The Effect of Technical Efficiency in Insurance Companies on Stock Performance: Data Envelopment Analysis Evidence from Jordanian Companies Listed in Amman Stock Exchange During the Period (2000-2006)

Moh'd M. Ajlouni
Yarmouk University, Jordan

Sinan Tobaishat
Hashemite University, Jordan

Abstract: The purpose of this study is to measure the technical efficiency of Jordanian insurance companies using data envelopment analysis. The period of the study (2000-2006) is the duration of observed improvements in this sector. The importance of this study is that it will give attention to what extent technical efficiency will support the companies overall goal and how Amman Stock Exchange (ASE) values such efficiency. The sample consists of 22 insurance companies listed in ASE. The inputs variables used to measure efficiency are technical reserves, equity, borrowings and operating expenses, whereas the outputs include premium and investment income. The results reveal that insurers' efficiency is increased over the study period, and ASE values the technical efficiency of insurance companies by appreciating their stock prices.

Key words: Technical Efficiency, Insurance, DEA, Amman Stock Exchange

1   Introduction

Insurance sector in Jordan is well regulated and provides a wide variety of services to the public. For a small country, Jordanian insurance sector is crowded, competitive and has many foreign insurance companies that share the market. Thus, insurance companies must be efficient to maximise the value of its stocks, whether by profit maximisation or cost minimisation. By providing evidence on how efficient are the Jordanian insurance companies and how the stock exchange values the efficiency of insurance companies, this study aims at measuring the efficiency of insurance sector in Jordan and its effect on stock performance. This might give attention to what extent technical efficiency supports the company's overall goal. In addition, this study is among the first to investigate such relationship.

2   Literature Review

Several studies applied the efficiency measurement on insurance companies. Ennsfellner et al. (2004) examine the developments in the production efficiency of the Austrian insurance market. The study provides evidence that the process of deregulation had positive effects on the production efficiency of Austrian insurers. Jametti and Ungern-Sternberg (2004) compare the cost efficiency of private and public property insurance providers in Switzerland during the period 1981-1998. The findings of the study show that the public insurance providers are about 20% more cost efficient than their private counterparts. Diacon et al. (2002) compare the international companies transacting long-term insurance in 15 European countries. The main results of the study are that technical and scale efficiency scores are strongly associated with insurer's size, while mix efficiency seems to increase linearity with size. The UK insurers appear to have particularly low levels of scale and mix efficiency when compared to their European counterparts. Noulas et al. (2001) studied the efficiency of non-life insurance companies in Greece during the period 1991-1996. The results of the study show that insurance firms are very efficient, and there are big differences among the sample firms in their efficiency levels. Cummins and Rubio-Misas (2001) studied the effects of deregulation and

consolidation in financial services markets by analysing the efficiency of Spanish insurance industry during the period 1989-1998. The results show that many small, inefficient and financially under-performing firms were eliminated from the market because of insolvency or liquidation. The results showed that consolidation reduces the number of firms operating with increasing returns to scale and it increases the number of firms operating with decreasing returns to scale.

Others examined non-insurance financial institutions efficiencies. Hermes and Nhung (2008) investigate the impact of financial liberalisation on bank efficiency in 10 emerging economies in Latin America and Asia. Their results strongly support the positive impact of financial liberalisation programs on bank efficiency. Pasiouras (2006) use data envelopment analysis (DEA) to investigate the efficiency of Greek commercial banking system over the period 2000-2004. The result indicates that the inclusion of loan loss provisions as an input increases the efficiency scores, while off-balance sheet items do not have a significant impact. Moreover, banks that have expanded their operations abroad appear to be more efficient than the ones operating only at the national level, and the number of branches also has a positive impact on efficiency whereas the number of ATMs does not appear to influence efficiency. Pasiouras et al. (2006) use DEA to investigate the efficiency of Greek commercial banks and its relation to stock performance during the period 2001-2005. The result of the study shows that bank efficiency is positively affecting stock performance. Galagedera and Edirisuriya (2006) investigate Indian bank efficiency. The results of the study show that smaller banks are less efficient and highly efficient banks have a higher equity-to-assets and higher return-to-equity ratios. There has been no growth in productivity in private sector banks, whereas the public sector bank demonstrates a modest positive change. Finally, technological change in the public sector banks reveals a growth, while the private sector banks experienced a negative growth of almost the same magnitude. Aikaeli (2006) analyses the efficiency of commercial banks in Tanzania for the period 1998-2004. The results of the study show that Bank of Tanzania still has many reasons to improve their performance.

