which impedes the calculation of the efficiency scores for the bank

Table 8. Univariate and multivariate regressions of the potential correlates of managerial efficiency in the Jordanian banking sector

	Panel 1: PRODUCTION MODEL						Panel 2: INTERMEDIATION MODEL					
	Univariate Regressions			Multivariate Regressions			Univariate Regressions			Multivariate Regressions		
	ME	PME	SE	ME	PME	SE	ME	PME	SE	ME	PME	SE
Constant	-	-	-	-3.155***	0.478	-2.896***	-	-	-	-1.807***	0.938***	-1.484***
Stability Var.												
Yr97	-0.035	-0.036	-0.005	-0.058*	-0.026	-0.014	-0.034	-0.006	-0.038	0.020	-0.019*	0.030*
Yr98	0.018	0.010	0.003	-0.013	0.028	-0.013	-0.026	0.010	-0.032	0.038***	-0.007	0.038**
Yr99	0.009	-0.002	0.001	-0.003	-0.003	0.026	0.015	0.002	0.022	0.057**	-0.010	0.056***
Yr00	0.011	-0.012	0.018	-0.018	0.016	-0.005	0.006	-0.010	0.025*	0.009	-0.035**	0.034*
Yr01	0.025	0.009	0.015	0.115***	0.127***	0.053	0.045**	0.001	0.039***	0.042	0.008	0.074***
Organization Var.												
InvBank	-0.158**	-0.015	-0.143***	0.055	0.170***	-0.079	-0.020	0.013	-0.039**	0.017	-0.007	0.034
IslBank	-0.077	-0.120***	-0.004	-0.153***	0.138**	-0.276***	-0.102**	-0.091***	-0.005	-0.261***	-0.109***	-0.135***
Ownership & Control Var.												
Ceo-Chair	0.102**	-0.095***	0.193***	0.000	-0.285***	0.266***	0.046***	-0.019*	0.057	0.137***	-0.006	0.128***
%ForOwn	0.057	0.020	0.026	-0.341***	0.029	-0.407***	-0.021	-0.060***	-0.003	-0.190***	0.051**	-0.218***
%PubOwn	-0.207	-0.161**	-0.092	-0.697***	-0.111	-0.629***	-0.004	-0.084**	0.033	-0.354***	-0.159***	-0.232***
%InstOwn	-0.240*	-0.157***	-0.270	0.133*	-0.103	0.235***	-0.120***	-0.097***	-0.023	0.209***	-0.091***	0.281***
%OwnCon	-0.403***	-0.159***	-0.413***	-0.236***	0.083	-0.298***	-0.196***	-0.126***	-0.090***	-0.184***	-0.058**	-0.104*
Market Structure Var.												
LoanShare	0.574***	0.185***	0.414***	-0.298	1.722***	-1.845*	0.158***	0.042***	0.101***	-1.116**	0.313	-0.863*
%ForBrn	0.611***	0.141***	0.494	0.546***	0.510***	0.116	0.195***	0.051***	0.126***	-0.116	0.045	-0.193*
Stock Performance Var.												
Earning/Share	0.020***	0.007***	0.013***	-0.002	-0.056**	0.051	0.006***	0.002***	0.004***	0.034*	-0.013	0.028
Price/Earning	0.001**	-0.000	0.001***	0.000	0.002***	-0.001**	0.0002**	-0.000	0.0002**	-0.001**	0.000	-0.001***
MV/BV	0.097**	0.193	0.098**	-0.011	0.008	-0.009	0.039**	0.008*	0.023*	0.009	-0.002	0.014
DivYield	-0.003	-0.014	0.004	0.017*	0.003	0.020**	0.011***	0.003**	0.006**	0.031***	0.013***	0.013
DivPayout	0.036	0.001	0.001	0.043**	-0.013	0.055**	0.004	-0.011	0.016	0.003	-0.012	0.012
Other Var.												
Age	0.007***	0.001**	0.006***	-0.015***	-0.008***	-0.011***	0.003***	0.001***	0.002***	-0.006***	-0.002***	-0.004***
Loans/TA	0.619***	0.185**	0.487***	0.289**	-0.002	0.324**	0.083	0.03	-0.013	0.411***	-0.094*	0.277***
Deposits/TL	0.222	-0.007	0.205	-0.829***	-0.573***	-0.488***	0.011	-0.043***	0.040	-0.271**	-0.237***	-0.184*
Equity/TA	-1.933***	-0.243	-1.534***	-1.873***	-1.657***	-1.058***	-1.119***	0.008	-0.594**	-1.404***	-0.273***	-1.160***
LogTA	0.245***	0.016	0.223***	0.604***	0.130**	0.535***	0.073***	-0.003	0.067***	0.366***	0.049**	0.309***
Model Stats												
R-Square	-	-	-	0.884	0.806	0.862	-	-	-	0.872	0.643	0.875
F-Value	-	-	-	20.017***	6.797***	16.389***	-	-	-	12.238***	4.719***	11.917***
DW	-	-	-	2.305	1.621	2.460	-	-	-	1.995	2.304	2.135