Stavare (2005) estimate European commercial banks' efficiency using DEA during the period 2002-2003 in a three relatively homogenous groups of countries with different level of economic development, and different involvement in the process of European integration. The results of efficiency estimation suggest that there exists an efficiency gap for banks in the six Central Eastern Europe countries in comparison to banks from Greece and Portugal representing the least developed of the 15 European countries. Maudos and Pastor (2003) analysed the efficiency in costs and profits of the Spanish banking sector during the period 1985-1996. The results show that the existence of profit efficiency levels well below those corresponding to cost efficiency, and alternative profit efficiency being below standard profit efficiency. The study concluded that the return on assets (ROA) and the return on equity (ROE) of the Spanish banking sector could increase by 2.4 and 24.4%, respectively, eliminating the combined inefficiency in costs and revenues.

Yildirim (2002) analyses the efficiency performance of the Turkish banking sector during the period 1988-1999. The results suggest that over the sample period both pure technical and scale efficiency measures show a great variation, and the sector did not achieve sustained efficiency gains. It is also reported that the sector suffers mainly from scale efficiency due to decreasing returns to scale. In addition, it reports differences in the efficiency performance of commercial banks with different ownership status. Efficient banks are more profitable, and pure technical efficiency and scale efficiency are positively related to size. Maghayereh (2004) analyses the effect of financial liberalisation on the efficiency of financial institutions represented by Jordanian commercial banks. The findings suggest that liberalisation program was followed by an observable increase in efficiency. Another finding of the study is that large banks demonstrated faster productivity growth during the liberalisation. Canhoto and Dermine (2000) use DEA

to evaluate banking efficiency in Portugal during the period 1990-1995. The results of the study show that efficiency scores increase over time, and new banks show highest mean of efficiency. This study is different from the previous studies because it is the first to examine the Jordanian insurance companies' technical efficiency and its effect on stock performance.

3 Institutional Background

3.1 Insurance Concept

Insurance is a promise of compensation for a specific potential future loss in exchange for a periodic payments. It has two fundamental characteristics. First, transferring risk from one individual to a group and, second, sharing losses by all members of the group (Emmett and Curtis, 1978). Insurance is a vital vehicle not just for transferring risk and sharing loss, but also for the development of the economy, that is by increasing production, wealth protection, capital creation and reducing inflation. In addition, insurance motivates communities by reimbursing the sick and averaged people, setting the research and studies to reduce losses, providing insured people with the actions that reduce the probability of loss.

3.2 Efficiency Concept

The concept of efficiency emphasises an insurer's ability to produce a given set of outputs (such as premiums and investment income) via the use of inputs such as administrative and sales staff and financial capital (Diacon et al., 2002). Efficiency can be decomposed into scale efficiency, scope efficiency, pure technical efficiency and allocative efficiency. Scale efficiency can be reached when a decision-making unit (DMU) operates in the range of constant returns to scale. Scope efficiency occurs when DMU operates in different diversified locations. Allocative efficiency happens when the DMU chooses the revenue maximising mix of outputs (Mahaftha, 2000). Technical efficiency is the proportion by which all inputs need to be reduced in proportion to adopt the most efficient production (Farrell, 1957). Technical efficiency score ranges between 0 and 1. Efficiency score of 1 means fully efficient DMU, while efficiency score of 0 means fully inefficient DMU. This study investigates pure technical efficiency because these companies have more controllability of its inputs than its outputs.