Figure 2. Jordanian Banking System - 2001

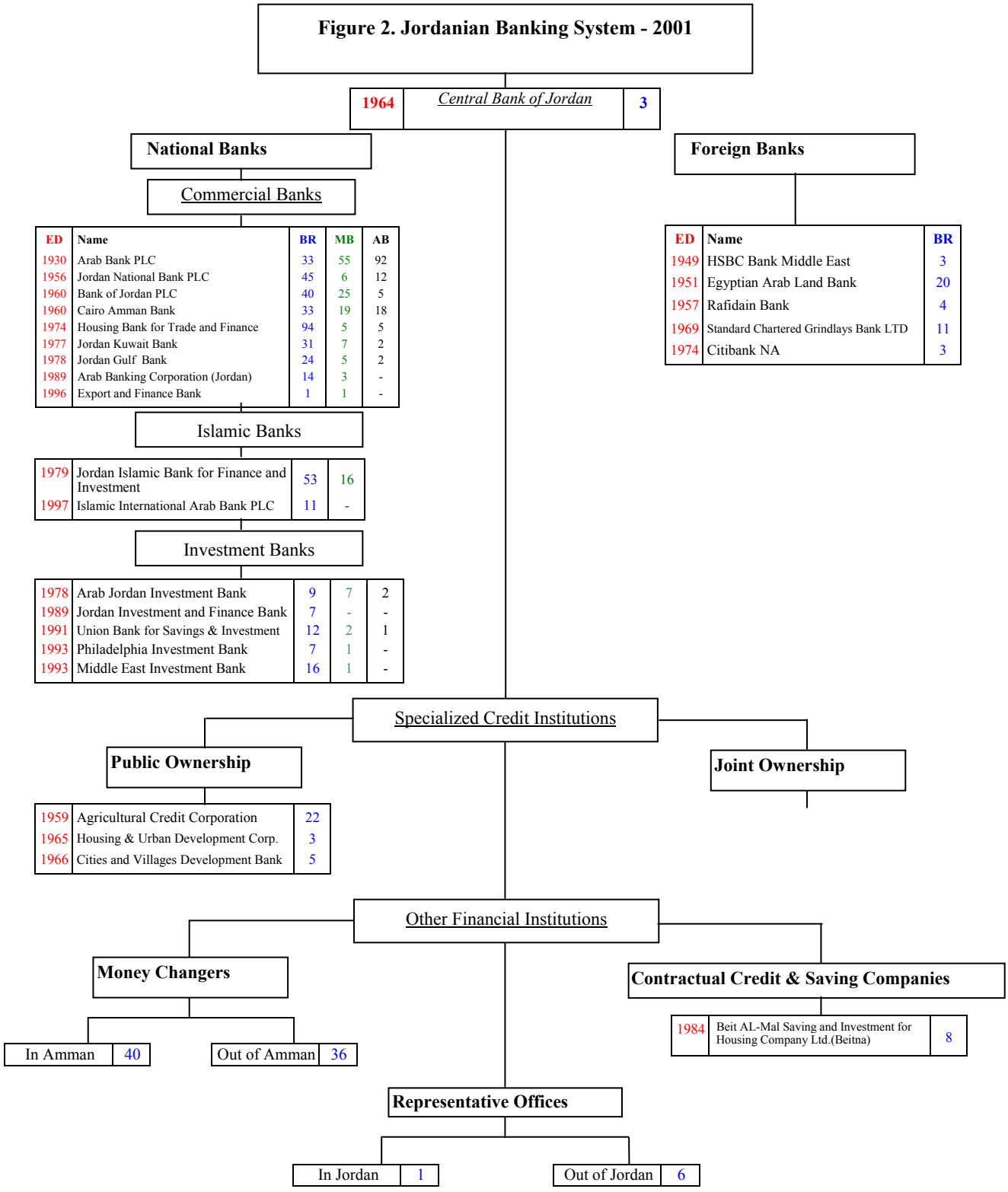
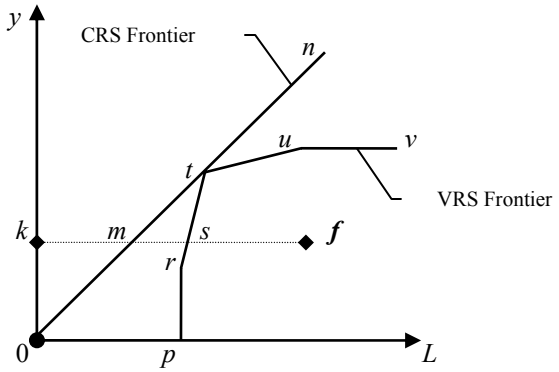


Figure 2. Definition of managerial efficiency (ME) measures



ME = PTE × SE
ME = km / kf
PTE = ks / kf
SE = km / ks