3.3 History of Insurance in Jordan

During the 1940s of the past century, insurance was not commonly used in Jordan except for the insurance of import credits, which required marine or road transportation insurance. As a result of political situation in the 1950s of the last century, Jordan was forced to discharge goods at Aqaba port that created the need for strong transportation system. At that time, a noticeable activity of car accident insurance and marine transportation took place. As a result for the need of providing coverage in these fields, insurance companies were established. The Law No. 9/1995 deregulated the market and obliged the increase of Jordanian insurance companies' capital to JD 2 millions for companies practising direct insurance and JD 20 millions for companies specialised in re-insurance. As for the foreign companies, the law forced them to increase the capital to JD 4 millions. As a result, eight new insurance companies entered into the market and the number of working companies increased to 25 local companies and one foreign company. In 2008, the number of companies increased to 29.

3.4 The Organisational Structure of the Insurance Market in Jordan

Jordan insurance sector consists of three main groups of institutions. These are Insurance Commission, Jordan Insurance Federation and insurance companies, detailed as follows (Jordan Insurance Commission, 2008).

Table 1 Selected financial data of the insurance sector in Jordan during the period 2000-2006 (in million JDs)

Items	2000	2001	2002	2003	2004	2005	2006
Total investments	146.7	150.6	169	214.2	264.9	410.1	409.3
Total assets	221	236.6	260.5	308.5	366.1	526.2	547.9
Technical provisions	97.9	109.3	123.4	131.6	143.2	156.2	170.8
Shareholders' equity	85	88.6	90.9	124.1	161.4	277.2	285.2
Gross written premiums inside Jordan	104.2	120.4	146.9	171.5	191.4	219.3	258.7
Net written premiums inside Jordan	64.3	76.5	94	114.2	126.9	139.3	158.1
Gross claims paid for premiums written inside Jordan	67.7	79.8	86	107.7	123.9	142.8	174
Net profit before tax	5.2	6.5	12.6	22	40	90.6	21.5

Source: Jordan Insurance Commission (JIC, 2008).

(1) The insurance commission established in 1999, which is an independent entity in terms of finance and management. This authority is in charge of regulating the insurance sector and controlling and supervising its works. (2) Jordan Insurance Federation is mainly concerned with developing technical activities for setting up the principles and costumes for the practice of the profession and presentation of the studies. It aims at promoting insurance business and conducts scientific researches and prepares statistics. (3) The insurance companies existing in Jordan has reached 29 companies in 2008. Table 1 reports the financial data of Jordanian insurance sector.

4 Methodology

This study employs the DEA. It is a non-parametric frontier method that uses linear programming techniques to discover the frontier firms and construct a convex linear surface (Diacon et al., 2002). It does not require the specification of a production or cost function but rather computes efficient 'best practice' production and cost frontiers based on linear combinations of firms in the industry (Cummins and Rubio-Misas, 2001). DEA has two approaches: the production and intermediation. The production approach views firms as a process to producing outputs using inputs (Ferrier and Lovell, 1990). The intermediation approach views firm as intermediaries between the provider of services and the users of services (Mester, 1994). This approach is recommended in this study because it takes the expenses into account (Berger and Humphrey, 1991; Elyasiani and Mehdian, 1990). In addition, it is extremely adaptable because various categories of services may be assigned as either inputs or outputs (Colwell and Davis, 1992). Thus, this study is employing the intermediation approach. This study uses input oriented model, rather than the output model, because the insurance companies have more controllability over its inputs than its outputs. However, there is no definite commonly agreed choice of inputs and outputs to be used (Xueming, 2003). According to the intermediation approach and the available data for insurance sector in Jordan, this study follows Diacon et al. (2002) inputs and outputs, as follows: *the inputs* are (1) total operating expense (X1) net of reinsurance commissions from general and long term (life) insurance accounts; (2) equity (X2) at start of the year; (3) total technical reserves (X3) for general and long-term insurance at start of the year. It equals unexpired risks reserve, and mathematical reserve; (4) total borrowings (X4) from creditors at start of the year. The *outputs* are (1) net earned premiums (Y1), (2) total investment income (Y2). This study

follows constant returns to scale (CRS) model for measuring efficiency of DMU adopted by Salhieh and Abu-Doleh (2004).

Maximise $E_k = \sum\limits_{i=1}^{m} V_{jk} \, Y_{jk}$

Subject to the following constraints:

(1) $\sum\limits_{i=1}^{m} U_{ik} \, X_{ik} = 1,$

(2) $\sum\limits_{j=1}^{n} V_{jk} \, Y_{jk} - \sum\limits_{i=1}^{m} U_{ik} \, X_{ik} \leq 0,$

(3) $U_{ik} \geq 0,\ i = 1, 2\ldots m.$

(4) $V_{jk} \geq 0,\ j = 1, 2\ldots n,$

(5) $\sum\limits_{i-1}^{m} U_{ik} = \sum\limits_{j=1}^{n} V_{jk}$

where V_{jk} is the weight placed on jth output (Y_j) of the kth DMU, U_{ik} is the weight placed on ith input (X_i) of the kth DMU, X_{ik} is the ith input parameter (X) of the kth DMU, Y_{jk} is the jth output parameter (Y) of the kth DMU, E_k is the relative efficiency score of kth DMU, m is the number of inputs and n is the number of outputs.

5 Data and Analysis

The data is collected from the annual report of insurance companies operating in Jordan (1999-2006) and the closing prices of insurance companies operating in Jordan (1999-2006). The sample consists of 22 insurances companies listed in Amman Stock Exchange (ASE) during the period 2000-2006. Insurance sector in Jordan includes 29 companies. Seven companies were excluded for validity reasons. The efficiency measurement system (EMS) software is used to measure insurance companies technical efficiency included in the sample of the study. The data analysed through input oriented approach DEA at CRS. Then, the technical efficiency scores are regressed against yearly stock performance calculated at the end of year closing price, as by Chu and Lim (1998).

5.1 Analysis of Insurance Technical Efficiency Score

The analysis of technical efficiency scores is conducted for general and life insurance efficiency and general insurance efficiency. Table 2 reports the results of DEA technical efficiency score for general and life insurance during the period 2000-2006.

It can be seen from the table that the technical efficiency scores for Jordanian insurance companies range between 13 and 86% during the period of the study. Nine companies have technical efficiency scores less than 50%, which seems to highlight week efficiency for these companies. Annual cross-sectional analysis reveals that the technical efficiency of the Jordanian insurance sector has improved. Such improvement can be attributed to the deregulating the sector. Table 3 summarises the annual cross-sectional technical efficiency scores during the study period.

These results suggest that there is a continuous growth in the technical efficiency from 41% in 2000 to 69% in 2005. In 2006, the technical efficiency scores decreased slightly to 68% because of decreasing investment income in these companies. Table 4 reports the results of DEA technical efficiency score for general insurance only during the period 2000-2006.

It appears from the table that the technical efficiency scores for general insurance companies range between 13 and 85% during the period of the study. Ten companies have technical efficiency scores less

Table 2   Statistical summary of technical efficiency scores for each general and life insurance company during the period 2000-2006

	DMU	Mean (%)	Std. deviation	Max.	Min.
1	United Insurance	86	0.15	1.00	0.54
2	Oasis Insurance	80	0.21	1.00	0.43
3	Philadelphia Insurance	73	0.18	1.00	0.54
4	Gerasa Insurance	72	0.24	1.00	0.37
5	Arab Jordanian Insurance Group	68	0.23	1.00	0.38
6	Jordan International Insurance	66	0.23	1.00	0.42
7	Arab Union International Insurance	62	0.30	1.00	0.25
8	Jordan Insurance	58	0.21	1.00	0.36
9	Jerusalem Insurance	57	0.20	0.98	0.35
10	Arab Assurers	55	0.13	0.84	0.44
11	Yarmouk Insurance and Reinsurance	54	0.31	1.00	0.21
12	Delta Insurance	54	0.28	1.00	0.29
13	Arab Orient Insurance	53	0.08	0.65	0.40
14	Middle East Insurance	51	0.21	1.00	0.35
15	Arabian Seas Insurance	49	0.23	1.00	0.25
16	Arab Life & Accident Insurance	48	0.15	0.74	0.29
17	Al-Nisr Al-Arabi Insurance	47	0.08	0.62	0.35
18	General Arabia Insurance	45	0.07	0.54	0.33
19	Jordan French Insurance	45	0.15	0.75	0.28
20	Islamic Insurance Company	41	0.04	0.47	0.34
21	Holy Land Insurance	40	0.09	0.58	0.26
22	The National Ahlia Insurance	13	0.05	0.21	0.07
	Mean	55	0.17	0.84	0.34

Table 3   Annual cross-sectional efficiency scores for insurance sector during 2000-2006

Year	Mean (%)	Std. deviation	Max.	Min.
2000	41	0.21	1.00	0.07
2001	44	0.22	1.00	0.12
2002	45	0.14	0.80	0.14
2003	57	0.23	1.00	0.07
2004	60	0.19	1.00	0.21
2005	69	0.26	1.00	0.15
2006	68	0.28	1.00	0.15

than 50%, which seems to highlight week technical efficiency for these companies. Once again, annual cross-sectional analysis shows that the technical efficiency of the general insurance sector has improved over the study period. Table 5 summarises the annual cross-sectional technical efficiency scores for general insurance during the study period.

Table 4   Statistical summary of technical efficiency scores for each general insurance company during the period 2000-2006

	DMU	Mean (%)	Std. deviation	Max.	Min.
1	United Insurance	85	0.17	1.00	0.54
2	Oasis Insurance	80	0.23	1.00	0.43
3	Philadelphia Insurance	73	0.20	1.00	0.54
4	Gerasa Insurance	72	0.26	1.00	0.37
5	Arab Jordanian Insurance Group	68	0.25	1.00	0.38
6	Jordan International Insurance	65	0.25	1.00	0.42
7	Arab Union International Insurance	62	0.32	1.00	0.26
8	Jordan Insurance	57	0.23	1.00	0.34
9	Delta Insurance	54	0.30	1.00	0.29
10	Jerusalem Insurance	54	0.20	0.93	0.34
11	Yarmouk Insurance & Reinsurance	54	0.34	1.00	0.20
12	Arab Orient Insurance	53	0.09	0.65	0.40
13	Arabian Seas Insurance	49	0.24	1.00	0.25
14	Middle East Insurance	49	0.24	1.00	0.32
15	Arab Assurers	46	0.16	0.74	0.29
16	Arab Life and Accident Insurance	44	0.15	0.64	0.27
17	Jordan French Insurance	44	0.16	0.74	0.27
18	General Arabia Insurance	43	0.07	0.52	0.30
19	Islamic Insurance Company	41	0.04	0.48	0.34
20	Holy Land Insurance	40	0.10	0.58	0.26
21	Al-Nisr Al-Arabi Insurance	38	0.08	0.55	0.28
22	The National Ahlia Insurance	13	0.05	0.21	0.07
	Mean	54	19%	82%	33%

Table 5   Annual cross-sectional efficiency scores for general insurance

Year	Mean (%)	Std. deviation	Max.	Min.
2000	40	0.21	1.00	0.07
2001	43	0.23	1.00	0.12
2002	44	0.14	0.80	0.14
2003	56	0.22	1.00	0.07
2004	59	0.20	1.00	0.21
2005	69	0.26	1.00	0.15
2006	67	0.28	1.00	0.15

Similar to those of the insurance sector, general insurance efficiency witnessed continuous growth during the period 2000-2005, whereby the efficiency scores were 40, 43, 44, 56, 59 and 69% respectively, while the efficiency score decreased slightly in 2006 to 67% for similar reason to that of the sector.

Table 6   The effect of technical efficiency scores of Jordanian insurance companies on stock prices during the period 2000-2006

Model	R	R²	Beta	Sig.	Constant	F	Sig.
The relationship between stock prices and general and life insurance technical efficiency scores	0.212	0.045	0.212	0.008	0.480	7.160	0.008
The relationship between stock prices and general insurance technical efficiency scores	0.202	0.041	0.202	0.012	0.467	6.494	0.012

5.2   Stock Exchange Valuation of Insurance Companies' Efficiency

The purpose of this section is to examine the relationship between stock price and insurance companies' efficiency. The mean value of 154 stock prices was JD 2.28 with a relatively high standard deviation of 1.62 because of the high variation in values of stock prices, which ranges between JD 0.45 and JD 9. General and life insurance technical efficiency had a mean score of 55% with a standard deviation of 0.24, while that of the general insurance score of 53% with similar standard deviation. The relationship between stock price and general and life insurance technical efficiency score is 21.2% significant, while that with general insurance is 20.2% significant. For obvious reason, the correlation between general insurance technical efficiency score and general and life insurance technical efficiency is 99.2% significant.

Simple regression analysis is utilised to identify the relationship between the dependent variable (stock price) and independent variable (technical efficiency score) and the degree that the independent variable affects the dependent variable. Table 6 reports the result of simple linear regression for stock prices and general and life insurance technical efficiency. The regression model shows that efficiency scores explain only 4.5% of the variation in the stock prices. However, the model is fit because the value of F statistics 7.160 is significant, and t-test of B is significant at less than 1% level of significance. This indicates that there is significant relationship between stock price and general and life insurance technical efficiency.

Similar results are reported in the table when regressing stock prices with general insurance technical efficiency scores. The model explains 4.1% of the dependent variable, fit with F statistics 6.494 is significant, and t-test of Beta is significant at about 1%. Thus, there is a significant relationship between stock prices and general insurance technical efficiency scores.

6   Summary and Conclusions

This study aimed at estimating the technical efficiency scores for Jordanian insurance companies and to investigate the impact of the efficiency scores on stock prices of these companies. The study analysis revealed that technical efficiency scores for Jordanian insurance companies range between 41 and 69% during the period 2000-2006, while that of insurance companies excluding life insurance activities ranges between 40 and 69% during the period of the study. Of 22 companies in the sample, 9 (10) general and life (general) insurance companies have technical efficiency scores less than 50% which is an indicator for low efficiency. Moreover, the analysis shows that there is a significant positive relationship between insurance companies' technical efficiency scores and stock prices. This seems to indicate that ASE does value the efficiency of the insurance companies.

According to the results of the study, it is recommended that managers of insurance companies should strive to reduce total operating expenses to maximise their technical efficiency. On the other hand, JIC

should set standards for the ratios of operating expenses and technical reserves to investment income and premiums; and JIC should facilitate merging of inefficienct insurance companies to reach economies of scale. Moreover, ASE should provide periodic efficiency scores of insurance companies to the public. Finally, because the technical efficiency of insurance companies has weak effect on stock price, future studies should concentrate on other variables that may influence stock price such as financial ratios.

References

Aikaeli, J. (2006). 'Commercial Banks Efficiency in Tanzania', Working Paper. SSRN: http://ssrn.com/abstract=980933.

Berger, A.N. & Humphrey, D.B. (1991). 'The dominance of inefficiencies over scale and product mix economics in banking', *Journal of Monetary Economics* Vol. 28, pp. 117-148.

Canhoto, A. & Dermine, J. (2000). 'A Non-Parametric Evaluation of Banking Efficiency in Portugal, New vs. Old Banks', Working Paper. http://ssrn.com/abstract=221168.

Chu, S.F. & Lim, H. (1998). 'Share performance and profit efficiency of banks in an ologopolistic market: evidence from Singapore', *Journal of Multinational Financial Management* Vol. 8, pp. 155-168.

Colwell, R. & Davis, E. (1992). 'Output and productivity in banking', *Scandinavian Journal of Economics* Vol. 94, pp. 111–129.

Cummins, D. & Rubio-Misas, M. (2001). 'Deregulation, Conthoghlidation, and Efficiency: Evidence from the Spanish Insurance Industry', Working Paper, Wharton Financial Institutions Center, Philadelphia, PA. http://ssrn.com/abstract=294687.

Diacon, S., Starkey, K. & Brien, C. (2002). 'Size and efficiency in long-term European Insurance Companies: an international Comparithoghn', *The Geneva Papers on Risk and Insurance* Vol. 27, No. 3, pp. 444-466.

Elyasiani, E. & Mehdian, S. (1990). 'Efficiency in the commercial banking industry, a production frontier approach', *Applied Economics* Vol. 22, pp. 539-551.

Emmett, J.V. & Curtis, M.E. (1978). 'Fundamentals of Risk and Insurance, 2nd ed.', Wiley/Hamilton Publication, New York.

Ennsfellner, K.C., Lewis, D. & Anderthoghn, R.I. (2004). 'Production efficiency in the Austrian insurance industry: a Bayesian examination', *The Journal of Risk and Insurance* Vol. 71, No. 1, pp. 135-159.

Farrell, M. (1957). 'The measurement of productive efficiency', *Journal of Royal Statistical Thoghciety*, *Series A* Vol. 120, pp. 253-281.

Ferrier, G. & Lovell, C.A.K. (1990). 'Measuring cost efficiency in banking: econometric and linear programming evidence', *Journal of Econometrics* Vol. 46, pp. 229-245.

Galagedera, D.U.A. & Edirisuriya, P. (2006). 'Performance of Indian Commercial Banks (1995-2002): An Application of Data Envelopment Analysis and Malmquist Productivity Index', Working Paper. http://ssrn.com/abstract=577922.

Hermes, N. & Nhung, V. (2008). 'The Impact of Financial Liberalization on Bank Efficiency: Evidence from Latin America and Asia', Working Paper. http://ssrn.com/abstract=983865.

Jametti, M. & Ungern-Sternberg, T. (2004). 'Assessing the Efficiency of an Insurance Provider: A Measurement Error Approach', Working Paper. http://ssrn.com/abstract=400161.

Kirkwood, K. & Nahm, D. (2006). 'Australian banking efficiency and its relation to stock returns', *The Economic Record* Vol. 82, No. 258, pp. 253-267.

Maghayereh, A.I. (2004). 'The effect of financial liberalization on the efficiency of financial institutions: the case of Jordanian commercial banks', *Journal of Transactional Management Development: Special Issue: Islam & Business: Cross-Cultural and Perspectives* Vol. 9, No. 2/3, pp. 71-106.

Mahaftha, B.M. (2000). 'Operating Efficiency and Stock Performance: The Case of Jordanian Banks', A Master Thesis, Yarmouk University, Irbid, Jordan.

Maudos, J. & Pastor, J.M. (2003). 'Cost and profit efficiency in the Spanish banking sector (1985-1996): a nonparametric approach', *Applied Financial Economics* Vol. 13, pp. 1-12.

Mester, L.J. (1994). 'How Efficient Are Third District Banks? Business Review', Federal Reserve Bank of Philadelphia, pp. 3-18.

Noulas, A.G., Hatzigayios, T., Lazaridis, J. & Lyroudi, K. (2001). 'Nonparametric production frontier approach to the study of efficiency of non-life insurance companies in Greece', *Journal of Financial Management and Analysis* Vol. 14, pp. 19-26.

Pasiouras, F. (2006). 'Estimating the Technical and Scale Efficiency of Greek Commercial Banks: The Impact of Credit Risk, Off-Balance Sheet Activities, and International Operations', Working Paper. http://ssrn.com/abstract=939524.

Pasiouras, F., Liadaki, A. & Zopounidis, C. (2006). 'Bank Efficiency and Share Performance: Evidence from Greece', Working Paper. http://ssrn.com/abstract=961259.

Salhieh, L. & Abu-Doleh, J. (2004). 'A decision making framework for Jordanian banking sector: a DEA approach', *Human and Social Sciences, Yarmouk Rersearch* Vol. 20, No. 4A, pp. 281-295.

Stavare, D. (2005). 'Efficiency of Banks in Regions at Different Stage of European Integration Process', Working Paper. http://ssrn.com/abstract=672184.

Xeuming, L. (2003). 'Evaluating the profitability and marketability efficiency of large banks: an application of data envelopment analysis', *Journal of Business Research* Vol. 56, No. 8, pp. 627-635.

Yildirm, C. (2002). 'Evolution of banking efficiency within an unstable macroeconomic environment: the case of Turkish commercial banks', *Applied Economics* Vol. 34, pp. 2289-2301.